

Quarterly Report on EMF Monitoring July - September 2023



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Bhutan InfoComm and Media Authority

Royal Government of Bhutan

September 2023

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1. Background

Electromagnetic Field (EMF) Emissions are the electric and magnetic fields that are produced by radios, microwaves, mobile phones and base stations (mobile towers). Telecommunications transmitters generate electromagnetic fields at radio and microwave frequencies. Transmitters have proliferated with siting of wireless communication networks often co-located among other transmitters and the transmitter used in contact with human bodies. If the EMF exposure is prolonged there may be issues of possible health risks although it is scientifically not proven. Such risks must be managed and prevented.

Currently International Commission on Non-Ionizing Radiation Protection (ICNIRP) standards and various other standards are adopted on the assessment and compliance of the exposure levels radiated from different electromagnetic spectrum sources according to the permissible levels in order to protect the people from exposure to higher RF radiations. The most sources of exposure include the cellular network using GSM, WCDMA, LTE and others which occupy the VHF, UHF, L and S band frequencies.

The Bhutan InfoComm and Media Authority have always been monitoring and measuring the EMF radiation level of each Telecommunication Base Transceiver station (towers) in the country based on the EMF emission standards. The Authority also certifies the EMF compliance of the mobile towers in the country mainly in urban areas and satellite towns areas.

The EMF emission standard is derived from the EMF radiation threshold developed by ICNIRP and the Authority has standardized the threshold level of EMF radiation exposure based on the regional threshold.

2. Monitoring

To ensure that Electromagnetic Field (EMF) emission exposure from the Cellular Base Transceiver Station are safe and within the prescribed standard, the Authority has monitored the EMF from July to September, 2023 in following places;

Sl.No	Name of the Monitored Places	Number of tower Monitored
1	YDF Area	3
2	RICB Colony	2
3	Zilukha	5
4	Babena (Upper/Lower)	2
5	Pamtsho	2

6	Jungshina	5
7	Changtagang	1
8	Drangrina	3
9	Taba	7

The Authority will continue to monitor and measure the mobile towers in the country and will be issued with the certificate of EMF threshold compliance respectively.

3. Objective of the Monitoring

The main objective of the EMF measurement monitoring is:

- To ensure the safe and reliable communication services.
- To test the exposure levels produced by any transmitter or emitter such as telecommunication facilities and mobile telephone base stations for safety purposes and maintain the EMF emission within the standard threshold.
- To ensure that all telecommunication equipment is safe and secure.

4. Details of the Equipment used for EMF Compliance Test

The details of existing EMF monitoring equipment of the Authority are as mentioned below:

Equipment Make/Model: Rohde & Schwarz
Type of the Antenna: Isotropic Antenna/Type (3-Axis)
Spectrum Analyzer: FSH8
Calibration details: Calibrated on 21-12-2022 and valid up to 2 to 3 years

5. Specification of the Equipment/ Instrument

The specification of the above equipment are as mentioned below:

- 3-axis, E-field antenna 30 kHz to 3 GHz
- Spectrum analyzer covering 9 kHz to 8 GHz
- RFEX Software package
- A 1.5 meter cable to separate the antenna from the meter
- Tripod to hold the antenna



Figure 1: Isotropic Antenna/Type (3-Axis)



Figure 2: Spectrum Analyzer FSH8

6. Measurement Parameter

The following quantities are measured while monitoring:

- Electric Field strength E in **V/m**
- Power density in (**$\mu\text{W}/\text{cm}^2$**)

7. Methodology

The following methodology processes are followed while carrying out the monitoring:

- The measurement is done around 10 meters to 20 meters away from the sectoral antenna's BTS towers facing towards the measurement equipment which is based on the ICNIRP standards measurement.
- The measurement result is taken as the average over a time period of 10 to 15 minutes.
- The measurement is done by Frequency selective method. The selected frequency is for 2G, 3G, and 4G for both the operators.
- Measurement values will be recorded and compare the measurement values with the reference level as per the international standard ICNIRP.

8. Reference Standards and Regulation/ICNIRP limits

According to Section 10(1), and 10(2) of the “Standard for the Establishment of Telecommunications Tower”

- 10 (1): All telecommunication and broadcasting sites shall ensure compliance with the ICNIRP Procedures and Standards for general public exposure and take immediate actions to rectify any non-compliant Sites.
- 10(2): Antennas in all sites shall not emit the EMF radiation more than the standards shown in the table below;

Frequency range	Electric field-strength (V/m)		Equivalent plane wave power-density $S_{eq}(W/m^2)$	
	general public	occupational	general public	Occupational
0.1 - 30 Hz	$300/(10^{0.5} * f^{0.7})$ MHz)	$600/(10^{0.5} * f^{0.7})$ MHz)	NA	NA
>30 – 400 MHz	$27.7/10^{0.5}$	$61/10^{0.5}$	0.2	1
>400 - 2000 MHz	$(1.375f^{0.5}(MHz)) / 10^{0.5}$	$(3f^{0.5}(MHz)) / 10^{0.5}$	(f/2000)	(f/400)
>2 - 300 GHz	19.289	43.323	1	5

9. Findings and Permissible limits of Electric Field and Power Density

The EMF measurement of the BTS tower was carried out in **YDF Area, RICB Colony, Zilukha Area, Babena(Upper/Lower), Pamtsho, Jungshina, Changtagang, Drangrina and Taba(Upper/Lower)** in Thimphu Thromde. It is found that the maximum exposures around all of the base stations are **very low** than prescribed exposure limits. The detailed measurement readings , findings, electric field and Power Density results are attached below in **Annexure I**.

