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**GOVERNMENT OF INDIA**

**MINISTRY OF JAL SHAKTI  
DEPARTMENT OF WATER RESOURCES, RIVER DEVELOPMENT AND GANGA  
REJUVENATION  
CENTRAL GROUND WATER BOARD**

**GROUND WATER YEAR BOOK  
HIMACHAL PRADESH  
(2018-2019)**

**NORTHERN HIMALAYAN REGION  
DHARAMSHALA  
(H.P)  
January, 2021**



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**GROUND WATER YEAR BOOK  
HIMACHAL PRADESH  
(2018-2019)**

**By**

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**NORTHERN HIMALAYAN REGION  
DHARAMSHALA  
(H.P)  
January, 2021**

## **FOREWARD**

*For an efficient management and development of ground water resources, it is imperative to have a reliable database on water level and water quality. Central Ground Water Board, in addition to various other activities on scientific studies related to groundwater, collects data from a network of National Hydrograph Network Stations also called Ground Water Monitoring Wells and prepares a scientific base for the proper planning and judicious use of available groundwater resources.*

*Most of the area in Himachal Pradesh is hilly, mountainous with few intermontane valleys in between them. The traditional ground water structures, which are under observation at present, are open wells mostly located in the valley area. Therefore, the ground water regime monitoring programme is concentrated mostly in valley area of the state and at some places in hard rock area. Efforts are however going on to increase the number of observation wells and include the piezometers of state government under the groundwater regime monitoring.*

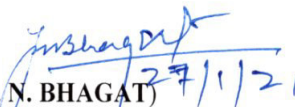
*The measurement of these National Hydrograph Network Stations is carried out four times in a year during the month of January, May, August and November and water samples are collected during pre-monsoon period viz., May for chemical analysis. The analysis of the data indicates the changes in ground water scenario and thereby helps in adopting measures if required in the area under monitoring for the sustainable development and management of the ground water resource. The human induced problems like depletion in water level, water logging, can be identified from the maps prepared during the analysis of water level data.*

*This report presents the water level data for the National Hydrograph Network Stations collected during the year 2018-2019 and its analysis and interpretations in the form of tables, maps and their descriptions to bring out the overall ground water scenario and the changes in ground water regime during the ground water year. The chemical results are awaited and will be issued separately.*

*The field data has been collected, processed and compiled by the scientific officers of NHR, Dharamshala. This report has been compiled by Smt. Rachna Bhatti, Scientist 'C' & Sh. Vidya Bhooshan, Senior Technical Assistant (Hg). A untiring work of map preparation was done by Ms Poonam, Draughtsman from CHQ, Faridabad. The samples were collected by Sh. Jugal Kishore Surveyor and entered in GEMS by Smt. Anju Devi draftsman. Analysis was done by C.G.W.B, NWR, Chandigarh. The efforts of Report & Processing Section in scrutiny, processing and issuance of report is also highly significant.*

*This ground water year book contains useful data for water year 2018-19 for all the planners and user agencies dealing with the development of ground water resources and it is hoped that it would be utilized fully for the real time management of ground water resources in the State.*

Dated: 27.01.2021  
Dharamshala

  
(J. N. BHAGAT)  
Regional Director

**GROUND WATER YEAR BOOK**  
**HIMACHAL PRADESH**  
**2018-2019**  
**EXECUTIVE SUMMARY**

- ❖ Central Ground Water Board, NHR has set up a network of 128 National Hydrograph Stations in the state of Himachal Pradesh. The monitoring commenced in the year 1969 with the establishment of 3 observation wells and since, then the number of monitoring station are being increased regularly so as to get the overall picture of ground water scenario in different hydrogeological set up of the state.
- ❖ Most of the area in Himachal Pradesh is hilly enclosing few small intermontane valleys. The traditional ground water structures under observation at present are dugwells and are mostly located in the valley areas only. Therefore, the ground water regime monitoring programme is concentrated mainly in valley areas of the state and some places in hard rock areas.
- ❖ All the 128 National Hydrograph Stations are located only in 7 districts out of the 12 districts in Himachal Pradesh. The reason being hilly terrain, hard approachability and insignificant number of structures available for monitoring.
- ❖ The average annual rainfall in the state varies from 600 mm to more than 2400 mm. The rainfall increases from south to north. Dharamshala in district Kangra, receives the 2<sup>nd</sup> highest rainfall of about 3000 mm in the Country.
- ❖ Water levels are being monitored four times in a year during the month of May, August, November and January. Water samples are collected during the month of May every year for chemical analysis of ground water quality.
- ❖ The depth to water level, recorded during May 2018 (Annexure - I), ranged between 0.56m (Kangra district) and 55.00 m bgl (Solan district) (Table-3). Out of 96 stations monitored, the majority of 86 NHS (89.58%) recorded DTWL, in the range between 2 - 20 m |bgl. 6 stations (6.25%), recorded shallow water levels, less than 2 m bgl and 3 stations (3.12%), recorded deep water levels, more than 20 m bgl in the state. and one well is showing greater than 40m, which is dry well.
- ❖ The depth to water level recorded during August 2018 ranges between (-0.18) m bgl (Kangra districts) to 28.98 m bgl (Solan district).
- ❖ The depth to water level recorded during November 2018 ranged between 0.31 m bgl in (Mandi district) to 31.58 m bgl in (Solan district).
- ❖ The depth to water level recorded during January 2018 ranged between ranged between 0.33m (Mandi district) to 28.69 m bgl (Una district).
- ❖ Monsoonal fluctuation of water level was analyzed for 105 stations for the period May 2018 – November 2018. out of the 105 stations, 94 stations (89.52%) have shown rise in water level and remaining 8 stations (7.61%) have shown fall in water level.
- ❖ Out of the 94 stations analysed, 33 stations (35.10 %) have shown rise in water level ranging from 0.14 mbgl (Kangra district) to 35.51 m (Solan district), whereas 1 stations (12.50%) have shown fall ranging from 0.03 m (Kullu district) to 28.87 m (Una district).

- ❖ Annual fluctuation data of water levels in May 2017 wrt May 2018 shows frequency distribution of rise and fall. Out of the 101 stations analysed, 38 stations (37.62%) have shown rise in water level ranging from 0.03 (Sirmaur) to 27.71 m (Solan district), whereas 63 stations (62.37 %) have shown fall ranging from 0.02m (Kangra district) to 3.23 m (Kangra district).
- ❖ Annual fluctuation of water level has been worked out by comparing DTW of November 2017 with November 2018. Out of the 107 stations, 90 stations (84.11%) have shown rise in water level ranging from 0.02m (Una district) to 35.51 m (Solan district) whereas 14 stations (13.08%) have shown fall ranging from 0.02 m (Una district) to 28.87 m (Una district).
- ❖ Annual fluctuation of water level has been worked out by comparing depth to water level of January 2018 with January 2019 . Out of the 96 stations analyzed, 79 stations (82.29%) have shown rise in water level ranging from 0.0 (Mandi and Una district) to 6.31 m (Sirmaur district) whereas 16 stations (16.66%) have shown fall ranging from 0.11 (Kangra district) to 28.69 m (Una district).
- ❖ Decadal water level fluctuation has been worked out by comparing water level data of May 2018 with the average mean of 10 years water level data of May (2008-2017). A perusal of data shows that out of 105 stations analysed, 32 stations (30.47%) have shown rise and 73 stations (69.52%), have shown fall in water level. 17 stations (53.12%) are showing rise in water level between 0 to 2m, 3 stations (9.37%) between 2 to 4m. and 12 stations (37.50%), more than 4m.
- ❖ Decadal water level fluctuation has been worked out by comparing water level data of August 2018 with the average 10 years water level data of August (2008-2017) A perusal of data shows that that out of 107 stations analyzed, 66 stations (61.68%) have shown rise and 41 stations (38.31%), have shown fall in water level. 45 stations (68.18%) are showing rise in water level between 0 to 2m, 12 stations (18.18%) between 2 to 4m. and 9 stations (13.63%), more than 4m. Out of 41 stations, 35 stations (85.36%) show fall in water level between 0 to 2m, 3 stations (7.31%) between 2 to 4 m and 3 stations (7.31%) more than 4m.
- ❖ Decadal water level fluctuation has been worked out by comparing water level data of November 2018 with the average water level data of November for 10 years (2008-2017) A perusal of data shows that out of 108 stations analyzed, 84 stations (77.77%) have shown rise and 24 stations (22.22%), have shown fall in water level. 67 stations (79.76%) are showing rise in water level between 0 to 2m, 8 stations (9.52 %) between 2 to 4m. and 9 stations (10.71%), more than 4m.
- ❖ Decadal water level fluctuation has been worked out by comparing water level data of January 2019 with the average water level data of January for 10 years (2009-2018). A perusal of data shows that out of 100 stations analysed, 69 stations (69.00 %) have shown rise and 31 stations (31.00%), have shown fall in water level. 59 stations (85.50%) are showing rise in water level between 0 to 2m, 8 stations (11.59%) between 2 to 4m. and 2 stations (2.89%), more than 4m. Out of 31 stations, 28 stations (90.32%) show fall in water level between 0 to 2m, 1 stations (3.22%) between 2 to 4 m and 2 stations (6.45%) more than 4m.

**GROUND WATER YEAR BOOK  
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2018-2019**

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## **1.0 INTRODUCTION**

Himachal Pradesh is located between the north latitude 30°22'40" & 33°12'40" and east longitude 75°47'55" & 79°04'20". It falls in Survey of India topographic sheets Nos. 52D, 52H, 52L, 53A, 53B, 53F, 53E and 53I and covers an area of 55,673 sq km. It is one of the predominantly hilly states in India, which lies in the western Himalayas. The length of Himachal Pradesh is about 355 km i.e. from northwestern part of Chamba to southeastern part of Kinnaur. The breadth of the state is about 270 km i.e. from western part of Una to northeast part of Lahaul and Spiti district. The state is bounded by the state of Jammu & Kashmir in north, Punjab state in west, Haryana state in south and Uttarakhand state in southeast and shares an international border with China (Tibet) in northeast.

Administratively, the state is divided in 12 districts, 76 tehsils, 34 sub-tehsils and 78 blocks. There are 20,690 villages, 3,226 Gram Panchayats, 59 towns, 28 Nagar Panchayats and 25 Nagar Parishads including Municipal Corporations. Lahaul & Spiti is the largest and Hamirpur is the smallest district of the state with geographical area of 12,835 and 1,118 sq km respectively.

The state has a population of 68,64,602 persons (Census 2011) having an average population density of 128 person per sq km. The male population in the state is 34,81,873 persons and female population is 33,82,729. The rural and urban population in the state is 61,76,050 and 6,00,552 persons respectively. The density of population in the state varies from as low as 2 persons/sq.km in Lahaul and Spiti district to 406 persons/sq km in Hamirpur district as compared to the state average of 128 persons/sq km.

Himachal region presents an intricate mosaic of mountain ranges, hills and valleys with altitude ranging from 350 m to 6500 m amsl. The Dhauladhar range looks in supreme majesty over the Kangra valley while the Pir Panjal, the Great Himalaya and the Zaskar ranges guard over Chamba, Lahaul & Spiti, Kullu and Kinnaur districts. The mountain slopes are covered with forests and meadows. The valleys below are interspersed with numerous streams, fields and quiet homesteads. There is general increase in elevation from east to west and from south to north. The physiographic divisions from south to north are the Outer Himalayas also known as Siwaliks (350 to 1500 m amsl), the Lesser Himalayan Range (1500-5000 m amsl), Great Himalayan Range (5000 – 6000 m amsl) and Zaskar Range (> 6000 m amsl)

Himachal state has a unique distinction of having drainage systems of both the Indus and the Ganga basin. The major river systems of the region are the Chandra-Bhaga or the Chenab, the Ravi, the Beas, the Satluj and the Yamuna. The catchments of these rivers are fed by snow and rainfall,

and are protected by fairly extensive cover of natural vegetation. Major rivers of the Indus river basin are the Chenab, the Ravi, the Beas and the Satluj. The Yamuna is the only river contributing water to Ganga basin.

The southwestern monsoon contributes about 70% of rainfall during monsoon period from July to September and about 30% occurs during non-monsoon period due to western disturbances and in the form of thunderstorm. Generally, rainfall increases from south to north. Western disturbances also shower rainfall in winters. Beyond Kullu towards Lahaul & Spiti and Kinnaur, rainfall decreases due to rain shadow effect. Spiti is the driest area with 50 mm rainfall because of being enclosed by High Mountain from all sides. The average annual rainfall in the districts of the state varies from about 600 mm in Lahaul & Spiti to more than 2400 mm in Kangra.

Central Ground Water Board, under part of its national ground water monitoring programme has established a network of observation stations in the state for periodic monitoring of ground water level and water quality. The ground water regime monitoring programme commenced during the year 1969 when the erstwhile groundwater wing of Geological Survey of India established 3 stations in the State. At present there are 128 Ground Water Monitoring Station (GWMS) in Himachal Pradesh. The year wise increase in GWMS in the State is given in Table-1.

**Table-1: Year wise increase in GWMS, Himachal Pradesh**

Year	Total Number of Ground Water Monitoring Stations
1969-73	3
1974-77	19
1978	32
1979	34
1980	35
1981	68
1982	69
1983-88	71
1989	72
1990-2000	79
2000-2010	86
2011-2013	102
2015-2016	111
2016-2017	128
2017-2018	128
2018-2019	128

The ground water monitoring is being carried out by Northern Himalayan Region, Dharamshala, since 1996. All the 128 GWMS are dug wells and are located in 7 districts of Himachal Pradesh out

of the 12 districts. The reason for not monitoring other districts is being the hard approachability due to terrain conditions and non- availability of ground water monitoring structures. The district wise break up of Ground Water Monitoring Stations and their occurrence in different hydrogeological setup is given in Table-2.

**Table-2: District wise GWMS & Hydrogeological setup**

S. No	District	Number of GWMS			
		Total	Valley Area Porous Formation (Quaternary)	Fissured Formation (Tertiary)	Fissured Formation (Proterozoic to Mesozoic)
1.	Hamirpur	4	4	-	-
2.	Kangra	46	31	15	-
3.	Kullu	4	4	-	-
4.	Mandi	9	9	-	-
5.	Sirmaur	17	15	2	-
6.	Solan	16	16	-	-
7.	Una	31	31	-	-
8.	Chamba	1	-	1	-
<b>TOTAL</b>		<b>128</b>	<b>110</b>	<b>18</b>	<b>-</b>

## 2.0 HYDROGEOLOGY

The major part of Himachal Pradesh is hilly and mountainous with few small intermontane valleys covering about 15% of the area. These valleys comprise of alluvial deposits, which form extensive aquifers and thus represent porous formations. Major valleys in the state are Indora-Nurpur and Kangra-Palampur valleys in district Kangra, Una valley in district Una, Balh valley in district Mandi, Nalagarh valley in district Solan and Paonta valley in district Sirmaur.

The Siwalik and Sirmaur group represent the Tertiary formation in the state. These two groups occur in the western part of the state and have northwest to southeast trend. The Siwalik comprises of boulder, conglomerate, sandstone and clay while, Sirmaur group comprises of shale, sandstone and clay. The primary porosity and permeability in the Tertiary formation is low to moderate and hence, these aquifers do not form high yielding aquifers.

The older rock formations of Proterozoic to Mesozoic eras constitute of igneous and metamorphic rocks like granite, gneiss, slate, schist, phyllite, quartzite etc. Because of their consolidated nature, these rock formations serve as poor aquifers. However, due to tectonic movements, they have been traversed by faults, thrust and joints, which have enhanced their ground water potential.

The quality of ground water in hard rocks and alluvial areas is by and large good and suitable for domestic and irrigational use. The distribution of the hydrogeological formations discussed above and their yield potential are given below in Table -3.

**Table-3: Hydrogeological Formations and their Yield Potential, in Himachal Pradesh**

Age	Rock Formation	Districts	Hydrogeological Characteristics
<b><i>POROUS FORMATIONS</i></b>			
Recent to sub Recent	Boulder, Cobble, Pebble, Sand, Silt, Clay,	Kangra, Una, Solan, Sirmaur, Mandi and Kullu	High Yield 30-75 m <sup>3</sup> /hr
<b><i>FISSURED FORMATIONS</i></b>			
Tertiary	Boulder Conglomerate Sandstone, Clay	Kangra, Solan, Sirmaur Bilaspur, Una, Mandi, and Hamirpur .	Moderate to Low Yield < 30 m <sup>3</sup> /hr
Proterozoic to Mesozoic	Shale, Slate, phyllite, Limestone, dolomite, Sandstone, Quartzite, Granite, Schist,	Lahaul & Spiti, Kinnaur, Chamba, Mandi, Simla, Kangra, Sirmaur, Solan, and Kullu	Moderate to Low Yield < 5 to 30 m <sup>3</sup> /hr

### 2.1 Proterozoic to Mesozoic Formations

Older formations of Proterozoic to Mesozoic age are constituted by groups like Sundernagar group, Shali-Deoban-Largi group, Vaikrita group, Jutogh group, Simla group, Krol group, Tal group, Kuling group, Lilang group, Tandi group etc. These groups comprise of granites, gneisses, slates, schists, phyllites, quartzites etc. and occur in Kangra, Chamba, Lahaul & Spiti, Kinnaur, Simla, Sirmaur, Kullu and Solan districts. These rocks are dense and consolidated in nature therefore; they bear low primary porosity and permeability, thus forming poor yielding hard rock aquifers. Secondary porosities have developed due to the tectonic movements. Weathered, fractured and contact zones however, form potential ground water zones.

Groundwater in hard rocks area is either developed through bore wells or springs at favorable locations. Springs are the major ground water sources in these formations and its yield ranges from seepages to more than 25 lps and are utilized for both domestic and irrigation purposes. Weathered mantle in low topographic areas, also forms poor aquifers. In some areas, percolation wells are also constructed. *Bowris* are also constructed in oozing out spring zones, for collection of water to fulfill the domestic water needs. Number of hot water springs also occurs in these formations.

## **2.2 Tertiary Formations**

The upper Tertiary formations ranging in age from Middle Miocene to Lower Pleistocene are represented by the rocks of Siwalik group and extend from northwest to southeastern part of the state. It comprises of great thickness of cobbles, pebbles, detritus rocks, clays and conglomerates. The Siwalik chain is widest in the valley of river Beas. On paleontological grounds the Siwalik are subdivided into three subgroups namely upper, middle and the lower Siwaliks.

The lower Tertiary formations ranging in age from Eocene to Lower Miocene are represented by the rocks of Sirmaur group. The Sirmaur group has also been sub-divided into three formations namely Kasauli, Dagshai and Subathu. The group comprises of shale, sandstone and clay. The Sirmaur group is separated by a fault from the Siwaliks.

Fracture zones and contact zones form important aquifers in the low topographic areas with poor to moderate yields. Yields of the tube wells are less than 30m<sup>3</sup>/hr constructed along the fault/fracture/contact zones. These fractures or faults zones form potential ground water zones for development.

## **2.3 Quaternary Formations**

The Quaternary formations occur either as major or minor valley fills/piedmont/fluvio-glacial deposits and alluvium. The major valley fill areas are Nurpur – Jawali – Nagrota Surian, Pragpur – Dadasiba, Palampur – Kangra valley fills in Kangra district; Shathlai and Sirkhad in Hamirpur district; Balh valley in Mandi district; Una valley in Una district; Nalagarh valley in Solan district; Paonta valley in Sirmaur district; Spiti valley in Lahaul & Spiti district. Ground water occurs under phreatic to semi-confined conditions in these deposits. In some of the valleys like Indora – Nurpur valley in Kangra district and Balh valley in Mandi district, confined aquifers are encountered.

