CENTERLINE

Radio Frequency – Electromagnetic Energy (RF-EME) Compliance Report

T-Mobile Water Tank Facility

Report Findings: T-Mobile is in compliance with FCC Regulations.

Site ID: 4BN0138A
Site Name: BN138/Twr Rd WT RFP
24 Tower Rd, Ashland, MA 01721
4/2/2024

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1.0 Executive Summary

Centerline has been contracted to perform a radio frequency (RF) analysis for a proposed equipment upgrade at the following T-Mobile wireless facility. This analysis includes theoretical emissions calculations ("Modeled Measurements"), which were performed assuming that all of the proposed radios operate at full power and uncombined in their RF paths to yield a worst-case scenario.

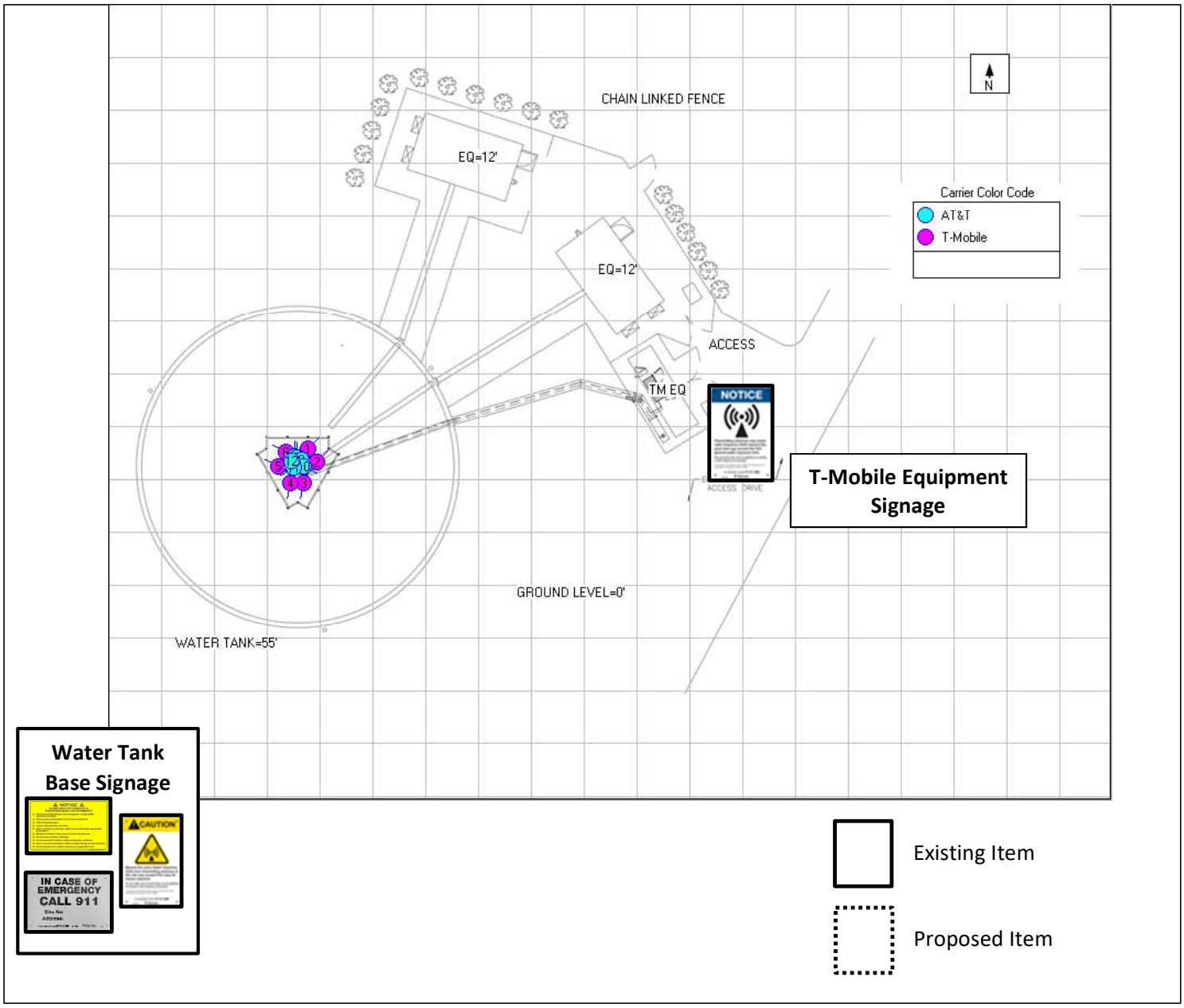
The facility (Site ID: 4BN0138A) is located on a water tank in Ashland, MA.

