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MCLANE MIDDLETON

June 27, 2017

BY HAND AND EMAIL (mcooley@nethorizons.com)

Board of Selectmen
Town of Needham
1471 Highland Avenue, 1st Floor
Needham, MA 02492
Attn: Marianne B. Cooley, Chair

Re: **Supplemental RF Compliance Report in Support of Petitions for Grant of Location to Attach Small Cell Antenna and Supporting Equipment to Existing Utility Poles**

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

Addresses: **Existing Utility Pole 7 located in public right of way on Webster Street, Needham (adjacent to 609 Webster Street)**

Existing Utility Pole 14 located in public right of way on Melrose Avenue, Needham (adjacent to 97 Melrose Avenue)

Existing Utility Pole 27-0 located in public right of way on Stevens Road, Needham (adjacent to 7 Stevens Road)

Existing Utility Pole 146/25 located in public right of way on Harris Avenue, Needham (adjacent to 200 Harris Avenue)

Existing Utility Pole 67 located in public right of way on Great Plain Avenue, Needham (adjacent to 443 Great Plain Avenue)

Existing Utility Pole 97/51 located in public right of way on West Street, Needham (near intersection of West Street, Dedham Avenue & South Street)

Existing Utility Pole 116-1 located in public right of way on Great Plain Avenue, Needham (adjacent to 1250 Great Plain Avenue)

Existing Utility Pole 72-3 located in public right of way on Chestnut Place, Needham (adjacent to 33 Chestnut Place)

Existing Utility Pole 25 located in public right of way on Great Plain Avenue, Needham (adjacent to 1437 Great Plain Avenue)

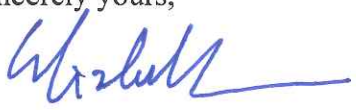
Dear Chair Cooley and Members of the Board of Selectmen:

In support of its petitions for grants of location to install small cell antennas and equipment on the nine above-referenced utility poles (the "Petitions"), and in response to the Needham Board of Health's June 16, 2017 letter to the Board of Selectmen, Verizon Wireless submits the enclosed supplemental radio frequency ("RF") compliance report prepared by Donald L. Haes, Jr., Ph.D., CHP dated June 27, 2017. Dr. Haes will attend this evening's continued hearing on the Petitions and will be prepared to discuss this report.

As you know, when it filed the Petitions, Verizon Wireless submitted an RF compliance report from Dr. Haes dated April 1, 2017 in order to demonstrate compliance with the Federal Communications Commission's ("FCC's") RF emissions guidelines. Dr. Haes' April 1, 2017 report, his testimony at the May 30, 2017 hearing, and this June 27, 2017 supplemental report collectively demonstrate and confirm that the RF emissions of each of the proposed small cell installations will comply with the FCC's guidelines.

This is significant because federal law prohibits local authorities from considering the effects of RF emissions from wireless facilities that comply with the FCC's RF emission guidelines. *See* 47 U.S.C. § 332(c)(7)(B)(iv) ("[N]o State or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the Commission's regulations concerning such emissions."). Once the wireless provider has demonstrated that its installation is compliant with the FCC guidelines, the issue may no longer be considered in the permitting process. In short, as dictated by federal law, Dr. Haes' conclusion that the proposed small cell installations will comply with the FCC RF emissions guidelines precludes any further discussion of this issue in these proceedings.

Sincerely yours,



Elizabeth F. Mason

EFM:

ec: Kate Fitzpatrick, Town of Needham
Sean Conway, VZW
Tom Hildreth, Esq.
Joshua P. Lanzetta, Esq.
Ralph Colarusso, Nexius

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

June 27, 2017

Town of Needham, Board of Selectmen
Needham Town Hall
1471 Highland Avenue
Needham, MA 02492

RE: Response to questions from the Needham Board of Health regarding the proposed installations of radio base station antennas and associated equipment for the Verizon Wireless Small Cell Personal Wireless Services facilities to be located on 9 different utility poles in Needham, MA.

PURPOSE

I write in response to the below questions (shown as italicized text for clarity) concerning my report dated April 1, 2017, regarding the information pertinent to the Verizon Wireless proposed installation of Small Cell (SC) Personal Wireless Services (PWS) facilities within Needham, MA. It should be noted that since the date of my report, the following three (3) Verizon Wireless SC sites have been withdrawn from consideration: SC01, SC10, and SC16.