The thickness of valley fills in Paonta, Una, Nalagarh, Nurpur and Andaura are generally more than 100 m whereas, in other areas its thickness is within 100 m. Groundwater occurs under unconfined to confined conditions. In general, depth to water level varies from 5 to about 60 m bgl. Artesian conditions also exist in lower and central part of Una valley, lower part of Nurpur, Andaura and Balh valley fills.

Ground water occurs under unconfined conditions in shallow valley fills areas developed along the river/streams. Discontinuous aquifers system is observed in Kangra, Sirmaur, Solan and Una districts. Depth to water level varies from < 2 to 20 m bgl. Ground water is developed through open dug wells, shallow and deep tube wells. The discharge of the tube wells varies up to 40 lps but generally ranges between 15 to 25 lps. There are about 8000 tube wells constructed including exploratory wells of CGWB in the valley fill deposits both for drinking and irrigation purpose. A large number of shallow boreholes fitted with hand pumps also exist in the state for developing groundwater.

### 3.0 GROUND WATER SCENARIO

The ground water level in the state is monitored regularly to have a review over the changes in ground water regime. The maps generated from these data help in identifying the areas, which are under water level rising and water level declining. With the help of these maps, suitable measures as per the demand of the area can be adopted for the sustainable ground water development. It also helps the planners to formulate the future strategy in various fields of ground water development.

For the purpose of presentation, the water levels and their changes are shown separately in alluvial and hard rock areas because of aquifer discontinuity. As discussed earlier, the major alluvial areas are Indura-Nurpur and Kangra-Palampur valley in district Kangra, Una valley in district Una, Balh valley in district Mandi, Nalagarh valley in district Solan and Paonta valley in district Sirmaur. In hard rock areas point values are given at places.

The water level is being monitored in the State four times in a year

1. May : 20<sup>th</sup> to 30<sup>th</sup> : represents water level of Pre-monsoon period
2. August : 20<sup>th</sup> to 30<sup>th</sup> : represents peak monsoon water level.
3. November : 1<sup>st</sup> to 10<sup>th</sup> : represents water level of Post-monsoon period.
4. January : 1<sup>st</sup> to 10<sup>th</sup> : represents the recession stage of water level

The data has been analyzed for each set of measurement and report has been prepared which include following maps to understand the groundwater regime in the area.

- A. Depth to water level maps : Water level scenario for the month in the area.
- B. Seasonal fluctuation maps : Water level fluctuation in comparison to Pre-monsoon.
- C. Annual fluctuation maps : Water level fluctuation in comparison to same month in the previous year.
- D. Decadal mean fluctuation maps : Water level fluctuation in the month of measurement with reference to the decadal average for the same month.

The depth to water level, seasonal fluctuation and annual fluctuation has been presented in Annexure-I, II and III. The decadal mean fluctuation has been tabulated in Annexure-IV. The ground water behavior in the seven districts of Himachal Pradesh has been discussed below.

#### 3.1 Depth to Water Level

##### 3.1.1 May 2018

The depth to water level, recorded during May 2018 (Annexure - I), ranged between 0.56m (Kangra district) and 55.00 m bgl (Solan district) (Table-3). Out of 96 stations monitored, the

majority of 86 NHS (89.58%) recorded DTWL, in the range between 2 - 20 m bgl. 6 stations (6.25%), recorded shallow water levels, less than 2 m bgl and 3 stations (3.12%), recorded deep water levels, more than 20 m bgl in the state. and one well is showing greater than 40m, which is dry well.

A perusal of the DTWL map of May 2018 shows that the shallow water level area of less than 2m bgl, occurs in eastern part of Kangra Palampur valley, Kullu valley and Mandi district. 2-5 m bgl and 5-10 m bgl water level occupies in most of the monitoring area of all the valleys of Himachal Pradesh, mainly in Kangra-Palampur valley, Nurpur- Indora valley and Una valley and few places of kullu valley and Balh valley. Water level 10-20m bgl in shown in major part of Nallagarh and Paonta valley. Deeper water levels, between 20-40m bgl are shown in Northern part of Paonta valley, outer fringes of Nalagarh valley and at few places of Una valley.

**Table-3: District wise number & % of NHS distribution, in different DWL of May 2018**

2.1

**Depth to Water Table**  
**Distribution of Percentage of Observation Wells**  
2018/May

State : Himachal Pradesh

District	No. of Wells Analysed	Depth to Water Table (mbgl)		No. / Percentage of Wells Showing Depth to Water Table (mbgl) in the Range of					
		Min	Max	0.0 - 2.0	2.0 - 5.0	5.0 - 10.0	10.0 - 20.0	20.0 - 40.0	> 40.0
HAMIRPUR	4	2.92	11.51	0	2	1	1	0	0
KANGRA	36	0.56	15.16	2	21	9	4	0	0
KULLU	3	1.54	8.47	1	0	2	0	0	0
MANDI	7	0.57	7.14	2	2	3	0	0	0
SIRMAUR	10	2.23	16.37	0	1	3	6	0	0
SOLAN	9	6.02	53.00	0	0	2	4	2	1
UNA	27	1.31	21.54	1	8	13	4	1	0
<b>Total</b>	96	0.56	53.00	6	34	33	19	3	1

### 3.1.2 August 2018

The depth to water level recorded during August 2018 (Annexure - I) ranges between (-0.18) m bgl (Kangra districts) to 28.98 m bgl (Solan district) (Table-5). Out of the 97 stations monitored the majority of 57 stations (58.76%) recorded DTW in the range between 2-20 m bgl, 35 stations (36.08%) have recorded shallow water level less than 2 m bgl, and only 5 stations (5.15%) have shown, more than 20 m bgl in the state.

A perusal of the DTW map for August 2018 indicates that the shallow water level area less than 2m bgl occurs in all the valleys of Himachal Pradesh, except Nalagarh and Paonta valley, mainly in Balh valley (Mandi district), all the valleys of Kangra district including Kangra Palampur valley and Nurpur Indaura valley and eastern & central part of Una valley. 2-5m bgl and 5-10 m bgl water level is recorded in couple of pockets in almost all the valley areas. 10 -20 m bgl water level is recorded in pockets in Una Valley, eastern part of Paonta valley and in fringes of Nalagarh valley. Deeper water levels are found at some places in Nalagarh and Una valley.

**Table-5:– Depth to water level - August 2018**

2.1

**Depth to Water Table**  
**Distribution of Percentage of Observation Wells**  
2018/Aug

State : Himachal Pradesh

District	No. of Wells Analysed	Depth to Water Table (mbgl)		No. / Percentage of Wells Showing Depth to Water Table (mbgl) in the Range of						
		Min	Max	0.0 - 2.0	2.0 - 5.0	5.0 - 10.0	10.0 - 20.0	20.0 - 40.0	> 40.0	
HAMIRPUR	4	1.57	4.97	2	2	0	0	0	0	
KANGRA	35	-0.18	4.54	18	17	0	0	0	0	
KULLU	3	1.09	8.47	1	0	2	0	0	0	
MANDI	8	0.31	4.18	3	5	0	0	0	0	
SIRMAUR	12	1.01	18.02	1	4	4	3	0	0	
SOLAN	8	4.79	28.98	0	2	0	2	4	0	
UNA	27	0.03	22.91	10	8	4	4	1	0	
<b>Total</b>	<b>97</b>	<b>-0.18</b>	<b>28.98</b>	<b>35</b>	<b>38</b>	<b>10</b>	<b>9</b>	<b>5</b>	<b>0</b>	

### 3.1.3 November 2018

The depth to water level recorded during November 2018 (Annexure - I) ranged between 0.31 m bgl in (Mandi district) to 31.58 m bgl in (Solan district) (Table-6). Out of 100 stations monitored, the majority of 68 NHS (68.00%) recorded DTWL, in the range between 2 - 20 m bgl. 28 stations (28.00%), recorded shallow water levels, less than 2 m bgl and 4 stations (5.76%), recorded deep water levels, more than 20 m bgl in the State.

A perusal of the DTWL map for November 2018 shows that the shallow water level areas of less than 2 m observed in eastern part of Kangra Palampur valley and in pockets of all the valleys, except Nalagarh and Paonta valleys. Water level of 2-5m & 5-10 m bgl is observed in major part of Kangra Palampur valley, whole of Indaura-Nurpur valley, Balh valley, Kullu valley southern part of Una Valley, Nalagarh valley Paonta valley respectively. 10-20 m bgl water level is shown in Una, Nalagah and Paonta valley only. Deeper water level more than 20m is confined mainly in central part



of Paonta valley in Sirmaur district, northern part of Nalagarh valley of Solan district and small part of Una valley.

**Table- 6: Depth to Water Level – November 2018**

2.1

**Depth to Water Table**  
**Distribution of Percentage of Observation Wells**  
2018/Nov

State : Himachal Pradesh

District	No. of Wells Analysed	Depth to Water Table (m bgl)		No. / Percentage of Wells Showing Depth to Water Table (m bgl) in the Range of					
		Min	Max	0.0 - 2.0	2.0 - 5.0	5.0 - 10.0	10.0 - 20.0	20.0 - 40.0	> 40.0
HAMIRPUR	4	1.78	6.06	1	2	1	0	0	0
KANGRA	36	0.42	8.87	25.00%	50.00%	25.00%			
				13	17	6	0	0	0
KULLU	2	1.57	6.49	36.11%	47.22%	16.67%			
				1	0	1	0	0	0
MANDI	7	0.31	4.95	50.00%		50.00%			
				1	6	0	0	0	0
SIRMAUR	12	1.32	24.71	14.29%	85.71%				
				1	2	4	4	1	0
SOLAN	9	4.14	31.58	8.33%	16.67%	33.33%	33.33%	8.33%	
				0	1	1	6	1	0
UNA	30	0.72	28.87	11.11%	11.11%	11.11%	66.67%	11.11%	
				11	8	5	4	2	0
<b>Total</b>	100	0.31	31.58	36.67%	26.67%	16.67%	13.33%	6.67%	0

### 3.1.4 January 2019

The depth to water level recorded during January 2018 (Annexure - I) ranged between 0.33m (Mandi district) to 28.69 m bgl (Una district) (Table-7). Out of 100 stations which are monitored, the majority of 74 NHS (74.00%) recorded DTW in the range between 2 - 20 m bgl. 22 stations (22.00%) recorded shallow water levels, less than 2 m bgl and 4 stations (4.00%) recorded deep water levels, more than 20 m bgl in the state. one well is showing greater than 40m, which is dry well.

A perusal of the DTW map of January 2019 shows that the shallow water level area occurs mainly in south eastern part of Kangra Palampur valley (Kangra district), southern part of Balh valley (Mandi district) and Eastern part of Una Valley. 2-5 m bgl & 5-10m bgl water level is depicted in all the valleys of Himachal Pradesh. 10-20 m bgl water level occupies Paonta valley and small parts of Nalagarh and Una valley. Deeper water level, more than 20m are confined mainly in central part of Paonta valley, Southern part of Nalagarh valley and at few places of Una valley.

**Table- 7: Depth to Water Level – January 2019**

**Depth to Water Table**  
**Distribution of Percentage of Observation Wells**  
 2019/Jan

State : Himachal Pradesh

District	No. of Wells Analysed	Depth to Water Table (mbgl)		No. / Percentage of Wells Showing Depth to Water Table (mbgl) in the Range of					
		Min	Max	0.0 - 2.0	2.0 - 5.0	5.0 - 10.0	10.0 - 20.0	20.0 - 40.0	> 40.0
HAMIRPUR	4	1.83	7.05	1	2	1	0	0	0
				25.00%	50.00%	25.00%			
KANGRA	36	0.46	10.50	7	20	8	1	0	0
				19.44%	55.56%	22.22%	2.78 %		
KULLU	3	0.99	8.47	1	0	2	0	0	0
				33.33%		66.67%			
MANDI	8	0.33	6.46	3	3	2	0	0	0
				37.50%	37.50%	25.00%			
SIRMAUR	12	1.42	27.52	1	0	4	6	1	0
				8.33%		33.33%	50.00 %	8.33%	
SOLAN	7	5.44	22.12	0	0	1	5	1	0
						14.29%	71.43 %	14.29%	
UNA	30	1.03	28.69	9	9	5	5	2	0
				30.00%	30.00%	16.67%	16.67 %	6.67%	
<b>Total</b>	<b>100</b>	<b>0.33</b>	<b>28.69</b>	<b>22</b>	<b>34</b>	<b>23</b>	<b>17</b>	<b>4</b>	<b>0</b>

### 3.2 Seasonal Water Level Fluctuation

To study the effect of monsoon and subsequent utilization for various needs like agriculture, irrigation and domestic etc, changes in water level are studied and are discussed below.

#### 3.2.1 May 2018 to November 2018

Monsoonal fluctuation of water level was analyzed for 105 stations for the period May 2018 – November 2018. A perusal of Table-8 shows that out of the 105 stations, 94 stations (89.52%) have shown rise in water level and remaining 8 stations (7.61%) have shown fall in water level.

The minimum rise in water level of 0.14 m was observed in Kangra District and the maximum rise 35.51 m was noticed in Solan District. Out of the 94 stations which have shown rise in water level, 33 stations (35.10%) show rise between the range of 0 to 2m, 39 stations (41.48%) between 2 to 4m and remaining 22 stations (23.40%) show rise more than 4m.

The minimum and maximum fall in water level of 0.03 m and 28.87 m was observed in Kullu and Una District. Out of them 1 stations (12.50%) have shown fall between 0-2 m, No stations has shown fall between 2-4 m and remaining 7 stations (87.50%) has shown fall >4m.

A perusal of map for seasonal fluctuation shows a rise in water level in major part of Paonta valley, Nalagarh valley, Una valley, Balh valley and Indora & Nurpur valley. Except a fall which is noticed in central part of Nalagarh valley, Western part of Una valley and northern part of Balh & Kullu valley.

**Table-8: Monsoonal Fluctuation - May 2018 to November 2018**

2.1

**District Wise - Fluctuation and Frequency Distribution From Different Ranges from One Period to Other**

From Year: 2018/May - To Year: 2018/Nov

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation(m)				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	4	0.85	5.45	-	-	1 25.00%	2 50.00 %	1 25.00%	0	0	0	4	0
KANGRA	37	0.14	7.58	-	-	13 35.14%	19 51.35 %	4 10.8%	0	0	0	36	0
KULLU	3	1.61	8.47	0.03	0.03	1 33.33%	0	1 33.33%	1 33.33%	0	0	2	1
MANDI	7	0.26	2.89	4.95	4.95	5 71.43%	1 14.29 %	0	0	0	1 14.2%	6	1
SIRMAUR	10	0.91	7.37	-	-	3 30.00%	2 20.00 %	5 50.00%	0	0	0	10	0
SOLAN	12	0.82	35.51	4.14	19.54	1 8.33%	2 16.67 %	6 50.00%	0	0	3 25.00%	9	3
UNA	32	0.32	6.61	19.88	28.87	9 28.13%	13 40.63 %	5 15.63%	0	0	3 9.3%	27	3
<b>Total</b>	105	1.61	2.89	0.00	28.87	33	39	22	1	0	7	94	8

**3.3 Annual Water Level Fluctuation**

Annual fluctuation in water level of GWMS during different monitoring periods were analysed and discussed below.

**3.3.1 May 2017 to May 2018**

Annual fluctuation of water level, has been worked out by comparing depth to water level of May 2017, with May 2018 and the data is presented in Annexure – III and its frequency distribution in various rise and fall ranges is given in Table-9.

Out of the 101 stations analysed, 38 stations (37.62%) have shown rise in water level ranging from 0.03 (Sirmaur) to 27.71 m (Solan district), whereas 63 stations (62.37 %) have shown fall ranging from 0.02m (Kangra district) to 3.23 m (Kangra district).

Out of stations which have shown rise in water level, 28 stations (73.68%) show rise between the range of 0 to 2m, 1 station (2.63%) has shown rise between 2 to 4m and only 9 stations (23.68%) shown rise more than 4m.

Similarly, for the stations which have shown fall in water level, 60 stations (95.23%) show fall between the range of 0 to 2m, 3 stations (4.76%) between 2 to 4m and No stations has shown fall more than 4m.

A perusal of map of Annual Water Level Fluctuation for May 2017 to May 2018 shows fall in water level in majority of monitoring areas. Fall of 0-2m is shown in Nurpur Indora valley, Kangra-Palampur valley of Kangra district, and major part of Nalagarh valley of Solan district, Paonta valley of Sirmour district, kullu valley of Kullu District. Fall >4 m is noticed in small pockets of Indora valley. Rise in water level is noticed in Kangra Palampur valley, southern part of Nalagarh valley and at some places in Paonta valley and Balh valley.

**Table-9: District wise number & % of NHS distribution in different Annual W/L Fluctuation Range (May 2017 - May 2018)**

2.1

**District Wise - Fluctuation and Frequency Distribution From Different Ranges from One Period to Other**

From Year: 2017/May - To Year: 2018/May

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation(m)				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	4	0.12	0.12	0.03	2.01	1 25.00%	0	0	2 50.00%	1 25.00%	0	1	3
KANGRA	35	0.09	13.44	0.02	3.23	6 17.14%	1 2.86%	1 2.86%	25 71.43%	2 5.71%	0	8	27
KULLU	3	-	-	0.30	1.20	0	0	0	3 100.00%	0	0	0	3
MANDI	7	10.13	10.13	0.17	1.28	0	0	1 14.29%	6 85.71%	0	0	1	6
SIRMAUR	10	0.03	8.99	0.16	1.53	4 40.00%	0	1 10.00%	5 50.00%	0	0	5	5
SOLAN	11	0.06	27.71	0.29	1.09	3 27.27%	0	2 18.18%	6 54.55%	0	0	5	6
UNA	31	0.07	24.00	0.03	1.39	14 45.16%	0	4 12.90%	13 41.94%	0	0	18	13
<b>Total</b>	101	10.13	0.12	0.02	3.23	28	1	9	60	3	0	38	63

**3.3.2 August 2017 to August 2018**

Annual fluctuation data of water level is presented in Annexure – III and its frequency distribution of rise and fall is given in Table-10. Out of the 107 stations, 69 stations (64.48%) have shown rise in water level ranging from 0.05 m (Kangra and Mandi District) to 32.34 m (Solan district) whereas 34 stations (31.77%) have shown fall ranging from 0.01 m (Kangra district) to 13.08 m (Una district).

Out of stations which have shown rise in water level, 51 stations (73.91%) show rise between the range of 0 to 2m, 5 stations (7.24 %) between 2 to 4m and remaining 13 stations (18.84%) show rise more than 4m.

Similarly, for the stations which have shown fall in water level, 29 stations (85.29%) show fall between the range of 0 to 2m, 1 stations (2.94%) between 2 to 4m and remaining 4 stations (11.76%) show fall more than 4m.

A perusal of map of Annual Water Level Fluctuation for August 2017 to August 2018 shows fall in water level in some of monitoring areas of eastern part of Kangra Palampur valley, Balh valley and kullu valley, in small pockets of Indora valley, Una valley and in small patch of Paonta valley, Nallagarh valley. Areas are showing water level rise in all the valleys, under monitoring area.

