Preface

Minerals are valuable natural resources being finite and non-renewable. They constitute the vital raw materials for many basic industries and are a major resource for development. The history of mineral extraction in India dates back to the days of the Harappan civilization. The wide availability of the minerals in the form of abundant rich reserves made it very conducive for the growth and development of the mining sector in India. The country is endowed with huge resources of many metallic and non-metallic minerals. Mining sector is an important segment of the Indian economy. Since independence, there has been a pronounced growth in the mineral production both in terms of quantity and value. India produces as many as 87 minerals, which includes 4 fuel, 10 metallic, 47 non-metallic, 3 atomic and 23 minor minerals (including building and other materials).

Minerals are classified into two groups, namely (i) Major minerals and (ii) Minor minerals. Amongst these two groups minor mineral have been defined under section 3 (e) of Mines and Minerals (Regulation and development) Act, 1957 and further governed by the state River/Stream Bed Mining Policy and Guidelines. They include building stones, gravel, ordinary clay, ordinary sand, limestone used for lime burning, boulders, kankar, murum, brick earth, bentonite, road metal, slate, marble, stones used for making household utensils etc. and other minerals not defined as minor minerals in the said Act are treated as major minerals. They include coal, manganese ore, iron ore, bauxite, limestone, kyanite, sillimanite, barites, chromite, silica sand, fluorite, quartz, sand used for stowing purposes in coal mines and many other minerals used for industrial purposes.

The mining activities in the state of Himachal Pradesh can basically be categorized as in large sector and in small sector. The large sector comprises of limestone projects for manufacturing lime, cement and other lime products while the small mining sector comprises mining of minor minerals like sand, stone, bajari, slate, shale and clay etc. which are basically building material to meet up the demand for infrastructure development of the state.

In pursuance to the orders of Hon’ble Supreme Court dated 27/02/2012 in the matter of Deepak Kumar etc. vs State of Haryana and Others, prior environment
clearance has now become mandatory for mining of minor minerals irrespective of the area of mining lease. As such ministry of Environment, Forest and Climate Change, Govt. of India vide notification dated 15/01/16 and 20/01/2016 has constituted the District Level Environment Impact Assessment Authority (DEIAA) for grant of Environment Clearance for category “B2” projects for mining of minor minerals. In the aforesaid notification dated 15/01/16, the procedure for preparation of district survey report, which shall form the basis for application for environment clearance, preparation of report and appraisal of projects, has been prescribed. Accordingly, the survey report for district Kullu has been prepared.
1. **Introduction**

Himachal Pradesh is situated in the western Himalayas covering an area of 55,673 kilometers and is mountainous having altitude ranging from 350 meters to 6,975 meters above the mean sea level. It is located between Latitude 30°22’40” N to 33°12’20” N and Longitude 75°45’55” E to 79°04’20” E. It has a deeply dissected topography, complex geological structure and a rich temperate flora. The drainage system of Himachal Pradesh encompasses rivers named Chandra Bhaga (the Chenab), the Ravi, the Beas, the Sutlej and the Yamuna. These rivers are perennial and are fed by snow, glaciers and rainfall. They are protected by an extensive cover of natural vegetation. Due to extreme variation in elevation, there is great variation in the climatic conditions of Himachal Pradesh. The climate varies from hot and sub-humid tropical in the southern tracts to more cold, alpine and glacial in the northern and eastern mountain ranges.

The study area, one of the twelfth districts of Himachal Pradesh i.e. the district Kullu was probably the most ancient state next to Kashmir and Kangra. Kullu or Kulu is the capital town of the Kullu district in the Indian state of Himachal Pradesh. It is located on the banks of the Beas River in the Kullu Valley about 10 kilometres (6.2 mi) north of the airport at Bhuntar. Kullu is a broad open valley formed by the Beas River between Manali and Largi. This valley is famous for its temples, beauty and its majestic hills covered with pine and deodar forest and sprawling apple orchards. The course of the Beas river presents a succession of magnificent, clad with forests of deodar, towering above trees of pine on the lower rocky ridges. Kullu valley is sandwiched between the Pir Panjal, Lower Himalayan and Great Himalayan Ranges. The Chinese pilgrim, Hiuen Tsang (AD 629-645) described the country of Kiu-lu-to (Kullu) situated at 117 miles to the north-east of Jalandhar which exactly corresponds with the position of Kulata. According to known history, it was founded in the first century of Christian era by one Behangamani Pal whose forefathers originally came from Tripura and had migrated from Allahabad and then to Mayapur near Hardwar. Many legends are associated with the name of Behangamani Pal. It appears that the people of the higher valley of Kullu at that time were suffering under the repressive regime of the Thankurs of Spiti and a keen desire to overthrow the Thakurs was smoldering in their hearts. Behangamani Pal organized what may be rightly called
the upper valley first revolution sparked off at Jagatsukh. A renowned astrologer of village Paljhot is believed to have helped him allot and his endeavors duly blessed by the powerful Goddess Hadimba, were crowned with success. This goddess is up to now is respected as the 'grandmother and the patron-deity' by the Rajas of Kullu. Pal dynasty was thus established. Its original capital was established at Jagatsukh and nearly ten generations ruled from there, till it was shifted to Naggar which remained as the seat of the Government for many as 1400 years till it was finally mover to Kullu.

Their rule continued till about 1,450 when reference is available of Raja Kelas Pal. After this, there was long break of about 50 years. It appears the Thakurs and the Ranas might have captured power during this period, forcing the Pal Rajas to flee from the valley. It was again in the fifteenth century that the name of the Sidh Singh appears as the Raja of Kullu. There is almost identical legend about Sidh Singh as marked the name of Behangamani Pal. He too rallied the people against the Thakurs and established the old Pal dynasty, duly pleased by the goddess Hadimba.

Reference may be made to Raja Jagat Singh (1637-1672) who conquered the fort the Madankot which belonged to Jihna Rana, above Manali and also the of Baragarh opposite to Naggar, where Rana Bhosal held his sway. It was during his regime that the famous idol of Raghunathji was brought from Ayudhya and installed at the temple of Raghunathji at Sultanpur (Kullu). This of course a historic turn of events, in-as-much as the Rajas who had till then Shaiv and Shaktik, adopted Vaishnava Dharma. Not only this, the Raja gave away the whole kingdom to Raghunathji by placing the image on the 'gaddi' (throne) and himself became the vice-president of Raghunathji. Since then, the Rajas of Kullu ruled the state in the name of Raghunathji.

Following image shows the location of Kullu District:
2. **Overview of Mining Activity in the District**

Mainly three types of minor mineral constituents such as sand, stone and bajri are required for any type of construction apart from other material like cement and steel. In earlier times, the houses/ buildings were constructed in form of small dwellings with walls made up of mud plaster, stone and interlocking provided with wooden frames and there were negligible commercial as well as developmental activities resulting in less demand of building material. However, with the passage of time, new vistas of developmental activities were started. As such the demand of minor minerals in the District started in increasing trend.

In order to meet out the requirement of raw material for construction, the extraction of sand, stone and bajari is being carried out exclusively from the river beds. The demand of sand is mainly met through by river borne sand whereas the demand of bajari/grit is either met through river borne collection or through manufactured grit by stone crushers. The demand of dressed or undressed stone is met through the broken rock material from the hill slope. The local residents used to lift gravel etc. from the river beds to meet out their bonafide requirement, however after coming into being the Himachal Pradesh Minor Minerals (Concession) Rules 1971 Repealed as Himachal Pradesh Minor Minerals (Concession) and Minerals (Prevention of illegal Mining, Storage and Transportation) Rules 2015, the mining is regulated.

In district Kullu, there is a boom in the construction activities especially in roads and Hotel industries, however, at present about 24 Nos of mining leases have been granted/executed are under operation and the demand of furnished material is still high.
### 3. List of Mining Leases in the District

