

FIGURE – 4.5 : EARTHQUAKE ACTIVE FAULT ZONE IN ISLAMABAD

#### **4.3.4 Seismology**

Horizontal and vertical seismic forces transmitted to the support structures by the ground during earthquake may cause extremely high mechanical stress to engineering structures as well as roads, seismic adaptation which is primarily related to the appropriate design of support structures and connections between the units.

The project area is located in Seismic Zone 2B, where 2B represents peak horizontal ground acceleration from 0.16 to 0.24g. Figure – 4.6 shows the Seismic Zoning Map indicating that project area is falling under Seismic Zone–2B.

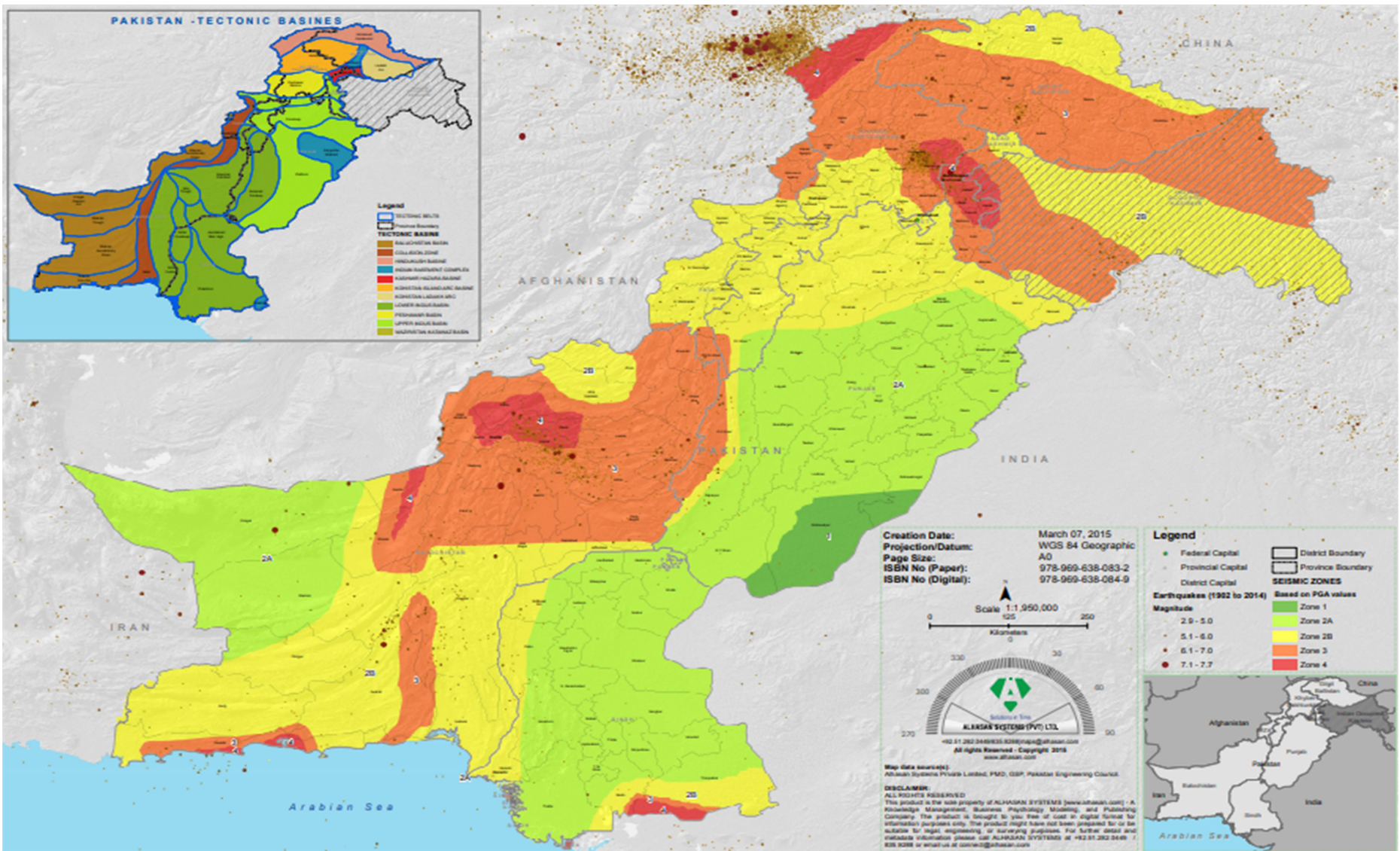


FIGURE – 4.6 : SEISMIC ZONING MAP OF PUNJAB

### 4.3.5 Climate

Climate of Islamabad is divided in two sub-categories as follows. Winter season fall in from October to March and Summer duration remains from April to September. Weather of Islamabad tends to change over several factors such as western disturbance, fog, dust storm, south west monsoon and continental storm.

Summarizes month-wise temperature, precipitation, and relative humidity of Islamabad is given in Table – 4.2.

**TABLE – 4.2 : MONTH-WISE TEMPERATURE, PRECIPITATION AND RELATIVE HUMIDITY**

Month	Mean Temperature		Precipitation (mm)	Relative Humidity (%)
	Maximum	Minimum		
January	17.6	2.6	56.0	63.5
February	19.1	5.1	73.5	61.8
March	23.9	9.9	89.8	56.6
April	30.1	15.0	61.8	40.1
May	35.3	19.7	39.2	34.1
June	38.6	23.7	62.2	36.0
July	35.0	24.3	267.0	60.7
August	33.4	23.5	309.9	70.3
September	33.5	20.6	98.2	61.3
October	30.9	13.9	29.3	54.9
November	25.4	7.5	17.8	59.6
December	19.7	3.4	37.3	65.0
<b>Annual</b>	<b>28.6</b>	<b>14.1</b>	<b>1142.1</b>	<b>55.8</b>

Six months' weather data of project site Bara – Kahu is given below in Figure – 4.7.