10. Satellite View of the Measurement Location/Telecom site

The satellite view of the measurement location of each telecom site or transmitter is attached in **Annexure 2**.

Annexure 1 (Measurement Results)

The detailed measurement readings of Electric Field and Power Density are attached below;

1. YDF Area (Tashi InfoComm Limited)

SL. No	Site Name	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	YDF	27.4732837	89.6311422	328	1800 MHz	18.44	1.65489777 7784	0.7264	Below the Limits

2. YDF Area (Bhutan Telecom Limited)

SL.No	Site Name	Latitude	Longitude	Cell Id	Frequency Band	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Swimming Pools	27.4707337	89.6336144	110	900 MHz	13.044	0.31018694 6628385	0.0255	Below the Limit
				23	850 MHz	12.676	0.55642130 8443698	0.0821	
				279	1800 MHz	18.00	1.30456476 457837	0.4514	

3. RICB Colony (Tashi InfoComm Limited)

Sl.No	Site Name	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Near RICB Colony	27.468576	89.6339671	1101	900 MHz	13.044	0.18181687 9315933	0.0088	Below the Limits
				40277	850 MHz	12.676	0.83747349 8824566	0.1860	
				356	1800 MHz	18.00	0.43530738 6582334	0.0503	

4. RICB Colony (Bhutan Telecom Limited)

Sl.No	Site Name	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
				1661	900 MHz	13.044	0.441493426 023682	0.0517	

1	Near RICB Colony	27.4668277	89.6340196	193	850 MHz	12.676	0.277752401 134496	0.0205	Below the Limits
				178	1800 MHz	18.00	0.590755288 096717	0.0926	

5. Zilukha (Tashi InfoComm Limited)

Sl.No	Site Name	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Zilukha Highway Monopole Tower 1	27.4783213	89.6250367	244	1800 MHz	18.44	1.2142162976 3372	0.3911	Below the Limits
2	Zilukha Highway Monopole Tower 2	27.4837728	89.6301661	338	1800 MHz	18.44	0.3917110494 74804	0.0407	Below the Limits
3	Near Zilukha School Monopole Tower	27.4886817	89.6292465	221	1800 MHz	18.44	1.5584574489 1175	0.6442	Below the Limits

6. Zilukha (BTL)

Sl.No	Site Name	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Zilukha Highway Monopole Tower	27.482039	89.6290287	129	1800 MHz	18.44	3.18383415 425781	2.6888	Below the Limits
2	Zilukha below school	27.4899225	89.6299471	5001	900 MHz	13.044	0.18781395 977141	0.0094	Below the Limits
				40211	850 MHz	12.676	0.81951442 4357412	0.0604	
				324	1800 MHz	18.00	0.47704456 4875627	0.1781	

7. Babena ((Bhutan Telecom Limited)

SL. No	Site Name	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Babena Top	27.5002698	89.6221573	5001	1800 MHz	18.44	0.367023023 64782	0.0357	Below the Limits
				40211	900 MHz	13.044	0.101312665 048552	0.0027	
				313	850 MHz	12.676	0.150307557 47676	0.0060	
2	Babena	27.5009711	89.6248173	405	1800 MHz	18.44	1.181915154 9929	0.3705	Below the Limits

8. Pamtsho (Tashi InfoComm Limited)

Sl.No	Site Name	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Pamtsho	27.5120769	89.6354528	143	1800 MHz	18.44	0.639372500 69808	0.1084	Below the Limits

9. Pamstho (Bhutan Telecom Limited)

Sl.No	Site Name	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Pamtsho	27.5077685	89.6357909	40211	900 MHz	13.044	0.166574550 792758	0.0074	Below the Limits
				5001	850 MHz	12.676	0.538664181 279948	0.0770	
				183	1800 MHz	18.44	0.300818572 31529	0.0240	

10. Jungshina (Tashi InfoComm Limited)

Sl.No	Site Name	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Jungshina Junction	27.5036947	89.6362027	373	1800 MHz	18.44	0.4173929864 7	0.0426	Below the Limits
				40277	900 MHz	13.044	0.2964192036	0.0223	
				1101	850 MHz	12.676	0.3238903693	0.0278	
2	Jungshina	27.4990252	89.6356306	391	1800MHz	18.44	0.8539226734 8	0.1934	Below the Limits

11. Jungshina (BTL)

Sl.No	Site Name	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Jungshina Near High Court	27.4970566	89.6341779	307	1800 MHz	18.44	0.90014295 2787393	0.2149	Below the Limits
2	Jungshina	27.5048974	89.6354444	470	1800 MHz	18.44	1.38511227 337522	0.5089	Below the Limits
3	Dechen Phodrang	27.5016219	89.6326288	5001	900 MHz	13.044	0.28373736 7764142	0.0214	Below the Limits
				40211	850 MHz	12.676	0.55867692 3	0.0828	
				74	1800 MHz	18.00	1.25032088	0.4147	

12. Changtagang ((Bhutan Telecom Limited)

SL.No	Site Name	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Changtagang	27.5574362	89.6474897	143	1800 MHz	18.44	0.67108157 8547588	0.1195	Below the Limits

13. Drangrina (Tashi InfoComm Limited)

Sl.No	Site Name	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Drangrina TICL Monopole	27.5293063	89.6402123	336	1800 MHz	18.44	2.67620770 396618	1.8998	Below the Limits

