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TOWN OF NEEDHAM
BOARD OF SELECTMEN

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April 7, 2017

VIA OVERNIGHT DELIVERY

Town of Needham
Board of Selectmen
1471 Highland Avenue, First Floor
Needham, MA 02492
Attn: Matthew Borrelli, Chairman

Re: Grant of Location Application to Install Wireless Antennas and Equipment on Existing Utility Poles in the Public Right of Way

Applicant: Cellco Partnership d/b/a Verizon Wireless ("VzW")

Dear Chairman Borrelli:

The purpose of this letter is to submit twelve (12) Grant of Location Petitions to install wireless communications equipment on separate and existing utility poles in Needham's public right of way in accordance with Chapter 166, Section 22 of the Massachusetts General Laws.

I. APPLICATION MATERIALS

Enclosed please find one (1) Petition, one (1) Order, and one (1) 11" x 17" plan-set for each utility pole listed in the table below. Also, please find one (1) Safety Report, and one (1) Federal Communications Commission ("FCC") license addressing the Cloud Radio Access Network ("CRAN").

	<u>VZW SITE NAME</u>	<u>UTILITY POLE NUMBER</u>	<u>APPROXIMATE ADDRESS</u>
1.	Needham MA SC01	168-1	20 Great Plain Terrace
2.	Needham MA SC06	7	609 Webster Street
3.	Needham MA SC10	33/30	270 Hunnewell Street
4.	Needham SC03 MA	14	97 Melrose Avenue
5.	Needham SC04 MA	27-0	7 Stevens Road

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6.	Needham SC05 MA	146/25	200 Harris Avenue
7.	Needham SC07 MA	67	443 Great Plain Avenue
8.	Needham SC09 MA	97/51	Dedham Avenue & South Street
9.	Needham SC16 MA	7-101	Central Avenue
10.	Needham SC19 MA	116-1	1250 Great Plain Avenue
11.	Needham SC21 MA	72-3	33 Chestnut Place
12.	Needham W SC03 MA	25	1437 Great Plain Avenue

II. PROJECT NARRATIVE & CRAN TECHNOLOGY

Wireless communications technology comprises the fastest growing segment of the communications industry. In 2017, rapidly developing technology, combined with insatiable consumer demand, has created a void in wireless infrastructure that service providers, such as Verizon, seek to remedy. In response to Needham's existing coverage gap, and given the FCC's recent 5G imperative, Verizon seeks to invest in wireless infrastructure to improve Needham's wireless network.

In the last year, Verizon rapidly introduced CRAN technology throughout the Commonwealth. This stealth antenna technology provides a pinpointed and camouflaged approach to the continued deployment of Verizon's LTE, AWS, and burgeoning 5G networks in Massachusetts. In essence, CRAN systems mount innocuous transformer-style antennas to existing utility poles. This covert—and site specific installation—allows Verizon to dramatically increase network capacity by accessing fiberoptic infrastructure connected to offsite and centrally located processing stations. CRAN's combination of targeted antennas and centralized processing provides enormous benefits to municipalities such as Needham, where network capacity demands are weighed against municipal aesthetics.

Each unit consists of a 12'0" x 38.7" cylindrical gray "Small Cell" antenna, designed to resemble common electric transformers seen throughout the United States. All proposed equipment 1) complies with applicable FCC radio frequency emissions standards and regulations, 2) requires minimal maintenance, and 3) does not impact utility, school, traffic or other municipal resources. Here, Verizon proposes mounting these units to the utility poles listed in Section I above.

Additionally, as stated herein, this proposal is part of Verizon's regional initiative to improve voice and data coverage in Massachusetts while developing 5G technology throughout greater

New England. To this end, Verizon secured master licensing agreements with National Grid and Eversource expediting the licensing and attachment of CRAN antennas to existing utility poles throughout the Commonwealth, including the Town of Needham.

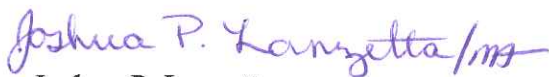
III. MUNICIPAL REVIEW OF CRAN AND SMALL CELL TECHNOLOGY

Under Massachusetts law, the grant of location process enables municipalities to oversee infrastructure development in the Commonwealth's public ways. M.G.L.A. 166 § 22 (2016). This process balances the goal of maintaining useable and navigable public ways with the Commonwealth's continued need for infrastructure development and directly intersects with federal telecommunications laws. M.G.L.A. 166 § 21 (2016). Generally, federal telecommunications law seeks to expedite wireless infrastructure development by limiting local zoning regulation of wireless facilities. 47 U.S.C. § 332(A) (1996). As such, when considering Grant of Location petitions for telecommunications facilities, Select Boards must consider 1) that Massachusetts and the federal government specifically seek to encourage expedited development of wireless communications infrastructure; 2) the TCA prohibits municipalities from taking action that prohibits or delays such development; and 3) municipalities must issue an order granting location to such projects if such development does not disrupt the continued use of the public way.

IV. CONCLUSION

For the aforementioned reasons, Verizon respectfully requests that the Board of Selectmen execute the Grant of Location Orders submitted herein. Please contact me with questions at 603-628-3162 or joshua.lanzetta@mclane.com.

Sincerely,



Joshua P. Lanzetta

JPL

Enclosures/

ULS License

PCS Broadband License - KNLH242 - Cellco Partnership**PA** This license has pending applications: 0007716969

Call Sign	KNLH242	Radio Service	CW - PCS Broadband
Status	Active	Auth Type	Regular

Market

Market	BTA051 - Boston, MA	Channel Block	F
Submarket	0	Associated Frequencies (MHz)	001890.00000000- 001895.00000000- 001970.00000000- 001975.00000000

Dates

Grant	07/23/2007	Expiration	06/27/2017
Effective	11/01/2016	Cancellation	

Buildout Deadlines

1st	06/27/2002	2nd	
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Notification Dates

1st	05/17/2002	2nd	
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Licensee

FRN	0003290673	Type	Joint Venture
-----	------------	------	---------------

Licensee

Cellco Partnership 5055 North Point Pkwy, NP2NE Network Engineering Alpharetta, GA 30022 ATTN Regulatory	P:(770)797-1070 F:(770)797-1036 E:LicensingCompliance@VerizonWireless.com
---	---

Contact

Verizon Wireless Licensing - Manager 5055 North Point Pkwy, NP2NE Network Engineering Alpharetta, GA 30022 ATTN Regulatory	P:(770)797-1070 F:(770)797-1036 E:LicensingCompliance@VerizonWireless.com
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Ownership and Qualifications

Radio Service Type	Mobile
Regulatory Status	Common Carrier Interconnected Yes

Alien Ownership

Is the applicant a foreign government or the representative of any foreign government?	No
Is the applicant an alien or the representative of an alien?	No
Is the applicant a corporation organized under the laws of any foreign government?	No
Is the applicant a corporation of which more than one-fifth of the capital stock is owned of record or voted by aliens or their representatives or by a foreign government or representative	No

thereof or by any corporation organized under the laws of a foreign country?

Is the applicant directly or indirectly controlled by any other corporation of which more than one-fourth of the capital stock is owned of record or voted by aliens, their representatives, or by a foreign government or representative thereof, or by any corporation organized under the laws of a foreign country?

Yes

The Alien Ruling question is not answered.

Basic Qualifications

The Applicant answered "No" to each of the Basic Qualification questions.

Tribal Land Bidding Credits

This license did not have tribal land bidding credits.

Demographics

Race

Ethnicity

Gender

ULS License

700 MHz Upper Band (Block C) License - WQJQ689 - Cellco Partnership**PA** This license has pending applications: 0007581227

Call Sign	WQJQ689	Radio Service	WU - 700 MHz Upper Band (Block C)
Status	Active	Auth Type	Regular
Market			
Market	REA001 - Northeast	Channel Block	C
Submarket	0	Associated Frequencies (MHz)	000746.00000000- 000757.00000000- 000776.00000000- 000787.00000000

Dates

Grant	11/26/2008	Expiration	06/13/2019
Effective	01/31/2017	Cancellation	

Buildout Deadlines

1st	06/13/2013	2nd	06/13/2019
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Notification Dates

1st	06/20/2013	2nd	
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Licensee

FRN	0003290673	Type	General Partnership
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Licensee

Cellco Partnership 5055 North Point Pkwy, NP2NE Network Engineering Alpharetta, GA 30022 ATTN Regulatory	P:(770)797-1070 F:(770)797-1036 E:LicensingCompliance@VerizonWireless.com
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Contact

Verizon Wireless Licensing Manager 5055 North Point Pkwy, NP2NE Network Engineering Alpharetta, GA 30022 ATTN Regulatory	P:(770)797-1070 F:(770)797-1036 E:LicensingCompliance@VerizonWireless.com
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Ownership and Qualifications

Radio Service Type	Mobile
Regulatory Status	Common Carrier Interconnected Yes

Alien Ownership

The Applicant answered "No" to each of the Alien Ownership questions.

Basic Qualifications

The Applicant answered "No" to each of the Basic Qualification questions.

Tribal Land Bidding Credits

This license did not have tribal land bidding credits.