The detail of mining lease in the district is as follows:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name and Address of Lease</th>
<th>Khasra Number of Lease</th>
<th>Area (Bigha/Kanal /Hectares)</th>
<th>Mohal/Mauza</th>
<th>Tehsil</th>
<th>Sub-division</th>
<th>District</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>M/s Gargacharya Stone Crusher VPO Largi, tehsil Sainj, District Kullu</td>
<td>Tukra No.-1 (Diverted Forest Land)</td>
<td>11-14 Bighas</td>
<td>Mauza Phati Rot Kothi Bhallan</td>
<td>Banjar</td>
<td>Banjar</td>
<td>Kullu</td>
</tr>
<tr>
<td>2.</td>
<td>M/s Ashapuri Stone Crushre, VPO Huria, tehsil Banjar, District Kullu</td>
<td>Tukda No.-3</td>
<td>5-00 Bighas</td>
<td>Mauza Diyar Kotkandi, tehsil Bhunter</td>
<td>Bhunter</td>
<td>Kullu</td>
<td>Kullu</td>
</tr>
<tr>
<td>3.</td>
<td>M/s Ashapuri Stone Crushre, VPO Huria, tehsil Banjar, District Kullu</td>
<td>Khasra no. 2574/2, 2584/2, 2893/2576/2</td>
<td>23-03-07 Bighas</td>
<td>Mauza Diyar Kotkandi, tehsil Bhunter</td>
<td>Bhunter</td>
<td>Kullu</td>
<td>Kullu</td>
</tr>
<tr>
<td>4.</td>
<td>M/s Ashapuri Stone Crushre, VPO Huria, tehsil Banjar, District Kullu</td>
<td>Khasra no. 2971/1</td>
<td>6-15-00 Bighas</td>
<td>Mauza Diyar Kotkandi, tehsil Bhunter</td>
<td>Bhunter</td>
<td>Kullu</td>
<td>Kullu</td>
</tr>
<tr>
<td>5.</td>
<td>M/s Ashapuri Stone Crushre, VPO Huria, tehsil Banjar, District Kullu</td>
<td>Khasra No. 2888/2567/2</td>
<td>21-03-12 Bighas</td>
<td>Mauza Diyar Kotkandi, tehsil Bhunter</td>
<td>Bhunter</td>
<td>Kullu</td>
<td>Kullu</td>
</tr>
<tr>
<td>6.</td>
<td>M/s Bhuvneshwari Stone Crusher</td>
<td>Tukda No.-1</td>
<td>15-00 Bighas</td>
<td>Mauza Diyar Kotkandi, tehsil Bhunter</td>
<td>Bhunter</td>
<td>Kullu</td>
<td>Kullu</td>
</tr>
<tr>
<td>7.</td>
<td>M/s Bhuvneshwari Stone Crusher</td>
<td>Khasra No. 2971/2</td>
<td>4-00 Bighas</td>
<td>Mauza Diyar Kotkandi, tehsil Bhunter</td>
<td>Bhunter</td>
<td>Kullu</td>
<td>Kullu</td>
</tr>
<tr>
<td>8.</td>
<td>M/s Dristi Stone Crusher VPO Huria, tehsil Banjar, District Kullu</td>
<td>Khasra No. 4745/2</td>
<td>13.00 Bighas</td>
<td>Mauza Ballan tehsil Bhunter District Kullu</td>
<td>Bhunter</td>
<td>Kullu</td>
<td>Kullu</td>
</tr>
<tr>
<td>9.</td>
<td>M/s Manorma Stone Crusher VPO Huria, tehsil Bhunter</td>
<td>Khasra No. 3435,3447,30 49</td>
<td>16-19 Bighas</td>
<td>Mauza Ballan tehsil Bhunter District Kullu</td>
<td>Bhunter</td>
<td>Kullu</td>
<td>Kullu</td>
</tr>
<tr>
<td>10.</td>
<td>M/s Himalayan Stone Crusher Village Bhagran PO Piplag, Tehsil Bhuter</td>
<td>Khasra No. 3669/1, 3670/1, 3671/1&amp;2882</td>
<td>16-19-07 Bighas</td>
<td>Mauza Diyar Kotkandi, tehsil Bhunter</td>
<td>Bhunter</td>
<td>Kullu</td>
<td>Kullu</td>
</tr>
<tr>
<td>12.</td>
<td>Gammon CMC JV NHPC-II Shilagarh Bhunter, District Kullu</td>
<td>Tukda No-1</td>
<td>14-13 Bighas</td>
<td>Mauza Shilagarh, Bhunter, Kullu</td>
<td>Bhunter</td>
<td>Kullu</td>
<td>Kullu</td>
</tr>
<tr>
<td>13.</td>
<td>M/s Paras Stone Crusher Village</td>
<td>Tukda No. 97/2</td>
<td>6-10 Bighas</td>
<td>Mauza Palchan, Manali</td>
<td>Manali</td>
<td>Manali</td>
<td>Kullu</td>
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<tr>
<td>14.</td>
<td>M/s Strabag Afcon JV Rohtang, Highway Tunnel Project, tehsil Manali District Kullu</td>
<td>Tukda No-2</td>
<td>0.48 Hectares</td>
<td>Mauza Phati Salang tehsil Manali</td>
<td>Manali</td>
<td>Manali</td>
<td>Kullu</td>
</tr>
<tr>
<td>15.</td>
<td>M/s Strabag Afcon JV Rohtang, Highway Tunnel Project, tehsil Manali District Kullu</td>
<td>Tukda No.-1</td>
<td>0.66 Hectares</td>
<td>Mauza Phati Salang tehsil Manali</td>
<td>Manali</td>
<td>Manali</td>
<td>Kullu</td>
</tr>
<tr>
<td>16.</td>
<td>M/s Chamunda Stone Crusher</td>
<td>Khasra No. 1421,1307</td>
<td>6-10 Bighas</td>
<td>Mauza kothi and bajaura</td>
<td>Bhunter</td>
<td>Kullu</td>
<td>Kullu</td>
</tr>
<tr>
<td>17.</td>
<td>Sh. Chet Ram Village Tinder PO Swad, Tehsil Anni, District Kullu</td>
<td>Khasra No. 2370, 2364</td>
<td>8-18 Bighas</td>
<td>Mauza Shilhi Pargana Janja tehsil Anni, District Kullu</td>
<td>Nirmand</td>
<td>Anni</td>
<td>Kullu</td>
</tr>
<tr>
<td>18.</td>
<td>Sh. Sunder Thakur, Director M/s Shobra hydro project Pvt. Shobra, PO Dhalpur Kullu</td>
<td>Kh. No. 2519,2493,25 1,2518,2516 ,2532489,12 7,134,3538,2 547,2522</td>
<td>5-10 Bighas</td>
<td>Mauza Dungri Dhar kothi Dugilag tehsil and District Kullu</td>
<td>Kullu</td>
<td>Kullu</td>
<td>Kullu</td>
</tr>
<tr>
<td>19.</td>
<td>M/s Siya Pal Thakur, Village Ropri tehsil Anni District Kullu</td>
<td>Tukda no.-1</td>
<td>12-10 Bighas</td>
<td>Mauza Phali Seodhar, Tehsil Anni</td>
<td>Nirmand</td>
<td>Anni</td>
<td>Kullu</td>
</tr>
<tr>
<td>22.</td>
<td>Sh. Tikram Ram, village Pukhari PO Brain, tehsil Sainj, District Kullu</td>
<td>Khasra No. 2714/1 and 2715/1</td>
<td>3-12 Bighas</td>
<td>Mauza Phali and Kothi Bhalan</td>
<td>Banjar</td>
<td>Banjar</td>
<td>Kullu</td>
</tr>
<tr>
<td>23.</td>
<td>Smt. Neelam Thakur W/o Anuram Ram Village Pobrain Sub- tehsil Sainj, District Kullu</td>
<td>Khasra no. 3434/1</td>
<td>3-16 Bighas</td>
<td>Mauza Phali and Khati Bhalan-II</td>
<td>Banjar</td>
<td>Banjar</td>
<td>Kullu</td>
</tr>
<tr>
<td>24.</td>
<td>Smt. Lata Devi Village Dandiyal Po and Sub tehsil Sainj District Kullu</td>
<td>Shumari No. 3 and 14</td>
<td>16-00 Bighas</td>
<td>Mauza Kothi Mohal Banogi</td>
<td>Banjar</td>
<td>Banjar</td>
<td>Kullu</td>
</tr>
<tr>
<td>25.</td>
<td>Bimla Devi W/o Sh. Radha krishan,</td>
<td>Khasra No. 3683/303</td>
<td>00-04-11 bighas</td>
<td>Mauza Mohal Railla/Bhallan Tehsil Banjar</td>
<td>Banjar</td>
<td>Banjar</td>
<td>Kullu</td>
</tr>
</tbody>
</table>
4. Detail of Royalty During Last Three Years

The detail of royalty for the last three years is as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Royalty (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012-2013</td>
<td>34776440</td>
</tr>
<tr>
<td>2013-2014</td>
<td>21879280</td>
</tr>
<tr>
<td>2014-2015</td>
<td>25599397</td>
</tr>
<tr>
<td>2015-2016</td>
<td>36997737</td>
</tr>
</tbody>
</table>

5. Detail of Production of Minor Mineral in the Last three years

The Detail of Production for the last three years is as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Mineral</th>
<th>Production (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012-13</td>
<td>Sand and Grit</td>
<td>865349</td>
</tr>
<tr>
<td>2013-14</td>
<td>Sand and Grit</td>
<td>544561</td>
</tr>
<tr>
<td>2014-15</td>
<td>Sand and Grit</td>
<td>638501</td>
</tr>
<tr>
<td>2015-16</td>
<td>Sand and Grit</td>
<td>564721</td>
</tr>
</tbody>
</table>

6. Process of Deposition of Sediments in the District

Mineral process of deposition of sediment includes the Fluvial process i.e. the physical interaction of flowing water and the natural channels of rivers and streams. The process plays an essential and conspicuous role in the denudation of land surfaces and the transport of rock detritus from higher to lower levels. Over much of the world the erosion of landscape, including the reduction of mountains and the building of plains, is brought about by the flow of water. As the rain falls and collects in watercourses, the process of erosion not only degrades the land, but the products of erosion themselves become the tools with which the rivers carve the valleys in which they flow. Sediment materials eroded from one location are transported and deposited in another, only to be eroded and redeposited time and again before
reaching the ocean. At successive locations, the riverine plain and the river channel itself are products of the interaction of a water channel’s flow with the sediments brought down from the drainage basin above.

The velocity of a river’s flow depends mainly upon the slope and the roughness of its channel. A steeper slope causes higher flow velocity, but a rougher channel decreases it. The slope of a river corresponds approximately to the fall of the country it traverses. Near the source, frequently in hilly regions, the slope is usually steep, but it gradually flattens out, with occasional irregularities, until, in traversing plains along the latter part of the river’s course, it usually becomes quite mild. Accordingly, large streams usually begin as torrents with highly turbulent flow and end as gently flowing rivers.

In flood time, rivers bring down large quantities of sediment, derived mainly from the disintegration of the surface layers of the hills and valley slopes by rain and from the erosion of the riverbed by flowing water. Glaciers, frost, and wind also contribute to the disintegration of the Earth’s surface and to the supply of sediment to rivers. The power of a river current to transport materials depends to a large extent on its velocity, so that torrents with a rapid fall near the sources of rivers can carry down rocks, boulders, and large stones. These are gradually ground by attrition in their onward course into shingle, gravel, sand, and silt and are carried forward by the main river toward the sea or partially strewn over flat plains during floods. The size of the materials deposited in the bed of the river becomes smaller as the reduction of velocity diminishes the transporting power of the current.

