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Calculated Radio Frequency Emissions Report

ME4097

5 Roots Rock Road, York, ME 03909

February 7, 2020

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1. Introduction

The purpose of this report is to investigate compliance with applicable FCC regulations for the proposed installation of AT&T antenna arrays on the water tank located at 5 Roots Rock Road in York, ME. The coordinates of the water tank are 43° 8' 51.55"N, 70° 38' 48.19" W.

AT&T is proposing to install nine (9) multi-band antennas (three per sector) and ground-based equipment to support its commercial AT&T LTE network and the FirstNet National Public Safety Broadband Network ("NPSBN").

Based on information provided as part of the project and researching publicly available FCC license databases, antennas operated by the Town of York are believed to be collocated on the water tank and included in the overall analysis. This report uses the planned antenna configuration for AT&T[1] and existing Town antennas to calculate the resulting % MPE (Maximum Permissible Exposure) at ground level, once the proposed installation has been completed.

2. FCC Guidelines for Evaluating RF Radiation Exposure Limits

In 1985, the FCC established rules to regulate radio frequency (RF) exposure from FCC licensed antenna facilities. In 1996, the FCC updated these rules, which were further amended in August 1997 by OET Bulletin 65 Edition 97-01. These new rules include Maximum Permissible Exposure (MPE) limits for transmitters operating between 300 kHz and 100 GHz. The FCC MPE limits are based upon those recommended by the National Council on Radiation Protection and Measurements (NCRP), developed by the Institute of Electrical and Electronics Engineers, Inc., (IEEE) and adopted by the American National Standards Institute (ANSI).

The FCC general population/uncontrolled limits set the maximum exposure to which most people may be subjected. General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

Public exposure to radio frequencies is regulated and enforced in units of milliwatts per square centimeter (mW/cm^2). The general population exposure limits for the various frequency ranges are defined in the attached "FCC Limits for Maximum Permissible Exposure (MPE)" in Attachment C of this report.

Higher exposure limits are permitted under the occupational/controlled exposure category, but only for persons who are exposed as a consequence of their employment and who have been made fully aware of the potential for exposure, and they must be able to exercise control over their exposure. General population/uncontrolled limits are five times more stringent than the levels that are acceptable for occupational, or radio frequency trained individuals. Attachment C contains excerpts from OET Bulletin 65 and defines the Maximum Exposure Limit.

Finally, it should be noted that the MPE limits adopted by the FCC for both general population/uncontrolled exposure and for occupational/controlled exposure incorporate a substantial margin of safety and have been established to be well below levels generally accepted as having the potential to cause adverse health effects.

[1] As referenced to AT&T's Radio Frequency Design Sheet updated 5/3/2019.

3. RF Exposure Calculation Methods

The calculated ground-level power density results displayed in the following figures were generated using the following formula as outlined in FCC bulletin OET 65:

$$\text{Power Density} = \left(\frac{\text{EIRP}}{\pi \times R^2}\right) \text{ X Off Beam Loss}$$

Where:

EIRP = Effective Isotropic Radiated Power;

R = Radial Distance = $\sqrt{(H^2 + V^2)}$;

H = Horizontal Distance from antenna;

V = Vertical Distance from radiation center of antenna;

Off Beam Loss is determined by the selected antenna patterns;

Ground reflection factor of 2.0;

These calculations assume that the transmitters are operating at full power and 100 percent capacity, and that all channels are transmitting simultaneously. Obstructions (trees, buildings, etc.) that would normally attenuate the signal are not taken into account. The calculations assume even terrain in the area of study and do not take into account actual terrain elevations which could attenuate the signal. As a result, the calculated power density and corresponding % MPE levels reported below are much higher than the actual signal levels will be from the final installations.

4. Antenna Inventory

Table 1 below outlines AT&T Mobility's proposed antenna configuration and the assumed antenna installation for the Town[2]. Any other antennas present on the tank are assumed to be inactive. The associated data sheets and antenna patterns for these specific antenna models are included in Attachments C and D.