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Race

Ethnicity

Gender

ULS License

AWS (1710-1755 MHz and 2110-2155 MHz) License - WQGB266 - Cellco Partnership

Call Sign	WQGB266	Radio Service	AW - AWS (1710-1755 MHz and 2110-2155 MHz)
Status	Active	Auth Type	Regular
Market			
Market	CMA006 - Boston-Lowell-Brockton-Lawrence-Haverhill, MA-NH	Channel Block	A
Submarket	0	Associated Frequencies (MHz)	001710.00000000- 001720.00000000- 002110.00000000- 002120.00000000

Dates

Grant	11/29/2006	Expiration	11/29/2021
Effective	11/01/2016	Cancellation	

Buildout Deadlines

1st	2nd
-----	-----

Notification Dates

1st	2nd
-----	-----

Licensee

FRN	0003290673	Type	General Partnership
-----	------------	------	---------------------

Licensee

Cellco Partnership	P:(770)797-1070
5055 North Point Pkwy, NP2NE Network Engineering	F:(770)797-1036
Alpharetta, GA 30022	E:LicensingCompliance@VerizonWireless.com
ATTN Regulatory	

Contact

Cellco Partnership	P:(770)797-1070
Licensing Manager	F:(770)797-1036
5055 North Point Pkwy, NP2NE Network Engineering	E:LicensingCompliance@VerizonWireless.com
Alpharetta, GA 30022	
ATTN Regulatory	

Ownership and Qualifications

Radio Service Type	Mobile
Regulatory Status	Common Carrier Interconnected Yes

Alien Ownership

Is the applicant a foreign government or the representative of any foreign government?	No
Is the applicant an alien or the representative of an alien?	No
Is the applicant a corporation organized under the laws of any foreign government?	No

Is the applicant a corporation of which more than one-fifth of the

capital stock is owned of record or voted by aliens or their representatives or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country? No

Is the applicant directly or indirectly controlled by any other corporation of which more than one-fourth of the capital stock is owned of record or voted by aliens, their representatives, or by a foreign government or representative thereof, or by any corporation organized under the laws of a foreign country? Yes

If the answer to the above question is 'Yes', has the applicant received a ruling(s) under Section 310(b)(4) of the Communications Act with respect to the same radio service involved in this application? Yes

Basic Qualifications

The Applicant answered "No" to each of the Basic Qualification questions.

Tribal Land Bidding Credits

This license did not have tribal land bidding credits.

Demographics

Race

Ethnicity

Gender

ULS License

AWS (1710-1755 MHz and 2110-2155 MHz) License - WQGA900 - Cellco Partnership

Call Sign	WQGA900	Radio Service	AW - AWS (1710-1755 MHz and 2110-2155 MHz)
Status	Active	Auth Type	Regular
Market			
Market	BEA003 - Boston-Worcester-Lawrence-Lowell-Brockton, MA-NH-RI-VT	Channel Block	B
Submarket	1	Associated Frequencies (MHz)	001720.00000000-001730.00000000-002120.00000000-002130.00000000

Dates

Grant	11/29/2006	Expiration	11/29/2021
Effective	11/01/2016	Cancellation	

Buildout Deadlines

1st	2nd
-----	-----

Notification Dates

1st	2nd
-----	-----

Licensee

FRN	0003290673	Type	General Partnership
-----	------------	------	---------------------

Licensee

Cellco Partnership 5055 North Point Pkwy, NP2NE Network Engineering Alpharetta, GA 30022 ATTN Regulatory	P:(770)797-1070 F:(770)797-1036 E:LicensingCompliance@VerizonWireless.com
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Contact

Cellco Partnership Licensing Manager 5055 North Point Pkwy, NP2NE Network Engineering Alpharetta, GA 30022 ATTN Regulatory	P:(770)797-1070 F:(770)797-1036 E:LicensingCompliance@VerizonWireless.com
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Ownership and Qualifications

Radio Service Type	Mobile
Regulatory Status	Common Carrier Interconnected Yes

Alien Ownership

The Applicant answered "No" to each of the Alien Ownership questions.

Basic Qualifications

The Applicant answered "No" to each of the Basic Qualification questions.

Tribal Land Bidding Credits

This license did not have tribal land bidding credits.

Demographics

Race	Gender
Ethnicity	



Universal Licensing System

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ULS License

Cellular License - KNKA201 - Cellco Partnership

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MAIN ADMIN LOCATIONS

Call Sign	KNKA201	Radio Service	CL - Cellular
Status	Active	Auth Type	Regular
Market			
Market	CMA006 - Boston-Lowell-Brockton-Lawrence-Haverhill, MA-NH	Channel Block	B (View Frequencies)
Submarket	0	Phase	2
Dates			
Grant	08/26/2014	Expiration	10/01/2024
Effective	11/01/2016	Cancellation	

Five Year Buildout Date

08/27/1989

Control Points

3 500 W. Dove Rd., TARRANT, Southlake, TX
P: (800)264-6620

Licensee

FRN	0003290673 (View Ownership Filing)	Type	General Partnership
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Licensee

Cellco Partnership	P:(770)797-1070
5055 North Point Pkwy, NP2NE Network Engineering	F:(770)797-1036
Alpharetta, GA 30022	E:LicensingCompliance@VerizonWireless.com
ATTN Regulatory	

Contact

Cellco Partnership	P:(770)797-1070
Licensing Manager	F:(770)797-1036
5055 North Point Pkwy, NP2NE Network Engineering	E:LicensingCompliance@VerizonWireless.com
Alpharetta, GA 30022	
ATTN Regulatory	

Ownership and Qualifications

Radio Service Type	Mobile		
Regulatory Status	Common Carrier	Interconnected	Yes

Alien Ownership

The Applicant answered "No" to each of the [Alien Ownership](#) questions.

Basic Qualifications

The Applicant answered "No" to each of the [Basic Qualification](#) questions.

Demographics

Race

Ethnicity

Gender

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DONALD L. HAES, JR., PH.D., CHP

Radiation Safety Specialist

MA Radiation Control Program Health Physics Services Provider Registration #65-0017
PO Box 198, Hampstead, NH 03841 603-303-9959 Email: donald_haes_chp@comcast.net

April 1, 2017

RE: Proposed installations of radio base station antennas and associated equipment for the Verizon Wireless Small Cell Personal Wireless Services facilities to be located on 12 different utility poles in Needham, MA.

PURPOSE

I have reviewed the information pertinent to the Verizon Wireless proposed installation of a total of 12 small cell (SC) personal wireless services (PWS) facilities at 12 different locations within Needham, MA. To determine regulatory compliance, theoretical calculations of maximal radio-frequency (RF) fields have been prepared for each site. The physical conditions are that Verizon Wireless proposes to install PWS omni-directional canister type antennas on 12 different utility poles. The antenna arrangement will include a single canister antenna on the utility pole along with two remote radio head (RRH) units. The mounting centerline height of the antennas varies according to the physical attributes of the individual host pole. This report provides written proof that the proposed facilities would comply with the all regulatory RF exposure guidelines.

This report considers the contributions of the Verizon Wireless PWS transmitters operating at their proposed capacity. The calculated values of RF fields are presented as a percent of current Maximum Permissible Exposures (%MPE) as adopted by the Federal Communications Commission (FCC),^{i,ii} and those established by the Massachusetts Department of Public Health (MDPH).ⁱⁱⁱ

SUMMARY

Theoretical RF field calculations data indicate the summation of the proposed Verizon Wireless RF contributions would be within the established RF exposure guidelines at each proposed site; see Figures 4A – 4L. This report provides written proof that the proposed facilities would comply with the FCC and MDPH RF exposure guidelines, including residential areas and in the surrounding neighborhoods.

Based on the theoretical RF fields I have calculated, it is my expert opinion that these facilities would comply with all regulatory guidelines for RF exposure to members of the public.

Note: The analyses, conclusions and professional opinions are based upon the precise parameters and conditions of **these specific 12 utility poles within Needham, MA**. Utilization of these analyses, conclusions and professional opinions for any personal wireless services installation, existing or proposed, other than the aforementioned has not been sanctioned by the author, and therefore should not be accepted as evidence of regulatory compliance.

EXPOSURE LIMITS AND GUIDELINES

RF exposure guidelines enforced by the FCC were established by the American National Standards Institute (ANSI) ^{iv} and the National Council on Radiation Protection and Measurement (NCRP).^v The RF exposure guidelines are listed for RF workers and members of the public. The applicable FCC RF exposure guidelines for the public are listed in Table 1, and depicted in Figure 1. All listed values are intended to be averaged over any contiguous 30-minute period.

Table 1: Maximum Permissible Exposure (MPE) Values in Public Areas			
Frequency Bands	Maximum Permissible Exposure (MPE)		
	Electric Fields	Magnetic Fields	Equivalent Power Density
0.3 – 1.34 MHz	614 (V/m)	1.63 (A/m)	(100) mW/cm ²
1.34 - 30 MHz	824/f (V/m)	2.19/f (A/m)	(100) mW/cm ²
30 - 300 MHz	27.5 (V/m)	0.073 (A/m)	0.2 mW/cm ²
300 - 1500 MHz	--	--	f/1500 mW/cm ²
1500 - 100,000	--	--	1.0 mW/cm ²

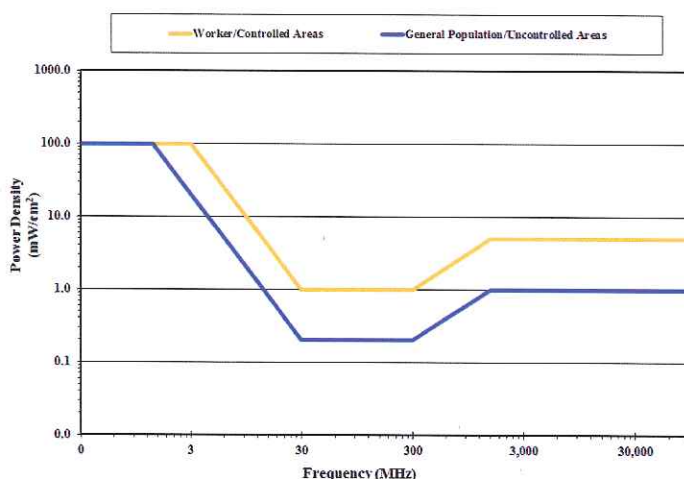


Figure 1: FCC Limits for Maximum Permissible Exposure (MPE)

NOTE: FCC 5% Rule – At multiple transmitter sites, actions necessary to bring the area into compliance with the RF exposure guidelines are the shared responsibility of all licensees whose transmitters produce RF field levels in excess of 5% of the applicable FCC MPEs.