The course of the rivers in the districts is full of occasional irregularities where the river loaded or flooded material is deposited. Various such locations are given in next chapters.

7. **General Profile of the District**

Kullu district has a unique geography with mountainous terrains and about 90% of its population living in villages situated in far-flung and inaccessible areas. It has four sub-divisions i.e. Manali, Kullu, Banjar and Anni and five developmental blocks i.e. Naggar, Banjar, Kullu, Anni and Nirmand. The entire Kullu district is part of the Mandi Parliamentary constituency. Natural calamities, like cloud bursts, flash floods, heavy
rains, earthquake, snowfall, hail storms, drought and accidents etc. cause a lot of misery to the people. The district has often been victim to natural calamities causing severe damage to life and property.

**KULLU DISTRICT at a GLANCE**

<table>
<thead>
<tr>
<th>Location</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>Himachal Pradesh</td>
</tr>
<tr>
<td>District</td>
<td>Kullu</td>
</tr>
<tr>
<td>Year of creation of District</td>
<td>1963</td>
</tr>
<tr>
<td>Total Area (SqKm)</td>
<td>5495</td>
</tr>
<tr>
<td>Total Assembly Constituency</td>
<td>4 - Manali, Kullu, Banjar, Anni</td>
</tr>
<tr>
<td>Major Rivers</td>
<td>Beas, Satluj, Parvati</td>
</tr>
</tbody>
</table>

**Population (2011 census)**

<table>
<thead>
<tr>
<th>Total</th>
<th>437903</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>225452</td>
</tr>
<tr>
<td>Urban</td>
<td>212451</td>
</tr>
<tr>
<td>Sex Ratio</td>
<td>942</td>
</tr>
<tr>
<td>Scheduled Cast</td>
<td>1,07,897</td>
</tr>
<tr>
<td>Scheduled Tribe</td>
<td>11351</td>
</tr>
</tbody>
</table>

**Administrative Units**

<table>
<thead>
<tr>
<th>Sub Divisions</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tehsils</td>
<td>4</td>
</tr>
<tr>
<td>Sub-Tehsils</td>
<td>2</td>
</tr>
<tr>
<td>Blocks</td>
<td>5</td>
</tr>
<tr>
<td>Towns</td>
<td>4</td>
</tr>
<tr>
<td>Total Villages</td>
<td>172</td>
</tr>
<tr>
<td>Total Police Stations/Posts</td>
<td>13</td>
</tr>
</tbody>
</table>

**Families**

<table>
<thead>
<tr>
<th>Total Families</th>
<th>76902</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural Families</td>
<td>69483</td>
</tr>
</tbody>
</table>
**SURVEY DOCUMENT DISTRICT KULLU**

**Urban Families**  
7419

**Literacy (2011 Census)**  
- Total: 72.9  
- Male: 83.98  
- Female: 60.88

**Panchayati Raj**  
- Total Panchayats: 204  
- Backward Panchayats: 71  
- Zila Parishad Members: 14  
- Panchayat Samiti Members: 103  
- Gram Panchayat Members: 1228  
- Total Panchayat Secretaries: 63  
- Total Panchayat Sahyaks: 120  
- Total Technical Assistants: 63

**Agriculture**  
- Total Agricultural Land (Hect.): 65186  
- Net Shown Area (Hect.): 36342  
- Irrigated Area (Hect.): 2878

**Industries**  
- Large & Medium Scale Units: 2  
- Small Scale Units: 1962  
- Industrial Area: 1

**Education**  
- Anganwaris: 376  
- Primary Schools: 727  
- Middle Schools: 107  
- High Schools: 49  
- Senior Secondary Schools: 31  
- Colleges: 2  
- I.T.I.'s: 1  
- Health


8. Land Utilization Pattern in the District

Population

As per census 2011, Kullu had population of 437,903 of which male and female were 225,452 and 212,451 respectively, housed in 76902 households located in 172 villages and 4 towns. The initial provisional data released by census India 2011, shows that density of Kullu district for 2011 is 80 people per sq. km. in 2001. Kullu district administers 5495 square kilometers of areas. Kullu district is the most rapidly growing district in the state in terms of population; the rural population grew by 24.89 per cent which was the highest rural growth in the state while urban population growth was 43.22 per cent during 1991-2001. This growth is attributed to the development of tourism industry, horticulture development and initiation of hydro-power generation ventures on a large scale which has attracted large number of people from the other areas. With regards to Sex Ratio in Kullu, it stood at 942 per 1000 male compared to 2001 census figure of 927. The average national sex ratio in India is 940 as per latest reports of Census 2011 Directorate. In 2011 census, child sex ratio is 962 girls per 1000 boys compared to figure of 960 girls per 1000 boys of 2001 census data.

Flora and Fauna
Kullu valley is famous for its varied biodiversity. It has some of the rarest of animals like Himalayan Tahr, Western Tragopan, Monal, Red Bear etc. The Great Himalayan National Park (GHNP) is also located in the district. The park was built in 1984. The park is spread over an area of 1,171 km$^2$ that lies between an altitude of 1500 to 6000m. In order to protect the flora and fauna of this Himalayan area many places are declared as wildlife sanctuaries like: Khokhan Sanctuary, Kais Sanctuary, Tirthan Sanctuary, Kanawar Sanctuary, Rupi Baba Sanctuary, Great Himalayan National Park, Van Vihar Manali.

**Agriculture and Horticulture**

The agricultural and horticultural practices of the region vary from other parts of India due to a variety of factors. The most important one is, of course, the unique climate and landscape of the Himalayas. The mountainous territory strongly influences both techniques and crops. Most agriculture takes place in the form of terrace cultivation, with small strips of the mountain slopes having been more or less levelled out to allow cultivation. The quality of the soil is less than optimal with few nutrients and many small stones and rocky patches. Further, the altitude leads to a harsh climate. While in the valleys with an altitude of around 1500 m above sea level the cultivation can still take place most of the year; it is reduced in the summer months in regions above 2500 m. Yet, the people there particularly depend on agriculture for survival, largely because the remote locality of their villages denies opportunities in other fields. The area is purely rain-fed, which creates difficulties if the monsoon and snow fall turn out weak. Problems of accessibility and transport are further crucial aspects of the farming in Kullu district.

Horticulture plays an important role in the economic life and prosperity of the people of Kullu. During the last three decades, Kullu has made tremendous progress in the field of Horticulture. Greater emphasis is being laid on this sector because the geographical features and climatic conditions prevailing in the district are ideally suited for fruit farming. Among all the fruits grown in Kullu, apples are most widely grown and represent commercially the most important fruit crop. The cultivated apple area is 18,524 hectares. The annual apple production usually lies between 80,000 to 90,000 metric tons. This represents about 9,000 truckloads of apples every year. Apart from apples other varieties of fruits grown in Kullu are plum, peach, apricot, pomegranates
and kiwi as well as nuts, especially almonds. These fruit plantations cover an area of 3065 hectares and the annual production is approximately 20,000 metric tons.

**Land Use and Land Cover**

The mountain systems are complex ecological entities endowed with a vast resource base for its populace; they also support livelihood and developmental activities in the adjacent lowland areas. Kullu district is situated in the central part of the Himachal Pradesh. The area is an example of a natural region as it is bounded by northwest-southeast running Pir-Panjal range in the north separating Beas River valley of Kullu from Chandra-Bhaga (The Chenab River) valley of Lahaul and Spiti district. Kullu is fifth largest district of Himachal Pradesh in terms of geographical area, ninth in terms of population that accounts for about 6.38 per cent of the total state population. The district has a population of about 0.43 million people living in 4 urban and 172 rural settlements. The historical information on land use of Kullu valley during 19th and early
20th centuries reveals that land use/land utilization arrangements in Kullu was based on Village-use areas; forests or pasture lands were considered as common property of the villages.

The post-independence period witnessed several socio-economic developments in the area in response to increased connectivity of the area with outside world. This resulted in substantial increase in area under cultivation of cash crops and settlements (Tucker, 1982; Saczuk, 2001; Gardner et al. 2002). Change in forest cover and rise of apple orchards was noticeable in Beas valley. In post 1970 period, drastic changes were witnessed in the district related to developmental activities. The construction of roads acted as a stimulus to horticulture development and connected the area to other parts leading to increased inflow of tourists and economic ventures. The remotely sensed analysis shows that in the early 1970s about 40 per cent of the total area in the district was under permanent snow cover/glacier and rocky/barren surfaces, both classes sharing similar proportion. In the last 4 decades, the snow cover has constantly declined resulting in an increase in rocky/barren surfaces either in the previously snow covered areas or barren land just below the permanent snow. The snow cover reduced by 10 per cent while barren surfaces increased by about 9 per cent during 1972-2005 (table 1). The forest cover in the area does not show a very large change and has reduced by about 6 per cent.

Forest

The Forests of Himachal Pradesh known for their grandeur and majesty are like a green pearl in the Himalayan crown. This life supporting systems are presently under great stress due to impact of modern civilization, economic development and growth in human and cattle population. According to national Forest Policy, 1988, at least two third i.e. 66% of the geographical area should be under forest in the hilly states like Himachal Pradesh. However, keeping in view that about 20 % of the area is inaccessible and beyond the tree limit, the State Government aims to bring 50% of the geographical area under forest cover.