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
9/29 29°/20° Hist. Avg. 31°/17°	9/30 32°/21° Hist. Avg. 31°/17°	10/1 28°/17° Hist. Avg. 31°/17°	10/2 30°/19° Hist. Avg. 31°/16°	10/3 26°/18° Hist. Avg. 31°/16°	10/4 29°/18° Hist. Avg. 31°/16°	10/5 30°/18° Hist. Avg. 31°/16°	10/27 30°/14° Hist. Avg. 28°/11°	10/28 30°/14° Hist. Avg. 28°/11°	10/29 30°/14° Hist. Avg. 28°/10°	10/30 30°/16° Hist. Avg. 27°/10°	10/31 30°/16° Hist. Avg. 27°/10°	11/1 25°/13° Hist. Avg. 27°/10°	11/2 27°/17° Hist. Avg. 27°/10°
10/6 26°/18° Hist. Avg. 30°/15°	10/7 30°/20° Hist. Avg. 30°/15°	10/8 32°/16° Hist. Avg. 30°/15°	10/9 31°/18° Hist. Avg. 30°/15°	10/10 31°/18° Hist. Avg. 30°/14°	10/11 31°/19° Hist. Avg. 30°/14°	10/12 31°/18° Hist. Avg. 30°/14°	11/3 28°/16° Hist. Avg. 27°/10°	11/4 28°/15° Hist. Avg. 26°/9°	11/5 28°/13° Hist. Avg. 26°/9°	11/6 20°/14° Hist. Avg. 26°/9°	11/7 18°/13° Hist. Avg. 26°/9°	11/8 22°/12° Hist. Avg. 26°/9°	11/9 25°/11° Hist. Avg. 26°/8°
10/13 32°/21° Hist. Avg. 30°/14°	10/14 32°/20° Hist. Avg. 30°/14°	10/15 32°/20° Hist. Avg. 29°/13°	10/16 32°/20° Hist. Avg. 29°/13°	10/17 31°/18° Hist. Avg. 29°/13°	10/18 27°/16° Hist. Avg. 29°/12°	10/19 26°/18° Hist. Avg. 29°/12°	11/10 27°/11° Hist. Avg. 25°/8°	11/11 25°/14° Hist. Avg. 26°/8°	11/12 20°/12° Hist. Avg. 25°/8°	11/13 23°/14° Hist. Avg. 25°/8°	11/14 24°/15° Hist. Avg. 25°/8°	11/15 22°/14° Hist. Avg. 25°/8°	11/16 20°/14° Hist. Avg. 25°/8°
10/20 28°/14° Hist. Avg. 29°/12°	10/21 29°/14° Hist. Avg. 29°/12°	10/22 29°/14° Hist. Avg. 29°/12°	10/23 29°/16° Hist. Avg. 28°/12°	10/24 31°/14° Hist. Avg. 28°/11°	10/25 29°/14° Hist. Avg. 28°/11°	10/26 29°/14° Hist. Avg. 28°/11°	11/17 24°/11° Hist. Avg. 24°/7°	11/18 24°/10° Hist. Avg. 24°/7°	11/19 23°/9° Hist. Avg. 24°/7°	11/20 21°/12° Hist. Avg. 24°/7°	11/21 18°/12° Hist. Avg. 24°/7°	11/22 18°/14° Hist. Avg. 24°/7°	11/23 21°/11° Hist. Avg. 23°/7°
10/27 30°/14° Hist. Avg. 28°/11°	10/28 30°/14° Hist. Avg. 28°/11°	10/29 30°/14° Hist. Avg. 27°/10°	10/30 30°/16° Hist. Avg. 27°/10°	10/31 30°/16° Hist. Avg. 27°/10°	11/1 25°/13° Hist. Avg. 27°/10°	11/2 27°/17° Hist. Avg. 27°/10°	11/24 22°/12° Hist. Avg. 23°/7°	11/25 23°/12° Hist. Avg. 23°/6°	11/26 20°/11° Hist. Avg. 23°/6°	11/27 18°/11° Hist. Avg. 22°/6°	11/28 20°/8° Hist. Avg. 22°/6°	11/29 20°/8° Hist. Avg. 22°/6°	11/30 21°/7° Hist. Avg. 22°/6°

October 2019

November 2019

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
12/1 22 <sup>o</sup> 7 <sup>a</sup> Hiat. Avg. 22 <sup>o</sup> 6 <sup>a</sup>	12/2 22 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 22 <sup>o</sup> 6 <sup>a</sup>	12/3 21 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 21 <sup>o</sup> 6 <sup>a</sup>	12/4 23 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 21 <sup>o</sup> 6 <sup>a</sup>	12/5 22 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 21 <sup>o</sup> 6 <sup>a</sup>	12/6 22 <sup>o</sup> 7 <sup>a</sup> Hiat. Avg. 21 <sup>o</sup> 6 <sup>a</sup>	12/7 23 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 21 <sup>o</sup> 6 <sup>a</sup>	12/29 13 <sup>o</sup> 2 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	12/30 16 <sup>o</sup> 2 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	12/31 16 <sup>o</sup> 3 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	1 24 <sup>o</sup> 3 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	2 17 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	3 15 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	4 17 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>
12/8 22 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 20 <sup>o</sup> 5 <sup>a</sup>	12/9 18 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 20 <sup>o</sup> 5 <sup>a</sup>	12/10 19 <sup>o</sup> 7 <sup>a</sup> Hiat. Avg. 20 <sup>o</sup> 5 <sup>a</sup>	12/11 20 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 20 <sup>o</sup> 5 <sup>a</sup>	12/12 14 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 20 <sup>o</sup> 5 <sup>a</sup>	12/13 13 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 20 <sup>o</sup> 5 <sup>a</sup>	12/14 13 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 20 <sup>o</sup> 5 <sup>a</sup>	5 12 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	6 10 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	7 11 <sup>o</sup> 7 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	8 8 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	9 16 <sup>o</sup> 2 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	10 17 <sup>o</sup> 3 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	11 13 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>
12/15 18 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 19 <sup>o</sup> 5 <sup>a</sup>	12/16 19 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 19 <sup>o</sup> 5 <sup>a</sup>	12/17 20 <sup>o</sup> 3 <sup>a</sup> Hiat. Avg. 19 <sup>o</sup> 5 <sup>a</sup>	12/18 15 <sup>o</sup> 2 <sup>a</sup> Hiat. Avg. 19 <sup>o</sup> 5 <sup>a</sup>	12/19 14 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 19 <sup>o</sup> 5 <sup>a</sup>	12/20 16 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 19 <sup>o</sup> 5 <sup>a</sup>	12/21 18 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 19 <sup>o</sup> 5 <sup>a</sup>	12 14 <sup>o</sup> 7 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	13 10 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	14 14 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	15 15 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	16 19 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	17 18 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	18 17 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>
12/22 22 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 19 <sup>o</sup> 5 <sup>a</sup>	12/23 20 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	12/24 16 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	12/25 17 <sup>o</sup> 1 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	12/26 14 <sup>o</sup> 3 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	12/27 13 <sup>o</sup> 2 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	12/28 9 <sup>o</sup> 2 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	19 16 <sup>o</sup> 3 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	20 17 <sup>o</sup> 7 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	21 11 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	22 30 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	23 18 <sup>o</sup> 3 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	24 19 <sup>o</sup> 3 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	25 16 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>
12/29 13 <sup>o</sup> 2 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	12/30 16 <sup>o</sup> 2 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	12/31 16 <sup>o</sup> 3 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	1/1 24 <sup>o</sup> 3 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	1/2 17 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	1/3 15 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	1/4 17 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 4 <sup>a</sup>	26 21 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	27 18 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	28 11 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	29 12 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	30 17 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	31 18 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	2/1 19 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>