THEORETICAL RF FIELD CALCULATIONS - GROUND LEVELS

METHODOLOGY

These calculations are based on what are called "worst-case" estimates. That is, the estimates assume 100% use of all transmitters simultaneously. Additionally, the calculations make the assumption that the surrounding area is a flat plane. The resultant values are thus conservative in that they over predict actual resultant power densities. The calculations are based on the following information for VERIZON WIRELESS:

1. Effective Radiated Power (ERP): See Table 2 inventory.
2. Antenna height (centerline, above ground level (AGL) See Table 2 inventory.
3. Antenna vertical radiation patterns; the source of the negative gain (G) values. "Omni directional" antennas are designed to focus the RF signal, resulting in "patterns" of signal loss and gain. These patterns (see **APPENDIX A**) display the loss of signal strength relative to the direction of propagation due to elevation angle changes.

Note: G is a unitless factor usually expressed in decibels (dB); where $G = 10^{(\text{dB}/10)}$.

For example: for an antenna *gain* of 3 dB, the net factor (G) = $10^{(3/10)} = 2$.

For an antenna *loss* of -3 dB, the net factor (G) = $10^{(-3/10)} = 0.5$.

To determine the magnitude of the RF field, the power density (S) from an isotropic RF source is calculated, making use of the power density formula as outlined in FCC's OET Bulletin 65, Edition 97-01: ^{vi}

$$S = \frac{P \cdot G}{4 \cdot \pi \cdot R^2}$$

Where:

P → Power to antenna (watts)

G → Gain of antenna

R → Distance (range) from antenna source to point of intersection with the ground (feet)

$R^2 = (\text{Height})^2 + (\text{Horizontal distance})^2$

Since: $P \cdot G = \text{EIRP}$ (Effective Isotropic Radiated Power) for broadcast antennas, the equation can be presented in the following form:

$$S = \frac{\text{EIRP}}{4 \cdot \pi \cdot R^2}$$

In the situation of off-axis power density calculations, apply the negative elevation gain (G^E) value from the vertical radiation patterns with the following formula:

$$S = \frac{\text{EIRP} \cdot G^E}{4 \cdot \pi \cdot R^2}$$

Ground reflections may add in-phase with the direct wave, and essentially double the electric field intensity. Because power density is proportional to the *square* of the electric field, the power density may quadruple, that is, increase by a factor of four (4). Since ERP is routinely used, it is necessary to convert ERP into EIRP; this is readily done by multiplying the ERP by the factor of 1.64, which is the gain of a half-wave dipole relative to an isotropic radiator. Therefore, downrange power density estimates can be calculated by using the formula:

$$S = \frac{4 \cdot (\text{ERP} \cdot 1.64) \cdot G^E}{4 \cdot \pi \cdot R^2} = \frac{\text{ERP} \cdot 1.64 \cdot G^E}{\pi \cdot R^2} = \frac{0.522 \cdot \text{ERP} \cdot G^E}{R^2}$$

To calculate the % MPE, use the formula:

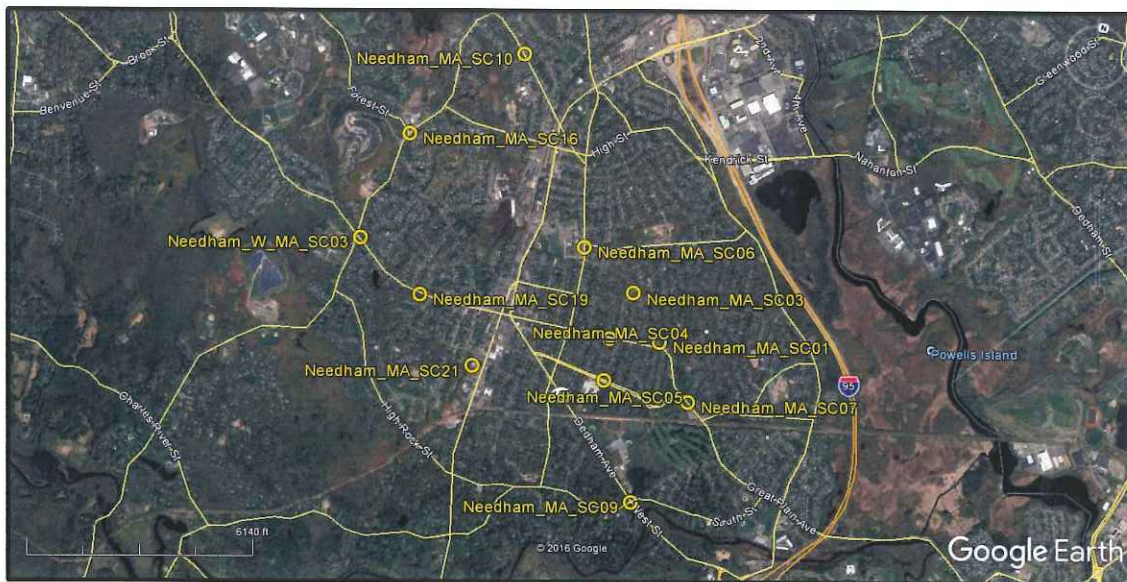
$$\% \text{ MPE} = \frac{S}{\text{MPE}} \cdot 100$$

OBSERVATIONS IN CONSIDERATION WITH FCC RULES §1.1307(B) & §1.1310

Is it physically possible to stand next to or touch any omni-directional antenna? No, access to the utility poles is restricted, and the utility companies will adhere to RF safety guidelines regarding potential access to the proposed PWS antennas mounted on the poles.

ANTENNA INSTALLATION LOCATIONS

The location of each proposed utility pole which would host a Verizon Wireless SC antenna is shown below in Figure 2.



**Figure 2: Proposed Location of 12 Utility Poles
Which Would Host a Verizon Wireless SC Antenna within Needham, MA.**

ANTENNA INVENTORIES

Table 2: Proposed Verizon Wireless Antenna Inventory Utility Poles in Needham, MA
Parameters: 560 watts ERP* of PCS @ 1970 MHz; 1173 watts ERP* of AWS @ 2145 MHz

Site Name	Address (See Figures 3A-3L)	Antenna Centerline (AGL)	Antenna Model
Needham MA SC01	20 Great Plain Ter	35' 5"	NH360QM-DG-2XR
Needham MA SC06	609 Webster St	41' 0"	NH360QM-DG-2XR
Needham MA SC10	270 Hunnewell St	41' 0"	NH360QM-DG-2XR
Needham SC03 MA	97 Melrose Ave	24' 0"	NH360QM-DG-2XR
Needham SC04 MA	7 Stevens Rd	26' 7"	NH360QM-DG-2XR
Needham SC05 MA	200 Harris Ave	28' 4"	NH360QM-DG-2XR
Needham SC07 MA	443 Great Plain Ave	39' 0"	NH360QM-DG-2XR
Needham SC09 MA	Dedham Ave & South St	24' 1"	NH360QM-DG-2XR
Needham SC16 MA	Central Ave	41' 0"	NH360QM-DG-2XR
Needham SC19 MA	1250 Great Plain Ave	24' 7"	NH360QM-DG-2XR
Needham SC21 MA	33 Chestnut Place	36' 6"	NH360QM-DG-2XR
Needham W SC03 MA	1437 Great Plain Ave	40' 6"	NH360QM-DG-2XR

Table Notes:

AWS: Advanced Wireless Services

PCS: Personal Communication Services

* ERP = Power out per channel (CH) X # channels per remote radio head (RRH) X #RRHs X gain the antenna provides within that frequency band.

RESULTS

The results of the percent Maximum Permissible Exposure (%MPE) calculations for the summation of the proposed Verizon Wireless contributions are depicted Figures 4A – 4L as plotted against linear distance from the base of each utility pole. The values have been calculated for a height of six feet above ground level in accordance with regulatory rationale. In addition to the six-foot height, and depicted on the graphs for reference only, values have been plotted for a height of 16 feet above ground level for comparison with a typical two-story structure. A logarithmic scale was used to plot the calculated theoretical %MPE values in order to compare with the MPE of 100%, which is so much larger that it would be off the page in a linear plot. The curves in the figures resemble a straight-line on the log-linear plots at distances beyond about five hundred feet. Within that distance, the curves are variable due to the application of the vertical radiation patterns.

