

**– City of Palo Alto –
Crown Castle • DAS Node Compliance Study
Nineteen Light Pole Locations • Palo Alto, California**

Statement of Hammett & Edison, Inc., Consulting Engineers

The firm of Hammett & Edison, Inc., Consulting Engineers, has been retained by the City of Palo Alto to evaluate the distributed antenna system located in Palo Alto, California, for compliance with appropriate guidelines limiting human exposure to radio frequency (“RF”) electromagnetic fields.

Executive Summary

Crown Castle had installed a Distributed Antenna System (DAS) in Palo Alto, consisting of antennas on nineteen municipal light poles. All radio frequency exposure levels under the existing conditions for anyone in publicly accessible areas near any of these nodes were well below the federal standard.

Prevailing Exposure Standards

The U.S. Congress requires that the Federal Communications Commission (“FCC”) evaluate its actions for possible significant impact on the environment. A summary of the FCC’s exposure limits is shown in Figure 1. These limits apply for continuous exposures and are intended to provide a prudent margin of safety for all persons, regardless of age, gender, size, or health. The most restrictive FCC limit for exposures of unlimited duration to radio frequency energy for several wireless services are as follows:

<u>Wireless Service</u>	<u>Frequency Band</u>	<u>Occupational Limit</u>	<u>Public Limit</u>
Microwave (Point-to-Point)	5–80 GHz	5.00 mW/cm ²	1.00 mW/cm ²
WiFi (and unlicensed uses)	2–6	5.00	1.00
BRS (Broadband Radio)	2,600 MHz	5.00	1.00
WCS (Wireless Communication)	2,300	5.00	1.00
AWS (Advanced Wireless)	2,100	5.00	1.00
PCS (Personal Communication)	1,950	5.00	1.00
Cellular	870	2.90	0.58
SMR (Specialized Mobile Radio)	855	2.85	0.57
700 MHz	700	2.40	0.48
[most restrictive frequency range]	30–300	1.00	0.20

General Facility Requirements

Antennas for base station use are designed to concentrate their energy toward the horizon, with very little energy wasted toward the sky or the ground. Along with the low power of such facilities, this means that it is generally not possible for exposure conditions to approach the FCC limits without being physically very near the antennas.

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Site Description

Crown Castle had installed 2-foot panel antennas high on the side of municipal light poles in public rights-of-way at nineteen locations within the City of Palo Alto, as listed in Figure 2. The sites were visited by Mr. Kevin Thompson, a qualified field technician employed by Hammett & Edison, Inc., on May 17, 18, and 27, 2017. Access to the antennas was restricted by their mounting heights. There were observed no other wireless telecommunications base stations located at any of these sites. A photograph of each node, taken at the time of the measurements, is included in Figure 3.

Measurement Results

The measurement equipment used was a Wandel & Goltermann Type EMR-300 Radiation Meter with Type 18 and 25 Isotropic Electric Field Probes (Serial Nos. F-0034 and E-0001, respectively). The meter and probes were under current calibration by the manufacturer. Power density measurements were taken at the individual antennas using a bucket-truck and at ground-level locations along the sidewalks and streets near each of the nineteen light poles. The applicable FCC public limit for the reported operation by Verizon Wireless in the AWS and PCS bands from these nodes is 1.0 mW/cm². Measured exposure conditions exceeding this public limit did not extend more than 1 foot in front of the antennas; conditions did not exceed the occupational limit at any of the antennas.

The maximum observed power density level for a person at ground near any of the nineteen nodes was 0.00070 mW/cm². With such low measured levels, it is likely that other RF sources may be contributing to the total; therefore, to be conservative, the maximum measured levels at ground are evaluated against 0.2 mW/cm², which is the most restrictive FCC public limit at any frequency. The maximum exposure level reported above represents 0.35% of that limit, and Figure 2 lists the maximum observed level near each of the nodes. The three-dimensional perimeter of RF levels equal to the public exposure limit did not reach any publicly accessible areas.

Conclusion

Based on the information and analysis above, it is the undersigned's professional opinion that the Crown Castle nineteen-node Distributed Antenna System in Palo Alto, California, as installed and operating at the time of the visits, complies with the FCC guidelines limiting public exposure to radio frequency energy and, therefore, does not for this reason cause a significant impact on the environment. The highest measured level in publicly accessible areas is much less than the prevailing standards allow for exposures of unlimited duration. The operations can be considered intrinsically compliant with the guidelines, so no mitigation measures are necessary for authorized persons who may need to work near the antennas.

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Authorship

This Compliance Certification has been prepared by the undersigned qualified Professional Engineer, holding California Registration Nos. E-13026 and M-20676, which expire on June 30, 2017. This work has been carried out under his direction, and all statements are true and correct of his own knowledge except, where noted, when data has been supplied by others, which data he believes to be correct.



A handwritten signature in blue ink that reads "William F. Hammett". The signature is written over a horizontal line.