**Table-10: Annual Fluctuation August 2017 - August 2018**

2.1

<u>District Wise - Fluctuation and Frequency Distribution From Different Ranges from One Period to Other</u>													
From Year: 2017/Aug - To Year: 2018/Aug													
State : Himachal Pradesh													
District Name	No. of Wells	Range of Fluctuation(m)				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	4	0.19	0.76	0.27	0.94	2 50.00%	0	0	2 50.00%	0	0	2	2
KANGRA	35	0.05	14.40	0.01	0.48	24 68.57%	3 8.57%	1 2.86%	6 17.14%	0	0	28	6
KULLU	3	0.18	0.18	0.16	8.47	1 33.33%	0	0	1 33.33%	0	1 33.33%	1	2
MANDI	8	0.05	0.26	0.07	0.10	5 62.50%	0	0	3 37.50%	0	0	5	3
SIRMAUR	12	0.07	4.64	0.22	9.59	6 50.00%	1 8.33%	1 8.33%	2 16.67%	1 8.33%	1 8.33%	8	4
SOLAN	13	1.18	32.34	0.06	10.23	1 7.69%	0	8 61.54%	3 23.08%	0	1 7.69%	9	4
UNA	32	0.07	21.73	0.08	13.08	12 37.50%	1 3.13%	3 9.38%	12 37.50%	0	1 3.13%	16	13
<b>Total</b>	107	1.18	0.18	0.01	13.08	51	5	13	29	1	4	69	34

### 3.3.3 November 2017 to November 2018

Annual fluctuation of water level has been worked out by comparing DTWL of November 2017 with November 2018 and data is presented in Annexure – III and its frequency distribution in various rise and fall ranges is given in Table-11. Out of the 107 stations, 90 stations (84.11%) have shown rise in water level ranging from 0.02m (Una district) to 35.51 m (Solan district) whereas 14 stations (13.08%) have shown fall ranging from 0.02 m (Una district) to 28.87 m (Una district).

Out of stations which have shown rise in water level, 64 stations (71.11%) show rise between the range of 0 to 2m, 12 stations (13.33 %) between 2 to 4m and remaining 14 station( 15.55%) show rise more than 4m.

Similarly, for the stations which have shown fall in water level, 11 stations (78.57%) show fall between the range of 0 to 2m, No station has shown fall between 2 to 4m and remaining 3 stations (21.42%) shown fall more than 4m.

A perusal of map of annual fluctuation of November 2017 to November 2018 showing fall in water levels in majority of valley areas. Nalagarh valley of Solan district is completely under fall conditions. 0-2m fall is shown in some part of Paonta valley, more than 4m is observed in the small pocket of Una, Balh & Kullu valley. Similarly rise in water level 0-2m is noticed along the fringe areas of all monitoring valleys. Rise more than 4 m is shown in Nalagarh valley and at few places of Una valley and Kangra palampur valley

**Table-11: Annual Fluctuation -November 2017 to November 2018**

2.1

<b>District Wise - Fluctuation and Frequency Distribution From Different Ranges from One Period to Other</b>													
From Year: 2017/Nov - To Year: 2018/Nov													
State : Himachal Pradesh													
District Name	No. of Wells	Range of Fluctuation (m)				No. of Wells /Percentage Showing Fluctuation						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	4	0.24	1.68	0.25	0.28	2	0	0	2	0	0	2	2
KANGRA	37	0.03	2.95	0.13	0.13	31	4	0	1	0	0	35	1
KULLU	3	8.47	8.47	0.31	0.33	0	0	1	2	0	0	1	2
MANDI	7	0.10	1.59	0.17	0.25	5	0	0	2	0	0	5	2
SIRMAUR	12	0.48	4.51	0.21	11.13	6	1	1	3	0	1	8	4
SOLAN	13	0.72	35.51	-	-	3	1	9	0	0	0	13	0
UNA	31	0.02	7.28	0.02	28.87	17	6	3	1	0	2	26	3
<b>Total</b>	<b>107</b>	<b>8.47</b>	<b>1.59</b>	<b>0.00</b>	<b>28.87</b>	<b>64</b>	<b>12</b>	<b>14</b>	<b>11</b>	<b>0</b>	<b>3</b>	<b>90</b>	<b>14</b>

### 3.3.4 January 2018 to January 2019

Annual fluctuation of water level has been worked out by comparing depth to water level of January 2018 with January 2019 and data is presented in Annexure – III and its frequency distribution in various rise and fall ranges is given in Table-12. Out of the 96 stations analyzed, 79 stations (82.29%) have shown rise in water level ranging from 0.0 (Mandi and Una district) to 6.31

m (Sirmaur district) whereas 16 stations (16.66%) have shown fall ranging from 0.11 (Kangra district) to 28.69 m (Una district).

Out of stations which have shown rise in water level, 66 stations (83.54%) show rise between the range of 0 to 2m, 9 stations (11.39%) between 2 to 4m and remaining 4 stations (5.06%) show rise more than 4m.

Similarly, for the stations which have shown fall in water level, 14 stations (87.50%) show fall between the range of 0 to 2m, No stations has shown between 2 to 4m and remaining 2 stations (12.50%) show fall more than 4m.

A perusal of map of annual fluctuation of January 2018 to January 2019 is showing fall & rise, about in same proportions. The fall in water level 0-2m is shown in Indora valley, and few places of Kangra Palampur valley, Balh valley, a part of Paonta valley. Fall in water level, more than 4m is observed in western part of Una valley only. Similarly rise in water level 0-2m is noticed in central & southern part of Indora Nurpur valley, Northern part of Balh valley, southern part of Una valley and part of Paonta valley.

**Table-12: Annual Fluctuation, January 2018 to January 2019**

### District Wise - Fluctuation and Frequency Distribution From Different Ranges from One Period to Other

From Year: 2018/Jan - To Year: 2019/Jan

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation (m)				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	4	0.21	1.93	-	-	4 100.00%	0	0	0	0	0	4	0
KANGRA	35	0.02	3.58	0.11	7.15	26 74.29%	1 2.86 %	0	7 20.00%	0	1 2.86%	27	8
KULLU	3	0.18	0.47	-	-	2 66.67%	0	0	0	0	0	2	0
MANDI	8	0.01	1.32	0.12	0.57	5 62.50%	0	0	3 37.50%	0	0	5	3
SIRMAUR	10	0.12	6.31	0.35	1.18	5 50.00%	0	1 10.00%	4 40.00%	0	0	6	4
SOLAN	7	0.08	8.14	-	-	3 42.86%	1 14.29 %	3 42.86%	0	0	0	7	0
UNA	29	0.01	3.05	28.69	28.69	21 72.41%	7 24.14 %	0	0	0	1 3.45%	28	1
<b>Total</b>	<b>96</b>	<b>0.21</b>	<b>0.47</b>	<b>0.00</b>	<b>28.69</b>	<b>66</b>	<b>9</b>	<b>4</b>	<b>14</b>	<b>0</b>	<b>2</b>	<b>79</b>	<b>16</b>

### 3.4 Decadal Fluctuations

The decadal variations were analyzed considering the decadal average of water level and the water level for the respective period.

#### 3.4.1 Decadal average of May (2008-2017) to May 2018

Decadal water level fluctuation has been worked out by comparing water level data of May 2017 with the average mean of 10 years water level data of May (2008-2017) and is presented in Annexure-IV and frequency distribution in various ranges is presented in Table -13.

A perusal of Table-13 shows that out of 105 stations analysed, 32 stations (30.47%) have shown rise and 73 stations (69.52%), have shown fall in water level. 17 stations (53.12%) are showing rise in water level between 0 to 2m, 3 stations (9.37%) between 2 to 4m. and 12 stations (37.50%), more than 4m.

Out of 73 stations, 62stations (84.93%) show fall in water level between 0 to 2m, 5 stations (6.84 %) between 2 to 4 m and 6 stations (8.21%) more than 4m.



A minimum rise in water level of 0.06 m was noticed in Hamirpur districts and the maximum rise of 33.15m is noticed in Una district. Similarly, the minimum and maximum fall of 0.02 m is noticed in Mandi district & maximum fall of 29.31 m is noticed in Solan district.

A perusal of map of Decadal Variation - Average of May (2008 - 2017) with May 2018 reveals fall less than 2m, in all the valleys of Kangra district, Mandi district, Sirmaur district, Solan district & Una district except at some places in Indaura valley, Balh valley and Kangra-Palampur valley and Nurpur valley, which is showing rise. A fall is 2-4m and >4 m is shown in Una , Indora valley , Kullu valley and Nallagarh valley.

**Table-13: District wise number & % NHS distribution in different Decadal W/L Fluctuation Range (May (2008 - 2017) with May 2018**

2.1

<u>District Wise - Fluctuation of Water Level with Mean and Selected Period</u>													
10 Years Mean ( 2008 May - 2017 May ) - 2018/May													
State : Himachal Pradesh													
District Name	No. of Wells	Range of Fluctuation				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise (m)		Fall (m)		Rise (m)			Fall (m)			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	4	0.06	0.06	0.18	1.96	1 25.00 %	0	0	3 75.00 %	0	0	1	3
KANGRA	36	0.16	13.76	0.03	3.48	9 25.00 %	3 8.33 %	2 5.56 %	20 55.56 %	2 5.56 %	0	14	22
KULLU	3	-	-	0.22	4.39	0	0	0	1 33.33 %	1 33.33 %	1 33.33 %	0	3
MANDI	8	7.87	7.87	0.02	1.63	0	0	1 12.50 %	7 87.50 %	0	0	1	7
SIRMAUR	10	0.16	8.83	0.08	0.94	4 40.00 %	0	1 10.00 %	5 50.00 %	0	0	5	5
SOLAN	12	0.25	27.37	1.61	29.33	1 8.33 %	0	3 25.00 %	4 33.33 %	0	4 33.33 %	4	8
UNA	32	0.10	33.15	0.13	4.15	2 6.25 %	0	5 15.63 %	22 68.75 %	2 6.25 %	1 3.13 %	7	25
<b>Total</b>	105	0.06	7.87	0.02	29.33	17	3	12	62	5	6	32	73

### 3.4.2 Decadal Average of August (2008 - 2017) to August 2018

Decadal water level fluctuation has been worked out by comparing water level data of August 2018 with the average 10 years water level data of August (2008-2017) and is presented in Annexure - IV and frequency distribution in various ranges is presented in Table -14.

A perusal of Table-14 shows that out of 107 stations analyzed, 66 stations (61.68%) have shown rise and 41 stations (38.31%), have shown fall in water level. 45 stations (68.18%) are showing rise in water level between 0 to 2m, 12 stations (18.18%) between 2 to 4m. and 9 stations (13.63%), more than 4m.

Out of 41 stations, 35 stations (85.36%) show fall in water level between 0 to 2m, 3 stations (7.31%) between 2 to 4 m and 3 stations (7.31%) more than 4m.

A minimum rise in water level of 0.00m was noticed in Una district and the maximum rise of 20.73 m is noticed in Una district. Similarly, the minimum and maximum fall of 0.00 m is noticed in Sirmaur district & maximum fall of 6.66 m is also noticed in Solan district.

A perusal of map Decadal Average of August (2008 - 2017) to August 2018 shows fall in water level in Paonta valley except central part of Sirmaur district complete Nalagargh valley of Solan district, central part of Una valley of Una district, some part of Balh valley of Mandi district and north central part of Kangra Palampur valley of Kangra district. Fall in water level, >4 m is shown in Kullu valley and couple of pockets of Una valley and Kangra-Palampur valley. Similarly rise in water level is noticed in kangra Palampur valley of Kangra district, central part of Una valley in Una district .

**Table-14: Decadal Fluctuation August (2008-2017) to August 2018**

**District Wise - Fluctuation of Water Level with Mean and Selected Period**

10 Years Mean ( 2008 Aug - 2017 Aug ) - 2018/Aug

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise (m)		Fall (m)		Rise (m)			Fall (m)			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	4	0.06	0.90	0.72	0.72	3 75.00 %	0	0	1 25.00%	0	0	3	1
KANGRA	35	0.01	8.63	0.03	0.34	21 60.00 %	6 17.14%	2 5.71%	6 17.14%	0	0	29	6
KULLU	3	0.25	0.25	1.51	4.40	1 33.33 %	0	0	1 33.33%	0	1 33.33%	1	2
MANDI	8	0.03	0.42	0.05	0.63	3 37.50 %	0	0	5 62.50%	0	0	3	5
SIRMAUR	12	0.06	8.60	0.00	3.11	3 25.00 %	2 16.67%	1 8.33%	5 41.67%	1 8.33 %	0	6	6
SOLAN	13	0.10	12.15	0.04	6.66	3 23.08 %	1 7.69%	4 30.77%	4 30.77%	0	1 7.69%	8	5
UNA	32	.00	20.73	0.04	4.70	11 34.38 %	3 9.38%	2 6.25%	13 40.63%	2 6.25 %	1 3.13%	16	16
<b>Total</b>	107	0.25	0.25	0.00	6.66	45	12	9	35	3	3	66	41

### 3.4.3 Decadal average of November (2008-2017) to November 2018

Decadal water level fluctuation has been worked out by comparing water level data of November 2018 with the average water level data of November for 10 years (2008-2017) and is presented in Annexure - IV and frequency distribution in various ranges in Table 15.

A perusal of Table-15 shows that out of 108 stations analyzed, 84 stations (77.77%) have shown rise and 24 stations (22.22%), have shown fall in water level. 67 stations (79.76%) are showing rise in water level between 0 to 2m, 8 stations (9.52 %) between 2 to 4m. and 9 stations (10.71%), more than 4m.

Out of 24 stations, 20 stations (83.33%) show fall in water level between 0 to 2m, 3 stations (12.50%) between 2 to 4 m and 1 stations (4.16 %) more than 4m.

A minimum rise in water level of 0.02 m was noticed in Una district and the maximum rise of 11.05 m is noticed in Solan district. Similarly, the minimum and maximum fall of 0.01 m is noticed in Mandi district & maximum fall of 13.27 m is also noticed in Una district.

A perusal of map of Decadal average of November (2008-2017) to November 2018 reveals fall in water level less than 2m.is shown in northern part of Indaura valley of Kangra district, major part of Una valley, Balh valley, a couple of places in Paonta valley and all Nalagarh valley. The fall between 2 to 4 m was noticed in, Una and Nalagarh valley. Similarly, rise is noticed in all the valleys from 0-2 m and 2- 4m except in major part of Nallagah valley and Kangra Palampur valley.

**Table-15: Decadal Fluctuation November (2008-2017) to November 2018**

**District Wise - Fluctuation of Water Level with Mean and Selected Period**  
10 Years Mean ( 2008 Nov - 2017 Nov ) - 2018/Nov

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation				No. of Wells /Percentage Showing Fluctuation						Total No. of Wells	
		Rise (m)		Fall (m)		Rise (m)			Fall (m)			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	4	0.39	1.79	-	-	4 100.00 %	0	0	0	0	0	4	0
KANGRA	37	0.06	7.41	0.09	0.30	28 75.68 %	3 8.11%	2 5.41%	4 10.81%	0	0	33	4
KULLU	3	4.78	4.78	0.27	0.93	0	0	1 33.33%	2 66.67%	0	0	1	2
MANDI	7	0.16	1.36	0.01	0.37	4 57.14 %	0	0	3 42.86%	0	0	4	3
SIRMAUR	12	0.02	10.88	0.04	2.68	5 41.67 %	0	1 8.33%	4 33.33%	2 16.67 %	0	6	6
SOLAN	13	0.48	11.05	0.05	3.59	3 23.08 %	2 15.38%	4 30.77%	3 23.08%	1 7.69 %	0	9	4
UNA	32	0.02	4.32	0.05	13.27	23 71.88 %	3 9.38%	1 3.13%	4 12.50%	0	1 3.13%	27	5
<b>Total</b>	108	1.36	4.78	0.00	13.27	67	8	9	20	3	1	84	24

**3.4.4 Decadal average of January (2009-2018) to January 2019**

Decadal water level fluctuation has been worked out by comparing water level data of January 2019 with the average water level data of January for 10 years (2009-2018) and is presented in Annexure - IV and frequency distribution in various ranges is presented in Table -15.

A perusal of Table-15 shows that out of 100 stations analysed, 69 stations (69.00 %) have shown rise and 31 stations (31.00%), have shown fall in water level. 59 stations (85.50%) are showing rise in water level between 0 to 2m, 8 stations (11.59%) between 2 to 4m. and 2 stations (2.89%), more than 4m. Out of 31 stations, 28 stations (90.32%) show fall in water level between 0 to 2m, 1 stations (3.22%) between 2 to 4 m and 2 stations (6.45%) more than 4m.

A minimum rise in water level of 0.02 m was noticed in Una district and the maximum rise of 6.44 m is noticed in Sirmaur district. Similarly, the minimum and maximum fall of 0.02 m is noticed in Kangra district & maximum fall of 7.68 m is noticed in Una district.

A perusal of map of Decadal average of January (2009-2018) to January 2019 reveals fall in water level less than 2m.is shown in small areas of Nurpur-Indaura valley of Kangra district, Balh valley, major part of Paonta valley and all Nalagarh valley. The fall between 2 to 4 m and >4 m was

noticed in few places of Una valley, Nalagargh valley and Paonta valley of Sirmour district. Similarly, rise is noticed in all the valleys from 0-2 m and 2- 4m except in major part of Indora valley.