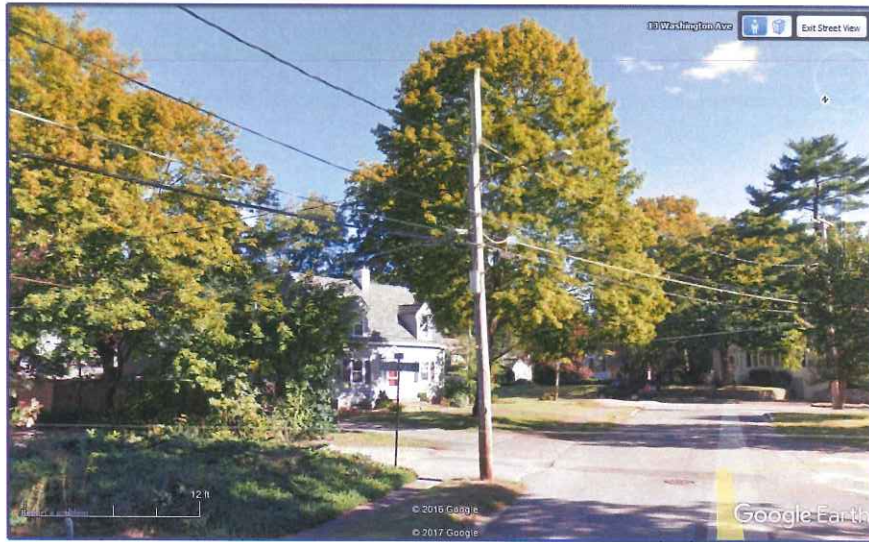


Figure 3A: Proposed Verizon Wireless Small Cell Antenna Site “Needham_MA_SC01”

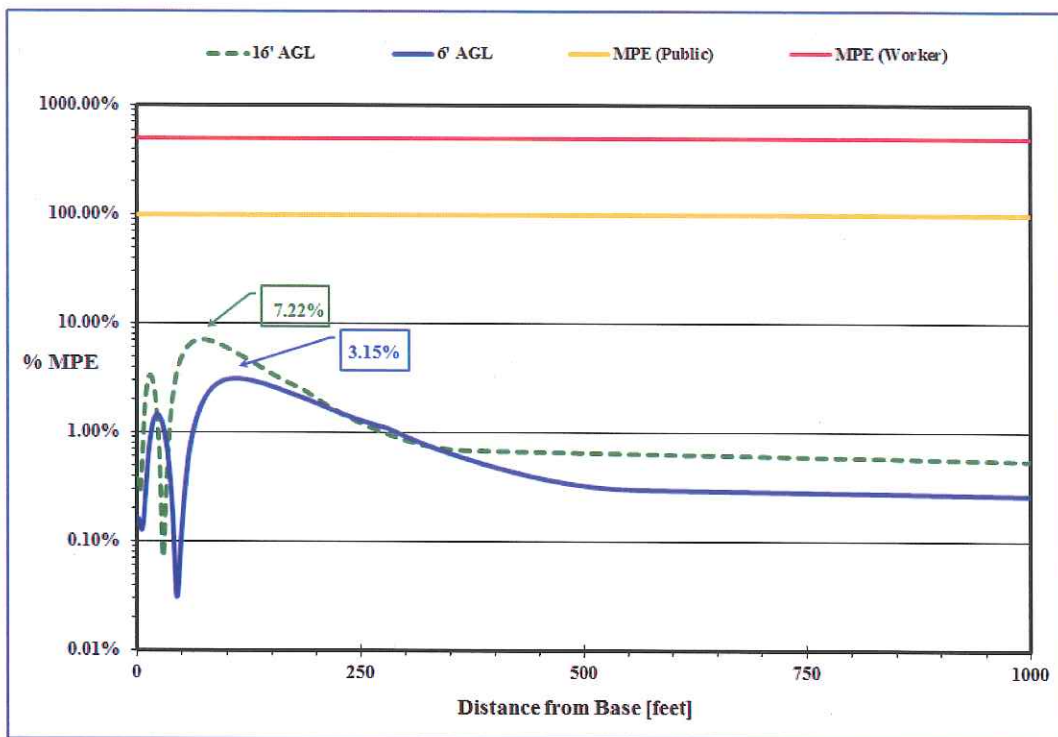


Figure 4A: Theoretical RF field calculations for the summation of the proposed Verizon Wireless Small Cell Antenna Site “Needham_MA_SC01”



Figure 3B: Proposed Verizon Wireless Small Cell Antenna Site "Needham_MA_SC03"

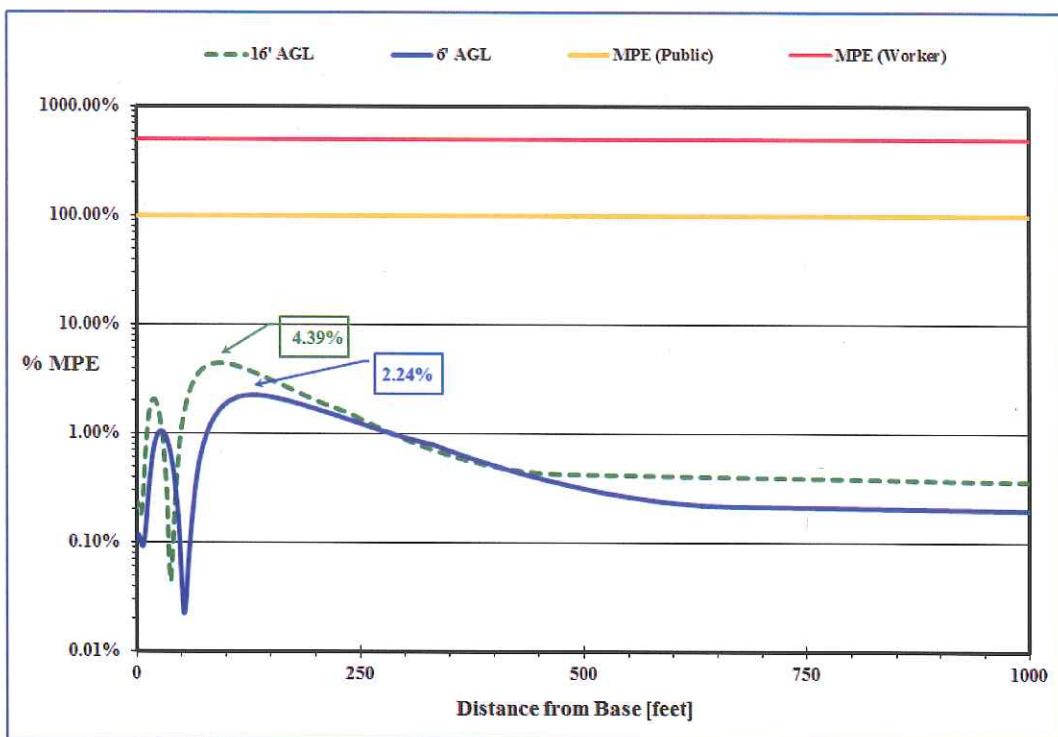


Figure 4B: Theoretical RF field calculations for the summation of the proposed Verizon Wireless Small Cell Antenna Site "Needham_MA_SC03"



Figure 3C: Proposed Verizon Wireless Small Cell Antenna Site “Needham_MA_SC04”

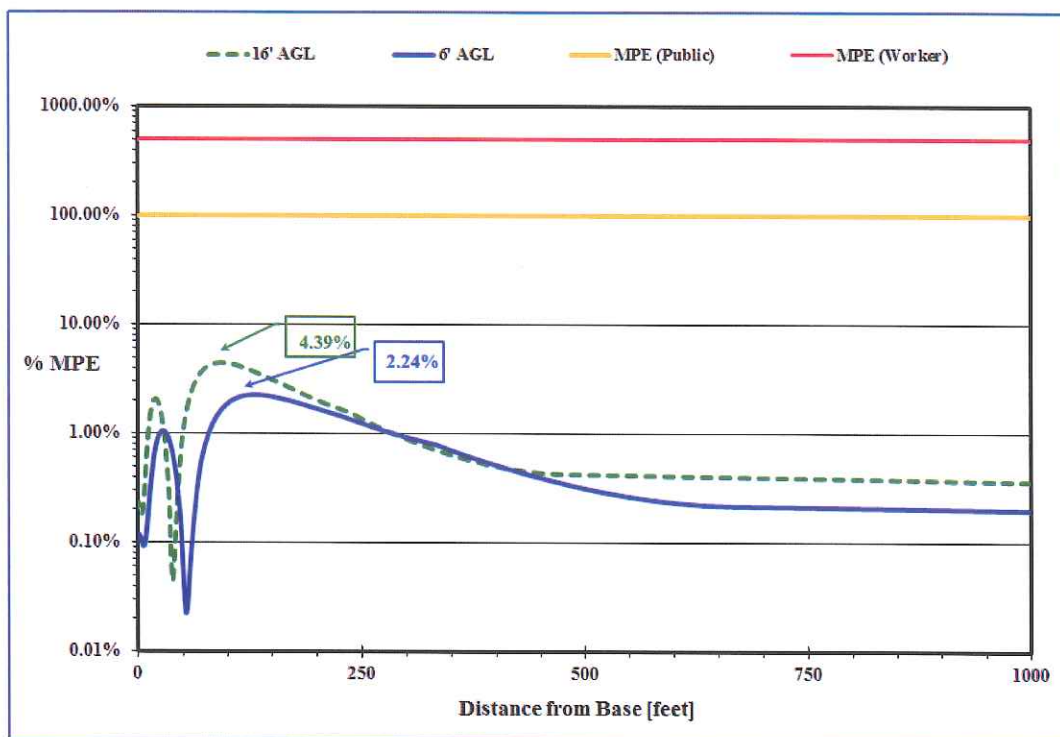


Figure 4C: Theoretical RF field calculations for the summation of the proposed Verizon Wireless Small Cell Antenna Site “Needham_MA_SC04”