Operator	Sector	TX Freq (MHz)	Power at Antenna (Watts)	Ant Gain (dBi)	Power EIRP (Watts)	Antenna Model	Beam Width	Mech. Tilt	Length (ft)	Antenna Centerline Height (ft)
AT&T	Alpha	763	160	15.9	6224.7	EPBQ-654L8H8-L2	67	0	8	75
		2100	240	17.7	14132.2		60			
		722	80	15.5	2838.5	HPA65R-BU8A	67	0	8	75
		2300	160	18.0	10095.3		60			
		739	160	15.9	6224.7	EPBQ-654L8H8-L2	67	0	8	75
		875	160	16.2	669.9		66			
		1900	160	17.7	9421.5		60			
	Beta	763	160	15.9	6224.7	EPBQ-654L8H8-L2	67	0	8	75
		2100	240	17.7	14132.2		60			
		722	80	15.5	2838.5	HPA65R-BU8A	67	0	8	75
		2300	160	18.0	10095.3		60			
		739	160	15.9	6224.7	EPBQ-654L8H8-L2	67	0	8	75
		875	160	16.2	669.9		66			
		1900	160	17.7	9421.5		60			
	Gamma	763	160	15.9	6224.7	EPBQ-654L8H8-L2	67	0	8	75
		2100	240	17.7	14132.2		60			
		722	80	15.5	2838.5	HPA65R-BU8A	67	0	8	75
		2300	160	18.0	10095.3		60			
		739	160	15.9	6224.7	EPBQ-654L8H8-L2	67	0	8	75
		875	160	16.2	669.9		66			
		1900	160	17.7	9421.5		60			
Town of York	Omnis (2)	173.3125	18.2	4.7	32.8	ANT150F2	360	0	5.0	87
Town of York	Omni	173.21	4.6	4.7	8.2	ANT150F2	360	0	5.0	87

Table 1: Antenna Inventory[3] [4]

[2] The Town of York antenna information is based on results of an FCC licensing search.

[3] Antenna heights are in reference to the Ramaker & Associates, Inc. drawings dated October 22, 2019 (Rev. A).

[4] Transmit power assumes 0 dB of cable loss.

5. Calculated % MPE Results

The calculated power density results at ground-level are shown in Figure 1 below. The calculations for this analysis range from 0 feet horizontal distance (directly below the antennas) to a value of 1,000 feet horizontal distance from the site. In addition to the other worst-case scenario considerations that were previously mentioned, the power density calculations to each horizontal distance point away from the antennas was completed using a local maximum off beam antenna gain (within ± 3 degrees of the true mathematical angle) to incorporate a realistic worst-case scenario.