December 2019

January 2020

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
1/25 21 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	1/27 18 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	1/28 11 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	1/29 12 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	1/30 17 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	1/31 18 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	1 19 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	1 23 <sup>o</sup> 10 <sup>a</sup> Hiat. Avg. 20 <sup>o</sup> 8 <sup>a</sup>	2 24 <sup>o</sup> 10 <sup>a</sup> Hiat. Avg. 20 <sup>o</sup> 8 <sup>a</sup>	3 25 <sup>o</sup> 11 <sup>a</sup> Hiat. Avg. 20 <sup>o</sup> 8 <sup>a</sup>	4 22 <sup>o</sup> 12 <sup>a</sup> Hiat. Avg. 20 <sup>o</sup> 8 <sup>a</sup>	5 14 <sup>o</sup> 12 <sup>a</sup> Hiat. Avg. 21 <sup>o</sup> 8 <sup>a</sup>	6 15 <sup>o</sup> 11 <sup>a</sup> Hiat. Avg. 21 <sup>o</sup> 8 <sup>a</sup>	7 14 <sup>o</sup> 10 <sup>a</sup> Hiat. Avg. 21 <sup>o</sup> 8 <sup>a</sup>
2 18 <sup>o</sup> 7 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	3 20 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 17 <sup>o</sup> 4 <sup>a</sup>	4 15 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	5 18 <sup>o</sup> 3 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	6 17 <sup>o</sup> 3 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	7 18 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	8 20 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	8 15 <sup>o</sup> 10 <sup>a</sup> Hiat. Avg. 21 <sup>o</sup> 9 <sup>a</sup>	9 21 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 21 <sup>o</sup> 9 <sup>a</sup>	10 23 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 21 <sup>o</sup> 9 <sup>a</sup>	11 23 <sup>o</sup> 10 <sup>a</sup> Hiat. Avg. 22 <sup>o</sup> 9 <sup>a</sup>	12 20 <sup>o</sup> 12 <sup>a</sup> Hiat. Avg. 22 <sup>o</sup> 10 <sup>a</sup>	13 20 <sup>o</sup> 10 <sup>a</sup> Hiat. Avg. 22 <sup>o</sup> 10 <sup>a</sup>	14 22 <sup>o</sup> 11 <sup>a</sup> Hiat. Avg. 22 <sup>o</sup> 10 <sup>a</sup>
9 20 <sup>o</sup> 4 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	10 22 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	11 19 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	12 19 <sup>o</sup> 12 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	13 22 <sup>o</sup> 11 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	14 23 <sup>o</sup> 12 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	15 23 <sup>o</sup> 10 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 5 <sup>a</sup>	15 24 <sup>o</sup> 11 <sup>a</sup> Hiat. Avg. 22 <sup>o</sup> 10 <sup>a</sup>	16 25 <sup>o</sup> 11 <sup>a</sup> Hiat. Avg. 22 <sup>o</sup> 10 <sup>a</sup>	17 27 <sup>o</sup> 12 <sup>a</sup> Hiat. Avg. 23 <sup>o</sup> 10 <sup>a</sup>	18 27 <sup>o</sup> 14 <sup>a</sup> Hiat. Avg. 23 <sup>o</sup> 10 <sup>a</sup>	19 28 <sup>o</sup> 13 <sup>a</sup> Hiat. Avg. 23 <sup>o</sup> 11 <sup>a</sup>	20 27 <sup>o</sup> 14 <sup>a</sup> Hiat. Avg. 23 <sup>o</sup> 11 <sup>a</sup>	21 24 <sup>o</sup> 15 <sup>a</sup> Hiat. Avg. 23 <sup>o</sup> 11 <sup>a</sup>
16 24 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 18 <sup>o</sup> 6 <sup>a</sup>	17 25 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 19 <sup>o</sup> 6 <sup>a</sup>	18 27 <sup>o</sup> 7 <sup>a</sup> Hiat. Avg. 19 <sup>o</sup> 6 <sup>a</sup>	19 21 <sup>o</sup> 11 <sup>a</sup> Hiat. Avg. 19 <sup>o</sup> 6 <sup>a</sup>	20 18 <sup>o</sup> 11 <sup>a</sup> Hiat. Avg. 19 <sup>o</sup> 6 <sup>a</sup>	21 22 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 19 <sup>o</sup> 6 <sup>a</sup>	22 22 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 19 <sup>o</sup> 6 <sup>a</sup>	22 26 <sup>o</sup> 12 <sup>a</sup> Hiat. Avg. 24 <sup>o</sup> 11 <sup>a</sup>	23 26 <sup>o</sup> 15 <sup>a</sup> Hiat. Avg. 24 <sup>o</sup> 11 <sup>a</sup>	24 20 <sup>o</sup> 15 <sup>a</sup> Hiat. Avg. 24 <sup>o</sup> 12 <sup>a</sup>	25 24 <sup>o</sup> 15 <sup>a</sup> Hiat. Avg. 24 <sup>o</sup> 12 <sup>a</sup>	26 25 <sup>o</sup> 15 <sup>a</sup> Hiat. Avg. 24 <sup>o</sup> 12 <sup>a</sup>	27 18 <sup>o</sup> 13 <sup>a</sup> Hiat. Avg. 25 <sup>o</sup> 12 <sup>a</sup>	28 21 <sup>o</sup> 13 <sup>a</sup> Hiat. Avg. 25 <sup>o</sup> 12 <sup>a</sup>
23 25 <sup>o</sup> 5 <sup>a</sup> Hiat. Avg. 19 <sup>o</sup> 7 <sup>a</sup>	24 25 <sup>o</sup> 10 <sup>a</sup> Hiat. Avg. 19 <sup>o</sup> 7 <sup>a</sup>	25 25 <sup>o</sup> 10 <sup>a</sup> Hiat. Avg. 20 <sup>o</sup> 7 <sup>a</sup>	26 26 <sup>o</sup> 10 <sup>a</sup> Hiat. Avg. 20 <sup>o</sup> 7 <sup>a</sup>	27 26 <sup>o</sup> 11 <sup>a</sup> Hiat. Avg. 20 <sup>o</sup> 7 <sup>a</sup>	28 18 <sup>o</sup> 13 <sup>a</sup> Hiat. Avg. 20 <sup>o</sup> 8 <sup>a</sup>	29 16 <sup>o</sup> 10 <sup>a</sup> Hiat. Avg. 20 <sup>o</sup> 8 <sup>a</sup>	29 25 <sup>o</sup> 12 <sup>a</sup> Hiat. Avg. 23 <sup>o</sup> 12 <sup>a</sup>	30 22 <sup>o</sup> 14 <sup>a</sup> Hiat. Avg. 23 <sup>o</sup> 12 <sup>a</sup>	31 22 <sup>o</sup> 15 <sup>a</sup> Hiat. Avg. 23 <sup>o</sup> 12 <sup>a</sup>	1/1 24 <sup>o</sup> 14 <sup>a</sup> Hiat. Avg. 23 <sup>o</sup> 12 <sup>a</sup>	2/1 23 <sup>o</sup> 12 <sup>a</sup> Hiat. Avg. 23 <sup>o</sup> 12 <sup>a</sup>	2/2 28 <sup>o</sup> 12 <sup>a</sup> Hiat. Avg. 24 <sup>o</sup> 13 <sup>a</sup>	2/3 29 <sup>o</sup> 15 <sup>a</sup> Hiat. Avg. 24 <sup>o</sup> 13 <sup>a</sup>