**Table –15: Decadal Fluctuation January (2009-2018) to January 2019**

2.1

<u>District Wise - Fluctuation of Water Level with Mean and Selected Period</u>													
10 Years Mean ( 2009 Jan - 2018 Jan ) - 2019/Jan													
State : Himachal Pradesh													
District Name	No. of Wells	Range of Fluctuation				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise (m)		Fall (m)		Rise (m)			Fall (m)			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	4	0.20	1.11	-	-	4	0	0	0	0	0	4	0
KANGRA	36	0.09	6.05	0.02	6.80	24 66.67 %	2 5.56%	1 2.78%	8 22.22%	0	1 2.78%	27	9
KULLU	3	0.38	0.38	0.28	3.61	1 33.33 %	0	0	1 33.33%	1 33.33 %	0	1	2
MANDI	8	0.06	1.25	0.13	0.53	5 62.50 %	0	0	3 37.50%	0	0	5	3
SIRMAUR	12	0.14	6.44	0.07	1.79	4 33.33 %	1 8.33%	1 8.33%	6 50.00%	0	0	6	6
SOLAN	7	0.66	3.87	0.13	1.73	1 14.29 %	2 28.57%	0	4 57.14%	0	0	3	4
UNA	30	0.02	2.50	0.17	7.68	20 66.67 %	3 10.00%	0	6 20.00%	0	1 3.33%	23	7
<b>Total</b>	100	0.38	0.66	0.00	7.68	59	8	2	28	1	2	69	31

## Depth to water level of May 2018, August 2018, Nov 2018 &amp; Jan 2019

State	Himachal Pradesh				
District	HAMIRPUR	Dtw May 2018	Dtw Aug 2018	Dtw Nov 2018	Dtw Jan 2019
1	Bagnalla	6.46	4.37	3.36	4.28
2	Bijari	4.94	1.81	1.78	1.83
3	Galore	2.92	1.57	2.07	2.27
4	Kangu	11.51	4.97	6.06	7.05
District	KANGRA				
5	Andaura	3.43	0.64	1.86	2.32
6	Bandh	3.38	0.26	0.91	9.12
7	Barota	8.50	2.63	4.06	5.32
8	Basa Bazira	8.00	4.54	7.37	8.64
9	Bhalad	3.69	0.17	0.93	1.14
10	Bhali	3.19	1.01	1.67	2.07
11	Bharmar	15.16	4.01	7.58	9.81
12	Bharoli	7.84	3.12	4.31	6.11
13	Bod	5.63	1.10	2.53	2.56
14	Chakban Ambari	6.61	3.06	4.35	4.62
15	Channaur	3.42	2.09	2.29	2.32
16	Darkati	2.56	0.66	1.07	1.37
17	Dehra Gopipur	5.23	2.98	3.01	3.82
18	Dehrian	2.24	1.13	1.44	1.56
19	Hardogri	4.42	2.57	2.81	3.63
20	Jagir	3.34	2.05	2.63	2.87
21	Jassur	4.09	2.79	1.73	2.65
22	Jwalaji	4.96	0.66	1.58	1.99
23	Kangra	10.14	4.08	6.57	10.50
24	Kathgarh	7.50	2.56	3.31	3.58
25	Kotla	2.98	-0.18	1.24	2.45
26	Manjgram	1.77	0.38	0.83	1.33
27	Mao	4.21	0.61	1.14	1.79
28	Mohtli	4.89	2.49	2.72	3.29
29	Nagrota	0.00	0.00	0.00	9.56
30	Old Kangra	4.97	0.49	2.29	3.03
31	Olherian	4.50	2.86	2.32	2.56
32	Pandtehr	0.56	0.39	0.42	0.46
33	Panjpir	4.86	1.77	3.21	3.69
34	Paprola	12.86	2.74	8.87	9.48
35	Rait	10.53	2.24	7.39	8.67
36	Raja-ka-talab	4.34	1.16	1.24	3.45
37	Rakar	4.54	1.42	2.42	2.89
38	Riali	4.31	1.91	3.65	3.80
39	Takipur	7.21	0.17	2.31	3.96
40	Thali	4.63	2.26	2.45	2.48
41	Thirtynine Mile	9.77	2.91	6.90	8.10
42	Bhatka	2.01	0.79	0.86	1.03
43	Parnalla	3.52	1.69	2.16	2.37
44	Lakhnaut	4.21	0.66	1.45	2.45
45	Ladhi	3.03	1.16	1.47	1.63

46	Naura	1.68	0.62	0.97	1.11
47	Changara	3.57	0.86	1.21	1.66
48	Barot	5.49	1.16	3.86	5.27
49	Kuth khana	11.64	6.57	6.82	7.49
50	Nagrota Gurudwara	DRY	2.16	6.77	9.56
<b>District</b>	<b>Kullu</b>	<b>Dtw May 2018</b>	<b>Dtw Aug 2018</b>	<b>Dtw Nov 2018</b>	<b>Dtw Jan 2019</b>
51	Gadauri	8.10	7.06	6.49	6.56
52	Hathithan	8.47	8.47	0.00	8.47
53	Kullu	1.54	1.09	1.57	0.99
<b>District</b>	<b>MANDI</b>				
54	Bahangrotu	7.14	4.01	4.25	5.07
55	Gagal	2.49	1.74	2.01	1.92
56	GUTKAR	0.00	4.18	4.95	6.46
57	Jarl	0.57	0.31	0.31	0.33
58	Jhiri	5.85	3.60	3.95	4.29
59	Kaned	1.95	0.38	0.44	0.74
60	Lohara	3.98	3.34	3.29	4.06
61	Ratti	5.12	3.93	4.24	4.31
62	Dinak	6.17	3.73	4.01	4.44
<b>District</b>	<b>SIRMAUR</b>				
63	Ajiwala	6.44	3.28	4.48	5.55
64	Akkawala	11.66	10.92	11.86	11.13
65	Badripur	15.63	7.63	10.01	11.31
66	Dhaulakuan	9.00	3.11	3.44	5.36
67	Kala-Amb	14.08	10.68	12.99	13.57
68	Khodawala	16.37	8.28	14.11	15.36
69	Kiyarda	9.81	2.81	5.43	9.21
70	Kolar	13.57	2.61	6.20	11.58
71	Nayagaon	13.01	5.74	8.93	11.70
72	Shambuwala	11.56	6.12	8.59	9.00
73	Shibpur	28.56	18.02	24.71	27.52
74	Trilokpur	2.23	1.01	1.32	1.42
75	Miserwala	7.79	2.06	3.62	6.35
76	Sainwala I	5.26	1.03	3.32	4.26
77	Kodewala	2.97	2.36	2.48	2.46
78	Kheri	2.22	1.88	2.18	2.48
79	Sainwala II	2.36	1.38	1.52	1.84
<b>District</b>	<b>SOLAN</b>				
80	Baddi	6.75	0.00	0.00	Abondaned
81	Barotiwala	0.00	23.93	19.54	22.12
82	Barun	37.56	28.98	31.58	DRY
83	Bhagheri	21.68	21.87	12.89	14.07
84	BHATOLI	14.10	0.00	10.89	12.42
85	Dhabota	14.29	10.23	12.05	12.18
86	Jagatpur	0.00	15.53	11.74	13.57
87	Jharmajri	13.62	0.00	0.00	Abondaned
88	Khera-chak	0.00	4.89	4.14	5.64
89	Mahadev	14.25	0.00	0.00	12.19
90	Manjhauli	0.00	0.00	0.00	Abondaned
91	Panjahra	55.00	22.66	19.49	21.35
92	Phalahi	6.02	4.79	5.20	5.44

93	Maganpura	DRY	4.77	4.73	5.67
94	Theda	11.39	5.44	3.91	5.26
95	Nalagarh	8.11	3.71	4.22	4.57
<b>District</b>	<b>Una</b>	<b>Dtw May 2018</b>	<b>Dtw Aug 2018</b>	<b>Dtw Nov 2018</b>	<b>Dtw Jan 2019</b>
96	Amb	6.67	3.21	2.27	2.91
97	Ambota	0.00	0.00	28.87	28.69
98	Babehr	5.67	1.03	1.82	1.93
99	Bawal	1.31	0.78	0.99	1.03
100	Bhadsali	16.37	15.44	13.03	12.96
101	Bhangana	3.06	0.47	0.72	1.15
102	Daulatpur	9.53	8.06	6.87	7.33
103	Dharampur	4.12	1.64	1.83	1.90
104	Gagret	12.00	7.22	6.46	7.37
105	Ghaneri	9.96	5.57	6.29	8.56
106	Guglahar	5.06	3.02	2.13	2.61
107	Ishapur	3.66	1.02	1.29	1.59
108	Jankaur	0.00	0.00	0.00	Abandoned
109	Jawar	2.28	1.47	1.01	1.16
110	Jhalera	6.11	3.88	3.25	4.06
111	Khanpur	5.68	3.99	4.13	4.85
112	Khwaja	3.06	0.22	1.58	1.97
113	Kuluwal	0.00	0.00	0.00	Abandoned
114	Kuthera Jaswala	7.79	6.03	5.63	6.25
115	Lalehri	13.14	10.92	8.96	10.26
116	Loharli	5.33	2.02	1.82	2.88
117	Mawa Kalan	0.00	22.91	20.24	21.12
118	Mubarikpur	6.69	3.77	2.94	2.98
119	Nangran	5.63	4.98	4.56	5.10
120	Panjawar	14.22	14.07	11.14	11.21
121	Panoh	3.74	0.00	2.19	2.20
122	Raipur Marwadi	21.54	19.23	16.20	16.61
123	Rajli Panjal	7.49	0.03	0.88	1.97
124	Santokhgarh	5.87	4.32	4.26	4.87
125	Singhnei	0.00	0.00	19.88	19.91
126	Tahliwala 1	2.93	0.41	0.97	1.27
127	Una	3.67	1.76	1.74	2.33
<b>District</b>	<b>Chamba</b>				
128	Upper Thulel	7.41	0.96	2.36	2.98



## Monsoonal Fluctuation of - Pre and post for 2018

State	Himachal Pradesh	
District	HAMIRPUR	Monsoon fl (may18- Nov18)
1	Bagnalla	3.10
2	Bijari	3.16
3	Galore	0.85
4	Kangu	5.45
District	KANGRA	
5	Andaura	1.57
6	Bandh	2.47
7	Barota	4.44
8	Basa Bazira	0.63
9	Bhalad	2.76
10	Bhali	1.52
11	Bharmar	7.58
12	Bharoli	3.53
13	Bod	3.10
14	Chakban Ambari	2.26
15	Channaur	1.13
16	Darkati	1.49
17	Dehra Gopipur	2.22
18	Dehrian	0.80
19	Hardogri	1.61
20	Jagir	0.71
21	Jassur	2.36
22	Jwalaji	3.38
23	Kangra	3.57
24	Kathgarh	4.19
25	Kotla	1.74
26	Manjgram	0.94
27	Mao	3.07
28	Mohtli	2.17
29	Nagrota	0.00
30	Old Kangra	2.68
31	Olherian	2.18
32	Pandtehr	0.14
33	Panjpir	1.65
34	Paprola	3.99

35	Rait	3.14
36	Raja-ka-talab	3.10
37	Rakar	2.12
38	Riali	0.66
39	Takipur	4.90
40	Thali	2.18
41	Thirtynine Mile	2.87
<b>District</b>	<b>KULLU</b>	
42	Gadauri	1.61
43	Hathithan	8.47
44	Kullu	-0.03
<b>District</b>	<b>MANDI</b>	
45	Bahangrotu	2.89
46	Gagal	0.48
47	GUTKAR	-4.95
48	Jarl	0.26
49	Jhiri	1.90
50	Kaned	-
51	Lohara	0.69
52	Ratti	0.88
<b>District</b>	<b>SIRMAUR</b>	
53	Ajiwala	1.96
54	Akkawala	-
55	Badripur	5.62
56	Dhaulakuan	5.56
57	Kala-Amb	1.09
58	Khodawala	2.26
59	Kiyarda	4.38
60	Kolar	7.37
61	Nayagaon	4.08
62	Shambuwala	2.97
63	Shibpur	-
64	Trilokpur	0.91
<b>District</b>	<b>SOLAN</b>	
65	Baddi	6.75
66	Barotiwala	-19.54
67	Barun	5.98
68	Bhagheri	8.79
69	Bhatoli	3.21
70	Dhabota	2.24
71	Jagatpur	-11.74
72	Jharmajri	13.62
73	Khera-chak	-4.14

74	Mahadev	14.25
75	Manjhauri	-
76	Panjahra	35.51
77	Phalahi	0.82
<b>District</b>	<b>UNA</b>	
78	Amb	4.40
79	Ambota	-28.87
80	Babehr	3.85
81	Bawal	0.32
82	Bhadsali	3.34
83	Bhangana	2.34
84	Daulatpur	2.66
85	Dharampur	2.29
86	Gagret	5.54
87	Ghaneri	3.67
88	Guglahar	2.93
89	Ishapur	2.37
90	Jankaur	0.00
91	Jawar	1.27
92	Jhalera	2.86
93	Khanpur	1.55
94	Khwaja	1.48
95	Kuluwal	0.00
96	Kuthera Jaswala	2.16
97	Lalehri	4.18
98	Loharli	3.51
99	Mawa Kalan	-20.24
100	Mubarikpur	3.75
101	Nangran	1.07
102	Panjawar	3.08
103	Panoh	1.55
104	Raipur Marwadi	5.34
105	Rajli Panjal	6.61
106	Santokhgarh	1.61
107	Singhnei	-19.88
108	Tahliwala 1	1.96
109	Una	1.93

- data not available

**Annexure-III**

**Annual Fluctuation of May 2017- May 2018, August 2017- August 2018  
November 2017- November 2018 and January 2018- January 2019**

<b>State</b>	<b>Himachal Pradesh</b>				
<b>District</b>	<b>HAMIRPUR</b>	<b>Annual fl may (17-18)</b>	<b>Annual fl Aug (17-18)</b>	<b>Annual fl Nov (17-18)</b>	<b>Annual fl Jan (18-19)</b>
1	Bagnalla	-0.03	-0.94	1.68	1.36
2	Bijari	-2.01	-0.27	0.24	0.21
3	Galore	0.12	0.19	-0.25	0.54
4	Kangu	-0.39	0.76	-0.28	1.93
<b>District</b>	<b>KANGRA</b>				
5	Andaura	-0.44	0.86	0.67	0.41
6	Bandh	-1.96	0.17	0.68	-7.15
7	Barota	-0.80	0.30	0.80	0.55
8	Basa Bazira		2.30	0.94	
9	Bhalad	-0.45	-0.02	0.61	0.29
10	Bhali	-0.61	0.20	0.38	0.20
11	Bharmar	-1.10	2.12	2.59	1.86
12	Bharoli	0.80	0.37	1.82	0.58
13	Bod	-0.72	0.39	0.54	0.07
14	Chakban Ambari	-2.29	0.33	0.04	-0.11
15	Channaur	-0.89		0.10	0.25
16	Darkati	-0.02	0.15	0.42	0.49
17	Dehra Gopipur	-0.06	0.10	1.28	0.36
18	Dehrian	-0.15	0.08	0.03	0.25
19	Hardogri	0.20	0.05	-0.13	-0.31
20	Jagir	-0.03		0.31	
21	Jassur	-0.52	0.37	1.01	0.42
22	Jwalaji	0.57	0.45	1.01	0.20
23	Kangra	1.03	0.75	2.95	-0.24
24	Kathgarh	-3.23	0.53	0.35	0.35
25	Kotla	0.09	0.11	0.94	0.13
26	Manjgram	-0.97	-0.05	0.13	0.02
27	Mao	-0.38	0.00	0.82	-0.17
28	Mohtli	-1.09	-0.01	0.77	0.33
29	Nagrota	13.44	14.40	0.00	-0.34
30	Old Kangra	3.75	0.60	0.79	0.03
31	Olherian		-0.17	0.89	0.50
32	Pandtehr	-0.14	-0.16	0.07	0.03

33	Panjpur	-0.20	0.34	1.26	0.23
34	Paprola	-0.83	1.55	2.47	3.58
<b>State</b>	<b>Himachal Pradesh</b>	<b>Annual fl may (17-18)</b>	<b>Annual fl Aug (17-18)</b>	<b>Annual fl Nov (17-18)</b>	<b>Annual fl Jan (18-19)</b>
35	Rait	-0.19	2.47	1.23	0.72
36	Raja-ka-talab	1.00	0.22	2.03	0.14
37	Rakar	-0.67	-0.48	0.82	0.42
38	Riali	-0.20	1.77	0.03	-0.16
39	Takipur	-0.93	0.79	1.73	0.58
40	Thali	-0.79	0.45	0.12	0.25
41	Thirtynine Mile	-1.01	1.68	0.75	-0.31
<b>District</b>	<b>KULLU</b>				
42	Gadauri	-0.45	-0.16	-0.31	0.18
43	Hathithan	-0.30	-8.47	8.47	0.00
44	Kullu	-1.20	0.18	-0.33	0.47
<b>District</b>	<b>MANDI</b>				
45	Bahangrotu	-0.64	0.19	1.59	0.86
46	Gagal		0.07	-0.25	0.82
47	GUTKAR	10.13	-0.10	1.23	1.32
48	Jarl	-0.17	0.05	0.10	0.01
49	Jhiri	-0.35	0.26	0.35	0.18
50	Kaned	-1.28	0.22		-0.12
51	Lohara	-0.21	-0.09	0.14	-0.57
52	Ratti	-1.11	-0.07	-0.17	-0.22
<b>District</b>	<b>SIRMAUR</b>				
53	Ajiwala	-0.18	-3.28	0.50	0.23
54	Akkawala		-9.59	-0.53	0.41
55	Badripur	8.99	1.98	0.48	
56	Dhaulakuan	0.40	1.09	1.16	6.31
57	Kala-Amb	1.92	0.80	-0.25	-0.52
58	Khodawala	-1.11	4.64	-11.13	-1.18
59	Kiyarda	-0.26	-0.22	1.19	-0.35
60	Kolar	-1.53	1.26	4.51	
61	Nayagaon	0.03	-1.02	0.73	-0.46
62	Shambuwala	0.18	2.32	1.34	1.27
63	Shibpur		0.66	2.07	0.12
64	Trilokpur	-0.16	0.07	-0.21	0.42
<b>District</b>	<b>SOLAN</b>				
65	Baddi	-1.09	6.75	6.75	
66	Barotiwala	27.71	1.18	6.55	4.70
67	Barun	-0.60	8.58	5.98	
68	Bhagheri	0.35	-0.25	8.79	8.14
69	Bhatoli	-0.29	14.10	2.90	1.68

70	Dhabota	0.31	-10.23	0.72	0.65
71	Jagatpur	22.35	7.12	5.90	4.37
<b>State</b>	<b>Himachal Pradesh</b>	<b>Annual fl may (17-18)</b>	<b>Annual fl Aug (17-18)</b>	<b>Annual fl Nov (17-18)</b>	<b>Annual fl Jan (18-19)</b>
72	Jharmajri	-0.90	13.62	13.62	
73	Khera-chak		-0.06	1.85	
74	Mahadev	-0.54	14.25	14.25	2.06
75	Manjhaul		7.00	7.00	
76	Panjahra	-0.52	32.34	35.51	
77	Phalahi	0.06	-0.25	0.73	0.08
<b>District</b>	<b>UNA</b>				
78	Amb	0.91	1.05	4.29	3.05
79	Ambota		0.00	-28.87	-28.69
80	Babehr	0.17	0.24	0.77	1.28
81	Bawal	-0.24	0.28	0.20	0.11
82	Bhadsali	-0.39	0.00		2.81
83	Bhangana	-0.03	0.09	7.28	0.26
84	Daulatpur	0.61	-0.18	1.66	1.41
85	Dharampur	0.76	4.03	1.01	1.17
86	Gagret	-1.39	4.78	0.95	0.91
87	Ghaneri	-1.38	-0.88	2.17	0.83
88	Guglahar	0.07	-0.10	1.42	1.62
89	Ishapur	0.11	0.69	1.25	1.05
90	Jankaur	5.94	0.00	0.00	
91	Jawar	-0.17	-0.48	0.03	0.01
92	Jhalera	-0.62	0.16	1.62	1.20
93	Khanpur	-0.57	0.07	-0.02	1.87
94	Khwaja	-0.54	0.31	0.53	0.24
95	Kuluwal	5.14	3.66	0.00	
96	Kuthera Jaswala	-0.12	-0.17	1.70	1.64
97	Lalehri	0.61	-0.96	-5.29	
98	Loharli	0.23	0.32	7.18	1.44
99	Mawa Kalan	22.63	-1.97	2.08	1.94
100	Mubarikpur	0.60	-0.30	1.60	2.15
101	Nangran	0.39	-0.47	0.02	0.28
102	Panjawar	0.60	-13.08	3.37	2.28
103	Panoh	-0.40	0.44	0.24	0.38
104	Raipur Marwadi	-0.36	-0.86	2.37	2.51
105	Rajli Panjal	0.08	0.34	2.74	2.77
106	Santokhgarh	0.43	-0.13	0.77	0.22
107	Singhnei	24.00	21.73	2.29	2.15
108	Tahliwala 1	-0.19	0.19	0.74	0.77
109	Una	0.82	-0.08	1.12	0.60

## Annexure-IV

**Decadal mean Fluctuation May (2008-2017 with May 2018), August (2008-2017 with Aug 2018)  
November (2008-2017 with Nov 2018) January 2009-2018 with Jan 2019)**