T-Mobile Measurements – Maximum Permissible Exposure (MPE%)

Measurement Type	General Population/ Uncontrolled (GP)	Occupational/ Controlled (OCC)
Max Modeled Measurement on Water Tank	6.59%	1.32%
Max Modeled Measurement at Ground Level	6.65%	1.33%

The FCC has established safety guidelines relating to potential RF-EME exposure from radio transmitters. FCC regulations define two separate tiers of exposure limits: Occupational/Controlled and General Population/Uncontrolled. The General Population limits are five times more conservative or restrictive than the Occupational limits and these limits apply to accessible areas where workers or the general public may be exposed to RF-EME. Areas equal to or greater than 100% GP MPE (20% OCC MPE) should use methods to reduce or control exposure. Any wireless operator that contributes 5% GP MPE (1% OCC MPE) or greater in an area that is identified to be greater than 100% GP MPE (20% OCC MPE) is responsible for taking corrective actions to bring the site into compliance.

In all areas of the site, the Modeled Measurement is less than 100% GP MPE (20% OCC MPE). T-Mobile has appropriate RF signage installed at the site as shown in the diagram below:



For further details see Section 5 Safety Recommendations.

2.0 Antenna Inventory

The antenna data below was supplied by T-Mobile and used to perform the analysis:

Operator & Sector	Antenna Number	Technology	Antenna Make	Antenna Model	Azimuth (°)	Centerline Height (ft) AGL*
T-Mobile Alpha	1	L700	COMMSCOPE	FFVV-65A-R2-V1	45	86.50
T-Mobile Alpha	1	N600	COMMSCOPE	FFVV-65A-R2-V1	45	86.50
T-Mobile Alpha	1	G1900	COMMSCOPE	FFVV-65A-R2-V1	45	86.50
T-Mobile Alpha	1	L1900	COMMSCOPE	FFVV-65A-R2-V1	45	86.50
T-Mobile Alpha	1	N1900	COMMSCOPE	FFVV-65A-R2-V1	45	86.50
T-Mobile Alpha	1	L2100	COMMSCOPE	FFVV-65A-R2-V1	45	86.50
T-Mobile Alpha	2	N2500	ERICSSON	AIR6419	45	86.50
T-Mobile Alpha	2	N2500	ERICSSON	AIR6419	45	86.50
T-Mobile Beta	3	L700	COMMSCOPE	FFVV-65A-R2-V1	190	86.50
T-Mobile Beta	3	N600	COMMSCOPE	FFVV-65A-R2-V1	190	86.50
T-Mobile Beta	3	G1900	COMMSCOPE	FFVV-65A-R2-V1	190	86.50
T-Mobile Beta	3	L1900	COMMSCOPE	FFVV-65A-R2-V1	190	86.50
T-Mobile Beta	3	N1900	COMMSCOPE	FFVV-65A-R2-V1	190	86.50
T-Mobile Beta	3	L2100	COMMSCOPE	FFVV-65A-R2-V1	190	86.50
T-Mobile Beta	4	N2500	ERICSSON	AIR6419	190	86.50
T-Mobile Beta	4	N2500	ERICSSON	AIR6419	190	86.50
T-Mobile Gamma	5	L700	COMMSCOPE	FFVV-65A-R2-V1	300	86.50
T-Mobile Gamma	5	N600	COMMSCOPE	FFVV-65A-R2-V1	300	86.50
T-Mobile Gamma	5	G1900	COMMSCOPE	FFVV-65A-R2-V1	300	86.50
T-Mobile Gamma	5	L1900	COMMSCOPE	FFVV-65A-R2-V1	300	86.50
T-Mobile Gamma	5	N1900	COMMSCOPE	FFVV-65A-R2-V1	300	86.50
T-Mobile Gamma	5	L2100	COMMSCOPE	FFVV-65A-R2-V1	300	86.50
T-Mobile Gamma	6	N2500	ERICSSON	AIR6419	300	86.50
T-Mobile Gamma	6	N2500	ERICSSON	AIR6419	300	86.50

*Above Ground Level

Sectors are comprised of one or more antennas grouped on azimuth, the compass direction toward which the antennas are pointed. Technology refers to the standard or generation of wireless technology. Centerline is the distance from the middle of the antenna to a reference point.