Lakes and Rivers
The Beas and Sutlej are the main rivers of the district. The Beas, which forms the world famous valley of Kullu, rises from the Pir Panjar Ranges near “Rohtang Pass” at a height of over 3900 meters above mean sea level and flows southwards for about 12m Kms. It leaves Kullu at place called Bajaura. Saij and Parvati are its main tributaries. The river Beas and its tributaries have lowest level during the winter months of December, January and February and highest level during June, July and August. Occasionally the floods also occur in Kullu in August. The Satluj River on the southern side of the district rises from Mansarovar in Tibet and touches the district in Nirmand Tehsil opposite Rampur Tehsil of Shimla District. Mantalai, Khirganga, Brighu, Dashar and Sarelosar lakes are also in this district. Apart from this some very beautiful water falls, Hot springs and lakes also form part of this district.

**Industries**

**Large & Medium Scale Industries:** There are 2 Medium & Large scale industrial enterprises located at village Raison manufacturing natural spring water and aerated water. Total fixed capital investment in these enterprises is Rs. 1549.4 lakh and providing employment to 147 persons including 21 Non- Himachalis.

**Small Scale Industries:** There are 1817 small scale industrial enterprises registered on permanent basis as on 31.03.2011, having fixed capital investment of Rs. 4054.65 lakh and providing employment to 10628 persons, out of which 123 are Non- Himachalis.

**Industrial Area:** Industrial Area, Shamshi is situated on N.H. 21, 7 Kms. From Kullu Town towards Bhunter. Total area of this industrial area is 82.19 bighas. 43 plots, 12 sheds and 16 shops have been developed in this area. At present 39 industrial enterprises are working in this industrial area having fixed capital investment of Rs. 907.60 lakh and providing employment to 414 persons.

9. **Physiography of the District**

**Physiology**

Kullu district situated in the lesser Himalayas between 31°20’ - 32°26’ north latitudes and 76°59’ - 77°50’ east longitudes possesses an intricate system of
mountain ranges which are the result of successive compression movements of the earth’s crust (Burrard and Hayden, 1933). The district is bounded by Pir-Panjal range in the north; Bara Bhangal in the northwest; the Greater Himalayas in the eastern boundary and Dhauladhar range in the southwest while River Sutlej marks the southern boundary of the district (map 1). The district has very high absolute relief ranging from 750-6200 meters.

The geomorphological character of Kullu is influenced by both glacial and fluvial processes (Sah & Mazari, 2007); the area is broadly divided into glaciers & permanent snow fields, rocky/barren slopes, valley slopes & ridges, and main valley floor. The glaciers & permanent snow fields are found in most of the eastern parts above an elevation of 4500 meters. The barren/rocky surfaces occupy the lower parts of glaciers and permanent snow fields while valley slopes occupy a large part in the district and consist of steep to moderately steep slopes, ridges and narrow valleys where slopes usually have an inclination of 30-40 degrees. The main valley floor of River Beas is dominated by outwash fan, alluvial fans and river terraces.

**Relief**
The area possesses high relative or local relief which refers to the difference between the highest and the lowest altitude in an area. The higher values indicate rapid rise in altitude and presence of faults, lower relief signifies mature topography. A determinant of morphological character of an area, relative relief has noteworthy alliance with landslide by acting as a triggering factor. As a risk agent, relative relief plays a decisive role in the vulnerability of settlements, transport network and land. In Kullu district, there is wide variation in relative relief, as shown in map, ranging from low to very high. About 13.39 %, 60.13% and 26.48 % area has low (below 200m), moderate (200-400m) and high (above 400m) relative relief respectively. About 13.39 %, 60.13% and 26.48 % area has low (below 200m), moderate (200-400m) and high (above 400m) relative relief respectively.

Climate

The great diversity in relief, variation in elevation, and the geographical location of Kullu district has given diverse climatic conditions. Generally, the climate is cold and dry and the year can be divided into three season:

1. Summer : March to June
2. Rainy : July to September

3. Winter : October to February

Summer season in Kullu starts in March and lasts until June. During summers, the maximum temperature reaches 30 degrees Celsius in the day, while the nights still retain...
a bit of chill. From December to February, this period is very chilly. Heavy frost occurs during this period. Snowfall generally occurs during December and January or an early snowfall may occur in November also. During this period, most of the parts of the district remain under cover of snow. Max temperature is 38.8° C and minimum is 5.2° C in winter. The average rainfall observed in the district is about 80 Cm. During rainy season Natural Calamities in the form of could burst and heavy floods have been taking place in district in past 2 to 3 decades. Also due to deposition of debris at the center of the nala, the erosion has been started along the banks of the river which leads to change the course of river many times. In some cases, water flowing along the banks results in undercutting of the slopes by a river. This undercutting serves both to increase the gradient of the slope, reducing stability, and to remove toe weighting, which also causes heavy landslides.

10. Rainfall of the District

The region has four distinct seasons. The area experiences severe winter from December to March followed by severe summer season lasting from April to June. The area receives rain fall under the influence of south -west monsoon from July to mid-September followed by post -monsoon season lasting up to November.

The climate of the district is sub-tropical in the valleys and tends to be temperate near the hilltops. In the higher region, the climate remains cold throughout the year. In winter snow often comes down to 1300 m above mean see level. Normally, it starts melting from the end of March from places lying below 3300 m. In summer, the whole Kullu valley and other low altitudes areas quite comfortable. The winter starts from the middle of November and continues till the middle of March. Thereafter, the mercury continues to rise till the onset of the monsoon, which starts from the last week of June or early July and continues till the middle of September. During October and November, the nights and days are pleasant and sunny. Average minimum and maximum temperature in the district varies from 1° C to 32° C. The district receives precipitation in the form of rainfall, mainly during the monsoon period from July to September. The average annual rainfall in the district is about 743.78 mm. Annual average rainfall from place to place in the district is highly variable and ranges from 577mm to more than 1150 mm.
During winters snow fall often occurs down to elevation of 1300m amsl. The following chart shows the variation in the rainfall in the kullu district during the years 2009 to 2013.

![Rainfall Statistics of the District]

**11. Geology and Mineral Wealth**

11.1. **Geology of Kullu District**

Kullu district falling in toposheet No. 53E/NW, having total area of 5495 Sq. km lying between latitudes 31°41’ and 31°58’ and longitudes 77°10’ and 77°21’. The various rock formations met with are the Chail Series, the Larji Series and the Banjar Series. These formations are separated by two thrusts, viz, the Chail thrust and Jaunsar thrust. In the western part of the map the Chails are thrust over the Larjis while in the eastern part the Larjis (Krol or Shali) are thrust over by Jaunsars. Due to erosion, the rocks of the Larji Series are exposed in a window. The area is marked by a number of hills and valleys characteristics of the sub-Himalayan topography. The highest and the lowest points are marked, by the Talawa Peak (3330 metres) and Bhuntar (943metres) respectively by the Sainj and the Bajaura nalsas and the Mahul Khad.
The major portion of the area is covered by the evergreen forests of the Deodar, Pine, Walnut and Kil trees. Small patches of cultivable lands are in the form of terraces. Wheat, maize, paddy are the main crops. The rock formations met with in the area from east to west are the Banjar series with associated basic rocks; the Larji Series and the Chail Series. Major part of the area consists of the rocks of the Banjar Series most of which farms the peaks and higher ranges of hills. The rocks of the Larji series are at lower levels. The contacts of the above-mentioned rock formations are marked by two thrusts. The above stratigraphic sequence of the rocks is established by field observations.

**Chail Series:** The Chail Series comprises the oldest rocks of the area. They are exposed on the western and partly on the eastern parts of the area. The Chail Series comprises slates, phyllites with thin bands of quartzite, garnetiferous gneiss and schists and cream and blue coloured, sheared, calcareous quartzite and limestones associated with bands of carbonaceous slates, phyllites and schists. Particularly, the presence of limestone, carbonaceous slates and phyllites in them recall similarities with the Chail Series of the type section in the Simla area. Sheared calcareous quartzite and limestone associated with carbonaceous phyllites and schists: The lowest member of the Chail Series comprises pink and grey coloured sheared calcareous quartzite and limestone associated with

<table>
<thead>
<tr>
<th>Series</th>
<th>Lithology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recent</td>
<td>River terrace and alluvium (unassorted boulders, cobbles and pebbles of granite, granite gneiss, silicified phyllite, slates, dolomite, limestone etc.)</td>
</tr>
<tr>
<td>Larji Series (Krol or Shali)</td>
<td>Predominantly dolomite interceded with thin bands of quartzites and limestone occasionally with thin parting of slate and phyllite.</td>
</tr>
<tr>
<td>Banjar Series (Jaunsars ?)</td>
<td>Massive quartzite, slate, phyllite interbedded with bands of quartzites, gritty phyllites calcareous quartzite and conglomeratic quartzites.</td>
</tr>
<tr>
<td>Chail Series</td>
<td>Slates, phyllites with bands of quartzites, garnetiferous gneisses and schists cream and blue coloured, sheared, calcareous quartzites and limestone associated with carbonaceous phyllite and schists.</td>
</tr>
</tbody>
</table>