14. Drangrina (Bhutan Telecom Limited)

Sl.No	Site Name	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Drangrina BTL	27.5320181	89.6395151	5001-1	900 MHz	13.044	0.19528894	0.0101	Below the Limits
				4135-2	850 MHz	12.676	0.52414215	0.0729	
				61	1800 MHz	18.44	0.39309898	0.0410	

2	Drangrina BTL	27.5120769	89.6354528	300	1800 MHz	18.44	1.3577531	0.4890	Below the Limits
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15. Taba (Tashi InfoComm Limited)

Sl.No	Site Name	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Upper Taba	27.5105971	89.6415759	436	1800MHz	18.44	1.121545691	0.337	Below the Limits
2	Upper Taba 3 Legged Tower	27.5145377	89.6418094	1101-256	900 MHz	13.044	0.27005583	0.0193	Below the Limits
				10023-21	850 MHz	12.676	0.42735456	0.0484	
				56	1800 MHz	18.44	0.479925820	0.0611	

16. Taba (Bhutan Telecom Limited)

Sl.No	Site Name	Latitude	Longitude	Cell ID	Frequency Band	Limits V/m	Field Strength V/m	Power Density ($\mu\text{W}/\text{cm}^2$)	Remark
1	Lower Taba BTL Monopole	27.5139699	89.6381429	404	1800 MHz	18.44	0.8919497657	0.2110	Below the Limits
2	Lower Taba BTL	27.5084034	89.6394172	181	1800 MHz	18.44	1.1885579788 7374	0.3747	Below the Limits
3	Upper Taba BTL 1	27.5105728	89.6416786	446	1800 MHz	18.44	1.2876783908 0995	0.3337	Below the Limits
4	Upper Taba BTL 2	27.5122652	89.6431065	258	1800 MHz	18.44	0.7637650146 67028	0.1547	Below the Limits
5	Upper Taba 3 Legged Tower	27.5145377	89.6418094	5001-10	900 MHz	13.044	0.2700558303 5	0.0193	Below the Limits
				4177-5	850 MHz	12.676	0.427354560	0.0484	
				258	1800 MHz	18.44	0.479925820	0.0611	

Annexure 2 (Satellite View of Location of Monitored Sites)

The following are the satellite view of the measurement location of the each Telecom site transmitter;

27.4732837 89.6311422

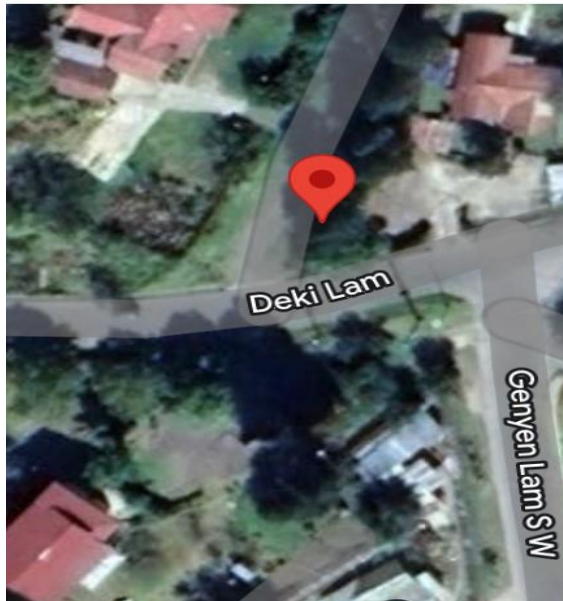


Figure 3: YDF (TICL)

27.4707337 89.6336144

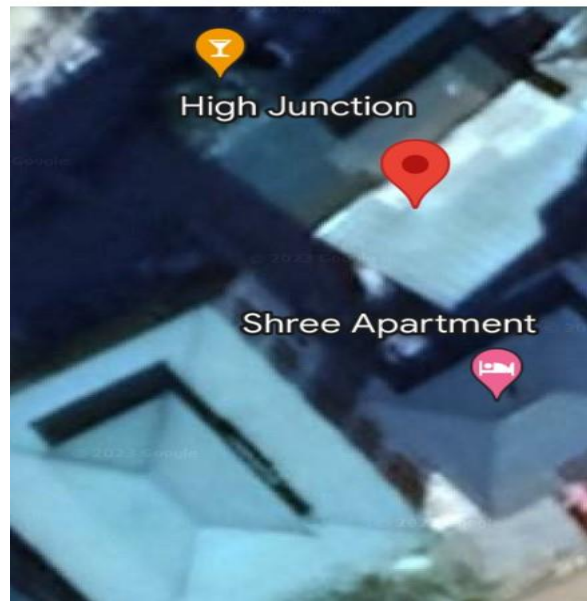


Figure 4: Swimming Pools (BTL)

27.468576 89.6339671

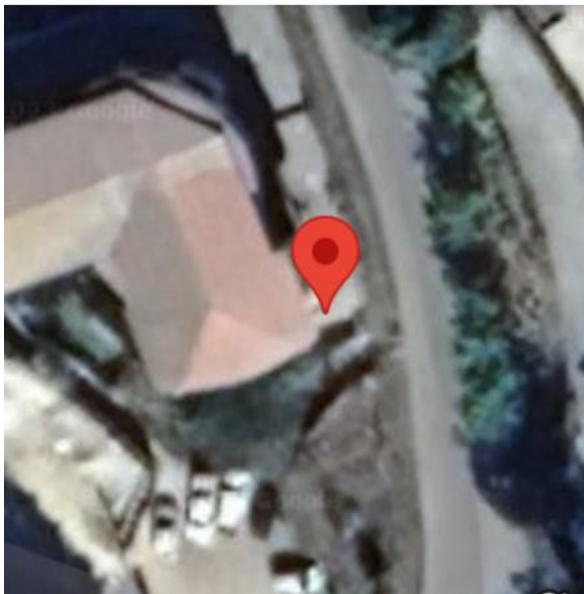


Figure 5: Near RICB Colony(TICL)