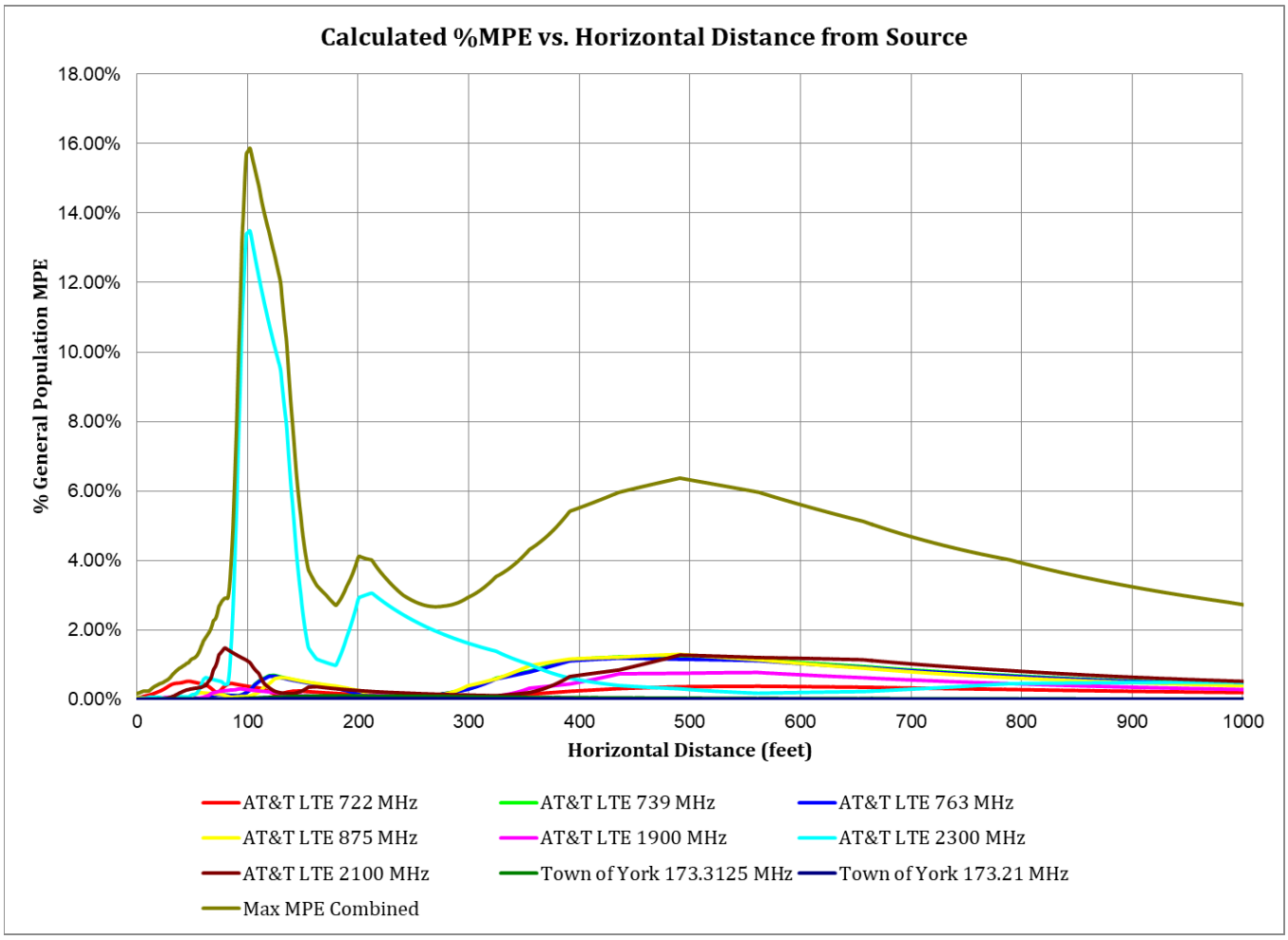

Figure 1: Graph of General Population % MPE vs. Distance

The highest combined percent of MPE (1**5.87%** of the FCC's General Population limit) is calculated to occur at a horizontal distance of 102 feet from the antennas. Please note that the percent of MPE calculations close to the site take into account off beam loss, which is determined from the vertical pattern of the antennas used. Therefore, RF power density levels may increase as the distance from the site increases. At distances of approximately 800 feet and beyond, one would now be in the main beam of the antenna patterns and off beam loss is no longer considered. Beyond this point, RF levels become calculated solely on distance from the site and the percent of MPE decreases significantly as distance from the site increases.

Table 2 below lists maximum percent of MPE values at ground-level as well as the associated parameters that were included in the calculations. As stated in Section 3, all calculations assume that the antennas are operating at full power and 100 percent capacity, and that all antenna channels are transmitting simultaneously. Obstructions (trees, buildings etc.) that would normally attenuate the signal are not taken into account. In addition, a six foot height offset was considered in this analysis to account for average human height. As a result, the calculated % MPE levels are significantly higher than the actual signal levels will be from the final installation. The results presented in Figure 1 and Table 2 assume level ground elevation from the base of the water tank out to the horizontal distances calculated.