The tectonic sequence in the area is given below:-

```
<table>
<thead>
<tr>
<th>Chail Series</th>
<th>THRUST</th>
<th>T1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banjar Series (Jaunsars ?)</td>
<td>THRUST</td>
<td>T2</td>
</tr>
</tbody>
</table>

(Larji Series Krols or Shalis ?)
carbonaceous phyllites and schists. They are observed along the Chail thrust. Exposures of limestone are seen about 0.4 km east of Bhib and in the nala north of Sajohr. A patch of this is also exposed at 0.2 km north of Jia. The outcrops are discontinuous as they are cut off at places by the thrust. The Chail limestone is greyish blue to cream coloured. Thin bands of greyish slates occur within these limestones. The limestones are associated with carbonaceous schists and phyllites. The carbonaceous phyllites and schists are well foliated and at places they are graphitic. The limestones are sheared at places probably due to the thrust movement. They are highly folded as seen north of Jia in the eastern part of the area.

**Gneissses and Schists:** The limestones are overlain by gneisses and schists. They are exposed in the vicinity of the Chail thrust. The outcrops continue from Bhansoli in the south up to Mahul-Khad in the western part and from 2 km. North of Jai up to Jhori in the eastern part of the area. The gneisses are grey to green in colour and medium grained in texture and are well foliated with dip ranging from 20° to 50°. At places they appear to be quartzose. The schists are sea green in colour and show well developed schistosity. They are biotite schist, quartz-schist and chlorite schists. Biotite schists occur as thin bands and are insignificant when compared to quartz schists and quartz-chlorite schists. They are profusely studded with garnets, not exceeding 1 to 2 mm. in diameter, as seen near Sohr and Khokhan in the western part and near Talote in the eastern part of the area. The garnetiferous schist appears to have undergone retrograde metamorphism. In thin section, garnets occur, as snow balls which show a spiral arrangement of inclusions of quartz, biotite etc. indicating that garnets have been rolled by differential movement of the matrix of the rock. This indicates that the rock has undergone dynamo thermal metamorphism. Quartz schist and quartz-chlorite schists are extensively developed and show well developed schistosity and at places lenses of quartz are seen showing boudinage structure along the plane of schistosity. They are soft and rather friable owing to the presences of thin lenticles of quartz. At places muscovite mica is seen associated with the schists, particularly at Bholan in the western portion of the mapped area.

**Quartzites:** Quartzite’s, not exceeding 5 metres in thickness occur as in interbedded member. At places they appear as major outcrops as seen west of Khokhan. They are
brownish grey in colour. They do not show any sedimentary features such as current bedding and ripple marks. At places they show slightly schistose structure, probably due to the development of sericite and muscovite mica.

**Slates and Phyllites:** Slates and phyllites are pale green to grey in colour. They form the upper most members of the Chail series. Thin bands of quartzites occur interbedded with the slates and phyllites. The latter are highly puckered and friable.

**Banjar Series:** The Banjar Series in this area comprises a group of low grade metamorphic rocks mostly quartzites, slates, phyllites and chlorite schists. They were first mapped around the Banjar town in the southern part of the area by Dass and Srikantia in 1961-62. From the field observations this group of rocks may be assigned a younger age to the Chail Series which shows a relatively higher grade of metamorphism. Further, as this series contains conglomeratic quartzite their resemblances with the rocks of Januarys Series of the type Simla area has been inferred and correlated. This correlation is tentative. The various units of the Banjar Series met with in the area form west to east are, slates, phyllites with interbedded quartzites, schists and a thick horizon of massive quartzite. Slates, phyllites and schists with interbedded quartzites Slates are steel grey in colour. Well-developed cleavages are almost parallel to bedding. They generally grade into phyllites and chlorite schists. Phyllites form a considerable thickness. They are greyish green in colour. They show well developed foliation. They are highly puckered and crumpled. Near their contact with the massive quartzite, phyllite grade into chlorite schists. They contain lenses of quartz along the planes of schistosity. Phyllites and schists are siliceous at places. Carbonaceous phyllites varying from 2 to 4 metres in width and 10-15 metres in length are seen associated with the phyllites near Chong. Specks of pyrite are seen within the carbonaceous phyllite. Quartzite bands varying in width from 5 to 30 metres occur interbedded within the slates, phyllites and schists. This is a characteristic association in this area. The quartzites are white, whitish grey, greenish and pinkish in colour. At places, they are quarried and used for roofing purposes. Massive quartzite A major band of quartzite with an outcrop width of over one km is seen to overlie conformable the slate-phylilite member. They are seen to extend from Dotha in the south up to Shat in the north. The quartzites are white in colour. They are massive and lack sedimentary features such as current bedding and ripple marks. At places sericite mica is
developed in the quartzites as seen near Borogi village. Basic intrusive at several places basic rocks are found in the form of sills and dykes. Near Dhara and Paral, the phyllites are intruded by basics rocks varying in thickness from 2 to 5 metres. The traps are dark green in colour, compact and hard. At some places, they are vesicular. Vesicles are filled up by secondary minerals such as quartz and calcite. At places these have been metamorphosed into chlorite schists.

**Larji Series (Krols or Shali?)** The rocks of the Larji Series occur in a ‘window’ between the Jaunsar- and the Chail thrusts, the exposures of the Larji Series are seen to continue from Takoli in the south up to Mahul *Khad* in the north. Further north no exposure is seen. The Larji Series comprises predominantly limestone and dolomite with thin partings of slates. The correlation of the Larji Series with the Krol or the Shali Series of the Simla area is only tentative. No sequence of the Krol series is established in the Larji area and we do not find the exposure of other units of the series as observed in the type area of the Krol belt.

**Structure**

Structurally the area is highly complicated due to complex folds and thrusts. The regional strike of the formations in the eastern part of the area, varies from NNW-SSW to NW-SE with abrupt changes particularly in the vicinity of the thrust. The dips vary from 10°-70° towards ENE to NE. In the western part, the Chails and the underlying Larjis (?) stike NNE-SSW to NE0SW. The dips vary from 20° to 70° towards NNW to NW.

**Thrusts**

The area has been traversed by two thrusts viz, the Jaunsar thrust and the Chail thrust. *The Jaunsar thrust* has brought the older metamorphic rocks of the Banjar series (Jaunsar) upon the un-metamorphosed rocks of the Larji Series. The Chail thrust separates the overlying older metamorphic rocks of the Chail Series and the underlying un-metamorphosed rocks of the Larji Series.

**The Chail Thrust**

In the western part of the mapped area the Chail thrust continues from Bhansoi in the south and extends up to Mahul Khad. Further north of Mahul Khad no exposure of limestone and dolomite belonging to the Larji Series are seen, which
limits the northern extension of the window. The sequence in which the thrusting in this area has taken place maybe summarized as follows:

First the Jaunsars were thrust over the Larjis, Later the Chail thrust brought the rocks of the Chail over the Jaunsars and the Larjis. Subsequently due to erosions, the underlying limestones and dolomites of the Larji Series are exposed on either side of the Beas river forming the window which Auden had first reported in 1942 during the course of his investigations for a dam site at Largi. Later Dass and Srkantia in 1961-62 field season found evidences to corroborate the views of Auden. Now the author with his field observations confirms the existence of a window. The angle at which thrusting has taken place is not exactly known. The dip of the thrust plane is estimated between 40° and 50° towards west.

Folds

The rocks in this area are highly folded. The rocks of the Banjar Series (Jaunsars) in this area, are folded into a major plunging anticline with the axis trending NE-SW approximately. This is in conformity with the trends of the minor fold axes. The rocks of the Larji Series are folded into a major plunging anticline with the axis trending N.N.W-S.S.E. in the southern part of the area. These are folded in to a plunging anticline, the axis of which is trending towards NNW-SSE (Dass and Srikantia), the around of plunge being 20°. So the rocks of the Larji Series form a doubly plunging anticline.

Joints

The rocks in this area highly jointed particularly the quartzite, the various joint orientations as observed are given below:

(i) N 70° W-S70°E dips vertical.
(ii) N 70° E-S70°W dipping 60° northwest to vertical.
(iii) N 20° to 30° W-S20° to 30° E dipping 30° to 60° towards northeast.
(iv) N 20° to 30° E- S20° to 30°W dipping 30° -70° towards southwest.

Mineral Wealth
Rivers can be called as open as well as underground circulatory system of a continent and in case of Kullu district of Himachal Pradesh River Beas and River Parvati are the main aortae which are the main conduits for carrying water, minerals and load to nurture and to shape the life and the land. History had shown us that rivers have provided us drinking water, agricultural lands, building material, means of transportation and a habitable ecosystem. In northern India, the main drinking water source direct or indirect comes from rivers only but as human activities are profoundly increased a systematic and scientific utilization of the system is very important.

Natural processes to shape the land by various means i.e. fluvial, erosional, Aeolian are slow and steady but any slight change to these processes can imbalance the process and resultant is the catastrophe. Deforestation, industrialization, urbanization, floodplain cultivation, dam and levee construction, and channelization have altered dramatically natural flow regimes. These changes have contributed to flooding, erosion, channel incision, contamination, non-native species introductions, and loss in ecological diversity. Although well harmonious techniques to harvest the natural resources can sustain the changes still slow and steady. The multiple and sometimes incompatible services we demand of rivers often lead to social conflicts. The policy and management decisions that surround these conflicts increasingly require the integration of science-based information that crosses traditional disciplines. Unfortunately, gaps in our understanding of river processes often limit our ability to manage rivers optimally.