27.4668277 89.6340196

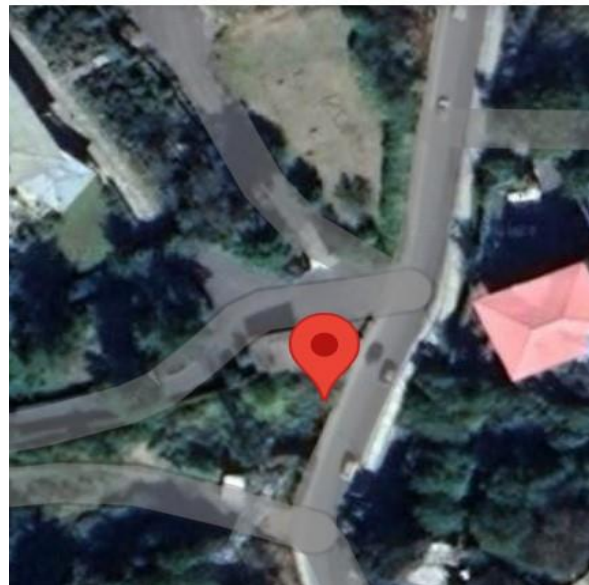


Figure 6: Near RICB Colony (BTL)

- 27.4783213 89.6250367

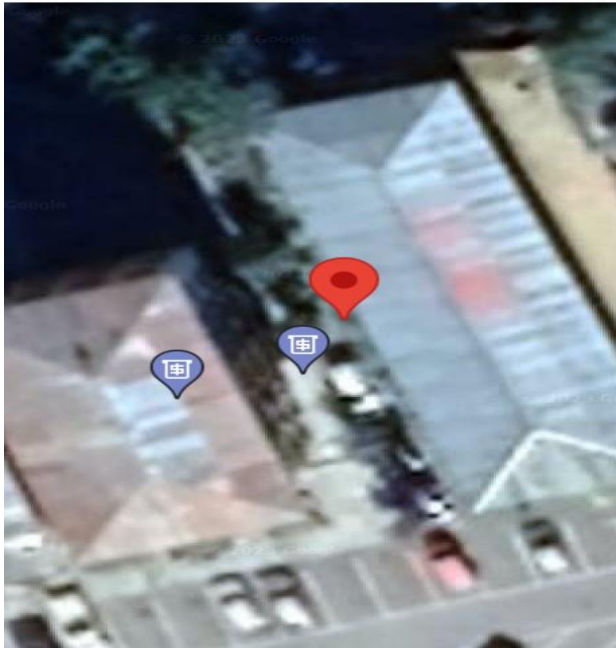


Figure 7: Zilukha Highway Monopole Tower 1(TICL)

27.4837728 89.6301661

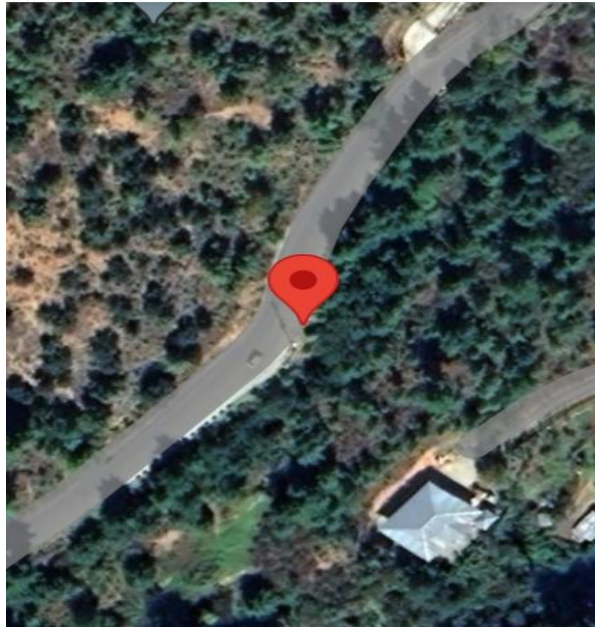


Figure 8: Zilukha Highway Monopole (TICL)

27.4886817 89.6292465



Figure 9: Near Zilukha School (TICL)

27.482039 89.6290287

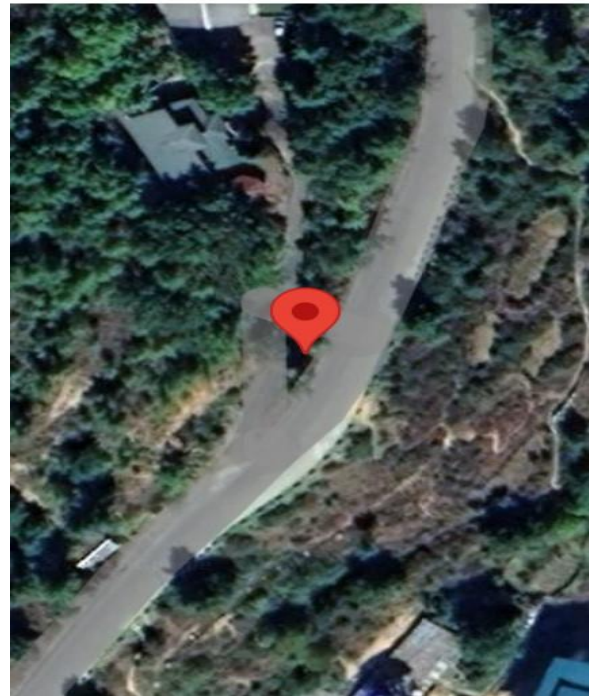


Figure 10: Zilukha Highway Monopole (BTL)