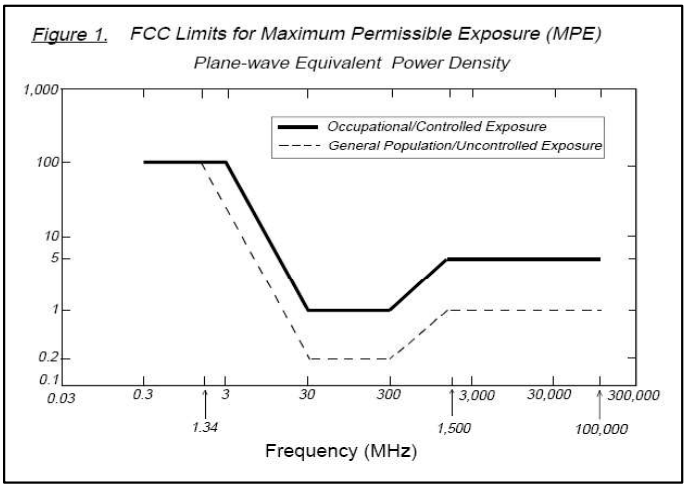
3.0 FCC Guidelines and Emissions Threshold Limits

All information used in this report was analyzed as a percentage of the MPE limits as detailed in 47 CFR § 1.1310 as well as Federal Communications Commission (FCC) OET Bulletin 65 Edition 97-01. The FCC MPE limits are typically expressed in units of milliwatts per square centimeter (mW/cm^2) or microwatts per square centimeter ($\mu W/cm^2$). The exposure limits vary depending upon the frequencies being utilized. The calculated power density at each sample point divided by the limit at each calculated frequency provides a result in % MPE. Summing the calculated % MPE from all contributors provides a cumulative % MPE at a particular sample point. Because exposure limits may vary for each frequency band, it is necessary to report % MPE rather than power density.

All results were compared to the FCC radio frequency exposure rules as detailed in 47 CFR § 1.1307(b) to determine compliance with the MPE limits for General Population/Uncontrolled environments as defined below. Additional details can be found in FCC OET 65.

Limits for Maximum Permissible Exposure (MPE)				
(A) Limits for Occupational/Controlled Exposure				
Frequency Range (MHz)	**Electric Field Strength (E) (V/m)**	**Magnetic Field Strength (H) (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/f2)*	6
30-300	61.4	0.163	1	6
300-1,500	--	--	f/300	6
1,500-	--	--	5	6
(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (E) (V/m)**	**Magnetic Field Strength (H) (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/f2)*	30
30-300	27.5	0.073	0.2	30
300-1,500	--	--	f/1,500	30
1,500-	--	--	1	30