February 2020

November 2019

FIGURE – 4.7 : SIX MONTH TEMPERATURE OF BARA KAHU

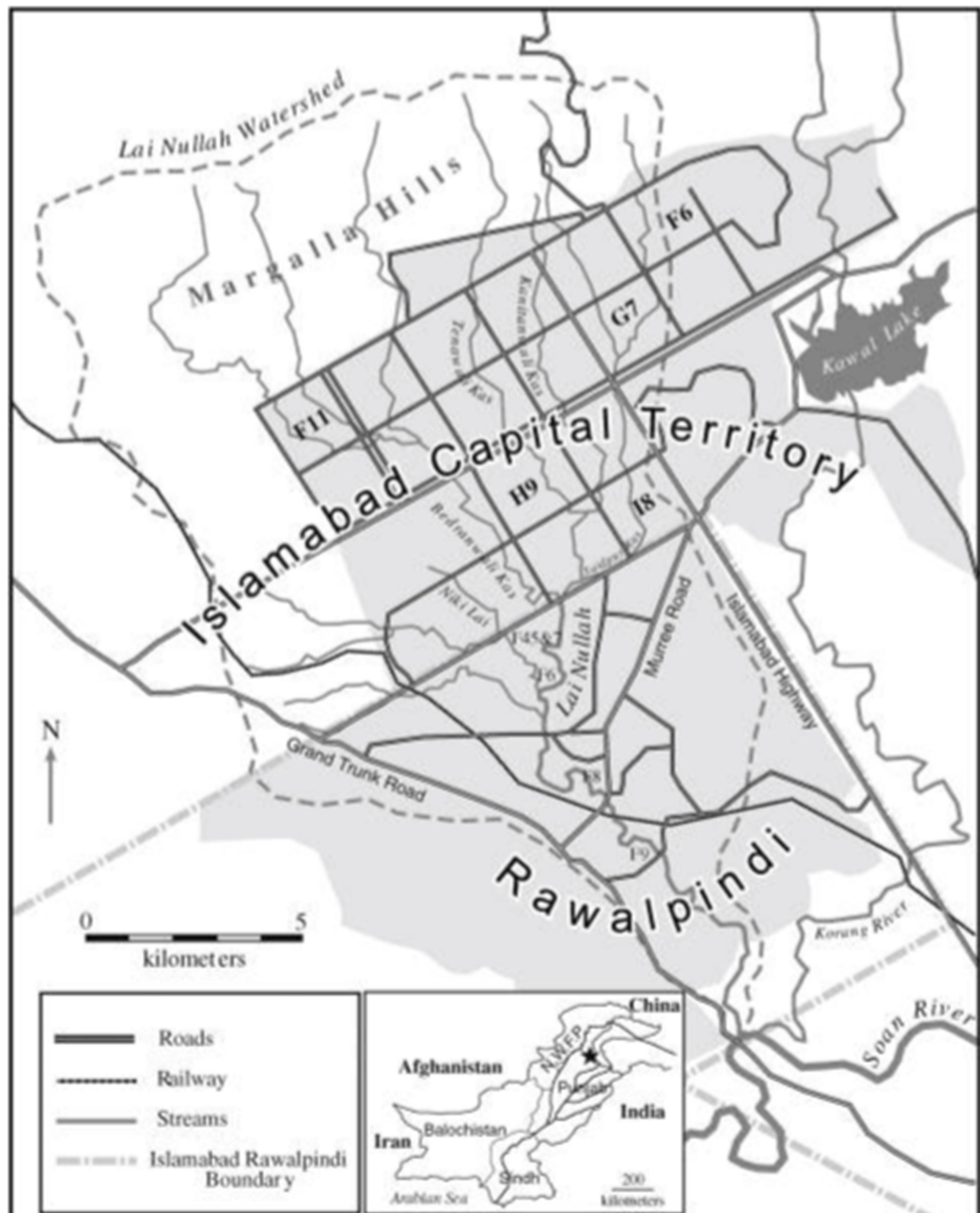
### 4.3.6 Hydrology and Drainage

Nullah Lai starts from Margalla hills in Islamabad. There are several tributaries of Nullah Lai, three major tributaries (Saidpur Kas, Tenawali Kas, and Bedarawali Kas) in the administrative jurisdiction of Islamabad. These tributaries originate from the Margalla Hills and fall into the Nullah Lai just upstream from Katarian Bridge on I.J. Principal Road, which is also the administrative boundary between Islamabad and Rawalpindi cities.