Figure 3D: Proposed Verizon Wireless Small Cell Antenna Site "Needham_MA_SC05"

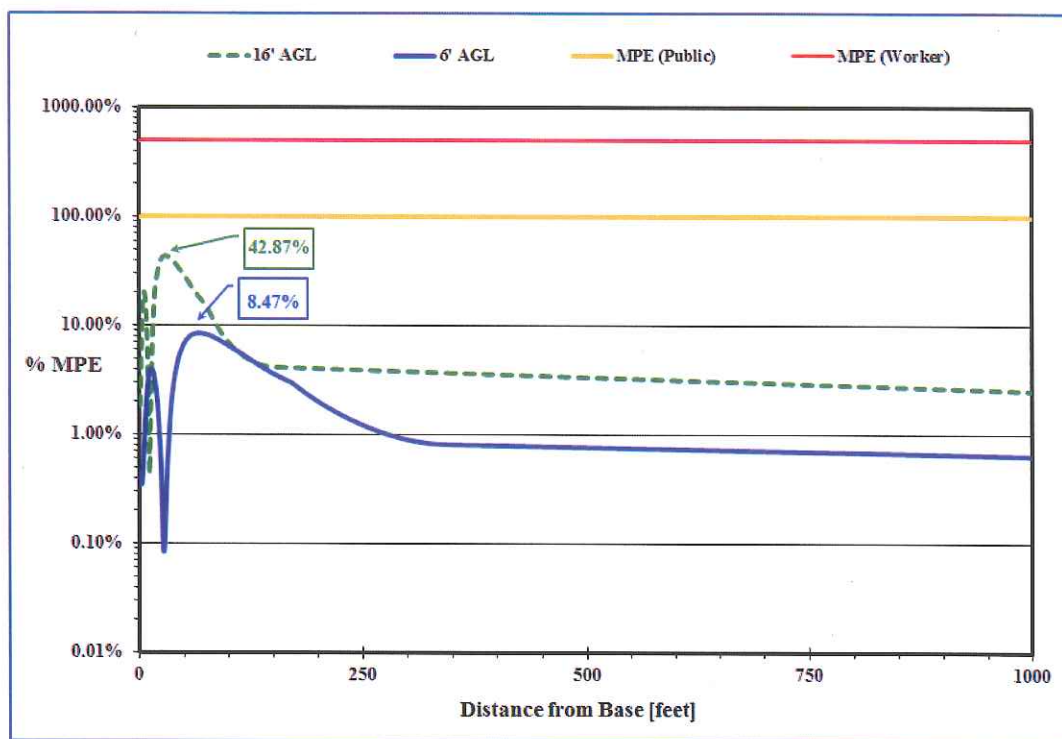


Figure 4D: Theoretical RF field calculations for the summation of the proposed Verizon Wireless Small Cell Antenna Site "Needham_MA_SC05"



Figure 3E: Proposed Verizon Wireless Small Cell Antenna Site “Needham_MA_SC06”

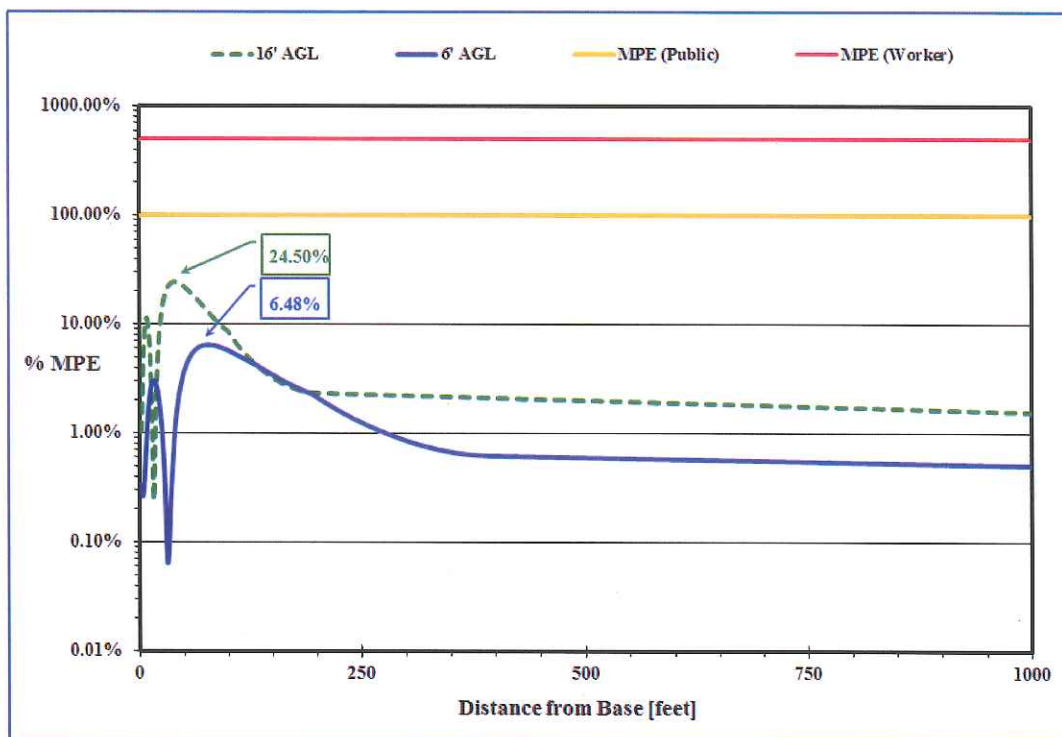


Figure 4E: Theoretical RF field calculations for the summation of the proposed Verizon Wireless Small Cell Antenna Site “Needham_MA_SC06”



Figure 3F: Proposed Verizon Wireless Small Cell Antenna Site "Needham_MA_SC07"

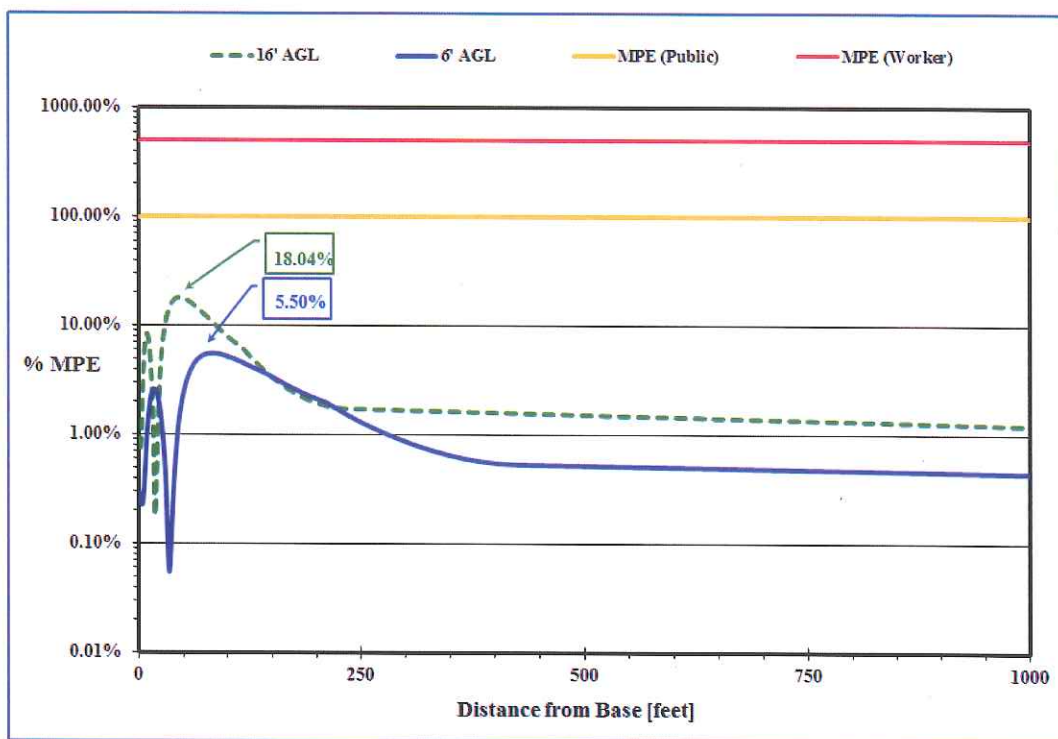


Figure 4F: Theoretical RF field calculations for the summation of the proposed Verizon Wireless Small Cell Antenna Site "Needham_MA_SC07"



Figure 3G: Proposed Verizon Wireless Small Cell Antenna Site "Needham_MA_SC09"