f = Frequency in (MHz)
* Plane-wave equivalent power density

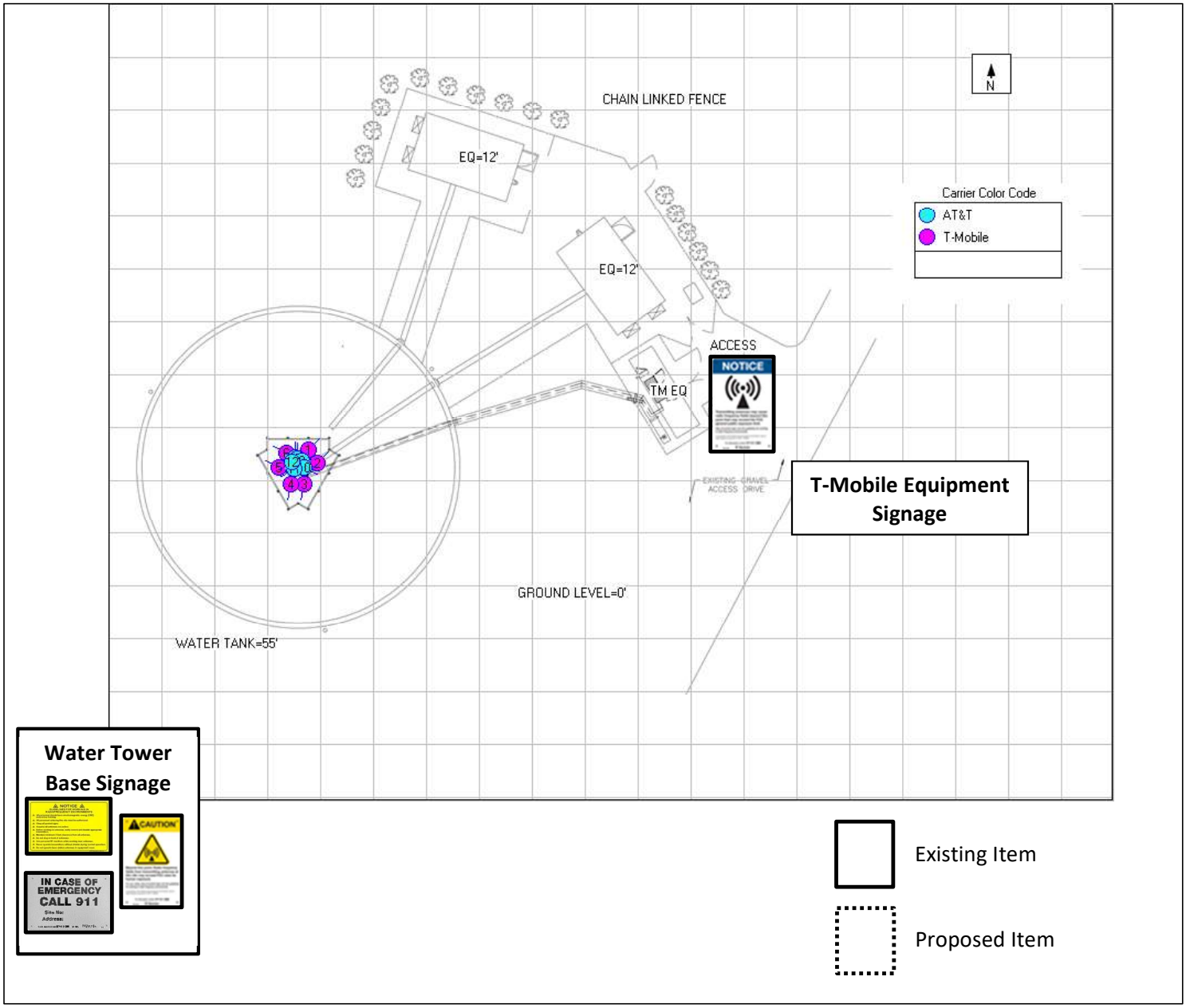


4.0 Modeled Measurements

Modeled calculations were performed based upon the data listed in Section 2.0 Antenna Inventory. All modeled calculations for this facility were performed assuming that all radios were running at full power and were uncombined in their RF paths with the configuration shown in Table 1. FCC OET Bulletin 65 – Edition 97-01 recommends that modeling of this nature should be done as described prior to yield a worst-case scenario. Due to the dynamic nature of many deployed systems the "real world" values will most likely be less than those shown in this section due to worst-case values being shown in all instances. For further details on how these calculations were performed, see Appendix A: Calculation Methodology.

Measurement Type	General Population/ Uncontrolled (GP)	Occupational/ Controlled (OCC)
Max Modeled Measurement on Water Tank	6.59%	1.32%
Max Modeled Measurement at Ground Level	6.65%	1.33%

5.0 Safety Recommendations



Access	• No action needed.
Alpha Sector	• No action needed.
Beta Sector	• No action needed.
Gamma Sector	• No action needed.

Occupational Safety and Health Administration (OSHA) Requirements

OSHA requires that those in the Occupational classification must complete training in RF Safety, RF Awareness, and Utilization of Personal Protective Equipment. OSHA also provides options for Hazard Prevention and Control:

Hazard Prevention	Control
• Utilization of good equipment • Enact control of hazard areas • Limit exposures • Employ medical surveillance and accident response	• Employ Lockout/Tag out • Utilize personal alarms & protective clothing • Prevent access to hazardous locations • Develop or operate an administrative control program

RF Signage and Barriers

RF signs should be obeyed at all times.