William F. Hammett, P.E.
707/996-5200

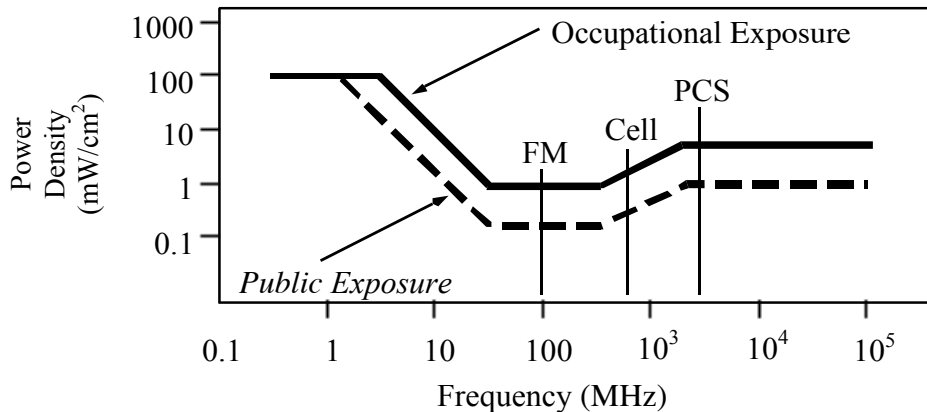
June 9, 2017

FCC Radio Frequency Protection Guide

The U.S. Congress required (1996 Telecom Act) the Federal Communications Commission (“FCC”) to adopt a nationwide human exposure standard to ensure that its licensees do not, cumulatively, have a significant impact on the environment. The FCC adopted the limits from Report No. 86, “Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields,” published in 1986 by the Congressionally chartered National Council on Radiation Protection and Measurements (“NCRP”). Separate limits apply for occupational and public exposure conditions, with the latter limits generally five times more restrictive. The more recent standard, developed by the Institute of Electrical and Electronics Engineers and approved as American National Standard ANSI/IEEE C95.1-2006, “Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,” includes similar limits. These limits apply for continuous exposures from all sources and are intended to provide a prudent margin of safety for all persons, regardless of age, gender, size, or health.

As shown in the table and chart below, separate limits apply for occupational and public exposure conditions, with the latter limits (in *italics* and/or dashed) up to five times more restrictive:

Frequency Applicable Range (MHz)	Electromagnetic Fields (f is frequency of emission in MHz)					
	Electric Field Strength (V/m)		Magnetic Field Strength (A/m)		Equivalent Far-Field Power Density (mW/cm ²)	
0.3 – 1.34	614	<i>614</i>	1.63	<i>1.63</i>	100	<i>100</i>
1.34 – 3.0	614	<i>823.8/f</i>	1.63	<i>2.19/f</i>	100	<i>180/f²</i>
3.0 – 30	1842/f	<i>823.8/f</i>	4.89/f	<i>2.19/f</i>	900/f ²	<i>180/f²</i>
30 – 300	61.4	<i>27.5</i>	0.163	<i>0.0729</i>	1.0	<i>0.2</i>
300 – 1,500	3.54√f	<i>1.59√f</i>	√f/106	<i>√f/238</i>	f/300	<i>f/1500</i>
1,500 – 100,000	137	<i>61.4</i>	0.364	<i>0.163</i>	5.0	<i>1.0</i>



Higher levels are allowed for short periods of time, such that total exposure levels averaged over six or thirty minutes, for occupational or public settings, respectively, do not exceed the limits, and higher levels also are allowed for exposures to small areas, such that the spatially averaged levels do not exceed the limits. However, neither of these allowances is incorporated in the conservative calculation formulas in the FCC Office of Engineering and Technology Bulletin No. 65 (August 1997) for projecting field levels. Hammett & Edison has built those formulas into a proprietary program that calculates, at each location on an arbitrary rectangular grid, the total expected power density from any number of individual radio sources. The program allows for the description of buildings and uneven terrain, if required to obtain more accurate projections.



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Measurement Results at Ground

Node #	Approximate Site Address	Maximum Measured Exposure Level	
		Power Density	vs. FCC Limit*
P01m	Across from 514 High Street	0.00012 mW/cm ²	0.060%
P02m2	Across from 471 Emerson Street	0.000090	0.045
P03m	Across from 470 Ramona Street	0.000054	0.027
P04m	Across from 450 Bryant Street	0.000096	0.048
P05m	Across from 461 Florence Street	0.00016	0.080
P06m2	Across from 502 Waverley Street	0.00019	0.095
P07m2	400 Hamilton Avenue	0.00050	0.25
P08m	300 Hamilton Avenue	0.00022	0.11
P09m2	635 Bryant Street	0.00040	0.20
P10m	158 Hamilton Avenue	0.00024	0.12
P11m	100 Hamilton Avenue	0.00026	0.13
P12m2	379 Lytton Avenue	0.00040	0.20
P13m	181 Lytton Avenue	0.00022	0.11
P14m	245 Lytton Avenue	0.00015	0.075
P15m	265 Lytton Avenue	0.00016	0.080
P16m	325 Lytton Avenue	0.00028	0.14
P17m	437 Lytton Avenue	0.00070	0.35
P18m	380 Hamilton Avenue	0.00017	0.085
P19m	220 Hamilton Avenue	0.00022	0.11

* Most restrictive FCC public exposure limit is 0.2 mW/cm².



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P01m



P02m2



P03m



P04m

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P05m



P06m2



P07m2



P08m

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P09m2



P10m



P11m



P12m2



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P13m



P14m



P15m



P16m



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P17m



P18m



P19m