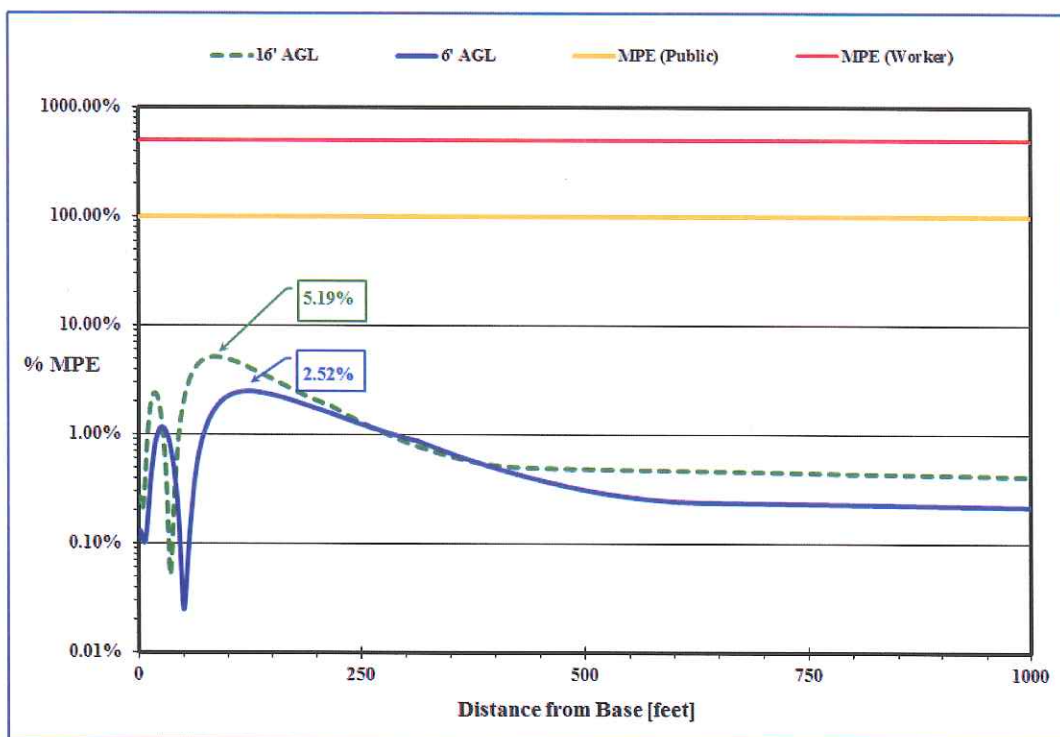


Figure 4G: Theoretical RF field calculations for the summation of the proposed Verizon Wireless Small Cell Antenna Site "Needham_MA_SC09"

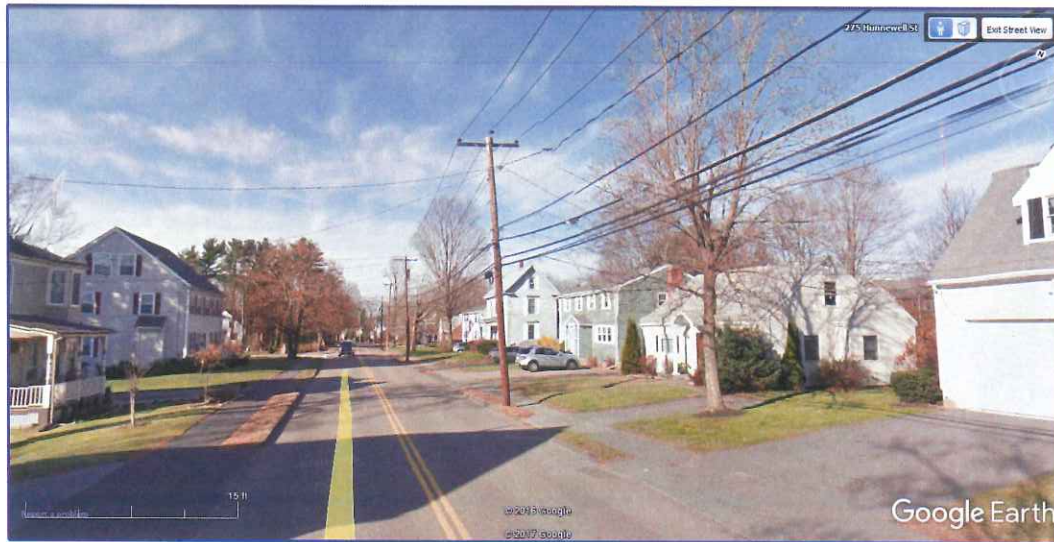


Figure 3H: Proposed Verizon Wireless Small Cell Antenna Site "Needham_MA_SC10"

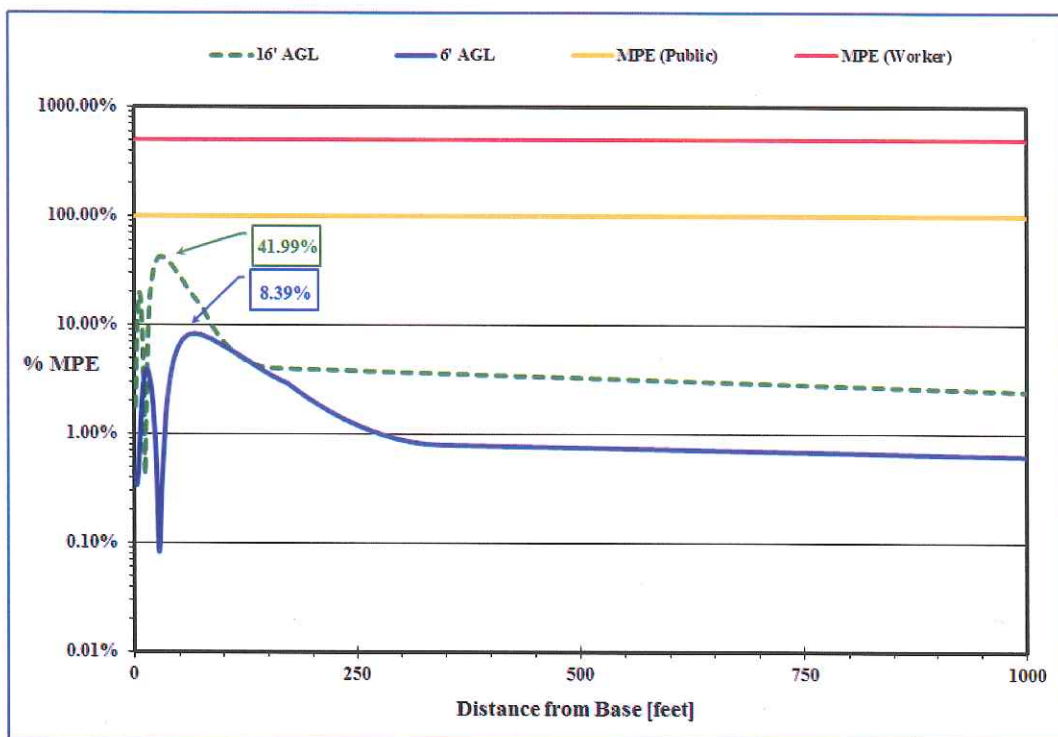


Figure 4H: Theoretical RF field calculations for the summation of the proposed Verizon Wireless Small Cell Antenna Site "Needham_MA_SC10"



Figure 3I: Proposed Verizon Wireless Small Cell Antenna Site “Needham_MA_SC16”

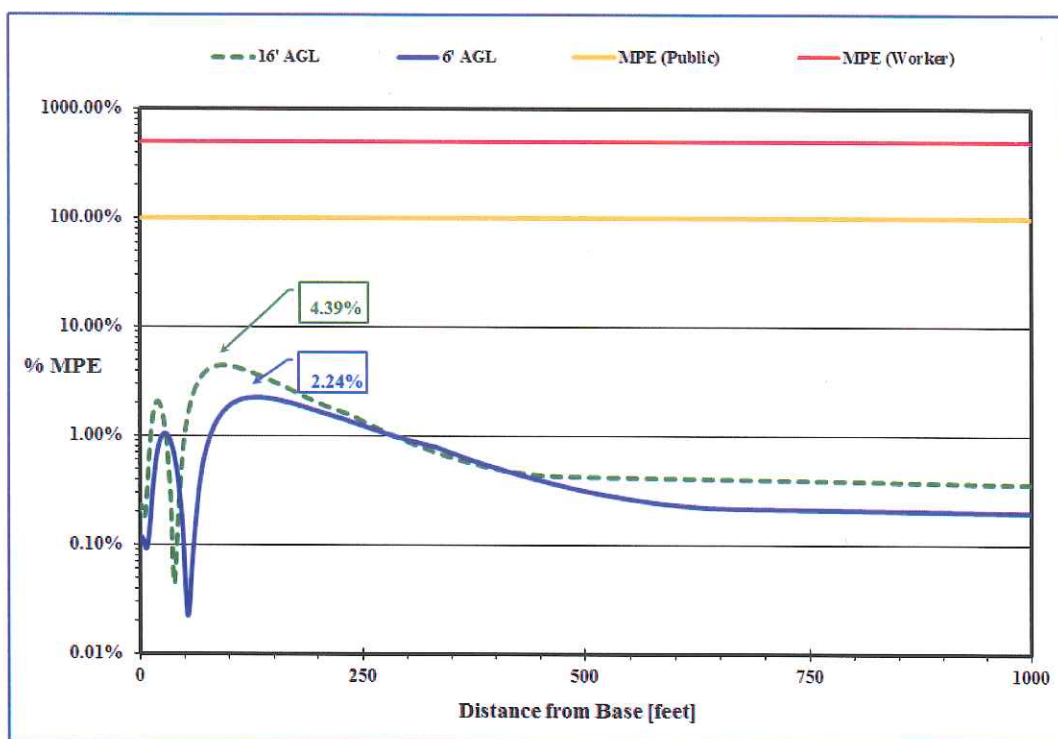


Figure 4I: Theoretical RF field calculations for the summation of the proposed Verizon Wireless Small Cell Antenna Site “Needham_MA_SC16”