11.2. **Major Rivers of Kullu District**

Kullu district is drained by one major river; the River Beas and in addition to this river there are three other secondary rivers namely; River Parvati which drains central part of the Kullu district, River Sainj which drains the central southern part of the district and River Tirthan which drains the southern part of the district. In the extreme southern part there are two small tributaries which join the River Sutlej in Shimla district. All
together the Kullu district is occupied mainly by one river basin called as Bear River Basin which is contributed by various river tributaries

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the River</th>
<th>Area Drained (SqKm)</th>
<th>% of Area drained in the District</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Beas River</td>
<td>1481</td>
<td>26.98</td>
</tr>
<tr>
<td>2.</td>
<td>Parvati River</td>
<td>1753</td>
<td>31.90</td>
</tr>
<tr>
<td>3.</td>
<td>Sainj River</td>
<td>792</td>
<td>14.41</td>
</tr>
<tr>
<td>4.</td>
<td>Tirthan River</td>
<td>575</td>
<td>10.46</td>
</tr>
<tr>
<td>5.</td>
<td>Sutlej Tributaries</td>
<td>710</td>
<td>12.92</td>
</tr>
<tr>
<td>6.</td>
<td>Gadsa Nala</td>
<td>184</td>
<td>3.35</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>5495</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

*Table 1 %age of Area Drained of the District*

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the River</th>
<th>Total Length in the District (KM)</th>
<th>Place of Origin</th>
<th>Altitude at Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Beas River</td>
<td>90</td>
<td>Beas Kund</td>
<td>4361</td>
</tr>
<tr>
<td>2.</td>
<td>Parvati River</td>
<td>88</td>
<td>Beili</td>
<td>4130</td>
</tr>
<tr>
<td>3.</td>
<td>Sainj River</td>
<td>57</td>
<td>Munda Tapra</td>
<td>3995</td>
</tr>
<tr>
<td>4.</td>
<td>Tirthan River</td>
<td>47</td>
<td>Tharthia Dhar Thach</td>
<td>4080</td>
</tr>
<tr>
<td>5.</td>
<td>Garsa/Hurla Nala</td>
<td>30</td>
<td>Above Sewadug Thach</td>
<td>3604</td>
</tr>
<tr>
<td>6.</td>
<td>Bahna Khad</td>
<td>25.5</td>
<td>Nuchi</td>
<td>3443</td>
</tr>
<tr>
<td>7.</td>
<td>Kurpan Khad</td>
<td>32.2</td>
<td>Shrikhand</td>
<td>4914</td>
</tr>
<tr>
<td>8.</td>
<td>Mahali Khad</td>
<td>16</td>
<td>Sakranda Dhar</td>
<td>4689</td>
</tr>
</tbody>
</table>

*Table 2 Showing Place of Origin*
Figure 1: Percentage of Area Drained

% of Area Drained in the District

- Beas River: 14%
- Parvati River: 16%
- Sainj River: 7%
- Tirthan River: 5%
- Gadsa Nala: 2%
- Sutlej Tributaries: 6%

Total: 50%
River Beas

The Beas River rises in the Himalayas in central Himachal Pradesh, India, and flows for some 470 kilometres (290 mi) to the Sutlej River in the Indian state of Punjab. Its total length is 470 kilometres (290 mi) and its drainage basin is 20,303 square kilometres (7,839 sq mi) large.

The river rises 4,361 metres (14,308 ft) above sea-level on the southern face of Rohtang Pass in Kullu district. It traverses the Mandi District and enters the Kangra District at Sandhol, 590 metres (1,940 ft) above sea-level. During its lower course the Beas is crossed by numerous ferries, many of which consist of inflated skins (darais). Near Reh in Kangra District it divides into three channels, which reunite after passing Mirthal, 300 metres (980 ft) above sea-level. On meeting the Sivalik Hills in Hoshiarpur, the river sweeps sharply northward, forming the boundary with Kangra District. Then bending round the base of the Sivalik Hills, it takes the southerly direction, separating the districts of Gurdaspur and Hoshiapur. After touching the Jullundur district for a short distance, the river forms the boundary between Amritsar and Kapurthala. Finally, the Beas joins the river Sutlej at the south-western boundary of Kapurthala district of Punjab after a total course of 470 kilometres (290 mi). The chief tributaries are Bain, Banganga, Luni and Uhal. The Sutlej continues into Pakistani Punjab and joins the Chenab River at Uch near Bahawalpur to form the Panjnad River; the latter in turn joins the Indus River at Mithankot. The waters of the Beas and Sutlej rivers are allocated to India under the Indus Waters Treaty between India and Pakistan.

Parvati River

Parvati River is a river in the Parvati Valley in Himachal Pradesh, northern India that flows into the Beas River at Bhuntar, some 10 km south of Kullu. It rises from the Man Talai Glacier below the Pin Parbati pass and flows in a gradual curve from north-northwest to west-southwest past the important temple town of Manikaran.

The river valley has been a route to various places: Lahul across the Sara Umga La pass, Spiti across the famous Pin Parbati pass, and the recently discovered (1995) Debsa Pass. The river has fine first-growth forests in its upper reaches which are being degraded as a consequence of development of its vast hydro-electric potential. There are geothermal springs on the banks of the river at Manikaran and Khirganga.
Parvati River has Pandav Nala, Tosh Nala, Manikaran Nala and Malana Nala as major tributaries on the right side and Kalga Nala, Sar Nalaha, Grahan Nala, Shat Nala and Charraur Nala on the left side.

**Sainj and Tirthan River**

The Sainj valley and the Tirthan valley are two sister valleys in the Kullu region. The route to Sainj is via Kullu and then on to Larji after passing close by Aut. The region is thick with forest as there have not been much of manmade projects unlike what has happened in most other similar regions. Yet, between the Sainj and the Tirthan valleys, the Sainj has suffered somewhat more than the Tirthan due unplanned projects launched for hydroelectric power generation in the Sainj valley and stream. Sainj is some 35 km by road from Kullu. The scenic beauty of the surrounding would sure capture any tourist’s heart while travelling towards their destination. The distinction between the Sainj and the Tirthan, which starts from the same glacier and then ends up at the Beas at the same spot also, after travelling their own separate routes, is the colour of the water. The Sainj River has water that is silty and muddy in appearance while the Tristan has clear and green tinted water flowing in it.

The Sainj River has further smaller tributaries namely Parkachi Thach nala, Shansher Nala, and Seund Nala on the right side and Shangarh Nala on the left bank. Similar the Tirthan River has Ghushaini Nala and Shapnil Nala on the right side and Shoja Nala/Stream, Banjar khad and Manglor Khad on the left side. Apart from these tributaries the Beas River has Solang Nala, Old nala, Fozal Nala, Sarvari Nala and Mohal Khad on the right side and Palchan Nala, Jagat Sukh Nala, and Aleo Nala on the left side.

**Drainage System**

The drainage pattern of river Beas is mostly dendritic to sub dendritic i.e. the tributaries meet at low angles and branch at random, like tree pattern. A dendritic drainage pattern indicates comparatively low permeable rocks which allow high drainage density in the district.

The relation of the drainage density (D) and the runoff (R) can be expressed as:

\[ \text{Percolation} = \frac{1}{D} \times R \]

Which means lower the D (Drainage density) lower will be the runoff (R) and higher will be the percolation and vise-versa.
Further, the dendritic pattern in the Kullu district i.e. in Himalayas System is mainly controlled by the structural influences which further limit the percolation of rain water to groundwater reserve at the structural contacts. Drainage density can affect the shape of a river's hydrograph during a rain storm. Rivers that have a high drainage density will often have a more 'flashy' hydrograph with a steep falling limb. High densities can also indicate a greater flood risk which leads to damage of roads and habitats. In Kullu district the drainage density range from 0.004 to 1.705 KM/KM2. The areas with high drainage density leads flooding in the lower areas and deposit the RBM (River Bourne Material) when the hydrograph limb fall steeply as shown in the image.
Stream Order

The stream order hierarchy was officially proposed in 1952 by Arthur Newell Strahler, a geoscience professor at Columbia University in New York City, in his article “Hypsometric (Area Altitude) Analysis of Erosional Topology.” The article, which appeared in the Geological Society of America Bulletin outlined the order of streams as a way to define the size of perennial (a stream with water its bed continuously throughout the year) and recurring (a stream with water in its bed only part of the year) streams.

When using stream order to classify a stream, the sizes range from a first order stream all the way to the largest, a 12th order stream. A first order stream is the smallest of the world's streams and consists of small tributaries. These are the streams that flow into and "feed" larger streams but do not normally have any water flowing into them. In addition, first and second order streams generally form on steep slopes and flow quickly until they slow down and meet the next order waterway.

First through third order streams are also called headwater streams and constitute any waterways in the upper reaches of the watershed. It is estimated that over 80% of the world’s waterways are these first through third order, or headwater streams.
Going up in size and strength, streams that are classified as fourth through sixth order are medium streams while anything larger (up to 12th order) is considered a river. For example, to compare the relative size of these different streams, the Beas River in the Kullu district is a 7th order stream. The world’s largest river, the Amazon in South America, is considered a 12th order stream.

Unlike the smaller order streams, these medium and large rivers are usually less steep and flow slower. They do however tend to have larger volumes of runoff and debris as it collects in them from the smaller waterways flowing into them.

**Basin Geometry Analysis**

Water basin of River Beas covered an area of 5068 SqKm in Kullu district and drains almost entire Kullu except extreme south. The water basin covers important tourist spots namely Bhunter, Kullu, Manali, Manikaran, Solang and Palchan and encompasses beautiful valleys of rivers Beas, Parvati, Sainj and Tirthan.

The highest point of the water basin is about 6443 meters and lowest point is 899 meters and entire water basin have an asymmetric geometry having average
length (L) along the main stream about 99.18 Km. The breadth (B) of the said area then can be calculate as:

\[ B = \frac{\text{Area}}{L} \]

Hence the breadth is about 51 Km.

The length breadth ratio of the Beas River basin in Kullu district comes out about 1.9 which means higher asymmetry. Further, higher the ratio higher will be the asymmetry.

**Reserve Calculation**

The reserve calculations are based on the following expression:

Total reserve = Volume × Tonnage Factor

Where volume of the deposit approximated by Length, Breadth and height parameters.

**Tonnage Factor**

Tonnage factor is the parameter that directly converts the volume of the mineral to the weight of the mineral. In metric system, the tonnage factor is the specific gravity of the ore and the specific gravity is a function of the mineral composition of the ore. The most accurate method of determination of specific gravity of the ore is to determine the average specific gravity of the individual mineral of the ore provided with the accurate relative percentages.

Relative percentage of minerals in Beas River System in Kullu district is as below

- Granite = 35 %
- Quartzite = 20 %
- Phyllite = 15 %
- Limestone = 7 %
- Dolomite = 10 %
- Slate = 3 %

Therefore, the total specific gravity of the mineral in Kullu district is calculated by

\[
\text{Granite} \quad \Rightarrow \quad 2.7 \times 0.35 = 0.945 \\
\text{Quartzite} \quad \Rightarrow \quad 2.8 \times 0.20 = 0.560
\]
Phyllite => 2.6 × 0.15 = 0.390
Limestone => 2.7 × 0.07 = 0.189
Dolomite => 2.7 × 0.10 = 0.270
Slate => 1.8 × 0.03 = 0.054
Total Specific Gravity = 2.4

The above calculated tonnage factor is not site specific which may vary.

**Annual Replenishment Factor**

Annual replenishment is based on the location of the depositional spot in the river bed, meandering of the river, geology, weathering condition and height of the rainfall in the area. The annual replenishment is determined here by the average of the various heights of deposition per year at a point and taken as 40% of mineral potential, during mining operations at a particular spot. Further, it is also noticed that the annual replacement factor cannot be fixed in such a dynamic Beas River basin which have experienced and experiencing high floods, Cloud bursts and tectonic disturbances.

**11.3. Reserve Deposits**

In Kullu district following numbers of Mineral Deposit Stretches have been observed and discovered in the River Beas water basin (only along River Beas) by a team of Geologists:

- Stretch 1: From Burwa to Vashisht (14 KM)
- Stretch 2: One Kilometer upstream and Downstream from Jagatsukh
- Stretch 3: From Haripur to Kullu (25 KM)
- Stretch 4: From Mohal to Aut (20 KM)

**Miscellaneous deposits**

- I. Shat Nalah deposit
- II. Sapagni deposit
- III. Nagni Village deposit
- IV. Kandugarh Deposit
### Portion of the River or Stream Recommended for Mineral Concession

<table>
<thead>
<tr>
<th>Portion of the River or Stream Recommended for Mineral Concession</th>
<th>Length of the Area Recommended for Mineral Concession (M)</th>
<th>Average width of the Area Recommended for mineral Concession (M)</th>
<th>Area recommended for mineral Concession (Sq M)</th>
<th>Minable Mineral Potential (MT)(60% of total Mineral Potential)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burwa to Vashist</td>
<td>14000</td>
<td>250</td>
<td>3500000</td>
<td>15120000</td>
</tr>
<tr>
<td>1 KM up and down stream Jagatsukh</td>
<td>2000</td>
<td>150</td>
<td>300000</td>
<td>1296000</td>
</tr>
<tr>
<td>Haripur to Kullu</td>
<td>25000</td>
<td>250</td>
<td>625000</td>
<td>2700000</td>
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<tr>
<td>Mohal to Aut</td>
<td>20000</td>
<td>75</td>
<td>150000</td>
<td>648000</td>
</tr>
<tr>
<td>Shat Nala Deposit</td>
<td>200</td>
<td>30</td>
<td>6000</td>
<td>25920</td>
</tr>
<tr>
<td>Nagni Village Deposit</td>
<td>1125</td>
<td>100</td>
<td>112500</td>
<td>48600</td>
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<tr>
<td>Spanagni Deposit</td>
<td>58</td>
<td>40</td>
<td>2320</td>
<td>10022</td>
</tr>
<tr>
<td>Kandugarh Deposit</td>
<td>1200</td>
<td>40</td>
<td>48000</td>
<td>207360</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>50625302</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 11.3.1. Stretch 1: From Burwa to Vashisht (14 KM)

This mineral stretch encompasses maximum length of 14 kilometers from Burwa to Vashisht. The total deposition in this length is by the weathering and flood erosion of glaciated material which is calculated about 15120000 MT. This Stretch covers famous tourist spot named as Solang. The total mineral potential of this stretch is given below in the table:

<table>
<thead>
<tr>
<th>Boulder (MT)</th>
<th>Bajari (MT)</th>
<th>Sand (MT)</th>
<th>Total Mineable Mineral Potential (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6804000</td>
<td>5292000</td>
<td>3024000</td>
<td>15120000</td>
</tr>
</tbody>
</table>

**The Total Annual Deposition**

| 2721600 | 2116800 | 1209600 | 6048000 |

Keeping in view the various mining constrains, following are the prominent areas found suitable for mineral concession in this stretch.

**A. Beas Kund Nala Deposit**
The mining spot has a volume of river borne material of about 500000 cubic meters with an approximate reserve of about 1440000 metric tons per annum; however, approach to the extraction point is questionable. The deposited material is flood accumulated and causing hindrance to the river flow. This area is also famous as tourist spot, hence the mining permissions for the extraction depends on the proper measures to keep the tourist spot flourish. The spatial location of the deposit is latitude 32°19'56.88"N and longitude 77° 8'59.26"E.

**B. Palchang Bridge Deposit**

The deposit constitutes accretion of flood eroded material comprised of boulder, cobbles and pebbles of gneisses and granites in sandy silty matrix which is depositing every year and causing instability of
road and private properties by shifting the river flow. In the vicinity of the deposit a small Hydro Electric Project is under running condition and is vulnerable to damages by the huge piles of boulders laid down by the river every year. The approximate volume of the deposit is about 150000 cubic meter with an estimated reserve of 432000 metric tons per annum. The spatial location of the deposit is latitude 32°18'28.86"N and longitude 77°10'32.30"E.

C. Sarai Nala Deposit

Sarai Nala Deposit is also a flood deposit like Palchan Deposit. The approximate volume of the deposit is about 200000 cubic meters with an approximate reserve of 576000 metric tons per annum. There is continuous deposition of boulders every year after the rainy season. The reserve need to be extracted to maintain the river flow gentle. The spatial location of the deposit is latitude 32°18'39.43"N and longitude 77°10'12.63"E. Near to this location a small hydro project is under function. Following picture shows the deposition at above said spot

Figure 4 Sarai Nala Deposit
This deposit having two large patches: one near the Nehru Kund Bridge at latitude 32°16’47.07”N and longitude 77°10’47.52”E and other near GREFF office at latitude 32°16’11.41”N and longitude 77°10’51.13”E. The Nehru Kund Bridge deposit have an estimated volume of 700000 cubic meter with an estimated reserve of 2016000 metric tons per annum while Near GREFF Office deposit have an estimated volume of 472500 cubic meter with an estimated reserve of 11360800 metric tons per annum. Both deposits are flood accredited having a sum of variety of boulders, pebbles and cobbles with sandy matrix.
11.3.2. **STRETCH 2: ONE KILOMETER UPSTREAM AND DOWNSTREAM FROM JAGATSUKH**

Comprising of almost 1 kilometer upstream and downstream from Jagatsukh, this stretch constitutes various braided depositions in the course of river. The tonnage of mineral potential calculated in this stretch is about 1296000 MT.

<table>
<thead>
<tr>
<th>Boulder (MT)</th>
<th>Bajari (MT)</th>
<th>Sand (MT)</th>
<th>Total Mineable Mineral Potential (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>583200</td>
<td>453600</td>
<td>259200</td>
<td>1296000</td>
</tr>
</tbody>
</table>

**The Total Annual Deposition**

<table>
<thead>
<tr>
<th>Boulder (MT)</th>
<th>Bajari (MT)</th>
<th>Sand (MT)</th>
<th>Total Mineable Mineral Potential (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>233280</td>
<td>181440</td>
<td>103680</td>
<td>518400</td>
</tr>
</tbody>
</table>

Keeping in view the various mining constrains, following are the prominent areas found suitable for mineral concession in this stretch.

A. **Chori Bihar Deposit**

This is a braided deposit formed as a result of little sluggishness in the flow of the river. The deposit is located near the Clath area of Manali block at latitude 32°11′55.82″N, longitude 77°11′18.79″E. In the downstream of this deposit about 0.5 KM there is also a small patch of boulders which is good for extraction in coupling with the main deposit. The main deposit has an estimated volume of 187500 cubic meter with an estimated reserve of 540000 metric tons per annum. The deposit is vulnerable to damage the NH-21 if there is no proper systematic and scientific extraction of material from time to time.
11.3.3. **STRETCH 3: FROM HARIPUR TO KULLU (25 KM)**

This stretch comprised of a length of 25 kilometers from Haripur to Kullu and have an estimated reserve of 27000000 MT. In this stretch the deposition is mainly by the flattening and channeling of the river. Hence proper extraction of the material is needed in these areas to prevent further damage to the local infra-structure.

<table>
<thead>
<tr>
<th>Boulder (MT)</th>
<th>Bajari (MT)</th>
<th>Sand (MT)</th>
<th>Total Mineable Mineral Potential (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12150000</td>
<td>9450000</td>
<td>5400000</td>
<td>27000000</td>
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</tbody>
</table>

**The Total Annual Deposition**

<table>
<thead>
<tr>
<th>Boulder (MT)</th>
<th>Bajari (MT)</th>
<th>Sand (MT)</th>
<th>Total (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4860000</td>
<td>3780000</td>
<td>2160000</td>
<td>10800000</td>
</tr>
</tbody>
</table>

Keeping in view the various mining constrains, following are the prominent areas found suitable for mineral concession in this stretch.

**A. Batar deposit**

Batar Deposit mainly constitutes of flood and terrace deposit located near the Tibetan colony at latitude 32.138726 N and longitude 77.157586 E. It has an approximate volume of 525000 cubic meter with an estimated reserve of 1512000 metric tons per annum.

*Figure 6 Batar Deposit*
B. Patlikulh Deposit

Patlikulh deposit is located near Manali at latitude 32.10440 N and longitude 77.1406164 E and comprised of two spots, each having an approximate length of 500 meters and an approximate width of 220 meters. The approximate volume of the deposit is about 337500 cubic meter with an approximate reserve of 972000 metric tons per annum.

C. Mandalgarh Deposit

The deposit is located at latitude 32.074994 N and longitude 77.129165 E and having two patched one on the right-hand side of river flow and other at the center of the river. Madalgarh deposit is comprised of medium to large boulders with loose sand. This deposit has an approximate volume of 50000 cubic meter with an average reserve 144000 cubic meter per annum.

D. Dolu Nala Deposit