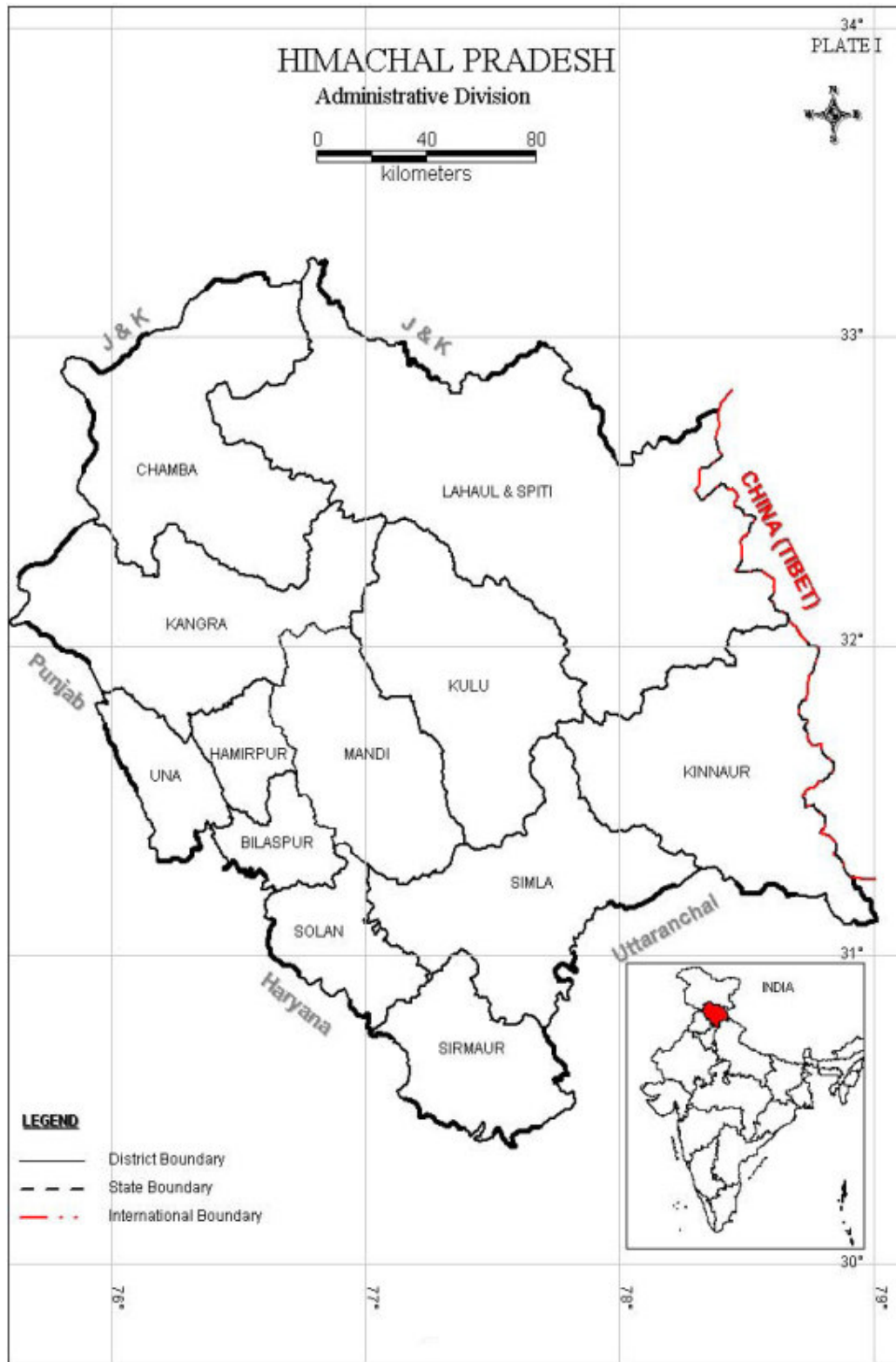
State	Himachal Pradesh				
District	HAMIRPUR	Decadal fl may(2008- 2017)wrt May 18	Decadal fl Aug(2008- 2017)wrt Aug18	Decadal fl Nov(2008- 2017)wrt Nov18	Decadal fl Jan(2009- 2018)wrt Jan19
1	Bagnalla	-0.18	0.06	1.79	1.11
2	Bijari	-1.96	-0.72	0.64	0.20
3	Galore	0.06	0.12	0.39	0.45
4	Kangu	-1.61	0.90	0.68	0.75
District	KANGRA				
5	Andaura	1.22	2.31	1.78	1.64
6	Bandh	-0.31	0.68	1.26	-6.67
7	Barota	-1.50	0.58	0.34	-0.04
8	Basa Bazira	-0.07	2.23	-0.30	0.00
9	Bhalad	0.95	0.15	0.48	0.56
10	Bhali	-0.83	0.17	0.06	0.14
11	Bharmer	0.95	2.84	2.62	1.34
12	Bharoli	-1.94	1.13	1.15	0.48
13	Bod	-2.31	0.09	0.17	0.11
14	Chakban Ambari	-0.03	0.44	-0.09	-0.13
15	Channaur	-0.05		1.21	1.11
16	Darkati	-0.17	0.08	0.40	0.72
17	Dehra Gopipur	0.24	0.13	0.88	0.11
18	Dehrian	0.18	-0.03	0.20	0.30
19	Hardogri	-0.03	0.56	0.09	-0.33
20	Jassur	1.15	0.09	2.93	2.95
21	Jwalaji	-1.35	-0.03	-0.26	-0.60
22	Kangra	2.48	1.13	2.13	0.35
23	Kathgarh	-3.48	0.13	0.14	-0.02
24	Kotla	-0.18	0.22	0.33	0.09
25	Manjgram	0.28	0.02	0.20	-0.05
26	Mao	0.54	-0.15	0.64	0.75
27	Mohtli	4.27	5.58	4.64	6.05
28	Nagrota	13.76	8.63	7.41	1.09
29	Old Kangra	2.10	2.48	0.85	0.87
30	Olherian	-0.85	-0.15	0.37	0.36

		<b>Decadal fl may(2008- 2017)wrt May 18</b>	<b>Decadal fl Aug(2008- 2017)wrt Aug18</b>	<b>Decadal fl Nov(2008- 2017)wrt Nov18</b>	<b>Decadal fl Jan(2009- 2018)wrt Jan19</b>
31	Pandtehr	0.41	-0.03	0.06	0.10
32	Panjpir	-0.39	0.09	0.26	0.20
33	Paprola	0.16	3.62	1.35	2.25
34	Rait	-0.63	2.35	0.59	0.36
35	Raja-ka-talab	-0.03	0.01	1.64	0.26
36	Riali	2.90	1.77	0.81	0.36
37	Rakar	-0.20	0.34	-0.16	-0.14
38	Takipur	-0.24	0.73	0.75	0.62
39	Thali	-0.66	0.35	0.08	0.15
40	Thirtynine Mile	-1.24	1.60	0.58	-0.31
<b>District</b>	<b>KULLU</b>				
41	Gadauri	-2.49	-1.51	-0.93	-0.28
42	Hathithan	-4.39	-4.40	4.78	-3.61
43	Kullu	-0.22	0.25	-0.27	0.38
<b>District</b>	<b>MANDI</b>				
44	Bahangrotu	-0.32	0.42	1.36	1.25
45	Gagal	-0.72	-0.40	-0.37	0.06
46	GUTKAR	7.87	-0.63	0.68	0.43
47	Jarl	-0.02	0.03	0.16	0.15
48	Jhiri	-1.63	-0.43	-0.01	-0.13
49	Kaned	-0.38	0.35		0.52
50	Lohara	-0.09	-0.05	0.30	-0.53
51	Ratti	-1.17	-0.52	-0.33	-0.37
<b>District</b>	<b>SIRMAUR</b>				
52	Ajiwala	-0.32	-0.36	0.13	-0.43
53	Akkawala		-3.11	-0.40	0.32
54	Badripur	1.27	-0.22	-2.68	2.24
55	Dhaulakuan	-0.94	0.00	0.32	0.90
56	Kala-Amb	0.16	0.06	-0.04	-0.29
57	Khodawala	-0.68	3.59	-2.33	-1.79
58	Kiyarda	0.48	-0.30	0.02	-0.47
59	Kolar	8.83	8.60	10.88	6.44
60	Nayagaon	-0.08	-1.87	-0.19	-0.18
61	Shambuwala	-0.88	0.56	-0.31	0.14
62	Shibpur		2.65	1.64	-0.07
63	Trilokpur	0.35	0.08	0.23	0.41
<b>District</b>	<b>SOLAN</b>				
64	Baddi	-1.82	4.79	4.35	0.00

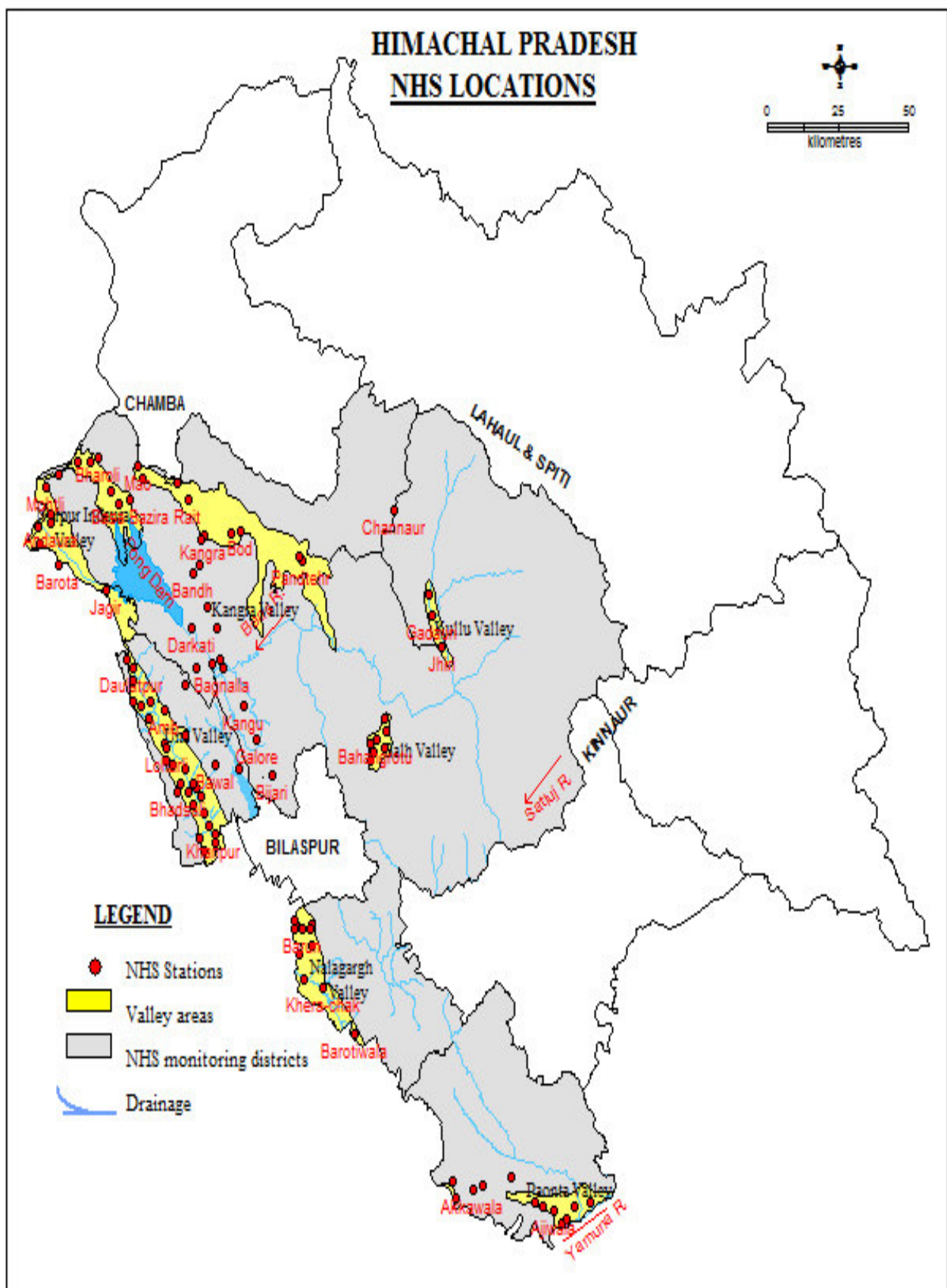


		<b>Decadal fl may(2008- 2017)wrt May 18</b>	<b>Decadal fl Aug(2008- 2017)wrt Aug18</b>	<b>Decadal fl Nov(2008- 2017)wrt Nov18</b>	<b>Decadal fl Jan(2009- 2018)wrt Jan19</b>
65	Barotiwala	27.37	0.37	5.58	-3.87
66	Barun	-8.55	0.10	-3.59	0.00
67	Bhagheri	-4.06	-6.66	1.20	0.66
68	Bhatoli	-1.74	11.83	-0.57	-1.73
69	Dhabota	-1.61	-0.04	-0.21	-0.13
70	Jagatpur	19.55	-1.36	3.61	3.27
71	Jharmajri	-4.84	12.15	8.03	
72	Khera-chak	5.15	-1.16	-0.05	
73	Mahadev	-1.86	10.85	11.05	-0.48
74	Manjhaul			3.81	
75	Panjahra	-29.33	3.35	0.38	
76	Phalahi	0.25	-1.73	0.51	-0.17
<b>District</b>	<b>UNA</b>				
77	Amb	0.36	-1.41	2.07	2.17
78	Ambota	33.15	-20.68	-13.27	-7.68
79	Babehr	-1.10	-0.23	0.36	1.31
80	Bawal	0.10	-0.36	0.39	0.64
81	Bhadsali	-0.94	0.66	1.35	2.50
82	Bhangana	-0.81	-0.28	1.66	0.21
83	Daulatpur	-1.16	1.56	-0.20	-0.22
84	Dharampur	-0.47	-1.93	0.93	0.98
85	Gagret	-3.84	0.07	0.72	0.42
86	Ghaneri	-1.74	0.57	0.05	-1.04
87	Guglahar	-0.98	0.46	0.86	0.93
88	Ishapur	-0.13	-1.46	1.23	1.00
89	Jankaur	4.99	-2.09	-2.83	
90	Jawar	-1.00	0.68	0.12	-0.17
91	Jhalera	-0.75	-0.18	1.25	0.83
92	Khanpur	-0.78	0.52	0.57	0.41
93	Khwaja	-0.69	-0.69	0.02	-0.19
94	Kuluwal	4.63	-3.20	3.24	
95	Kuthera Jaswala	-0.78	0.47	0.74	0.69
96	Lalehri	-0.98	1.83	0.76	0.87
97	Loharli	-0.95	0.00	4.32	1.20
98	Mawa Kalan	21.08	3.65	0.67	-0.49
99	Mubarikpur	-0.82	0.04	0.74	1.14

		<b>Decadal fl may(2008- 2017)wrt May 18</b>	<b>Decadal fl Aug(2008- 2017)wrt Aug18</b>	<b>Decadal fl Nov(2008- 2017)wrt Nov18</b>	<b>Decadal fl Jan(2009- 2018)wrt Jan19</b>
100	Nangran	-0.28	-0.72	0.12	0.04
101	Panjawar	-0.87	-4.70	1.96	2.26
102	Panoh	-0.60	1.02	-0.05	0.02
103	Raipur Marwadi	-4.15	-3.55	-0.68	-0.49
104	Rajli Panjal	-2.62	1.17	1.06	1.16
105	Santokhgarh	-0.52	-0.48	0.33	0.10
106	Singhnei	21.60	20.73	1.03	1.35
107	Tahliwala 1	-0.55	2.22	0.43	0.46
108	Una	-0.26	-0.22	0.58	0.39

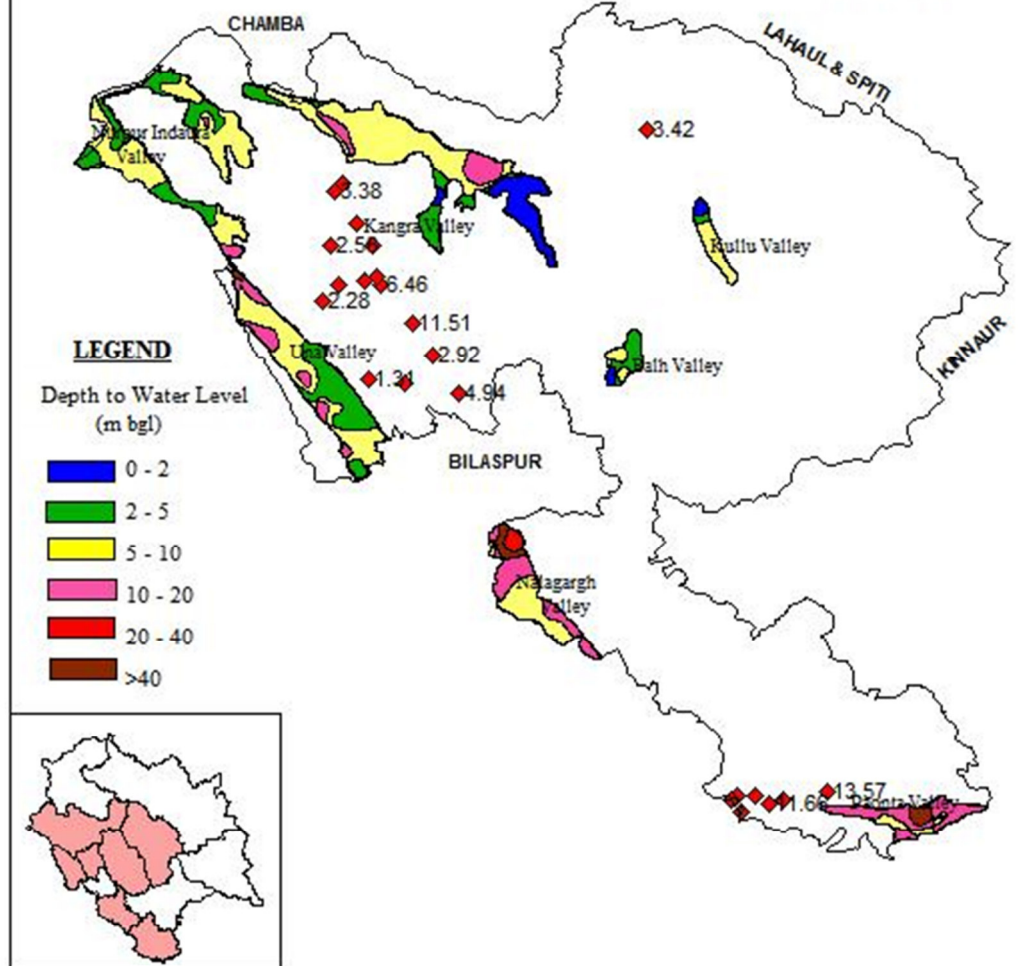
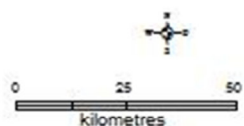