Figure 3J: Proposed Verizon Wireless Small Cell Antenna Site “Needham_MA_SC19”

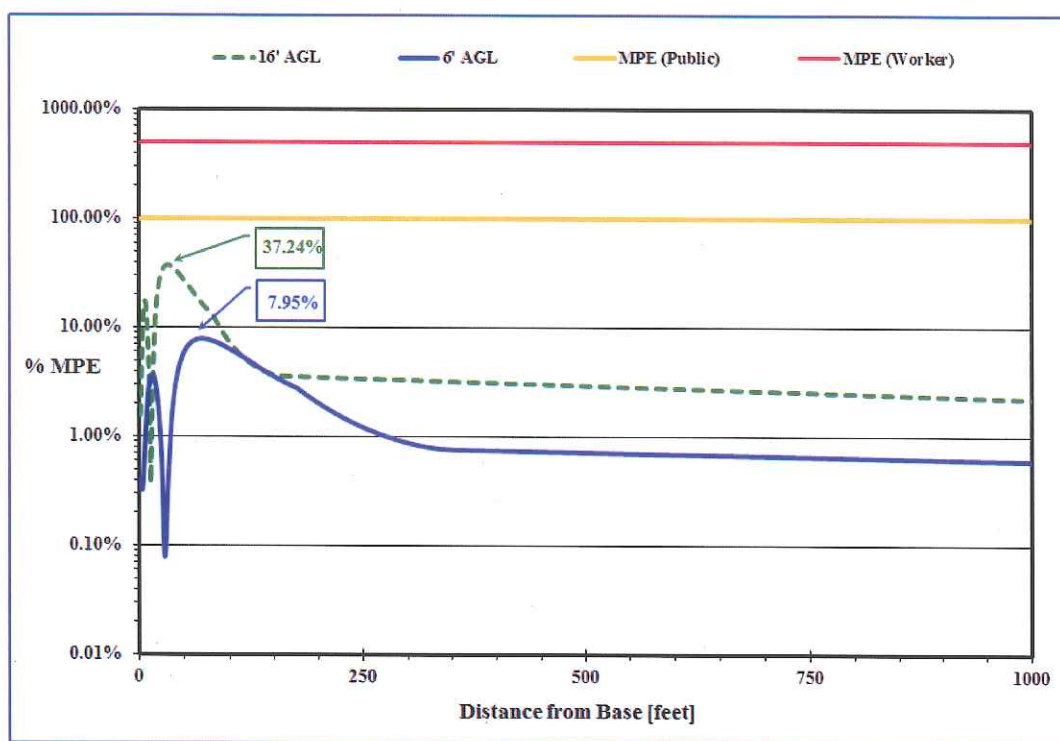


Figure 4J: Theoretical RF field calculations for the summation of the proposed Verizon Wireless Small Cell Antenna Site “Needham_MA_SC19”



Figure 3K: Proposed Verizon Wireless Small Cell Antenna Site "Needham_MA_SC21"

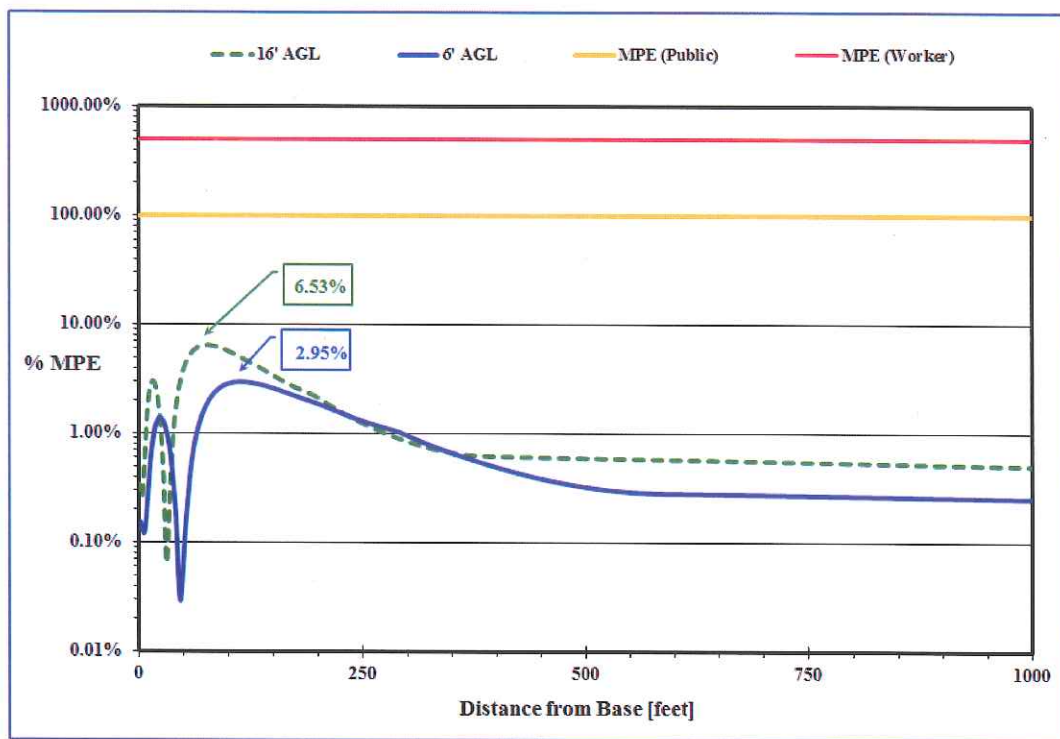


Figure 4K: Theoretical RF field calculations for the summation of the proposed Verizon Wireless Small Cell Antenna Site "Needham_MA_SC21"

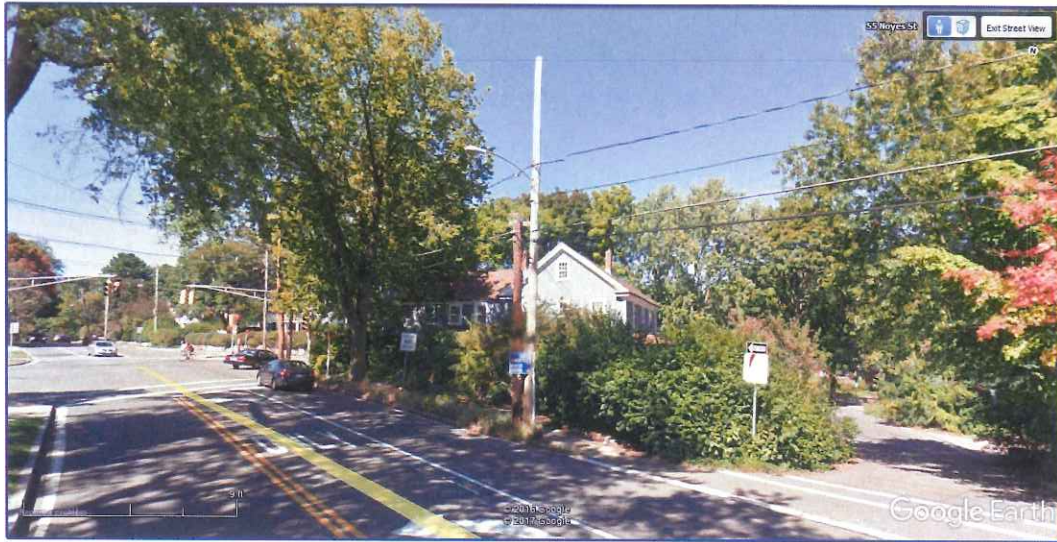


Figure 3L: Proposed Verizon Wireless Small Cell Antenna Site “Needham_W_SC03”