Nullah Lai basin drains a total area of 235 Km<sup>2</sup> South of Margalla Hills, with 70% of the watershed falling within the territory of Islamabad and the remaining 30% within the downstream Rawalpindi municipal and cantonment limits. Figure – 4.8 describes the

Nullah Lai watershed in Rawalpindi–Islamabad conurbation. Stretching from the Margalla hills in the federal capital Islamabad at north–western edge until the Soan River at south– eastern edge in the District Rawalpindi the maximum length of the Lai Nullah does not exceed 45 km.

The Korang River enters into the district near Chattar Park and joins the Soan River near model village Humak. There is a famous lake and dam with a spillway known as Rawal Lake and Rawal Dam respectively, built at this river providing portable water to Rawalpindi city. Gumareh Kas stream originates from Murree hills at the district boundary near village that joins river Soan after passing through.



**FIGURE – 4.8 : LAI NULLAH WATERSHED IN RAWALPINDI – ISLAMABAD CONURBATION**

Mian Nullah's Crossing Project Site :

- (i) Single span bridge at km 6+800 near Dhok Jillani bus stop
- (ii) Five span bridge at km 7+300 near Kernal Amanullah Road (Mangu Town)
- (iii) Single Span bridge at Km 9+100 near Bhaira Pul Bus Stop

Figure – 4.9 shows the Nullah Bridge near Jillani Town located in project site.



**FIGURE – 4.9 : NULLAH BRIDGE NEAR JILLANI TOWN**

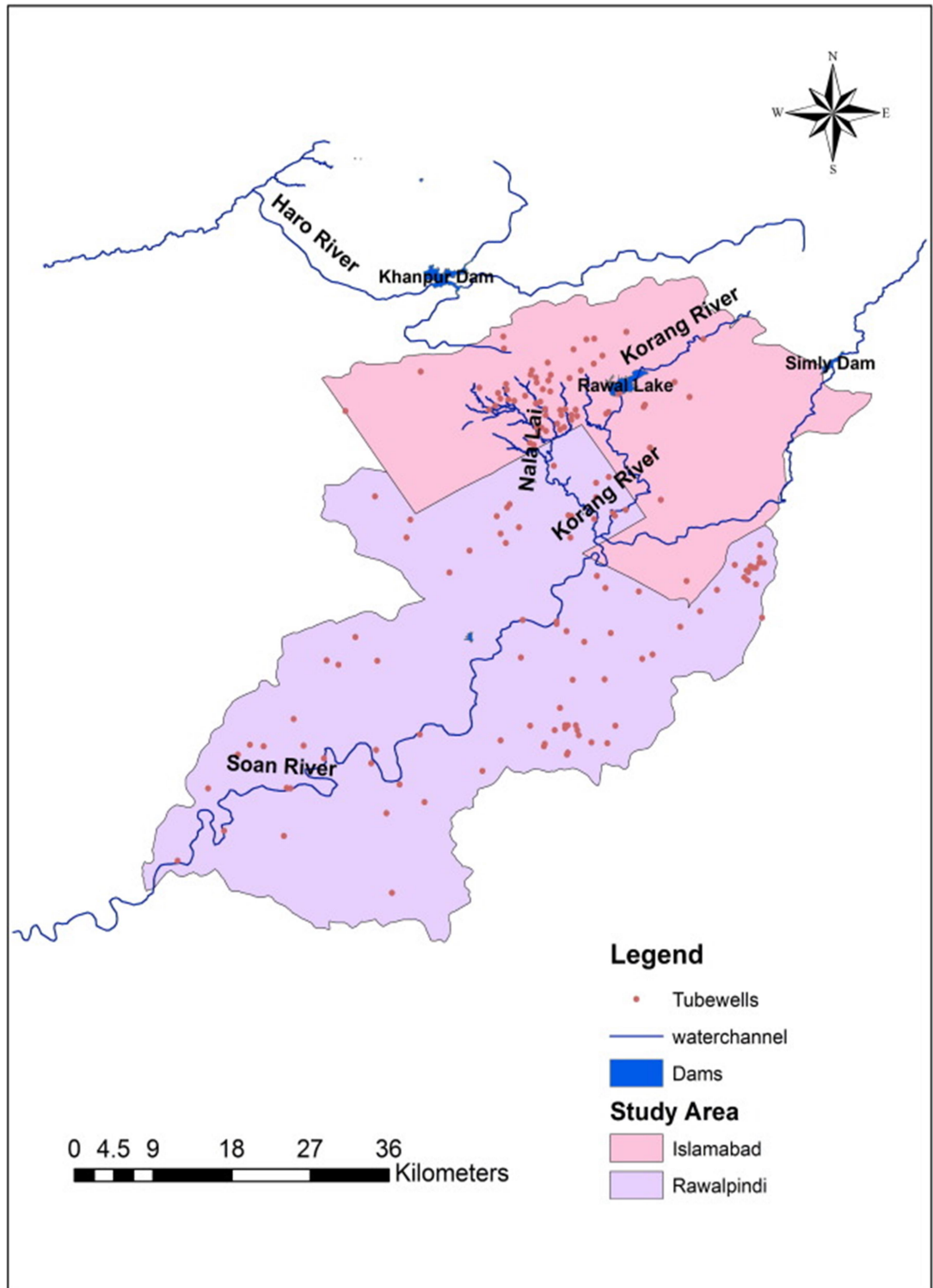
#### **4.3.7 Surface Water Quality**

The main surface water source in the project area is the Nullah Lai. Nullah Lai originating from the Margalla hills in Islamabad passes through the city of Rawalpindi and flows into the River Soan. The Soan takes its rise from within a few kilometers of Murree Hill station; it flows down the deep valley and passes close to Rawalpindi city and finally joins the Indus 16 km below Makhad. The Nullah Lai has a number of tributaries carrying storm-water flows and the wastewater from the residential, commercial and industrial establishments. The summer rains begin in about second week of July and end about in the beginning of September. This Nullah is also used for disposal of solid waste, which not only contaminates water but also hinders its smooth flow.

#### **4.3.8 Groundwater Quality**

The municipal water supply is the main source of water supply in the project area. Depth of groundwater table ranges from 40 to 60 meters. For establishing baseline conditions, groundwater samples were collected. Samples were analyzed in the laboratory for microbiological and chemical parameters.

Water resource vulnerability of Islamabad is shown in Figure – 4.10 below :



**FIGURE – 4.10 : WATER RESOURCE VULNERABILITY**

#### **4.4 ECOLOGICAL ENVIRONMENT**

As climate of Islamabad is humid sub-tropical climate, the vegetation of the area falls under scrub, dry, tropical thorn forest type as per phyto-geographical classification of the area.