Carrier	Number of Transmitters	Power out of Base Station Per Transmitter (Watts)	Antenna Height (Feet)	Distance to the Base of Antennas (Feet)	Power Density (mW/cm^2)	Limit (mW/cm^2)	% MPE
AT&T LTE 1900 MHz	1	160.0	75.0	102	0.002711	1.000	0.27%
AT&T LTE 2100 MHz	1	240.0	75.0	102	0.010616	1.000	1.06%
AT&T LTE 2300 MHz	1	160.0	75.0	102	0.134924	1.000	13.49%
AT&T LTE 722 MHz	1	80.0	75.0	102	0.001766	0.481	0.37%
AT&T LTE 739 MHz	1	160.0	75.0	102	0.001333	0.493	0.27%
AT&T LTE 763 MHz	1	160.0	75.0	102	0.001333	0.509	0.26%
AT&T LTE 875 MHz	1	160.0	75.0	102	0.000599	0.583	0.10%
Town of York 173.21 MHz	1	4.6	87.0	102	0.000018	0.200	0.01%
Town of York 173.3125 MHz	1	18.2	87.0	102	0.000071	0.200	0.04%
						Total	**15.87%**

Table 2: Maximum Percent of General Population Exposure Values[5]

[5] Please note that % MPE values listed are rounded to two decimal points. The total % MPE listed is a summation of each unrounded contribution. Therefore, summing each rounded value may not reflect the total value listed in the table.

In order to factor in any ground elevation variations around the proposed site, % MPE levels were also calculated at a selection of specific points with consideration to each selected location's ground elevation relative to that of the proposed site. Table 3 below lists the % MPE calculated at these selected points in the vicinity of the proposed tower. For completeness, the calculations consider both a 6' individual standing at ground level around the proposed site and also standing at 10' above ground level (AGL), to represent an individual on a 2nd floor deck of a nearby home. Please note that % MPE values inside of a neighboring home would be lower than the calculated values shown in this report, as these values do not account for building penetration losses.

The highest % MPE calculated for an individual standing at ground level is **14.96%** of the **FCC General Population/Uncontrolled limit** and the highest percent of MPE calculated at 10' AGL is **17.03% of the FCC limit (General Population/Uncontrolled).** Both maximums are calculated to occur at Location 12, approximately 108 feet east of the proposed site. These calculated values incorporate the antenna pattern of the particular antenna models listed in Table 1 to determine the "Off Beam Loss" factor shown in the power density formula from Section 3.