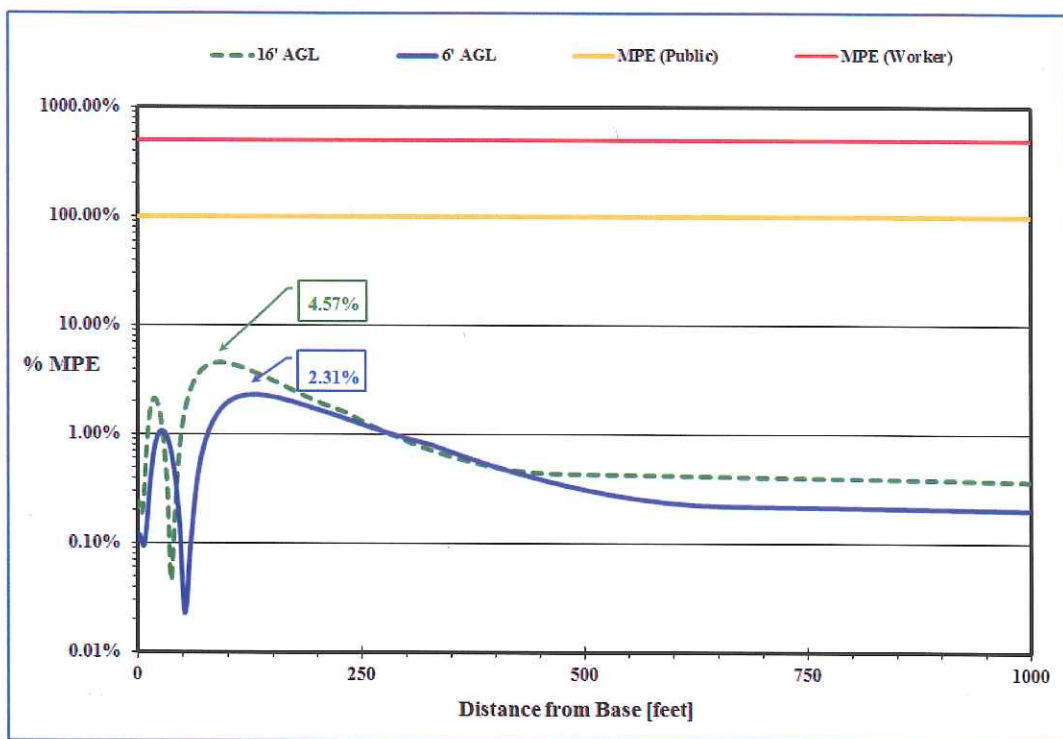


Figure 4L: Theoretical RF field calculations for the summation of the proposed Verizon Wireless Small Cell Antenna Site “Needham_W_SC03”

CONCLUSION

Theoretical RF field calculations data indicate the summation of the proposed Verizon Wireless RF contributions would be within the established RF exposure guidelines at each proposed site; see Figures 4A – 4L. This report provides written proof that the proposed facilities would comply with the FCC and MDPH RF exposure guidelines, including residential areas and in the surrounding neighborhoods.

The number and duration of calls passing through PWS facilities cannot be accurately predicted. Thus, in order to estimate the highest RF fields possible from operation of these installations, the maximal amount of usage was considered. Even in this so-called "worst-case", the resultant increase in RF field levels are far below established levels considered safe.

Based on the theoretical RF fields I have calculated, it is my expert opinion that these facilities would comply with all regulatory guidelines for RF exposure to members of the public.

Feel free to contact me if you have any questions.

Sincerely,

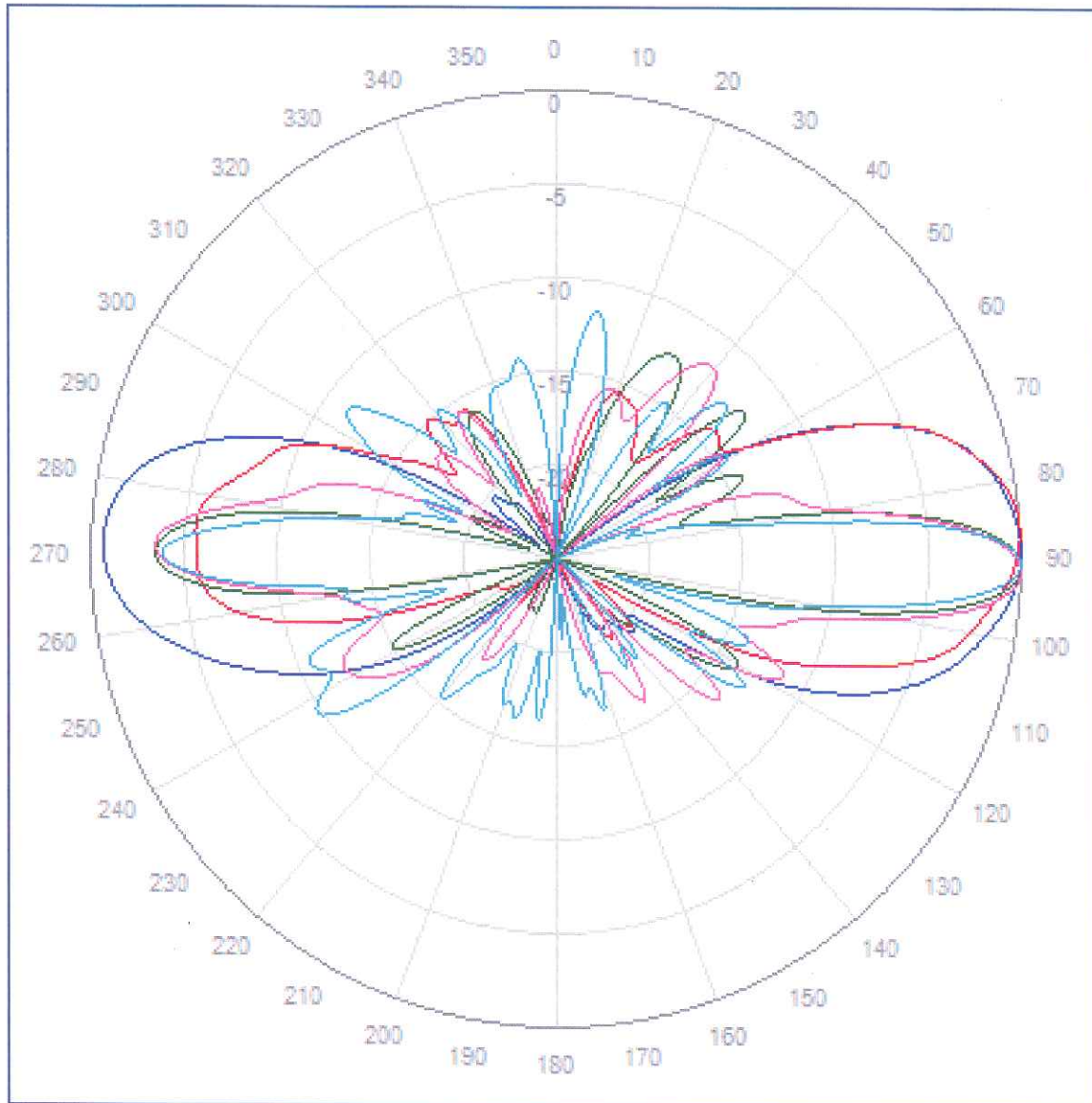


Donald L. Haes, Jr., Ph.D

Certified Health Physicist

Note: The analyses, conclusions and professional opinions are based upon the precise parameters and conditions of **these specific 12 utility poles within Needham, MA**. Utilization of these analyses, conclusions and professional opinions for any personal wireless services installation, existing or proposed, other than the aforementioned has not been sanctioned by the author, and therefore should not be accepted as evidence of regulatory compliance.

APPENDIX A



**Composite Vertical Radiation Patterns for Proposed Small Cell Omni Antennas
For Specific Verizon Wireless Proposed PWS PCS & AWS Frequencies**

DONALD L. HAES, JR., PH.D., CHP

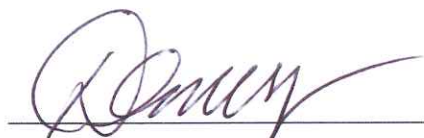
Radiation Safety Specialist

MA Radiation Control Program Health Physics Services Provider Registration #65-0017
PO Box 198, Hampstead, NH 03841 603-303-9959 Email: donald_haes_chp@comcast.net

STATEMENT OF CERTIFICATION

1. I certify to the best of my knowledge and belief, the statements of fact contained in this report are true and correct.
2. The reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions, and are personal, unbiased professional analyses, opinions and conclusions.
3. I have no present or prospective interest in the property that is the subject of this report and I have no personal interest or bias with respect to the parties involved.
4. My compensation is not contingent upon the reporting of a predetermined energy level or direction in energy level that favors the cause of the client, the amount of energy level estimate, the attainment of a stipulated result, or the occurrence of a subsequent event.
5. This assignment was not based on a requested minimum environmental energy level or specific power density.
6. My compensation is not contingent on an action or event resulting from the analyses, opinions, or conclusions in, or the use of, this report.
7. The consultant has accepted this assessment assignment having the knowledge and experience necessary to complete the assignment competently.
8. My analyses, opinions, and conclusions were developed and this report has been prepared, in conformity with the *American Board of Health Physics* (ABHP) statements of standards of professional responsibility for Certified Health Physicists.

Date: April 1, 2017



Donald L. Haes, Jr., Ph.D

Certified Health Physicist

ENDNOTES

- ⁱ. Federal Register, Federal Communications Commission Rules; *Radiofrequency radiation; environmental effects evaluation guidelines* Volume 1, No. 153, 41006-41199, August 7, 1996. (47 CFR Part 1; Federal Communications Commission).
- ⁱⁱ. Telecommunications Act of 1996, 47 USC; Second Session of the 104th Congress of the United States of America, January 3, 1996.
- ⁱⁱⁱ. 105 CMR 122.000: Massachusetts Department of Public Health, *Non-Ionizing Radiation Limits for: The General Public from Non-Occupational Exposure to Electromagnetic Fields, Employees from Occupational Exposure to Electromagnetic Fields, and Exposure from Microwave Ovens*.
- ^{iv}. ANSI/IEEE C95.1-1999: American National Standard, *Safety levels with respect to human exposure to radio frequency electromagnetic fields, from 3 KHz to 300 GHz (Updated in 2010)*.
- ^v. National Council on Radiation Protection and Measurements (NCRP); *Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields*, NCRP Report 86, 1986.
- ^{vi}. OET Bulletin 65: Federal Communications Commission Office of Engineering and Technology, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields*; Edition 97-01, August 1999.