27.4899225 89.6299471

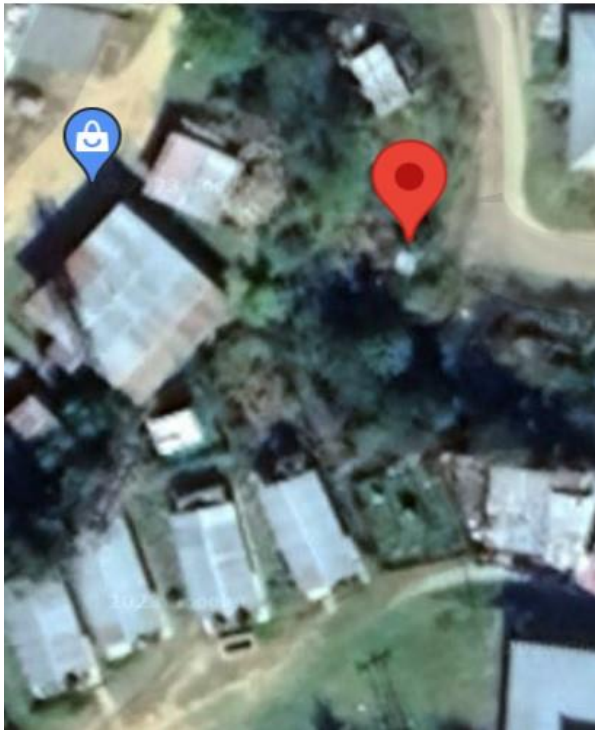


Figure 11: Zilukha below school (BTL)

27.5009711 89.6248173



Figure 13: Babena (BTL)

27.5002698 89.6221573



Figure 12: Babena Top (BTL)

27.5120769 89.6354528

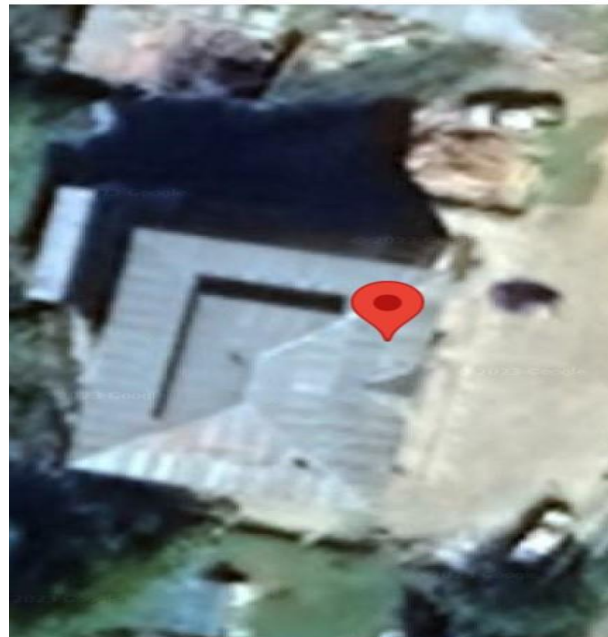


Figure 14: Pamtsho (TICL)

27.5077685,89.6357909

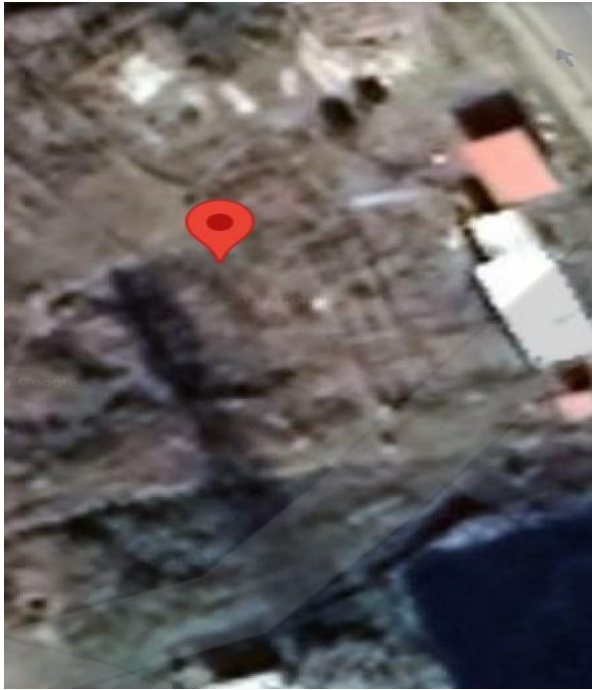


Figure 15: Pamtsho (BTL)