Location	Address	Latitude	Longitude	Dist. From Site (feet)	Ground Elevation Difference	Composite % MPE @ 6' AGL (Uncontrolled / General)	Composite % MPE @ 16' AGL (Uncontrolled / General)
1	12 Avon Ave.	43.14658	-70.64728	424	17.9	2.38%	4.03%
2	15 Avon Ave.	43.14700	-70.64724	278	9.6	2.26%	2.73%
3	16 Avon Ave.	43.14665	-70.64744	419	18.8	2.23%	3.71%
4	18 Avon Ave.	43.14675	-70.64778	437	18.7	2.45%	4.18%
5	22 Avon Ave.	43.14705	-70.64800	407	12.6	2.84%	5.04%
6	23 Avon Ave.	43.14727	-70.64776	309	8.2	2.15%	3.50%
7	26 Avon Ave.	43.14686	-70.64859	575	18.0	3.85%	5.01%
8	31 Avon Ave.	43.14751	-70.64845	461	7.5	4.65%	6.77%
9	32 Avon Ave.	43.14734	-70.64873	546	11.5	4.56%	5.87%
10	1 Camden Ave.	43.14777	-70.64561	301	0.1	2.94%	5.69%
11	3 Camden Ave.	43.14786	-70.64578	262	1.4	2.63%	3.83%
12	**4 Camden Ave.**	**43.14782**	**-70.64639**	**108**	**0.5**	**14.96%**	**17.03%**
13	5 Camden Ave.	43.14809	-70.64612	223	3.4	3.64%	3.53%
14	7 Camden Ave.	43.14829	-70.64635	247	6.2	2.89%	3.02%
15	8 Camden Ave.	43.14804	-70.64660	140	2.1	9.43%	4.49%
16	2 Field Ave.	43.14874	-70.64622	414	15.8	2.50%	4.29%
17	6 Fernald Ave.	43.14709	-70.64662	215	4.3	3.64%	3.77%
18	10 Fernald Ave.	43.14728	-70.64616	208	1.0	3.96%	4.01%
19	14 Fernald Ave.	43.14748	-70.64606	192	-0.7	3.63%	4.76%
20	23 Fernald Ave.	43.14758	-70.64483	510	-0.8	6.37%	7.82%
21	24 Fernald Ave.	43.14789	-70.64522	412	1.6	5.30%	8.07%
22	7 Huckins Ave.	43.14767	-70.64759	229	3.4	3.40%	3.40%
23	8 Huckins Ave.	43.14802	-70.64804	371	1.2	4.38%	7.66%
24	11 Huckins Ave.	43.14792	-70.64743	206	0.9	3.98%	4.10%
25	15 Huckins Ave.	43.14810	-70.64727	214	1.0	3.91%	3.83%
26	16 Huckins Ave.	43.14842	-70.64757	353	-0.1	4.28%	7.79%
27	21 Huckins Ave.	43.14852	-70.64689	313	7.0	2.25%	3.92%
28	22 Huckins Ave.	43.14878	-70.64715	423	3.9	4.94%	7.42%
29	64 Long Sands Road	43.14624	-70.64686	523	24.3	2.87%	4.07%
30	72 Long Sands Road	43.14670	-70.64631	372	13.7	2.18%	3.82%
31	78 Long Sands Road	43.14692	-70.64597	340	6.7	2.61%	4.82%
32	86 Long Sands Road	43.14721	-70.64539	396	1.3	5.13%	8.00%
33	90 Long Sands Road	43.14734	-70.64501	476	-0.1	6.29%	8.23%
34	96 Long Sands Road	43.14774	-70.64455	583	0.4	5.73%	6.62%
35	8 Roots Rock Road	43.14727	-70.64671	147	2.1	6.69%	4.02%

Table 3: Calculated % MPE Results at Selected Points[6]

[6] Positive ground elevation differences indicate the selected point's ground elevation is lower than that of the proposed site; negative values indicate selected point is above that of the proposed site.

Figure 2 below is an aerial view of the proposed facility and the surrounding area. Labeled points indicate the selected locations analyzed in the % MPE calculations listed above in Table 3.

Figure 2: Aerial View of Selected Locations

6. Conclusion

The above analysis concludes that RF exposure levels from the site with AT&T's proposed configuration and the existing Town of York antennas will be well below the maximum permissible levels as outlined by the FCC in the OET Bulletin 65 Ed. 97-01. Using the conservative calculation methods and parameters detailed above, the maximum cumulative percent of MPE in consideration of AT&T's proposed installations and existing Town of York antennas is calculated to be **15.87% of the FCC limit (General Population/Uncontrolled)**. This maximum cumulative percent of MPE value is calculated to occur 102 feet away from the site.

The maximum cumulative percent of MPE of the selected points around the proposed site, with consideration to any ground elevation differences, is calculated to be **14.96% of the FCC limit (General Population/Uncontrolled)** and the highest percent of MPE calculated at 10' above ground level is **17.03% of the FCC limit (General Population /Uncontrolled).** This maximum percent of MPE value at both ground level and 10' AGL is calculated to occur at Location 12, approximately 108 feet east of the proposed site.

7. Statement of Certification

I certify to the best of my knowledge that the statements in this report are true and accurate. The calculations follow guidelines set forth in FCC OET Bulletin 65 Edition 97-01, IEEE Std. C95.1, IEEE Std. C95.3, and IEEE Std. C95.7.