#### 4.4.1 Flora

Flora of the tract consists of low forests of branchy trees forming a canopy, varying in density from complete closure under the most favorable conditions to scattered single trees or groups on the drier sites. The trees and shrubs are mostly and often with thorny small evergreen leaves, but some like olive and pomegranate are without thorns and have leaves of moderate size though with xerophytic features. Chir pine trees are also found on higher altitudes on the northern slopes of Margalla Hills.

Vegetation of Islamabad has been described as subtropical, dry, broad leaved forests as per categorization of forest types by Mr. Mahmood Iqbal Shaikh. (Forests and Forestry in Pakistan, 1997).

As the area is part of Pothohar Plateau, the vegetation is characteristic of the tract. **Kau** (*Olea cuspidate*) is the climax species. It grows almost in pure form on northern slopes and in cool and sheltered situations on the southern slopes.

Elsewhere **Phulahi** (*Acacia modesta*) dominates. **Sanatha** (*Deodonia viscosa*), **Granda** (*Carissa spinatum*) and **Pataki** (*Gymnospora royaleana*) grow as secondary species.

With the shifting of Capital to Islamabad and urbanization of the tract, the majority of original vegetation of the tract was removed and replaced by commercial and residential hubs.

#### 4.4.2 Fauna

Due to the extensive urbanization of the area and construction all around it, wild animals have mostly migrated to the surrounding Margalla hills, but still wildlife such as wild boar, jackals, fox, rats, hare and porcupines are present in the extensive and densely wooded green belts of the two intersecting road i.e. Kashmir Highway and Islamabad Highway. Wild boars sometimes even come on the roads during the night and get killed by the fast moving traffic on these roads.

Margalla hills, which surround the Study Area on the northern, western and eastern sides, are within 10 km radius of the Project Area but are outside of Study Area. These are the abode of several species of wildlife including monkeys, exotic birds and carnivorous such as rare and presently endangered Margalla Leopards.

Commonly found animals in Margalla hills include Rhesus monkeys, Jackals, Wild boars, porcupine and mongoose.

Wild boars generally stay, close to hills, occasionally particularly in winter, when the hills are cold, they can be seen quite far from Margalla hills. Often the boars will have small hideouts in the green belts in and around the city.

### 4.5 SOCIO-ECONOMIC ENVIRONMENT

This section deals with the social conditions of the Project Area. During the desk / office study, available reports / documents were comprehensively studied. During the field

survey interviews with the shopkeepers, students, pedestrians, Advocates, staff of NHA, EOAB, Police and educational institute, drivers (taxi, rickshaw, wagon etc.), were held and observations were also recorded after giving due consideration during survey.

#### **4.5.1 Demography**

Population: Islamabad capital territory consists of population over 2 million. according to the search findings the density is 2,207 persons / Sq. KM.

##### **4.5.1.1 Religion**

The population of district is predominantly Muslims i.e. 95.5 per cent. The next higher percentage is of Christian with 4.1 points, followed by Ahmadi 3 per cent. While other minorities like Hindu (jati), Scheduled castes etc. are very small in number. The proportion of Muslims is higher in rural areas (98.8 per cent), as compared to their counterparts in urban (93.8 per cent). Christians are mostly living in urban areas representing 5.7 per cent as compared to just 0.9 per cent in rural areas. Similarly, Ahmadis are more in urban area as compared to their proportion in rural areas.

##### **4.5.1.2 Ethnic Structure**

For the study of ethnography Islamabad can be divided into two parts i.e. urban and rural. In Islamabad city people belonging to almost all possible races and tribes of Pakistan are living. Regarding people living in rural area, they are mostly Rajput. The important sub-division are Bhatti, Rawal, Janjua and Chohan. Besides, Gujjar, Awan, Mughal, Qureshi, Syed and Satti are also living there. Some of the other minor tribes are the Jat, Malyar and Pathan and some Khattar.

##### **4.5.1.3 Mother Tongue**

The mother tongue refers to the language used for communication between parents and their children in any household. Punjabi is the predominantly language being spoken in Islamabad Capital Territory, representing 71.6 per cent of population followed by Urdu spoken by 10.1 per cent, Pushto 9.5 per cent and Siraiki 1.1 per cent while others speak Sindhi Balochi, Bravi, Dari etc. The proportions of people speaking Urdu, Sindhi, Pushto, Siraiki and other languages except Punjabi are more in urban area than in rural areas.

##### **4.5.1.4 Sex Ratio**

Sex ratio, i.e. proportion of males for every 100 females, was 117 per cent recorded in 1998 Census which had decreased from 119 in 1981. The ratio was 118 per cent in rural area and 122 in urban area.

#### **4.5.2 Economic Conditions**

##### **4.5.2.1 Economical Active Population**

The economically active population is defined here as the persons working, most of the time during the year preceding the census date i.e. 5th March, 1998, looking for work,

laid off and un–paid family helpers assisting their family. The economically active population as enumerated in the last census was 23.0 per cent of the total population or 30.7 per cent of the population 10 years and over i.e., the population exposed to the risk of entering the economically active life at any time. The formal percentage is known as Crude Activity Rate (CAR) while the latter is known as Refined Activity Rate (RAR). Of the total male population 39.5 per cent were economically active, while 77 per cent not economically active, 25 per cent children under 10 years, 13 per cent students, 33 per cent domestic workers while 6 per cent were land lords, property owners, retired persons, disabled etc. the participation rate is higher in the urban area as compared to people living in rural area.

#### **4.5.2.2 Unemployment**

Unemployment rate is measured as ratio of looking for work and laid off in total employed population comprising those looking for work, laid off and un–paid family helpers, generally representing in percentage. The unemployment rate in Islamabad Capital Territory was 15.7 per cent which was mainly due to unemployment among male representing 16.8 per cent. Female employment rate was just 1.7 per cent. This is because of their small proportion in their total proportion. The unemployment rate was almost three times higher in rural as compared to urban areas representing 28.7 and 10.1 per cent respectively.

#### **4.5.2.3 Occupations**

Majority of the population of the Project area is working in different Government Departments such as Agricultural department, Passport office, Higher Education Commission office, etc as well as private offices like Banks, mobile offices, some people are also running their own small level businesses like hotels & restaurants, medical stores, health clinics, departmental stores, etc

#### **4.5.2.4 Industry**

In order to meet local requirement, C.D.A., has allotted 450 Industrial plots in I–9, I–10 Sectors of Islamabad and Kahuta Triangle. The city has 11 main markets in addition to Industrial and Trade Centre as well as Blue area. Fecto Cement Factory is also situated near the Margallah hills and 9 stone crusher units are also functioning within the limits of Islamabad.