27.5036947,89.6362027

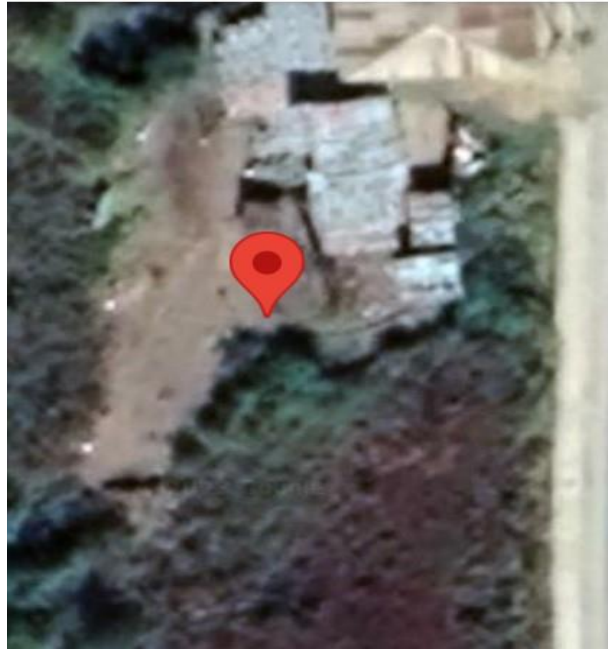


Figure 16: Jungshina Junction (TICL)

27.4990252,89.6356306



Figure 17: Jungshina (TICL)

27.4970566,89.6341779

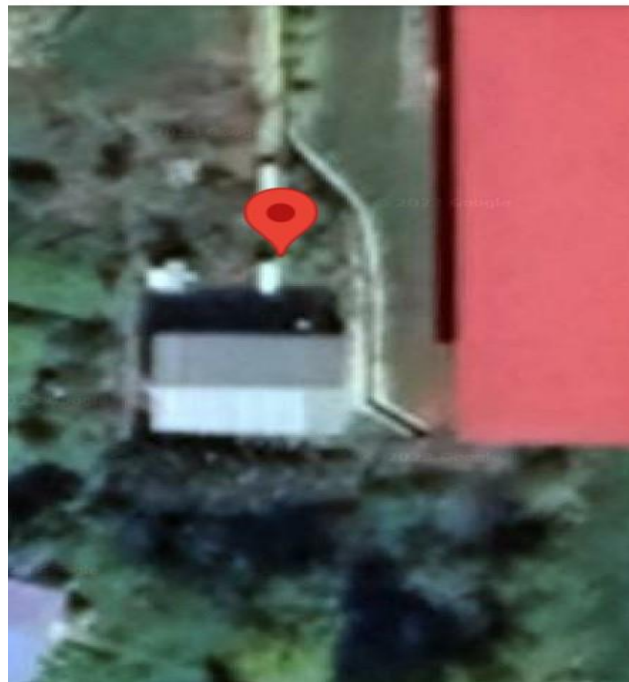


Figure 18: Jungshina Near High Court (BTL)

27.5048974,89.6354444

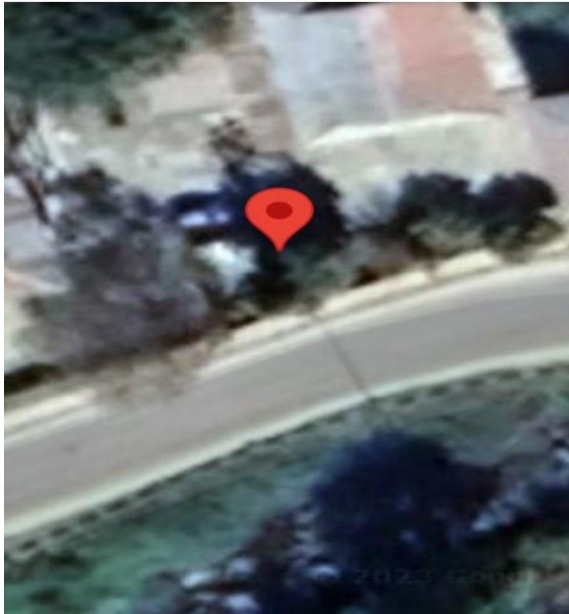


Figure 19: Jungshina (BTL)

27.5016219,89.6326288

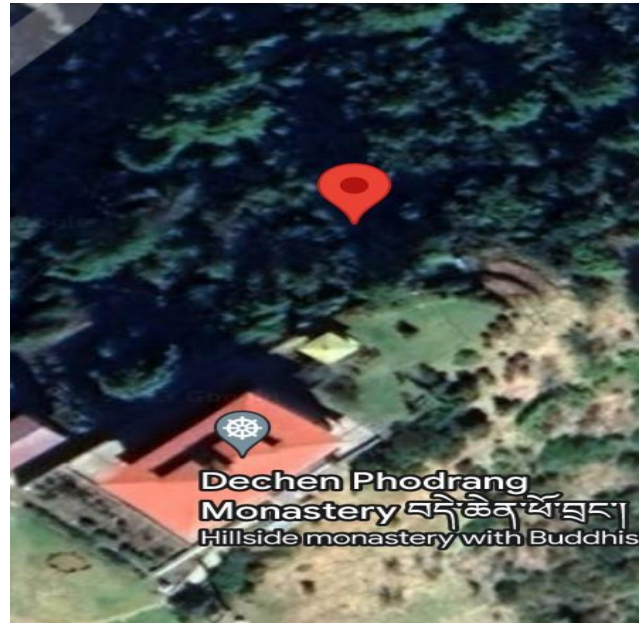


Figure 20: Dechen Phodrang (BTL)

27.5574362,89.6474897



Figure 21: Changtagang(BTL)

27.5293063,89.6402123



Figure 22: Drangrina Monopole(TICL)