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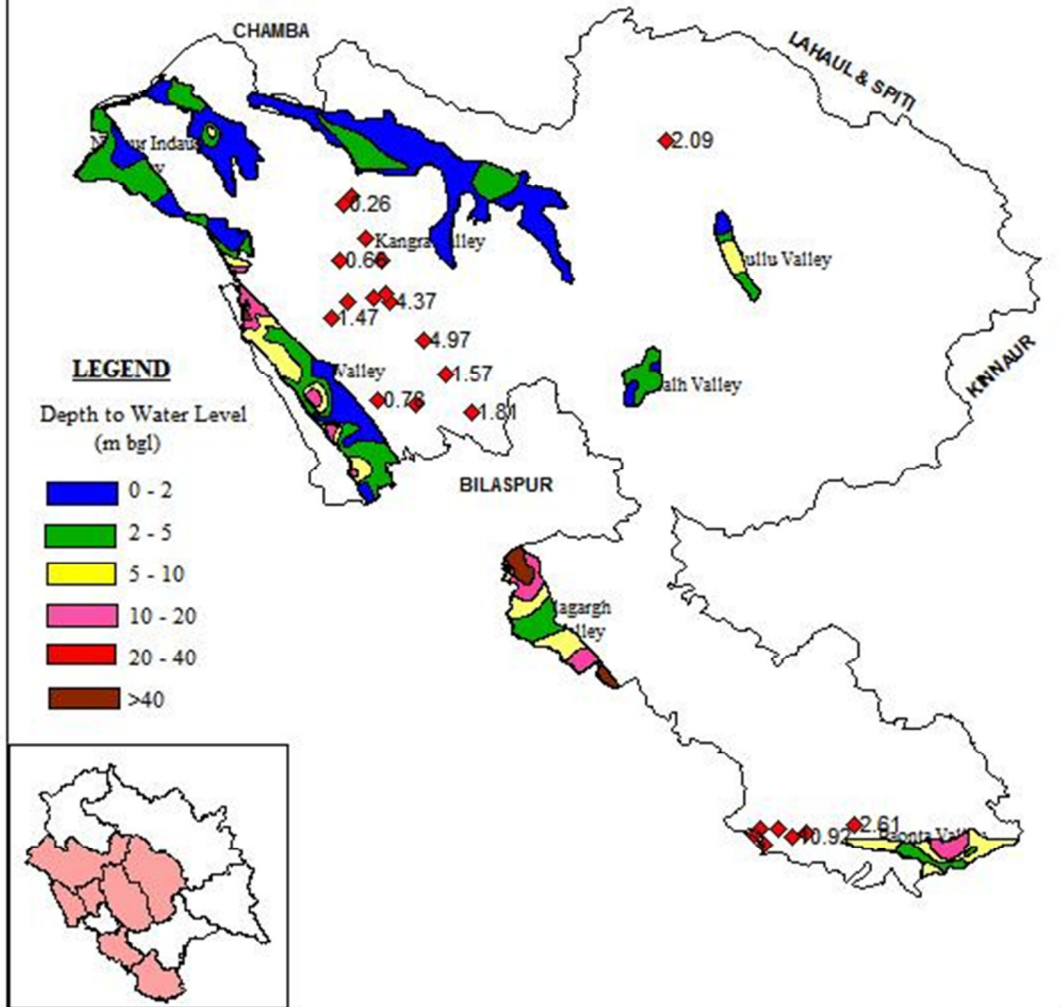
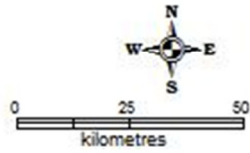


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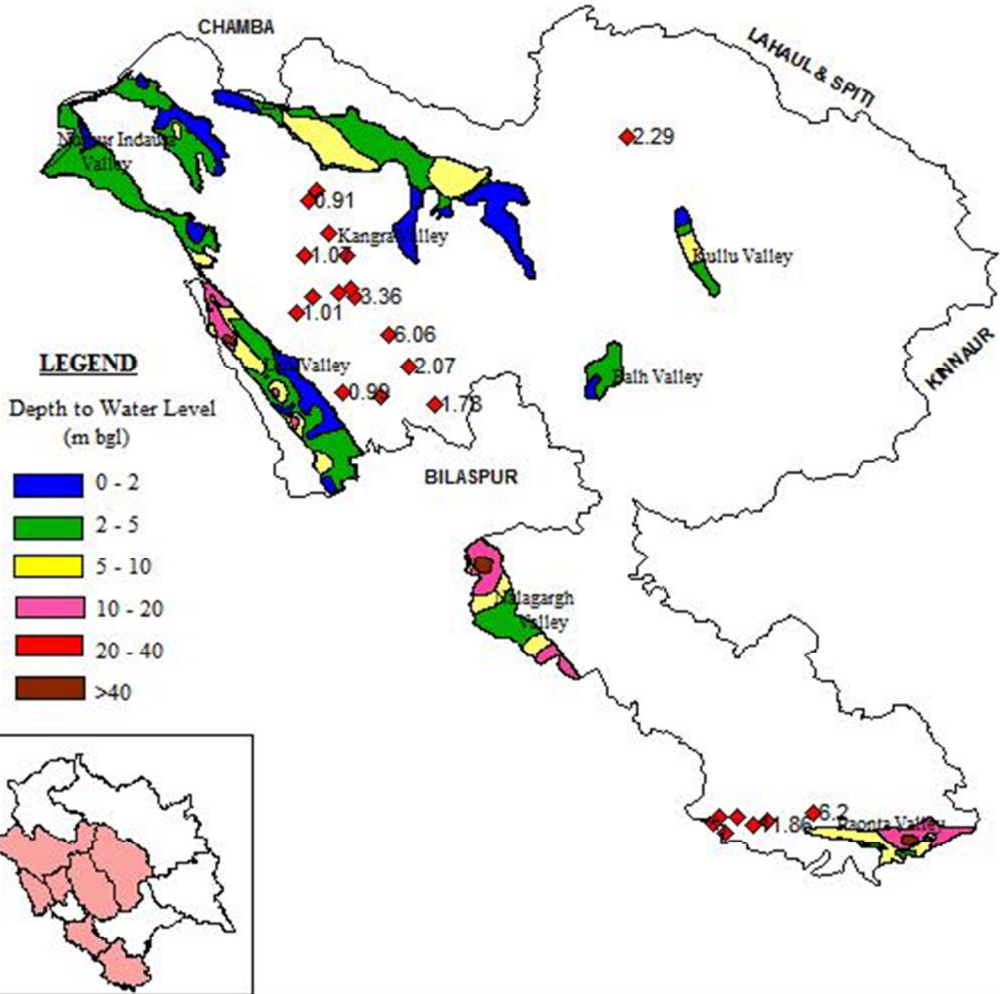
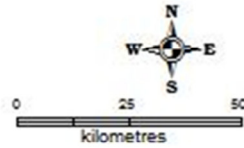
MAY - 2018



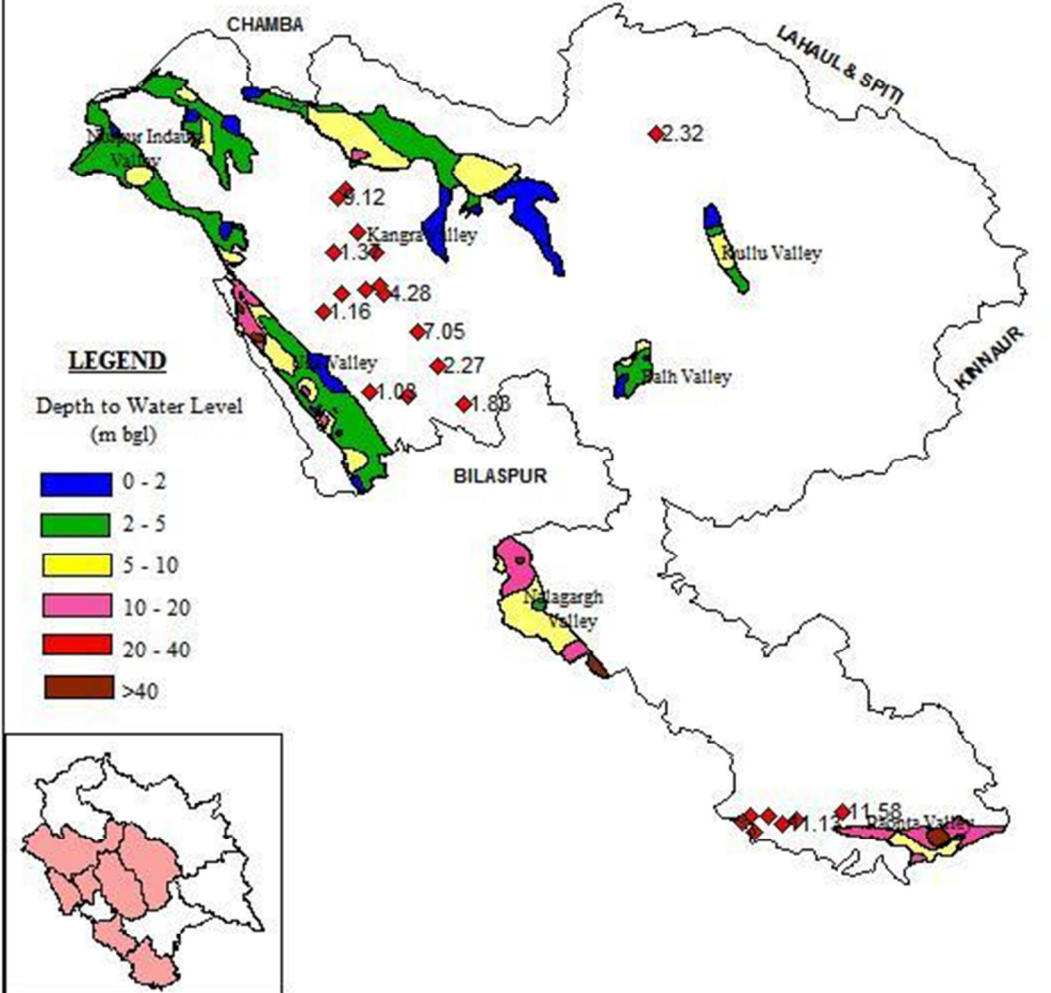
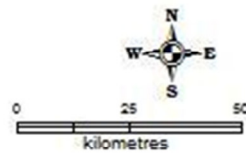
HIMACHAL PRADESH  
**DEPTH TO WATER LEVEL**  
AUGUST - 2018



HIMACHAL PRADESH  
**DEPTH TO WATER LEVEL**  
NOVEMBER - 2018

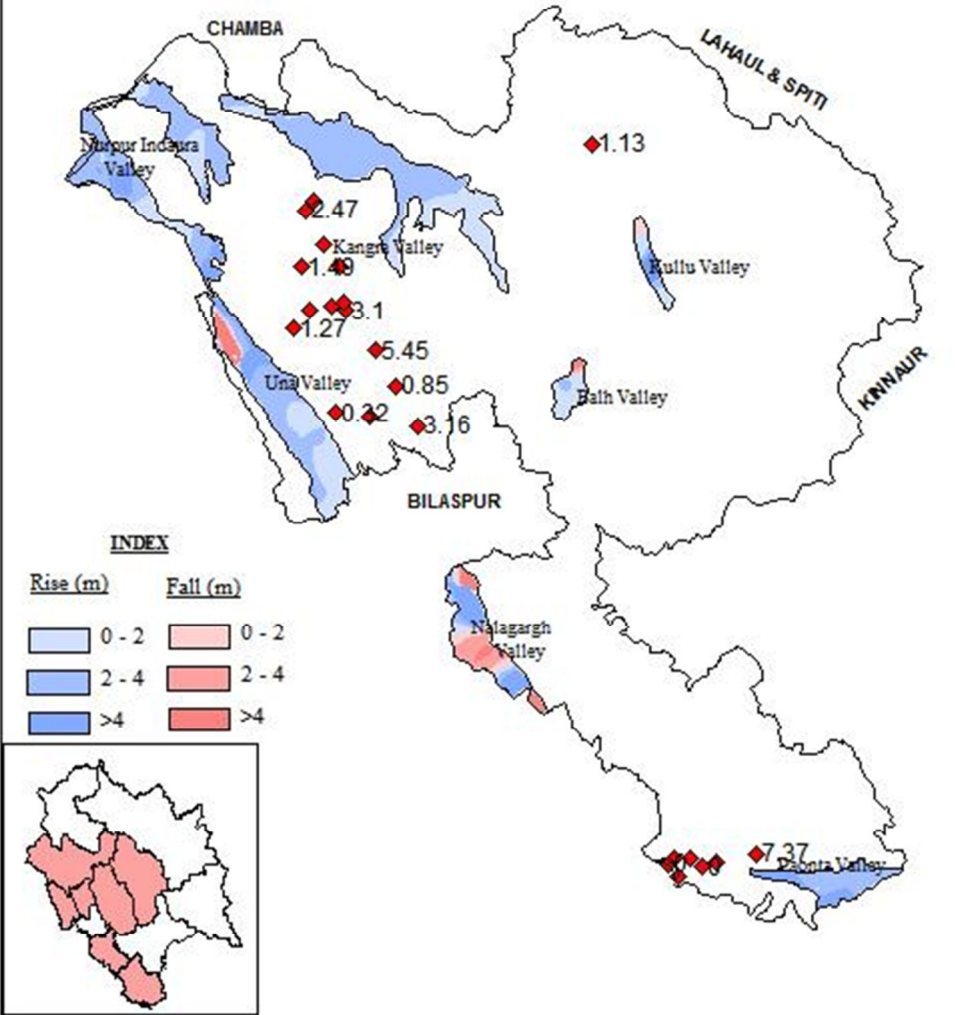
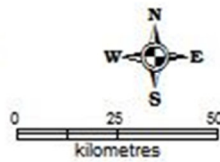


**HIMACHAL PRADESH  
DEPTH TO WATER LEVEL  
JANUARY - 2018**





HIMACHAL PRADESH  
**MONSOON FLUCTUATION**  
 (May 2018 w.r.t Nov 2018)

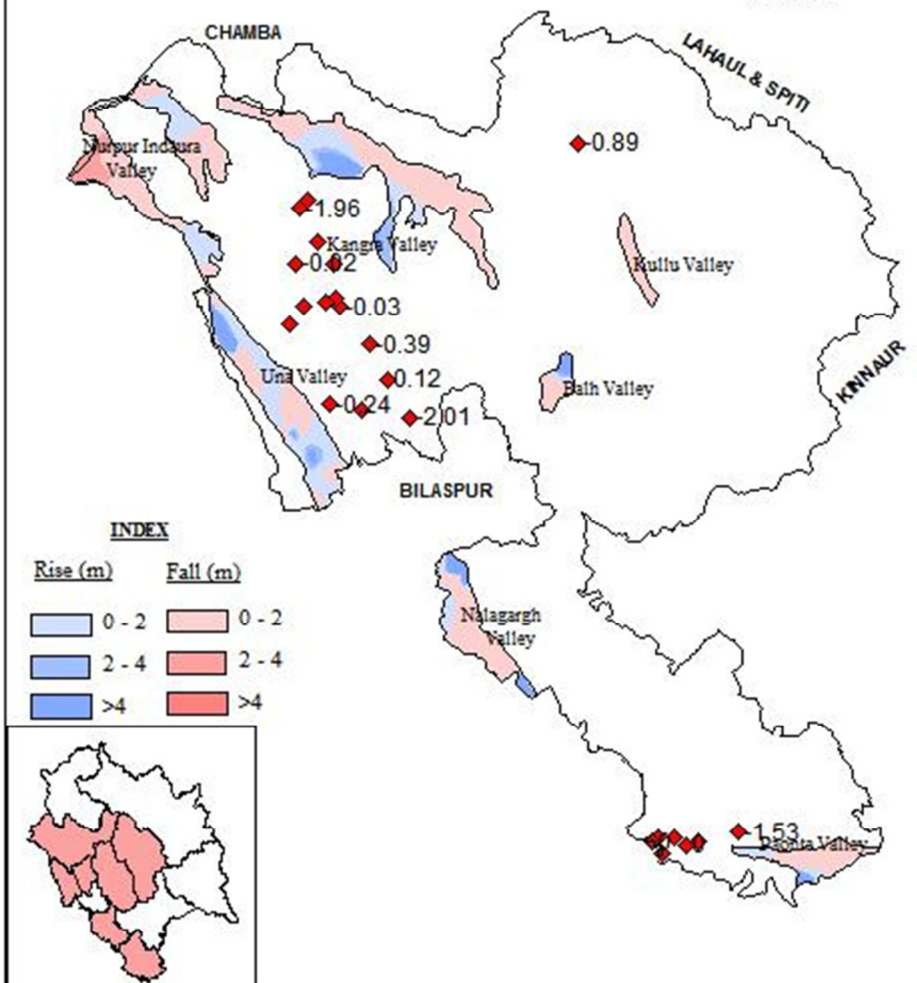
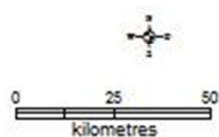


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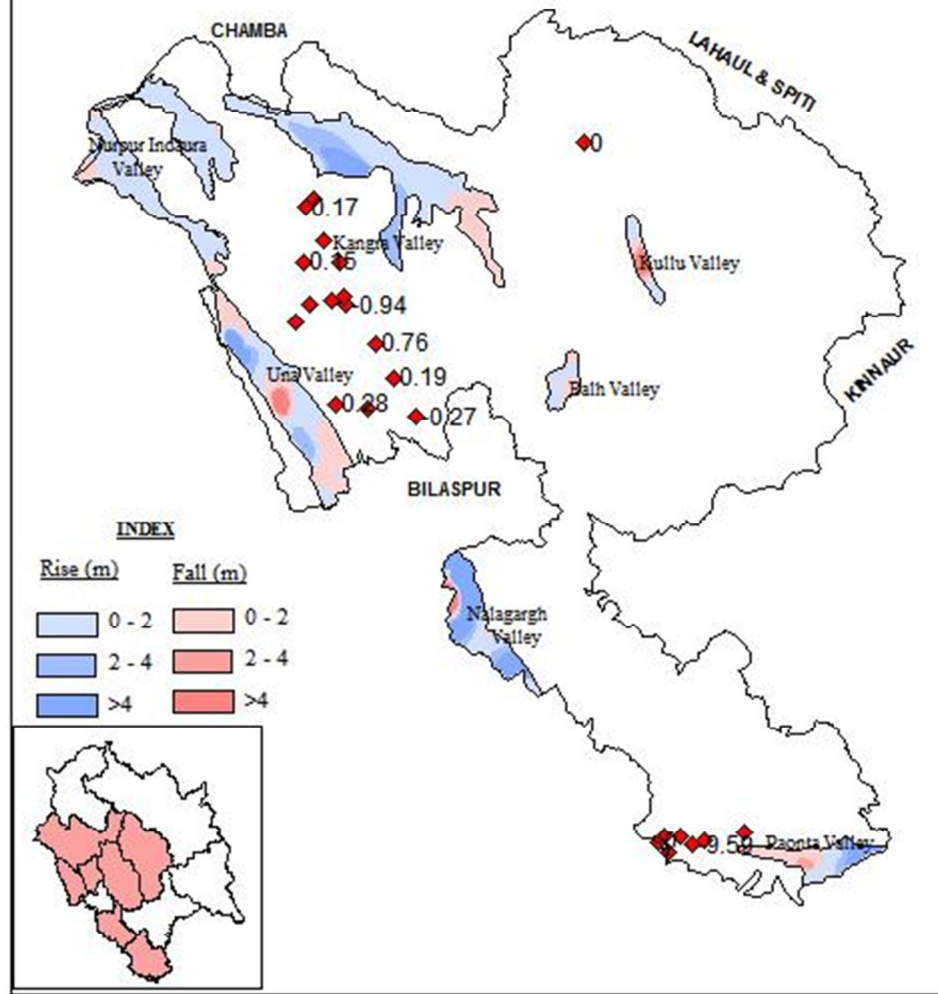
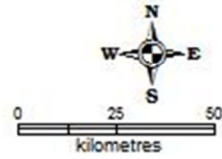
Rise (m)	Fall (m)
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2 - 4	2 - 4
>4	>4