#### **4.5.3 Educational Facility**

Islamabad has three universities Quaid–e–Azam University, Allama Iqbal Open University and International Islamic University. There are two campuses of Hamdarad University, Karachi, Sindh and Al–Khair University Muzaffarabad, AJK. In addition to that there are 07 Degree Colleges, 13 Higher Secondary, 79 High Schools, 46 Middle and 216 Primary Schools. There are additional 14 Islamabad Model Colleges.

In project site following educational facilities are available including school campuses, colleges and universities :

- ❖ The Educator, Bara Kahu Campus
- ❖ Islamabad Grammer School
- ❖ Mukhtar School
- ❖ Ghazali College for Women
- ❖ Rawalpindi College of commerce
- ❖ IMCB Bara Kahu
- ❖ Virtual University Murree Road Campus
- ❖ Bara – Kahu Polytechnic College Bara – Kahu Islamabad



**FIGURE – 4.11 : EDUCATIONAL FACILITIES IN BARA KAHU**

#### 4.5.4 Health Facilities

The major health facilities available in the District are Federal Government Services Hospital, Capital Hospital, Pakistan Institute of Medical Sciences (PIMS), Children Hospital, National Institute of Health and Shifa International Hospital. Besides, 35 (ICT) Dispensaries, Maternal Child Hospital (MCH), 03 Rural Health Centers and 13 Basic Health Units in rural area are functioning day and night. The health network of ICT seems to be satisfactory as compared with other areas of the country. Likewise, PIMS hospital and Basic level private health facilities are also available in the communities along the project area.

In project Site Bara Kahu following health facilities are available :

- ❖ Ayesha Memorial Medical Center
- ❖ Khaliq Rehman Medical Center
- ❖ Umer Ayub Medical Complex
- ❖ Sara Hospital



**FIGURE – 4.12 : MEDICAL FACILITIES IN BARA KAHU**

#### **4.6 QUALITY OF LIFE VALUES**

The city received a major boost with the start of the construction of Islamabad in 1961 which saw greater investment and even enjoyed a brief stint as the country's temporary capital. The modern-day city is socio-economically tied with Islamabad and the larger metropolitan area, with a large people commuting to Islamabad, particularly due to the presence of several suburbs in Rawalpindi. The city is also a major transit point due to presence on the Grand Trunk Road and presence of Benazir Airport and the under-construction Liaquat Airport. The city is also a tourist attraction due to its historical haveli's, while it is a popular transit point for tourists visiting Rohtas Fort, Azad Kashmir, Taxila and Gilgit-Baltistan.

##### **4.6.1 Language**

The Languages spoken in Rawalpindi district are Punjabi (83.9%), Urdu (7.5%), Pashto (5.3%), and others (3.3%).

##### **4.6.2 Parks and places of interest**

Parks provide intrinsic environmental, aesthetic, and recreation benefit to our cities. They are also a source of positive economic benefits. They enhance property values, increase municipal revenue, bring in homebuyers and workers, and attract retirees. Following parks are present in Bara Kahu.

- ❖ Jillani Playground
- ❖ Sanober Hills Islamabad
- ❖ Din Palace & Park



**FIGURE – 4.13 : PARKS IN BARA KAHU**

## **5.0 ANALYSIS OF ALTERNATIVES**

The alternatives for the proposed project and their relative potential impacts on the environment were considered to evaluate the best project option. To examine the general characteristics of the area for the purpose of determining the most feasible route or routes for further more detailed investigations Reconnaissance Survey was conducted.

### **5.1 RECONNAISSANCE SURVEY**

Data collected from reconnaissance survey is used for feasibility study of all different routes, preparation of approximate estimates of quantities and costs. This helps in selection of most suitable alternatives. This survey also helps in determining any deviations required in the basic geometric standards to be adopted for the highway facility. Reconnaissance survey is generally not required for the work consisting of improvements to existing roads unless bypass roads are involved.

### **5.2 RECONNAISSANCE SURVEY METHODS**

The reconnaissance survey methods may be conducted in the following sequence :

- (i) Study of topographical survey sheets, agricultural, soil, geological and meteorological maps and aerial photography.
- (ii) Aerial photography wherever necessary and feasible, and
- (iii) Ground reconnaissance including another round of serial reconnaissance for inaccessible and difficult stretches, where required.

### **5.3 ALIGNMENTS STUDY**

Alignments Study / Surveys are widely provided for feasibility study, safety and protection purposes of different routes and highways. The alignment studies include horizontal alignment, cross section angle and vertical alignment of roads. The process of alignment is available as most important and crucial process for road safety. Different kinds of advanced and innovative techniques are used to carry out the alignment study. The alignment study of road is not an easy and quick task. A new road should be aligned very carefully as improper alignment would result in one or more of the following disadvantages:

- (i) Increase in construction cost
- (ii) Increase in maintenance cost
- (iii) Increase in vehicle operation cost
- (iv) Increase in accident rate

Once a highway is constructed, development takes place along the adjoining land and subsequent changes in alignment or improvements in geometric standards become very difficult. A badly aligned highway is not only a source of potential traffic hazard, but also causes a consideration increases in transportation cost and strain on the drivers and

passengers. Therefore, proper investigation and planning is important in a road project, keeping in view the current needs as well as the future developments of the region.

#### **5.4 EXISTING ALIGNMENT**

Project is located in Capital Territory of Islamabad. The project alignment mostly passes through rolling terrain. The start point of proposed Bara – Kahu Flyover / Overhead Bridge is at Km 6+500 on N-75 near Jillani Town, Islamabad. Single span bridge over mullah exists at Km 6+800 near Dhok Jillani Bus Stop.

The existing alignment of project runs through Bara Kahu town almost all of its length. Existing road is metaled, 7.5-meter-wide (North Bound & South Bound Carriageway) with 2.0 meter outer and up to 1.0 meter inner shoulders on both sides all along its length and new jersey barrier at the middle. At Km 8+000 two collector roads from both sides of N-75 are intersecting with the main carriageway. Simly Dam road from right side & Kiani road on left side intersect at this location. Pedestrian overhead bridge is provided at this location for the cross movement of pedestrians, as this point is busiest location where traffic congestion is often observed.

End point of proposed Bara – Kahu Flyover / Overhead Bridge is at Km 10+000. At this location Qaziabad link road from left side and Shahpur link road from right side intersect N-75 at this location. Islamabad Police check post is also situated at the proposed end point from here on wide raised median separates both carriageways.