Sokol Andoni

February 5, 2020

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RF Engineer
C Squared Systems, LLC

Date

Keith Vellante

February 7, 2020

Reviewed/Approved By: Keith Vellante
RF Manager
C Squared Systems, LLC

Date

Attachment A: References

OET Bulletin 65 - Edition 97-01 - August 1997 Federal Communications Commission Office of Engineering & Technology

IEEE C95.1-2005, IEEE Standard Safety Levels With Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz IEEE-SA Standards Board

IEEE C95.3-2002 (R2008), IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields With Respect to Human Exposure to Such Fields, 100 kHz-300 GHz IEEE-SA Standards Board

IEEE C95.7, IEEE Recommended Practice for Radio Frequency Safety Programs, 3 kHz to 300 GHz. IEEE-SA Standards Board

Attachment B: FCC Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure[7]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	f/300	6
1500-100,000	-	-	5	6

(B) Limits for General Population/Uncontrolled Exposure[8]

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	f/1500	30
1500-100,000	-	-	1.0	30

f = frequency in MHz * Plane-wave equivalent power density

Table 4: FCC Limits for Maximum Permissible Exposure

[7] Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

[8] General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

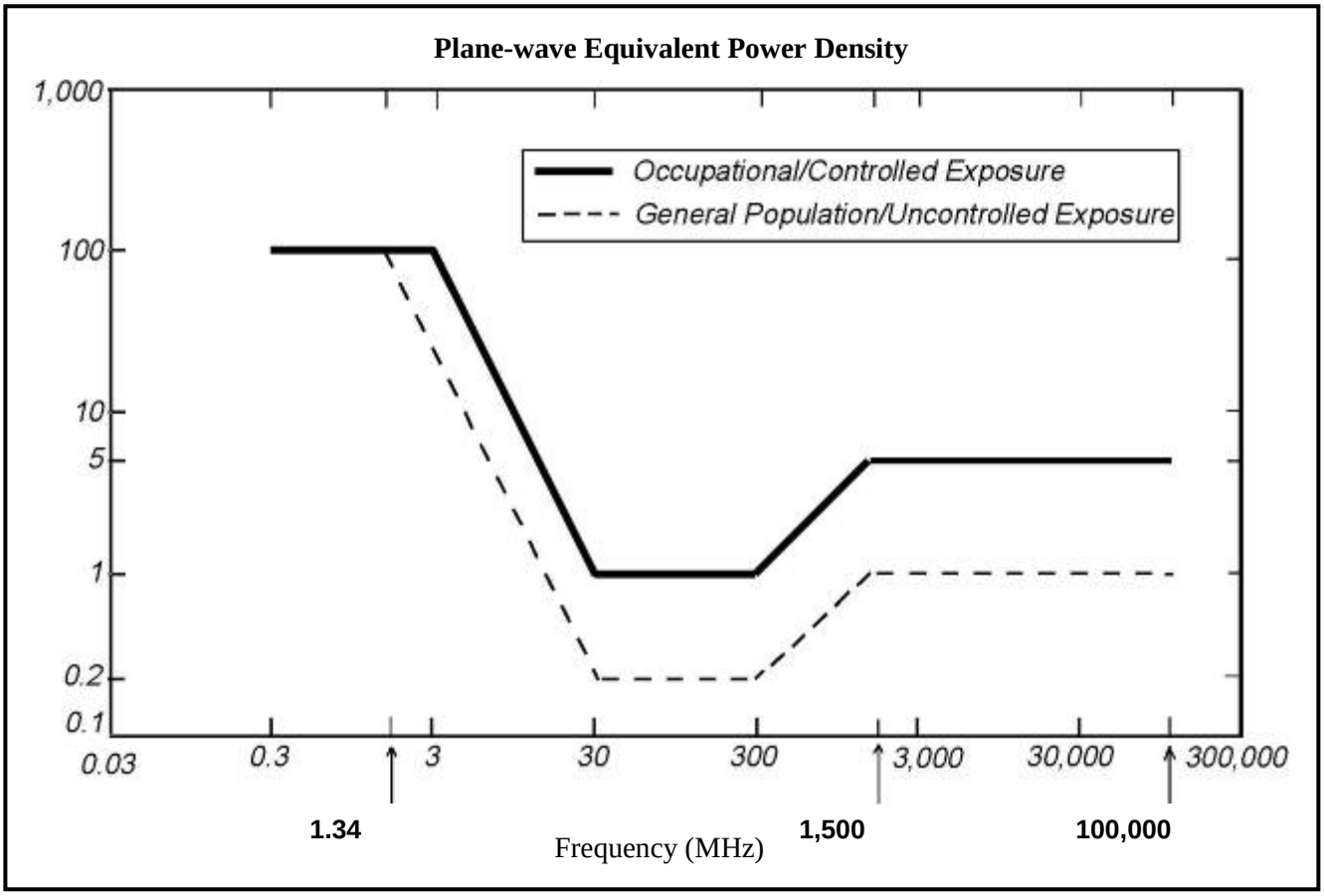
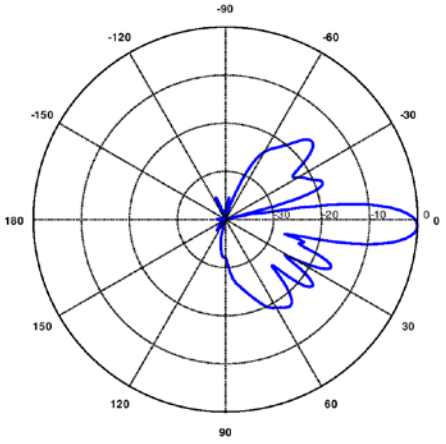