# HIMACHAL PRADESH ANNUAL FLUCTUATION

(May 2017 w.r.t May 2018)



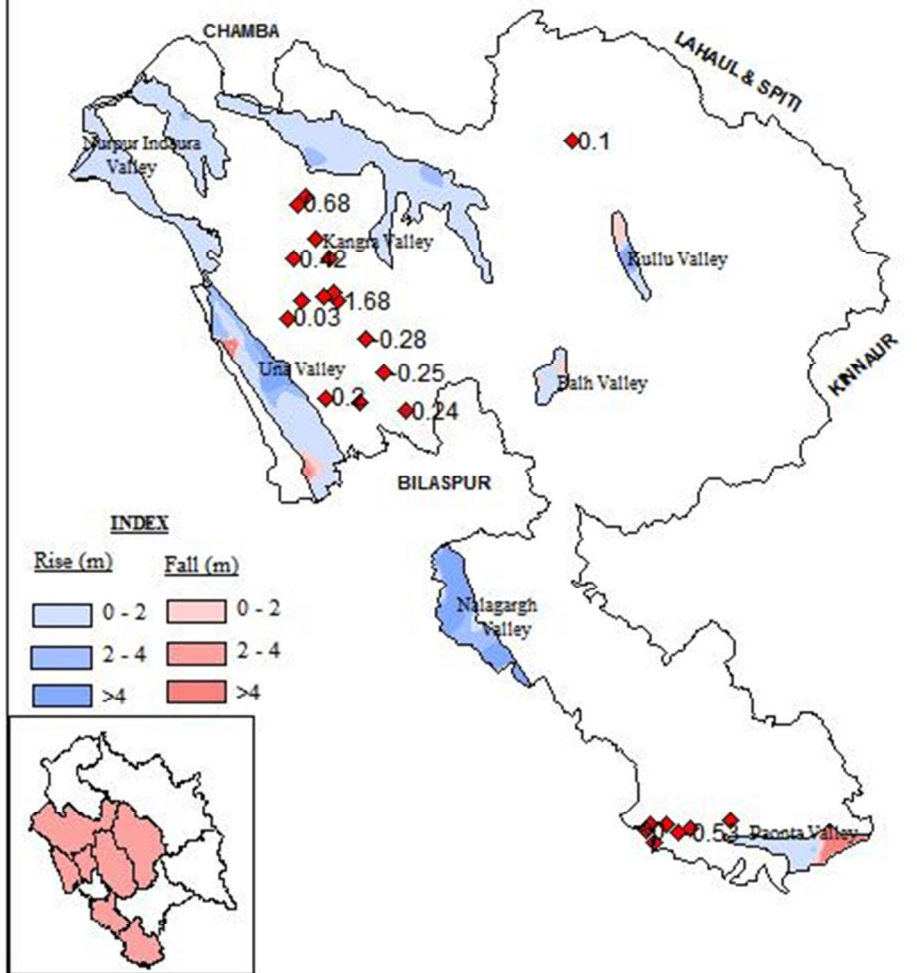
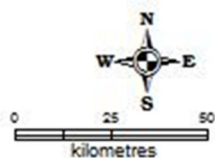
HIMACHAL PRADESH  
**ANNUAL FLUCTUATION**  
 (August 2017 w.r.t August 2018)



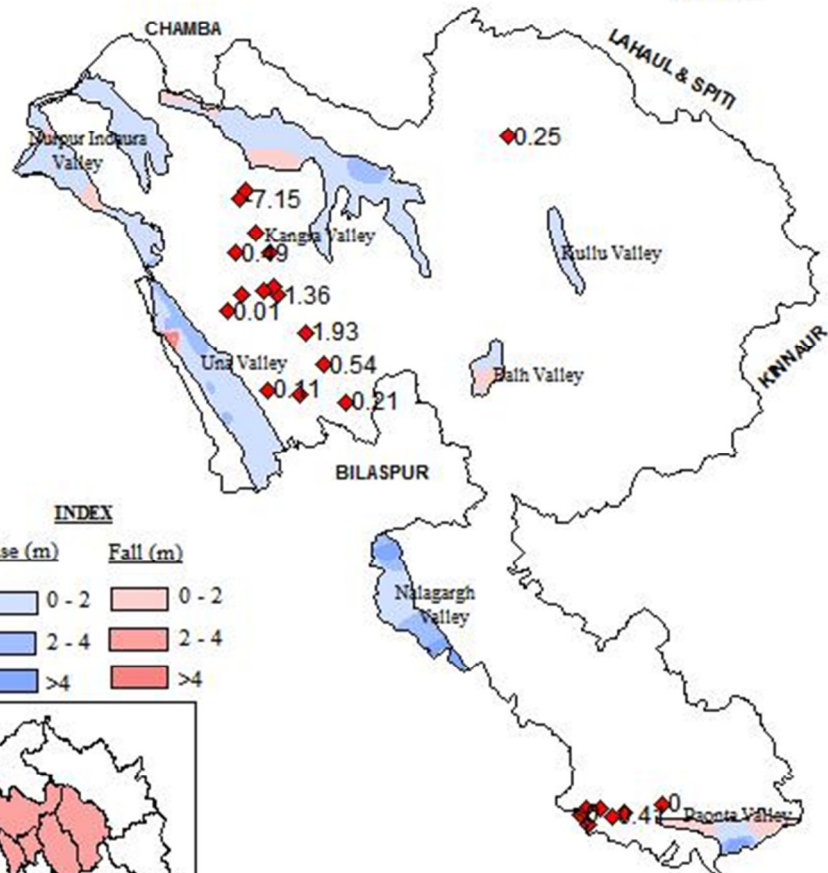
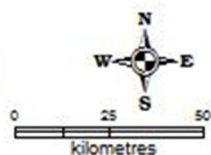
**INDEX**

Rise (m)	Fall (m)
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2 - 4	2 - 4
>4	>4

HIMACHAL PRADESH  
**ANNUAL FLUCTUATION**  
 (November 2017 w.r.t November 2018)



HIMACHAL PRADESH  
**ANNUAL FLUCTUATION**  
 (January 2018 w.r.t January 2019)

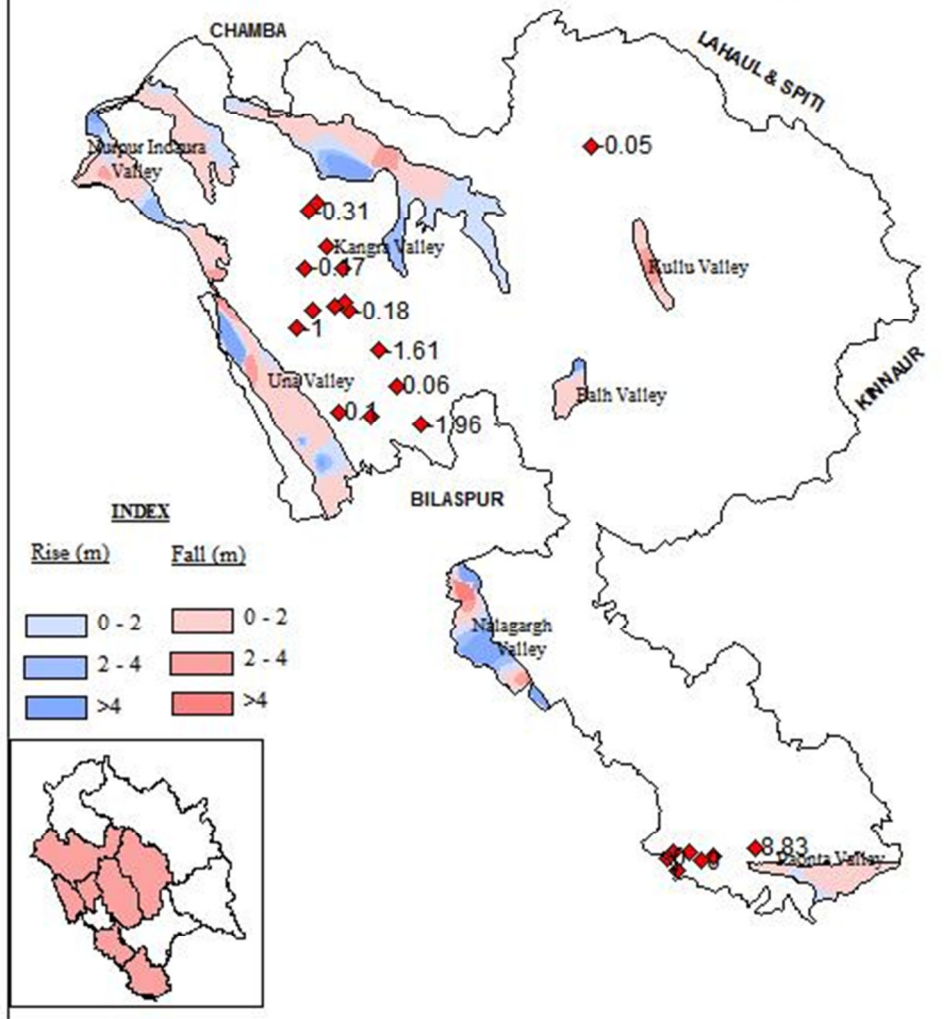
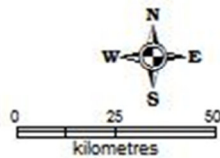


**INDEX**

Rise (m)	Fall (m)
0 - 2	0 - 2
2 - 4	2 - 4
>4	>4

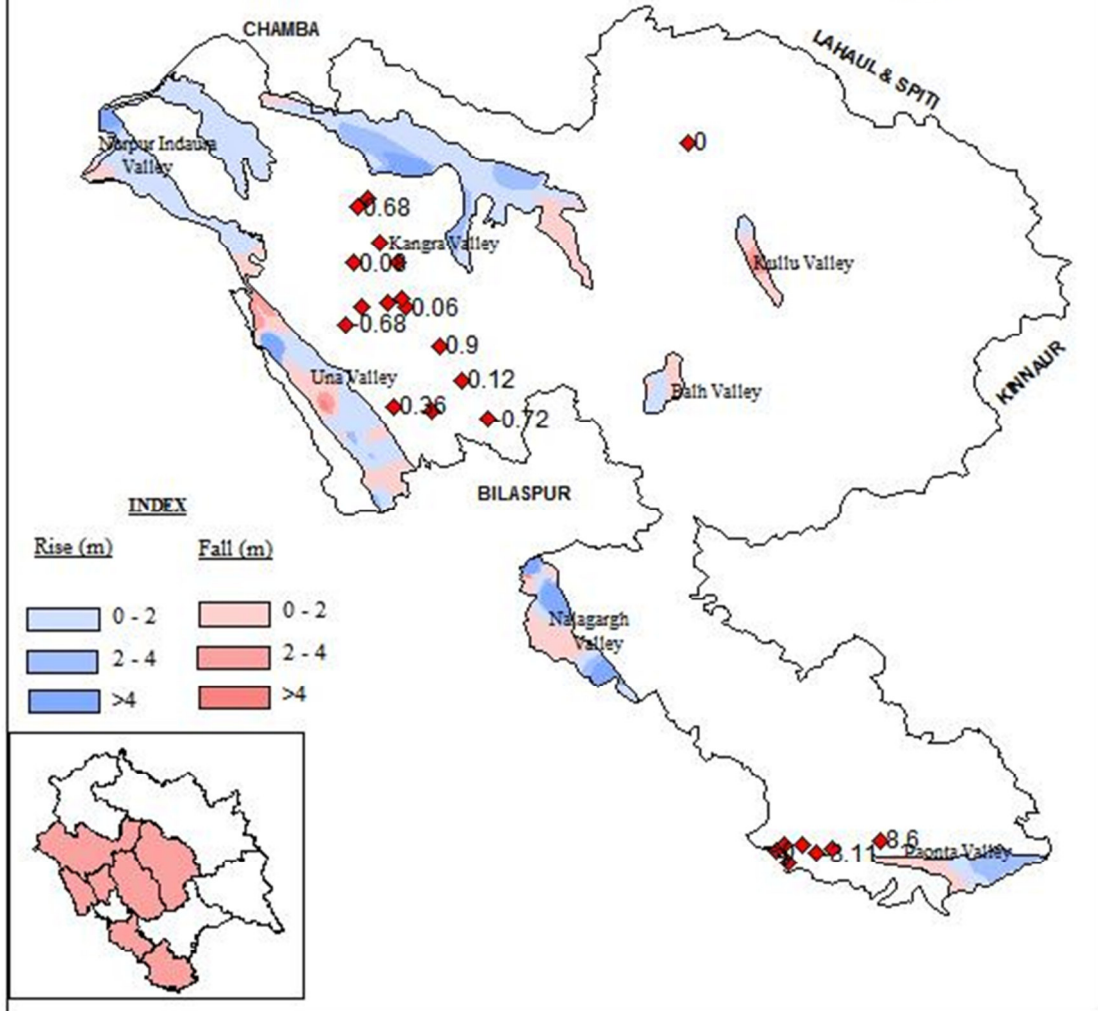
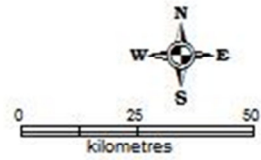


HIMACHAL PRADESH  
**DECADAL FLUCTUATION**  
 (May 2008-May 2017) w.r.t May 2018

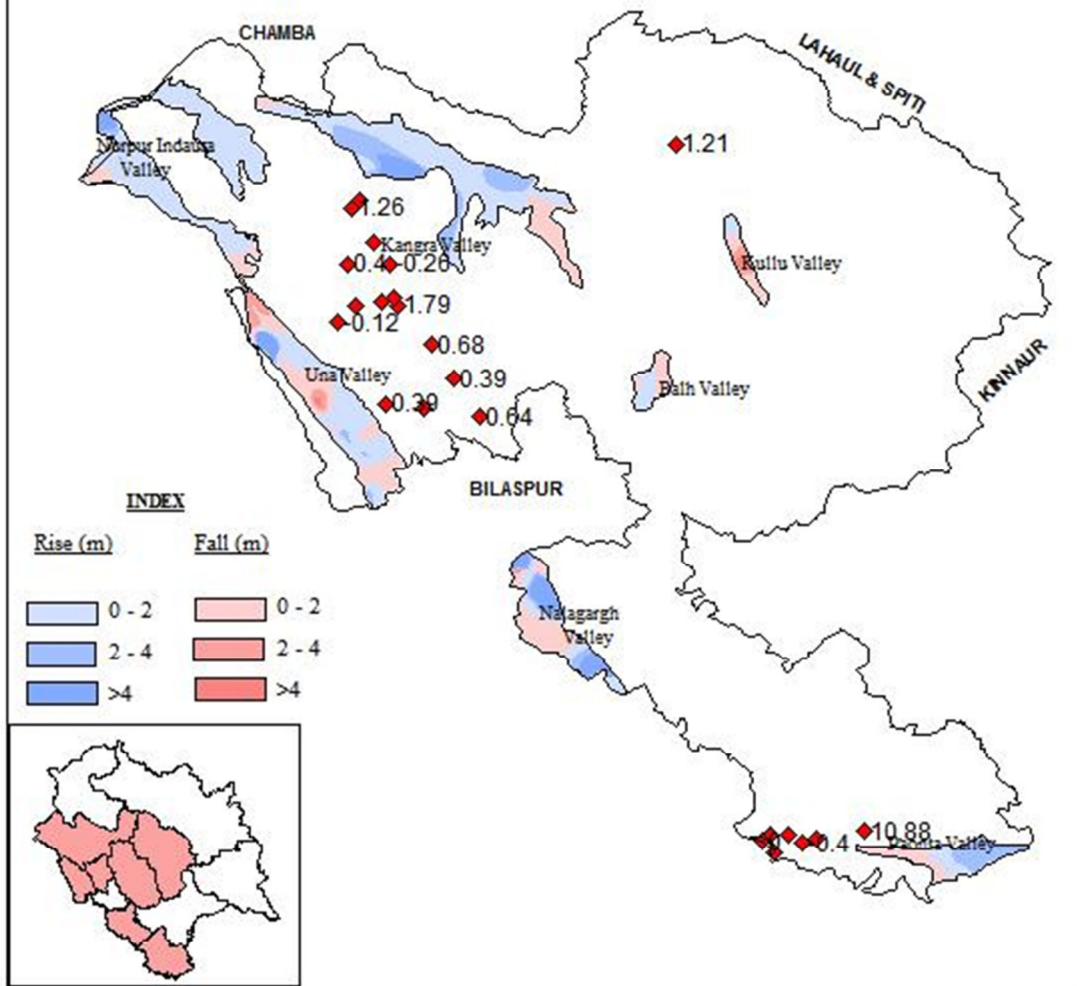
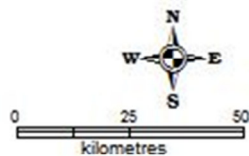


# HIMACHAL PRADESH DECADAL FLUCTUATION

(Aug 2008-Aug 2017) w.r.t Aug 2018

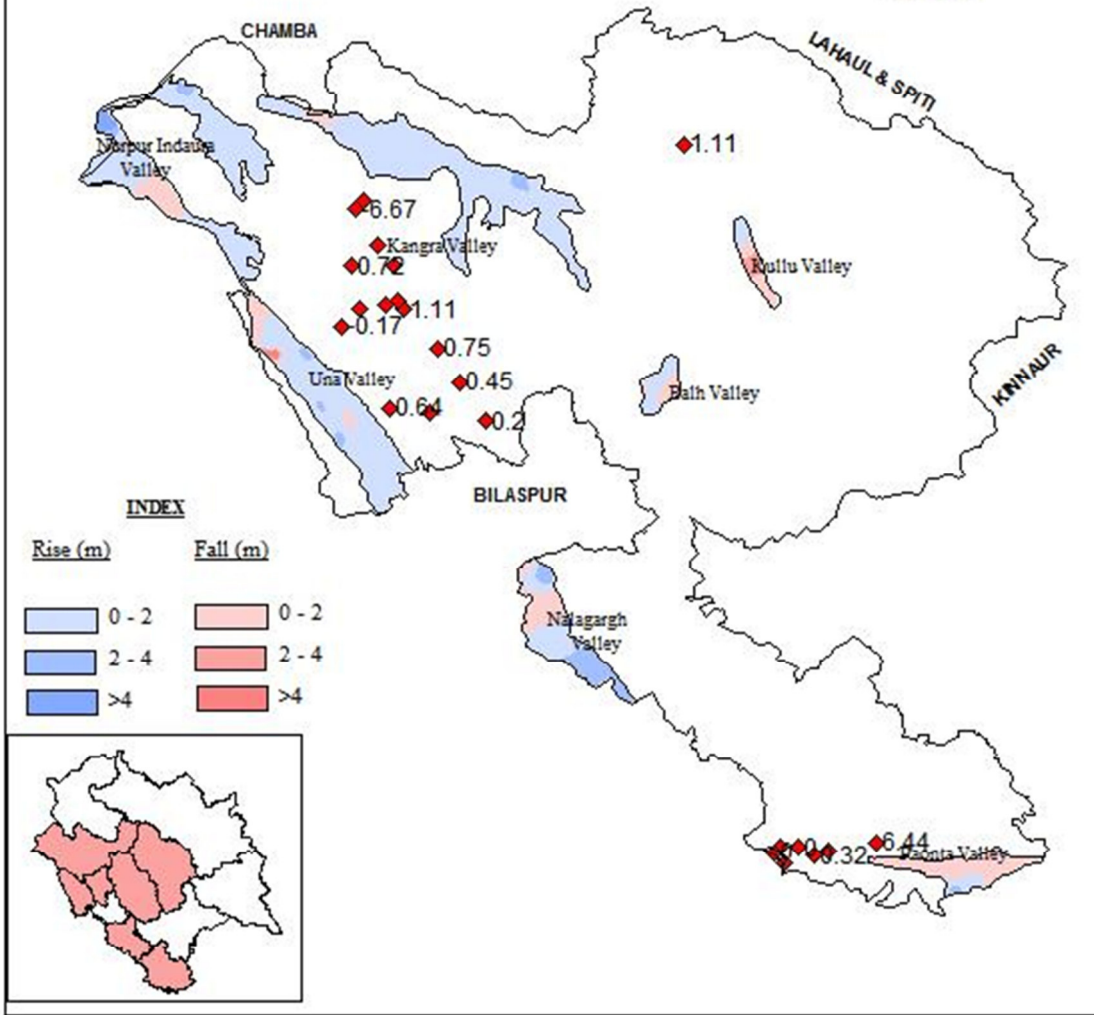
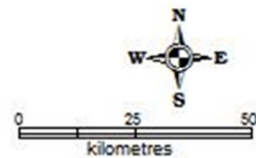