This deposit is at the center of the river causing the river to bifurcate leading to toe erosion of the NH-21 at Kataria milestone. It is mainly constituting of medium to large sized boulders of various rock types. The deposit comprised of two patches about 500 and 300 metre in length having an approximate volume of 120000 cubic meters with an estimated reserve of 345600 metric tons per annum.

E. Bandrol Deposit

Deposit is located at latitude 32.032023 N and longitude 77.131331 E and comprised of 3 pockets; one in canter, one at RHS and one at LHS of the river flow. Bandrol deposit has an approximate volume of 375000 cubic meter with an average
reserve of about 1080000 metric tons per annum and comprised of boulders from small to medium size with loose sand.

11.3.4. **STRETCH 4: FROM MOHAL TO AUT (20 KM)**

This stretch comprised of 20-kilometer length from Mohal to Aut. In this stretch, most of the deposits around Kullu district near Aut area are found submersed in the water of Largi Dam, however, sand which can be extracted after de-siltation. Total reserve estimated in this stretch is about 6480000 MT.

<table>
<thead>
<tr>
<th>Boulder (MT)</th>
<th>Bajari (MT)</th>
<th>Sand (MT)</th>
<th>Total Mineable Mineral Potential (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2916000</td>
<td>2268000</td>
<td>1296000</td>
<td>6480000</td>
</tr>
</tbody>
</table>

**The Total Annual Deposition**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1166400</td>
<td>907200</td>
<td>518400</td>
<td>2592000</td>
</tr>
</tbody>
</table>

Keeping in view the various mining constrains, following are the prominent areas found suitable for mineral concession in this stretch.

**A. Jia Deposit**
The Jia Deposit is discovered near Bhunter on the left bank of the river at latitude 31°54'21.40"N and longitude 77° 9'8.68"E. This deposit has an approximate volume of 5000 cubic meter and an estimated reserve of 14400 metric tons per annum. The main constitution of the deposit is boulders and pebbles. This spot is repeatedly noticed vulnerable for illegal mining activities, though a good deposit of river born material and more estimated reserve can be replenished every year if the banks are protected and check dams are constructed in the appropriate locations at the site.

B. Bhunter Deposit

The deposit is located on the left side of Bhunter Airport at latitude 31°52'44.98"N and longitude 77° 9'20.84"E, in the middle of river Beas. It is a big pocket of large to medium boulders with sandy and silty matrix. The deposition is causing shifting of river channel towards the left bank and the consequences are toe erosion on the bank. The approximate volume of deposit is 43750 cubic meter having an approximate reserve of 126000 metric tons per annum.
C. Jarad Deposit

The deposit is discovered near Bhunter at latitude 31°51'29.66"N and longitude 77° 9'59.91"E, having a volume of 12000 cubic meter and an approximate reserve of 34560 metric tons per annum. There are two pockets of river borne material located adjacent to each other. The area is private as well as forest land and having an IPH scheme in the vicinity.

11.3.5. Other Deposits

A. Shat Nala Deposit
Shat Nalaha Deposit is located near the Shat Village up to the confluence of nala with the river at latitude 31°58'18.83"N and longitude 77°13'7.92"E. The river borne material is deposited in small pockets along both banks comprising mainly boulders and pebbles. The approximate volume of the deposit is about 6000 cubic meter having an estimated reserve of 17280 metric tons per annum.

**Figure 11 Shat Nala Deposit**

B. **Sapangni Deposit**

Deposit is located at latitude 31°45.556 N and longitude 77° 15.501 E on the left side of the river Sainj river and comprised of small to medium bounders with loose sand. It has an approximate volume of 2250 cubic meter with an average reserve of 66816 metric tons per annum. This area is also applied by the lessee for extraction of mineral.

C. **Kandugarh Deposit**
Deposit is located at latitude 31.487512 N and longitude 77.412255 E and mainly comprised of pebbles, boulders of phyllite, schist and quartzite. On the left bank of the river a water flour mill is operational. The area can be approached from the left bank.

![Kandugarh Deposit](image)

Figure 12 Kandugarh Deposit

11.3.6. **Terrace Deposit**

At the border of Kullu and Shimla district along the river Sutlej, terrace deposits has been found. This deposit has been laid down by the river during geological past floods and presently represents huge pile of boulders, pebbles and sands. Since the Sutlej is a major river in Himachal Pradesh, extraction of minor minerals along and on the river bed need to be proper scientific and systematic monitoring so as to prevent hazards in future.
Considering all these observed mining spots and dynamics of River Beas Basin the total reserves calculations largely depends on the geomorphology, lithology, sediment load of rivers and slope of the area. The total length of drainage in Kullu district (Beas River Basin) is about 970 km and slope of the terrain varies from nearly flat area i.e. 0° around river beds to steep slopes i.e. 80° around the high hills and geo-morphologically the district comprised of river terraces, highly dissected hills.
and piedmont zones. Lithologically the area comprised of quartzite, phyllites, granite, dolomite, slate and shales. Total reserve for the entire length of rivers in the basin can be approximated as 50 million tons.

12. **Conclusion and Recommendations**

   The part of river/stream beds recommended for grant of mineral concessions in this report are based on reconnaissance survey conducted for whole of district Kullu however before grant of any mineral concession in a particular river/stream bed, the guidelines contained in River/Stream bed mining policy 2015 has to be followed in addition to site specific conditions as specified by the Joint Inspection Committee and recommendation thereof. In the Policy Guidelines, following general conditions are mentioned.

1. No River/Stream bed mining shall be allowed without the recommendations of the Sub-Divisional Level Committee.
2. No River/Stream bed mining shall be allowed without getting clearance under Forest Conservation Act, 1980 if the area attracts the provisions of FCA. 1980.
3. No River/Stream bed mining shall be allowed within 75 meters from the periphery of soil conservation works, nursery plantation, and check dams or within the distance as recommended by the Sub-Divisional Committee, whichever is more.
4. No River/Stream bed mining shall be allowed within 1/5th of its span or 5 meters from the bank or as specified by the Sub-Divisional Committee which ever more is.
5. No River/Stream bed mining shall be allowed within 200 meters U/S and D/S of Water Supply Scheme or the distance as specified by the Sub-Divisional Committee whichever is more.
6. No River/Stream bed mining shall be allowed within 200 meters U/S and 200 to 500 mts D/S of bridges depending upon the site-specific conditions.
7. No approach road from PWD road shall be allowed to River/Stream beds mining, unless lessee/contractor obtains written permission from Executive Engineer PWD for making road leading to all intake places from the PWD Roads.
8. No mechanical mining through mechanical excavator including any other earth moving machines like JCB, Bouldozer, Pocklain, Loders etc shall be carried out in river or stream Bed by the lease holder or permit holder or contractor as the case may be.

9. No boulder/cobbles/hand broken road ballast shall be allowed to be transported outside the State from River/Stream beds, so as to reduce pressure on the River/Stream beds.

10. No digging of more than 3 feet shall be allowed in River/Stream beds.

11. Every leaseholder shall supply in advance, the Registration Nos of vehicle engaged in transportation of mineral from mining area to his industrial unit. This would ensure checking of illegal vehicles carrying minerals.

12. Every lessee/contractor shall ensure that his labour/s does not involve in fish poaching.

13. No blasting shall be allowed in river/stream beds.

GENERAL RECOMMENDATIONS/CONCLUSIONS

During the preparation of the present report only 5 No’s of rivers/ streams has been studied in detail, as the rest of the streams/rivers either have very insignificant annual replenishment/ approachability problem or are very narrow at most of the places and as such are not fit for grant of mineral concession for mineral based industries, however it is also important to mention here that because of the regular demand of sand, stone and bajri for the developmental activities in the respective areas, such streams are prone to illegal mining, as such if any person/party applies for grant of mining lease. The same may be granted to meet out the local demands, or any exigency subject to the approval from the joint Inspection Committee subject to the further study of the particular area as per the notification dated 15/01/2016 of Ministry of Environment, Forest and Climate Change. These mineral concessions shall also reduce demand load and will be helpful to minimize illegal extraction of minerals, failure of which may result in to illegal mining at odd hours and shall be haphazard and more detrimental to the local ecology.
Irrespective of following geo-scientific considerations, it is also suggested that steps to be taken into account during the river bed mining in a particular area:

1. Abandoned stream channels or terrace and inactive floodplains may be preferred rather than active channels and their deltas and floodplains.
2. Stream should not be diverted to form inactive channel.
3. Mining below subterranean water level should be avoided as a safeguard against environmental contamination and over exploitation of resources.
4. Large rivers and streams whose periodic sediment replenishment capacities are larger, may be preferred than smaller rivers.
5. Segments of braided river system should be used preferably falling within the lateral migration area of the river regime that enhances the feasibility of sediment replenishment.
6. Mining at the concave side of the river channel should be avoided to prevent bank erosion. Similarly, meandering segment of a river should be selected for mining in such a way as to avoid natural eroding banks and to promote mining on naturally building (aggrading) meander components.
7. Continued riverbed material mining in a given segment of the river will induce seasonal scouring and intensify the erosion activity within the channel. This will have an adverse effect not only within the mining area but also both in upstream and downstream of the river course. Hazardous effects of such scouring and enhanced erosion due to riverbed mining should be evaluated periodically and avoided for sustainable mining activities.
8. Mining Lease (ML) areas should be demarcated on the ground with Pucca pillars so as to avoid illegal unscientific mining.
9. The auction shall be done as per the recommendation /approval of the Sub-Divisional Level Committee.