27.5320181,89.6395151

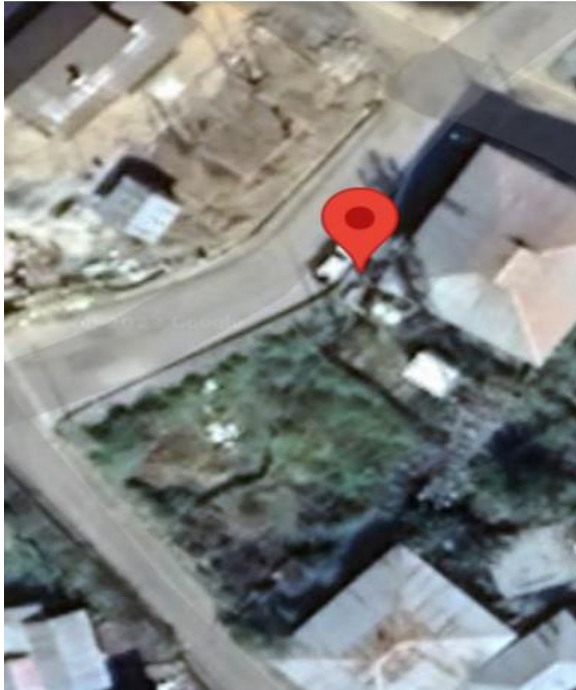


Figure 23: Drangrina BTL(BTL)

27.5120769,89.6354528

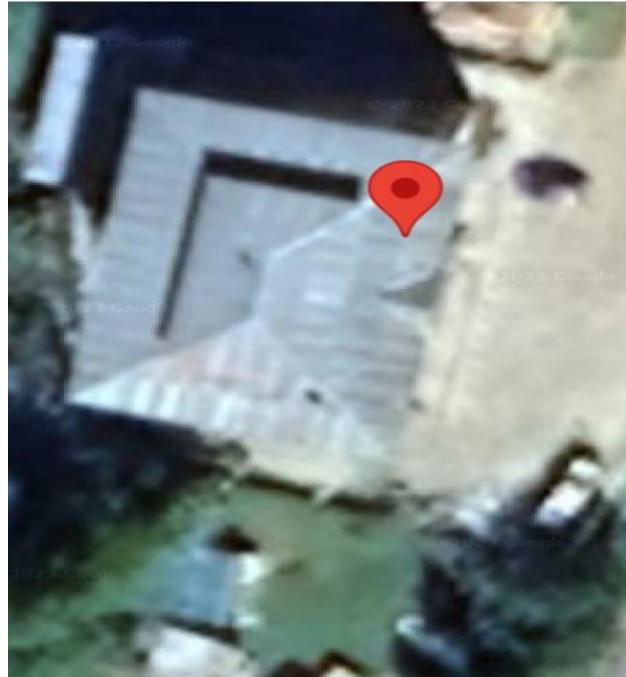


Figure 24: Drangrina (BTL)

27.5105971,89.6415759

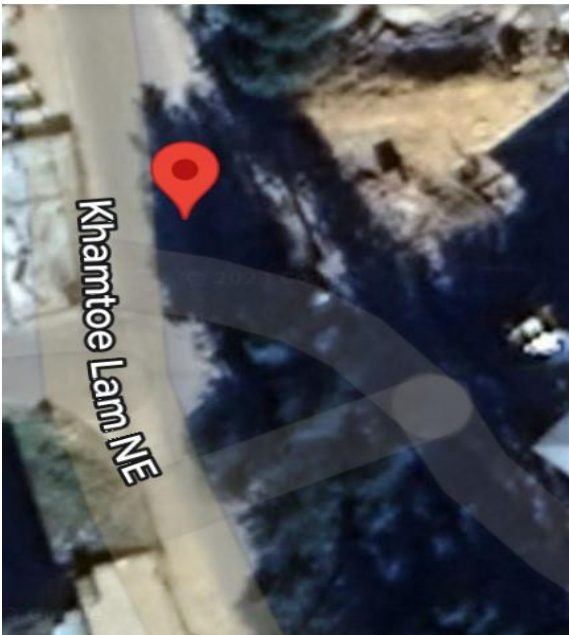


Figure 25: Upper Taba (TICL)

27.5145377,89.6418094

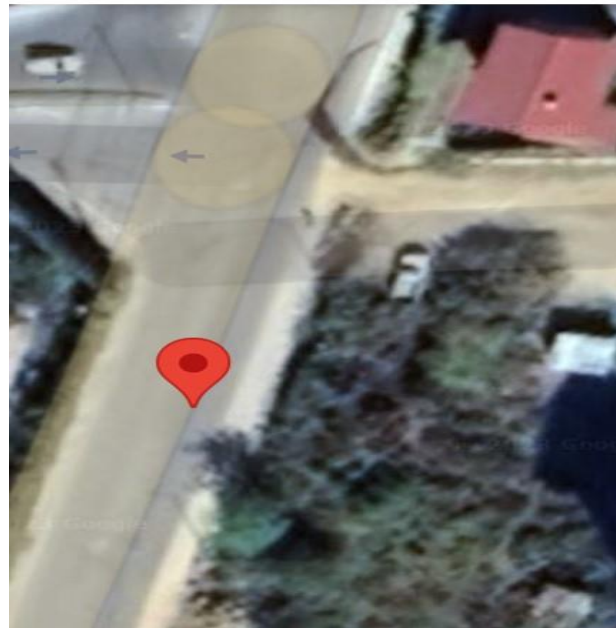


Figure 26: Upper Taba 3 Legged Tower(TICL)