HIMACHAL PRADESH  
**DECADAL FLUCTUATION**  
 (Nov 2008-Nov 2017) w.r.t Nov 2018





HIMACHAL PRADESH  
**DECADAL FLUCTUATION**  
 (Jan 2009-Nov 2018) w.r.t Jan 2019



S. No	Unique ID	District	Location	pH*	EC* in µS/cm at 25° C	CO <sub>3</sub>	HCO <sub>3</sub>	Cl*	SO <sub>4</sub>	NO <sub>3</sub>	F*
						mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	1234	Kangra	Bharoli	8.36	604	48	85	78	50	7.35	0.15
2	1235	Kangra	Hardogri	8.61	618	72	134	35	52	8.55	0.21
3	1236	Kangra	Rakkar	8.37	422	36	73	43	28	6.71	0.15
4	1237	Kangra	Dehra Gopipur	8.42	580	36	110	57	6.72	71	0.39
5	1238	Kangra	Jawalamukhi	8.06	751	0	256	106	9.6	12	0.18
6	1239	Kangra	Dehrian	8.12	322	0	159	28	15	17	0.15
7	1240	Kangra	Bandh	8.31	310	36	85	28	8	4.9	0.34
8	1241	Kangra	Takipur	8.21	393	0	109	50	17	35	0.2
9	1242	Kangra	Mao	8.32	244	24	73	21	BDL	2.96	0.12
10	1243	Kangra	Bhalad	8.3	488	24	122	43	40	18	0.26
11	1244	Kangra	Darkati	8.29	357	0	159	28	25	13	0.15
12	1245	Kangra	Bharmar	8.43	306	36	110	28	BDL	5.04	<0.05
13	1246	Kangra	Raja Ka Talab	8.34	255	36	85	21	BDL	11	0.26
14	1247	Kangra	Kuth Khana	8.29	195	0	110	14	BDL	0.44	0.20
15	1248	Kangra	Barot	7.95	348	0	195	35	17	3.5	0.15
16	1249	Kangra	Riyali	8.31	273	24	110	21	12	8.3	0.12
17	1250	Kangra	Jagir	8.17	518	0	219	57	25	17	0.23
18	1251	Kangra	Barota	8.35	382	24	110	43	14	25	<0.05
19	1252	Kangra	Olehrian	8.42	798	36	146	78	6.72	4.34	0.09
20	1253	Kangra	Kathgarh	8.47	357	36	171	28	BDL	2.07	<0.05
21	1254	Kangra	Andaura	8.09	464		256	35	35	8.05	0.11
22	1255	Kangra	Channur	8.75	602	48	220	28	12	28	0.22
23	1256	Kangra	Changrara	8.50	267	24	110	14	19	5.88	<0.05
24	1257	Kangra	Mothli	8.39	419	24	98	50	5	23	<0.05
25	1258	Kangra	Pnjpir	8.42	268	60	24	21	25	11	<0.05
26	1259	Kangra	Jassur	8.40	360	36	73	28	5	22	<0.05
27	1260	Kangra	Thali	8.27	186	0	110	14	BDL	4.44	<0.05
28	1261	Kangra	Basa Bazira	8.49	344	36	98	21	16	16	<0.05
29	1262	Kangra	Bod	8.39	681	36	73	78	78	45	<0.05
30	1263	Kangra	Bhatka	8.46	294	36	98	14	5.0	5.38	0.15
31	1264	Kangra	Parnalla	8.17	281	0	110	35	11	5.59	0.22
32	1265	Kangra	Lakhnaut	7.72	413	0	183	35	18	23	<0.05
33	1266	Kangra	Kotla	8.45	423	36	110	28	20	24	<0.05
34	1267	Kangra	Bhali	7.74	700	0	232	70	49	12	<0.05
35	1268	Kangra	Manjgram	7.82	402	0	171	47	5	14	<0.05
36	1269	Kangra	39 Miles (shahpur)	8.46	308	48	73	21	32	13	<0.05
37	1270	Kangra	Rait	8.41	381	36	73	28	17	27	<0.05
38	1271	Kangra	Kangra	8.26	264	0	122	21	5.28	18	<0.05
39	1272	Kangra	Old Kangra	8.49	397	24	134	21	22	17	0.31
40	1273	Kangra	Nagrota Gurudwra	8.17	178	0	73	28	BDL	9.7	<0.05
41	1274	Kangra	Chakban Ambari	7.52	130	0	24	28	BDL	7.44	<0.05
42	1275	Kangra	Naura	8.24	234	0	109	21	5	6.61	0.12
43	1276	Kangra	Ladhi	8.18	274	0	109	28	11	1.90	<0.05

44	1277	Kangra	Paprola	8.02	196	0	61	28	BDL	15	0.20
45	1278	Kangra	Pandtehr	7.90	168	0	48	28	5.00	5.84	0.12
46	1279	Una	Nangran	8.44	269	24	122	14	8.64	7.49	0.12
47	1280	Una	Khanpur	8.56	654	48	146	49	92	6.70	0.33
48	1281	Una	Santokhgarh	8.02	513	0	207	28	94	13	0.23
49	1282	Una	Talhiwal	8.39	637	36	97	106	BDL	5.99	<0.05
50	1283	Una	Lalehri	8.48	467	36	97	28	21	45	0.30
51	1284	Una	Dharampur	8.34	338	12	98	35	5.76	24	0.45
52	1285	Una	Badsali	7.97	1094	0	61	156	60	226	0.19
53	1286	Una	Ishpur	8.55	1047	24	109	155	169	60	0.22
54	1287	Una	Panjawar	8.36	344	12	122	28	14	44	0.16
55	1288	Una	Guglehar	8.41	662	12	122	77	79	48	0.31
56	1289	Una	Loharli	8.15	449	0	122	21	27	120	0.1
57	1290	Una	Kuthera Jaswan	8.30	338	48	12	28	45	70	<0.05
58	1291	Una	Gagret	8.17	381	0	85	42	45	66	<0.05
59	1292	Una	Singhnei	8.43	412	36	170	14	41	11	0.13
60	1293	Una	Ganehri	8.36	311	24	109	21	56	21	0.16
61	1294	Una	Mawa Kalan								Leake
62	1295	Una	Daulatpur	7.89	970	0	244	141	108	24.62	0.367
63	1296	Una	Babehr	8.14	341	0	158	42	32	11	0.263
64	1297	Una	Raipur Marwadi	8.20	290	0	97	49	12	34	0.10
65	1298	Una	Mubarakpur	8.40	579	36	122	78	21	22	0.26
66	1299	Una	Amb	8.65	469	48	183	56	8	<0.20	0.21
67	1300	Una	Jawar	8.47	418	24	122	35	11	28	0.34
68	1301	Una	Panoh	8.62	406	36	159	42	24	6.63	0.23
69	1302	Una	Khawala	8.32	587	24	86	92	65	9.44	0.28
70	1303	Una	Jalehra	8.50	492	24	110	49	78	9.27	0.49
71	1304	Una	Una	8.51	761	24	171	85	28	64	0.19
72	1305	Una	Bawal	8.53	667	48	244	35	35	5.95	0.31
73	1306	Una	Bhangana	8.27	473	0	110	63	35	36	0.07
74	1307	Una	Rajli Panjal	8.78	768	36	268	63	25	3.84	<0.05
75	1308	Hamirpur	Bijhri	8.30	364	24	73	43	22	15	0.19
76	1309	Hamirpur	Galore	8.37	355	36	73	35	7	16	0.07
77	1310	Hamirpur	Kangu	8.29	383	0	159	35	22	8.52	0.10
78	1311	Hamirpur	Bhagnallah	8.23	354	0	134	28	18	24	0.10
79	1312	Solan	Brotiwala	8.31	251	24	85	21	13	14	<0.05
80	1313	Solan	Theda	7.88	549	0	134	71	58	22	0.25
81	1314	Solan	Kherachak	8.45	467	24	98	50	19	36	<0.05
82	1315	Solan	Magan Pura	8.03	928	0	61	113	70	237	0.16
83	1316	Solan	Nalagarh	8.42	827	24	98	120	122	46	0.36
84	1317	Solan	Dabota	8.53	592	24	122	70	28	55	0.10
85	1318	Solan	Mahadeva	8.49	318	12	110	14	48	17	<0.05
86	1319	Solan	Panjiara	8.07	359	0	183	21	12	20	0.10
87	1320	Solan	Jagatpur	8.46	296	36	85	14	42	6.71	0.10
88	1321	Solan	Bagheri	8.36	416	24	98	35	32	55	0.16
89	1322	Solan	Palahi	8.09	459	0	183	35	15	48	<0.05
90	1323	Solan	Baruna	8.44	281	24	98	21	BDL	27	0.25

91	1324	Solan	Bhatoli	8.18	301	0	110	21	21	39	0.21
92	1325	Sirmour	Khodawala	8.24	425	0	183	21	76	14	<0.05
93	1326	Sirmour	Shibpur	8.24	511	0	110	28	88	49	0.11
94	1327	Sirmour	Badirpur	8.22	446	0	122	43	36	55	0.14
95	1328	Sirmour	Ajiwala	8.16	280	0	146	21	18	10	0.07
96	1329	Sirmour	Kiyarda	7.98	102	0	49	7.09	2	1.09	<0.05
97	1330	Sirmour	Miserwala	8.50	472	48	110	28	52	25	0.14
98	1331	Sirmour	Nayagaon	8.27	285	0	122	14	20	5.85	0.11
99	1332	Sirmour	Sainwalai	8.13	246	0	73	21	33	13	<0.05
100	1333	Sirmour	Dhaulakuan	8.10	330	0	98	21	60	13	0.24
101	1334	Sirmour	Kolar	8.24	393	0	109	42	40	26	0.31
102	1335	Sirmour	Kodewala	8.61	353	24	170	56	10	1.09	0.31
103	1336	Sirmour	Shambhu Wala	8.30	1976	12	61	14	12	5.82	0.12
104	1337	Sirmour	Akkwala	8.56	261	36	122	35	BDL	0.70	0.09
105	1338	Sirmour	Sainwala II	9.14	1339	156	329	92	80	0.43	0.65
106	1339	Sirmour	Kala Amb	8.27	616	0	109	85	103	16	0.31
107	1340	Sirmour	Kheri	8.34	372	24	146	56	BDL	6.32	0.26
108	1341	Sirmour	Tirlokpur	8.89	967	72	244	141	100	5.82	0.44
109	1342	Mandi	Jarl	8.45	327	36	85	63	BDL	2.81	0.07
110	1343	Mandi	Dinak	8.52	337	36	109	49	BDL	1.74	1.63
111	1344	Mandi	Kaned	8.59	330	24	146	57	18	9.84	0.29
112	1345	Mandi	Rati	8.28	436	0	134	85	57	8.74	0.21
113	1346	Mandi	Bangrotu	7.82	1231	0	244	198	121	21	0.31
114	1347	Mandi	Lohara	8.34	638	12	110	120	66	14	0.27
115	1348	Mandi	Gaagal	7.02	235	0	98	64	BDL	1.26	0.30
116	1349	Mandi	Gutkar	8.10	251	0	110	57	18	11	0.53
117	1350	Mandi	Jhiri	8.11	279	0	110	57	BDL	27	0.32
118	1351	Kullu	Gadauri	8.35	331	24	85	57	BDL	30	0.20
119	1352	Kullu	Kullu	8.54	506	48	171	71	BDL	29	0.50
120	1353	Chamba	Upper Thulel	8.41	369	36	73	50	BDL	12	0.27

**Note: The Test results relate only to the sample tested**

**Test Methods:**

pH-	APHA 23rd Edition; 4500 H <sup>+</sup> B
EC-	APHA 23rd Edition; 2510 B
CO <sub>3</sub>	APHA 23rd Edition; 2320 B
HCO <sub>3</sub>	APHA 23rd Edition; 2320 B

Ca-	APHA 23 <sup>rd</sup> Edition; 3500 Ca B
Mg-	APHA 23 <sup>rd</sup> Edition; 3500 Mg <sup>+</sup> B
TH-	APHA 22 <sup>nd</sup> Edition; 2340 C

**Analysed by:**

( Rishiraj)                      Kiran Lale  
ACH                                      STA(Chemical)

<b>PO<sub>4</sub></b>	<b>Ca<sup>*</sup></b>	<b>Mg<sup>*</sup></b>	<b>Na</b>	<b>K</b>	<b>SiO<sub>2</sub></b>	<b>TH *as CaCO<sub>3</sub></b>
mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
<0.1	36	36	38	0.2	19	240
<0.1	84	17	29	0.4	11	280
<0.1	32	29	9	0.2	12	200
<0.1	32	34	35	2.3	14	220
<0.1	44	24	80	1.3	7	210
<0.1	40	15	17	2.9	9	160
<0.1	36	7.29	28.5	2.1	10	120
<0.1	48	15	13	1.5	18	180
<0.1	32	12	2	1	19	130
<0.1	28	27	34	6	21	180
<0.1	28	17	23	14.3	10	140
<0.1	56	4.84	11	1.9	10	170
<0.1	42	8.51	13	2.3	11	140
<0.1	16	2.43	15	0.1	17	80
<0.1	12	44	23	2.2	16	180
<0.1	8.01	34	8	2.6	15	160
<0.1	56	15	44	6.1	13	200
<0.1	20	24	22	22	12	150
<0.1	36	29	29	25	14	210
<0.1	56	4.84	37	2.0	16	160
<0.1	40	29	40	0	11	220
<0.1	28	22	82.2	1.9	22	160
<0.1	24	17	19.9	1.7	23	130
<0.1	40	9.72	35	1.2	15	140
<0.1	49	9.72	11.9	1.7	14	160
<0.1	32	22	5	1.3	11	170
<0.1	28	4.84	10	2.5	10	90
<0.1	24	29	9.0	2.8	8	180
<0.1	48	32	35	20	7	250
<0.1	28	15	19	0.4	8	130
<0.1	44	2.43	16.9	0.5	18	120
<0.1	68	7.29	16	3.1	19	200
<0.1	40	19	24	1.0	15	180
<0.1	44	29	54	6.9	14	230
<0.1	56	17	5	3.6	19	210
<0.1	32	22	21	1.0	10	170
<0.1	40	9.72	26	3.7	11	140
<0.1	40	4.84	14	2.2	16	120
<0.1	52	9.72	13	16	14	170
<0.1	20	2.43	21	3	17	60
<0.1	12	2.4	9.6	4	10	40
<0.1	32	7.0	8.0	3.3	9	110
<0.1	32	12	4	4	8	130

<0.1	28	2.0	11	0.00	8	80
<0.1	16	7.0	8	2.5	12	70
<0.1	20	19	20	3	11	130
<0.1	28	0	60	3	15	240
<0.1	56	29	28	1.9	17	260
<0.1	52	24	30	1.9	16	230
<0.1	28	34	10	6.4	19	210
<0.1	29	9	25	9	21	111
<0.1	92	29	74	6.1	20	350
<0.1	44	24	162	15	23	210
<0.1	24	24	18	11	8	160
<0.1	28	31	70	2.1	4	200
<0.1	56	12	31	1	7	190
<0.1	40	19	19	11	15	180
<0.1	64	12	4	11	14	210
<0.1	48	24	18	11	12	220
<0.1	28	31	15	5.2	11	200

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<0.1	44	36	124	4	15	260
<0.1	40	17	28	2	12	170
<0.1	28	21	12.9	2.3	9	160
<0.1	36	29	48	1.7	12	210
<0.1	12	34	68	1.3	15	170
<0.1	56	12	17	0.4	17	190
<0.1	12	21	74	1.8	10	120
<0.1	40	17	66	6.5	9	170
<0.1	20	24	64	1.8	15	150
<0.1	20	32	95	1.1	13	180
<0.1	20	32	89	3.7	8	180
<0.1	36	17	40	1	15	160
<0.1	12	12	149	0.4	18	80
<0.1	32	17	22	0.8	20	150
<0.1	48	4.86	20	7.4	18	140
<0.1	44	15	18	2.9	15	170
<0.1	32	12	28	0.1	13	130
<0.1	20	12	30	0.9	16	100
<0.1	56	15	42	1.5	13	200
0	24	9.72	65.2	2	15	100
<0.1	112	19	52	1.9	16	360
<0.1	24	29	125	7.6	16	180
<0.1	24	19	81.2	1.7	18	140
0	20	9.68	47.8	1.4	20	90
<0.1	32	12	36.3	1.8	22	130
<0.1	20	7.29	55.1	0.1	15	80
<0.1	20	14	62.8	2.3	17	110
<0.1	36	14	49.3	0.6	12	150
<0.1	20	12	33.2	2.2	9	100

<0.1	16	17	30	1	15	110
<0.1	32	44	5.3	2.3	13	260
<0.1	56	19	18.6	2.9	18	220
<0.1	32	26	25.3	0.7	16	190
<0.1	32	19	8.4	0.7	15	160
<0.1	8.01	4.86	6.2	0.1	17	40
<0.1	64	22	21.9	0	15	240
<0.1	20	15	16.1	2.5	15	110
<0.1	24	15	5.4	3.3	19	120
<0.1	40	12	15.5	1.6	16	150
<0.1	40	19	16.6	0.3	18	180
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<0.1	16	19	40	3.1	25	120
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<0.1	32	21	74	3.3	25	170
<0.1	36	14	42	3.9	22	150
<0.1	8	4	265	16	19	40
<0.1	24	21	34	0.6	15	150
<0.1	20	26	29.4	1.6	16	160
<0.1	32	22	39.8	12	25	170
<0.1	20	44	30	4.5	13	230
<0.1	77	56	97	26	15	390
<0.1	40	42	42	1.4	16	270
<0.1	32	8	25	7.0	18	110
<0.1	52	10	13	2.8	20	170
<0.1	40	12	18	5.0	24	150
<0.1	56	34	7.0	2.8	23	200
<0.1	60	17	44	17	19	230
<0.1	24	12	42	2	21	110

Na	IS 3025 (Pt45) 1993
K	IS 3025 (Pt45) 1993
PO <sub>4</sub>	APHA 23rd Edition;4500-P E
SiO <sub>2</sub>	APHA 23rd Edition;4500-SiO2 B

**(Authorized Signatory)**

**( Rishiraj)**

ACH for OIC Lab