Figure 3: Graph of FCC Limits for Maximum Permissible Exposure (MPE)

Attachment C: AT&T Mobility Antenna Model Data Sheets and Electrical Patterns

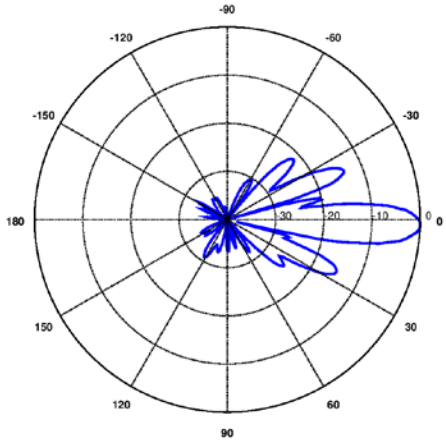
722 MHz

Manufacturer:	CCI
Model #:	HPA65R-BU8A
Frequency Band:	698-806 MHz
Gain:	15.5 dBi
Vertical Beamwidth:	9.7°
Horizontal Beamwidth:	67°
Polarization:	±45°
Dimensions (L x W x D):	96.0” x 11.7” x 7.6”



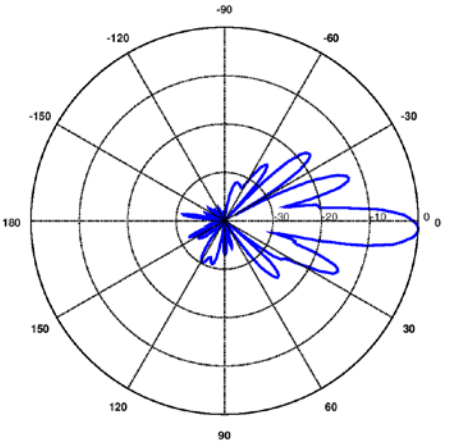
739/763 MHz

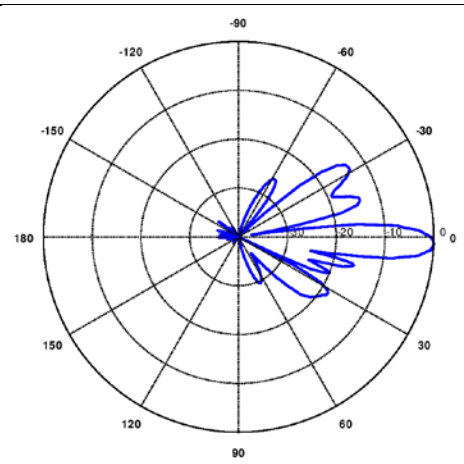
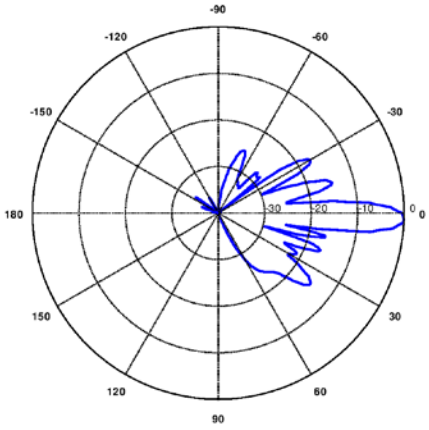
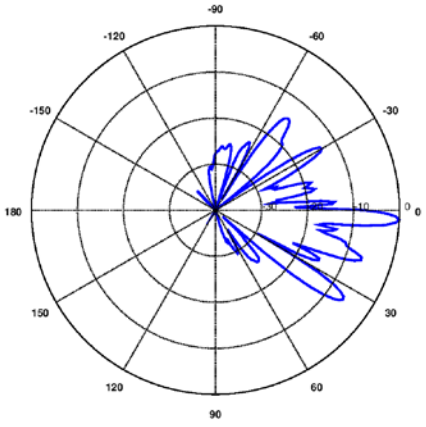
Manufacturer:	KMW
Model #:	EPBQ-654L8H8-L2
Frequency Band:	698-806 MHz
Gain:	15.9 dBi
Vertical Beamwidth:	9.3°
Horizontal Beamwidth:	67°
Polarization:	±45°
Dimensions (L x W x D):	96.0” x 21.0” x 6.3”



875 MHz

Manufacturer:	KMW
Model #:	EPBQ-654L8H8-L2
Frequency Band:	806-894 MHz
Gain:	16.2 dBi
Vertical Beamwidth:	8.7°
Horizontal Beamwidth:	66°
Polarization:	±45°