##### **Main Link Roads**

Following main link roads also connect the main carriageway (N-75) from Km 6+500 to Km 10+000

- ❖ Kohsaar Town Road (Right Side)
- ❖ Kernal Amanullah Road (Left Side)

##### **Main Nullahs**

There are three main Nullahs cross the existing alignment of N-75 where bridges are provided.

- ❖ Single span bridge at km 6+800 near Dhok Jillani bus stop
- ❖ Five span bridge at km 7+300 near Kernal Amanullah Road (Mangu Town)
- ❖ Single Span bridge at Km 9+100 near Bhaira Pul Bus Stop

##### **Main Bus Stops**

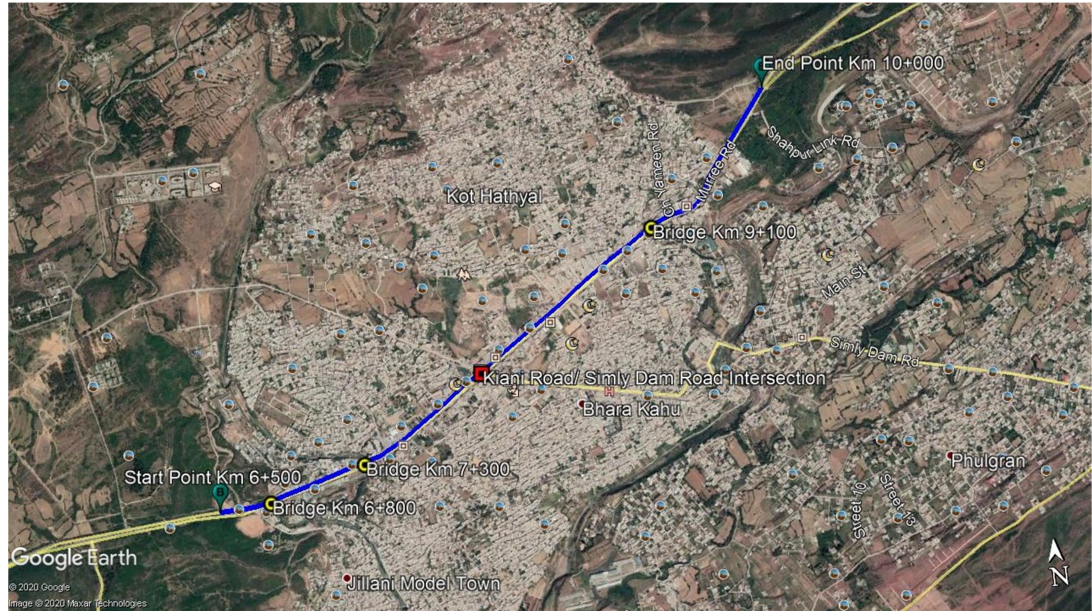
There are four main bus stops situated along the existing alignment, including :

- ❖ Dhok Jillani Bus Stop @ Km. 6+700
- ❖ Bus Adda @ Km. 8+000 (Intersection of Simly Road / Kiani Road)



- ❖ Bara – Kahu (Jhugi) Bus Stop @ Km. 8+500
- ❖ Bhaira Pul Bus Stop @ Km. 9+000

Figure – 5.1 below shows the existing alignment of Bara – Kahu Flyover / Overhead Bridge project.



**FIGURE – 5.1 : EXISTING ALIGNMENT OF PROJECT**

From Jillani Town to Qaziabad the alignment runs in the middle of built-up / urban area of Bara – Kahu. In addition to three bridges, one curve having sharp curvature is encountered on the existing alignment / route at Km 9+400.

Difference in the profile of both carriageways of existing alignment is observed in some reaches of the existing alignment.

## 5.5 PICTORIAL VIEW OF EXISTING ALIGNMENT

Following are the pictures of the existing alignment.



**Start Point of Flyover Bara – Kahu near Jillani Town**



**Nullah Bridge near Jillani Town**



**Dhok Jillani Bus Stop Right Side**



**Bus Adda at Intersection Kiani Road**



**Kiani Road**



**Simly Dam Road**



**Pedestrian Overhead Bridge – Kiani Road**



**Bridge-1 @ Km. 6+800 (Right Side)**



**Bridge-2 @ Km. 7+300 (Left Side)**



**Bridge-2 @ Km 7+300 (Right Side)**



**Bridge-3 @ Km 9+100**



**Dhok Jillani Bus Stop @ Km 6+700**



**Bus Terminal @ Km 8+000**



**Bara - Kahu Bus Stop @ Km 8+500**



**Bhaira Pul Bus Stop @ Km 9+000**



**Police Check Post and Qaziabad Link Road**



**U-Turn near Qaziabad Link Road**



**Shahpur Link Road (Right Side)**



**Proposed End Point of Flyover**

**FIGURE – 5.2 : PICTORIAL VIEW OF EXISTING ALIGNMENT  
(START TO END POINT)**

## **5.6 RECONNAISSANCE SURVEY AND ALIGNMENT STUDY**

An extensive reconnaissance survey is conducted to assess the feasibility of alternative alignments to bypass the urban area / built-up area of Bara – Kahu to avoid the construction of proposed Flyover / Overhead Bridge, if possible.

General topographic features including terrain, land use properties, availability of land, agriculture, geotechnical, geological characteristics and length of alternate route are assessed in the reconnaissance survey of the project alignment alternatives.

This survey is also based on the study of maps and other available data identified during the inception phase. Existing lower-resolution contour maps published or developed from photogrammetric mapping, are sufficient only for planning purposes. However, for concept development, feasibility study and detail design we will need to expand the existing topographical data include data from field surveys and an initial site reconnaissance.

### **5.6.1 Project Alignment Study**

Following main parameters are considered in determining the route selection and or to propose improvements in the existing alignment of the project road:

- ❖ Median (NJB) separated four (04) lane dual carriageway 7.30 m (3.65 m per lane), 1.0 –2.0 meter paved inner and 2.0 –3.0 meter paved outer shoulders on each side.
- ❖ Embankment and structural heights with respect to hydraulic requirements.
- ❖ Utmost possibility to follow natural contours to avoid cutting.
- ❖ Provision of required radii of horizontal curvatures for design speed.
- ❖ Avoid long and steep grades / slopes to meet the design standards.
- ❖ Improvement of horizontal alignment of existing road
- ❖ Minimum destruction to properties.