27.5139699,89.6381429

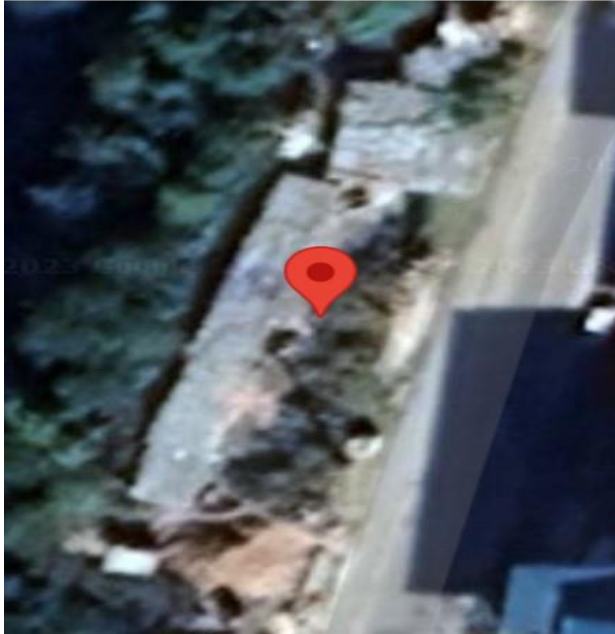


Figure 27: Lower Taba Monopole(BTL)

27.5084034,89.6394172

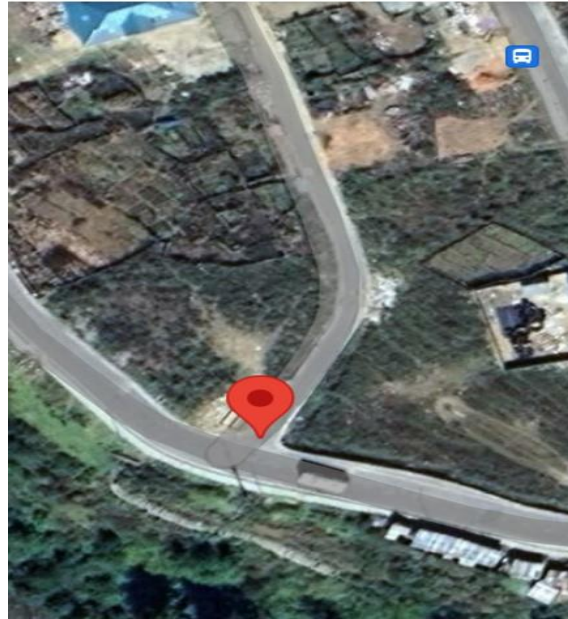


Figure 28: Lower Taba BTL (BTL)

Annexure 3 (Image of Monitored BTS)

The following are the images of the each Telecom BTS transmitters;



Figure 29: YDF Area (TICL)



Figure 30: Swimming Pool Area(BTL)



Figure 31: RICB Colony(TICL)



Figure 32: RICB Colony (TICL)



Figure 33: Zilukha Highway (TICL)



Figure 34: Zilukha Highway (BTL)



Figure 35: Zilukha Highway (TICL)

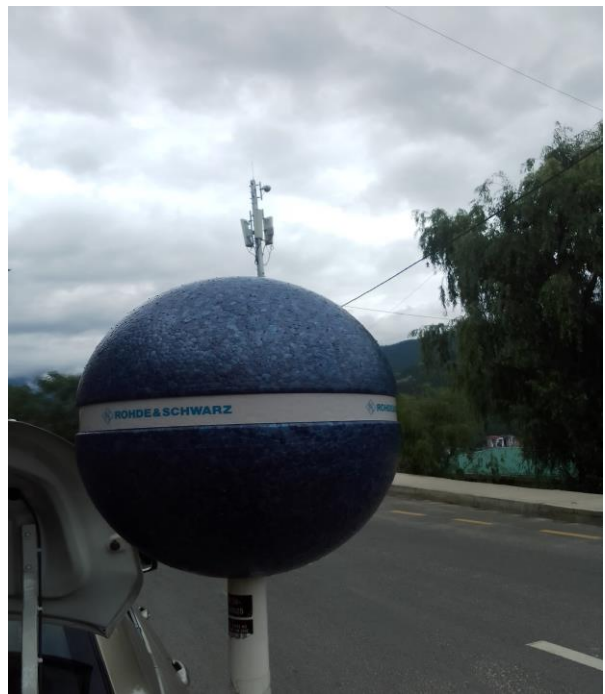


Figure 36: Zilukha School (BTL)



Figure 37: Babena (BTL)



Figure 38: Babena top (BTL)



Figure 39: Jungshina (BTL)



Figure 40: Pamtsho (TICL)



Figure 41: Pamtsho (BTL)



Figure 42: Jungshina (TICL)



Figure 43: Jungshina Near India House (TICL)



Figure 44: Near High court (BTL)



Figure 45: Changtagang (BTL)



Figure 46: Drangrina (BTL)



Figure 47: Drangrina (TICL)



Figure 48: Lower Taba (BTL)



Figure 49: Lower Taba (BTL)



Figure 50: Upper Taba (TICL)



Figure 51: Upper Taba (BTL)



Figure 52: Upper Taba (BTL)



Figure 53: Upper Taba 3 Legged Tower (BTL) Tower.



Figure 54: Upper Taba (TICL) 3 Legged Tower.



Figure 55: Below Zilukha School (TICL)



Figure 56: Dechen Phodrang Lhakhag (BTL)