Sign	Description
	**RF Guideline Sign** Gives guidelines on how to proceed in areas that may exceed either the FCC's General Population or Occupational exposure limits.
	**Information Sign** Informational Sign to be posted at access points.
	**Blue Notice Sign** Used to inform individuals that they are entering an area that may exceed the FCC's General Population limits. It must be placed so it is visible from all approachable sides. It must also be just outside of the area predicted to exceed the MPE limits so it can be read without standing within the affected area.
	**Yellow Caution Sign** Used to inform individuals that they are entering an area that may exceed either the FCC's General Population or Occupational exposure limits. It must be placed so it is visible from all approachable sides. It must also be just outside of the area predicted to exceed the MPE limits so it can be read without standing within the affected area.
	**Orange Warning Sign** Used to inform individuals that they are entering an area that may exceed 10x the FCC's Occupational exposure limit. It must be placed so it is visible from all approachable sides. It must also be just outside of the area predicted to exceed the MPE limits so it can be read without standing within the affected area.

If there are workers in an area with a sign that they do not understand, they can call the NOC Number at 877-611-5868 for guidance.

6.0 Conclusion

In all areas of the site, the Modeled Measurement is less than 100% General Population MPE (20% Occupational MPE). Based on worst-case predictive modeling, there are no areas at ground level at this site related to the proposed antennas that exceed the FCC's General Population or Occupational MPE limits. At ground level, the maximum power density generated by the antennas is approximately 6.65% GP MPE (1.33% OCC MPE).

The facility is compliant with FCC regulations. No further action is required by T-Mobile policy.

To reduce the risk of exposure and/or injury, Centerline recommends that access to the areas associated with the active antenna installation be restricted and secured where possible.

7.0 Certification

Michael Fischer, P.E.
Registered Professional Engineer (Electrical)
Pennsylvania License Number PE076436
Expires September 30, 2025

Signed 02 April 2024

Michael Fischer

Site ID: 4BN0138A
Site Name: BN138/Twr Rd WT RFP
Site Address: 24 Tower Rd, Ashland, MA 01721

Appendix A: Calculation Methodology

Centerline has performed theoretical calculations on all transmission equipment located on this facility. All calculations have been performed using the RoofMaster® software from Waterford Consultants LLC. This software performs calculations using a cylindrical model for very conservative power density predictions within the near-field of the antenna where the antenna pattern has not truly formed yet. Within this area power density values tend to decrease based upon an inverse distance function. At the point where it is appropriate for modeling to change from near-field calculations to far-field calculations the power decreases inversely with the square of the distance. This modeling technique is accurate with low antenna centerlines, such as rooftops, where persons can get close to the antennas and pass through fields in close proximity.

The below calculation in Figure 1 shows the theoretical distribution of power over an imaginary cylinder with equal power distribution in all directions.

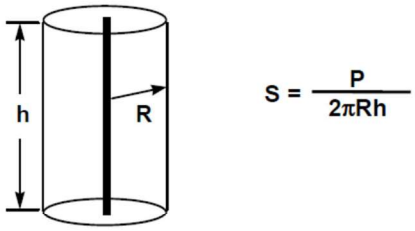


Figure 1: Distribution of power over an imaginary cylinder in all directions

This model can be modified for directional antennas to show directionality of power distribution. This formula will tend to be conservative as it assumes that all power is focused between the 3 dB power roll off points as shown in Figure 2.

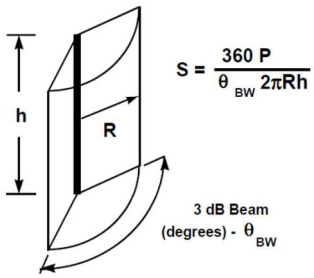


Figure 2: Distribution of power over an imaginary cylinder in all directions inside the half power roll off points (HBW)

The antenna configuration for T-Mobile at this facility is shown above in **Section 2.0 Antenna Inventory**. All calculations for this facility were performed assuming that all radios were running at full power and were uncombined in their RF paths with the configuration shown in table 1. FCC OET Bulletin 65 – Edition 97-01 recommends that modeling of this nature should be done as described prior to yield a worst-case scenario. Due to the dynamic nature of many deployed systems the "real world" values will most likely be less than those shown in this report due to worst-case values being shown in all instances. For all "Other" systems at this facility, exact equipment was used if available. In instances where "Other" system equipment was not available, standard radio configurations for these systems were utilized based upon prior experience with these systems on facilities in this area.