Dimensions (L x W x D):	96.0” x 21.0” x 6.3”



1900 MHz Manufacturer: KMW Model #: EPBQ-654L8H8-L2 Frequency Band: 1910-2180 MHz Gain: 17.7 dBi Vertical Beamwidth: 7.4° Horizontal Beamwidth: 60° Polarization: ±45° Dimensions (L x W x D): 96.0” x 21.0” x 6.3”	
2100 MHz Manufacturer: KMW Model #: EPBQ-654L8H8-L2 Frequency Band: 1910-2180 MHz Gain: 17.7 dBi Vertical Beamwidth: 7.4° Horizontal Beamwidth: 60° Polarization: ±45° Dimensions (L x W x D): 96.0” x 21.0” x 6.3”	
2300 MHz Manufacturer: CCI Model #: HPA65R-BU8A Frequency Band: 2300-2400 MHz Gain: 18.0 dBi Vertical Beamwidth: 4.0° Horizontal Beamwidth: 60° Polarization: ±45° Dimensions (L x W x D): 96.0” x 11.7” x 7.6”	

Attachment D: Town of York Antenna Model Data Sheets and Electrical Patterns

170 MHz

Manufacturer:	Telewave, Inc.
Model #:	ANT150F2
Frequency Band:	148-174 MHz
Gain:	4.65 dBi
Vertical Beamwidth:	38°
Horizontal Beamwidth:	360°
Polarization:	Vertical
Dimensions (L x W):	60” x 2.75