The installation proposal from Verizon Wireless and the report from Donald Haes do leave open some questions which are important to answer, and we believe that Verizon Wireless should provide the Board of Selectmen, Board of Health, and Needham residents, answers to the following questions and concerns:

- *The percent Maximum Permissible Exposure from the radiation safety specialist report by Donald Haes was computed with 6' above ground level (AGL) and 16' AGL. To confirm, the 6' and 16' AGL represent the height at which one could come in contact with the radiation, not the height of the proposed antennas?*
- *The radiation exposure level graph that Donald Haes includes in his project analysis and report (Figure 3A, 3B, etc) would benefit from additional clarification and explanation of the exposure drop-off and rebound within the 1-25 ft. range.*
- *Would Verizon Wireless please provide specifications for the small cell units? Are there vertical radiation patterns for the omni-directional antenna?*
- *Omni-directional antennas radiate at 360°. Would Verizon Wireless please provide more specific radiation patterns for the omni-directional antennas beyond Appendix A from the radiation safety specialist report? What is the distance covered by each small-cell unit?*

- *The percent Maximum Permissible Exposure from the radiation safety specialist report by Donald Haes was computed with 6' above ground level (AGL) and 16' AGL. To confirm, the 6' and 16' AGL represent the height at which one could come in contact with the radiation, not the height of the proposed antennas?*

The results of the percent Maximum Permissible Exposure (%MPE) "worst case" calculations for the summation of the proposed Verizon Wireless contributions are as plotted against linear distance from the base of each utility pole. The values were calculated for a height of six feet above ground level (6' AGL) in accordance with regulatory rationale. In other words, the calculated values represent the absolute highest value under worst case conditions one could be exposed to assuming a continuous field of transmission. The height of 6' AGL represents the closest point to the elevated source (and thus presumably highest) value an average human could be exposed to while walking on the ground. In order to read the graphs, find a distance from the base of the utility pole of interest on the bottom scale, and read the value on the horizontal scale corresponding to the point on the solid blue line.

To be conservative, I also provide a value at 16' AGL. The height of 16' AGL represents the closest point to the elevated source (and thus presumably highest) value an average human could be exposed to while walking on a second story. Similarly, find a distance from the base of the utility pole of interest on the bottom scale, and read the value on the horizontal scale corresponding to the point on the dotted green line.

- *The radiation exposure level graph that Donald Haes includes in his project analysis and report (Figure 3A, 3B, etc) would benefit from additional clarification and explanation of the exposure drop-off and rebound within the 1-25 ft. range.*

The results of the percent Maximum Permissible Exposure (%MPE) "worst case" calculations for the summation of the proposed Verizon Wireless contributions were calculated using the FCC recommended equations for power density (S) and %MPE as shown below in Equations 1 and 2, respectively:

EQ #1 $$\mathbf{S = \frac{0.522 \cdot ERP \cdot G^{E}}{R^{2}}}$$

EQ #2 $$\mathbf{\%\ MPE = \frac{S}{MPE} \cdot 100}$$

As seen in EQ#1 and EQ#2, the variables are "distance from source" **(R)**, and the vertical gain of the antenna **(G^{E})**, for a given maximum value of ERP ("worst case"). The value for "MPE" is a fixed value based on frequency of the transmitting source. Also notice that the distance value R varies inversely with distance. The values for G^{E} are fixed values obtained from the antenna manufacturer (See Appendix A) and represent the gain of the power from the antenna input based on reference angle to the antenna.

As one moves away from the antenna, the distance increases, and thus the value for S will DECREASE with the inverse of the square of the distance. HOWEVER, as one also moves away from the antenna, the angle between the base of the antenna and the reference point becomes more shallow, and generally INCREASES the antenna gain value (G^E) and thus the overall value for S INCREASES. Due to the exponential nature of the distance factor, it eventually becomes the predominant factor for loss of transmitting signal intensity, and the overall values drop off about inverse square. Up close, however, the decrease due to distance is not as effective in signal DECREASE as the gain is in signal INCREASE, and therefore there is inherent variability based on the antenna patterns.

- *Would Verizon Wireless please provide specifications for the small cell units? Are there vertical radiation patterns for the omni-directional antenna?*

The specification sheets for the proposed antennas are included in the next two pages. The vertical radiation patterns were obtained from the antenna manufacturer (See Appendix A) and represent the gain of the power from the antenna input based on reference angle to the antenna. If the reference was to the horizontal radiation patters, see Appendix B. Note that I did not assume any loss along the direction of propagation, and thus did not apply any loss along the horizontal directions.

- *Omni-directional antennas radiate at 360°. Would Verizon Wireless please provide more specific radiation patterns for the omni-directional antennas beyond Appendix A from the radiation safety specialist report? What is the distance covered by each small-cell unit?*

The vertical and horizontal radiation patterns were obtained from the antenna manufacturer (See Appendix A and B) and represent the SPECIFIC GAIN of the power from the antenna input based on reference angle to the antenna, for SPECIFIC frequencies and SPECIFIC antenna ports. Depending on ideal conditions of atmosphere (clear day) and topography (level ground), a Small Cell site can provide "adequate" AWS and PCS coverage to about ½ mile.

Feel free to contact me if you have any questions.

Sincerely,

Donald L. Haes, Jr., Ph.D
Certified Health Physicist

Product Specifications

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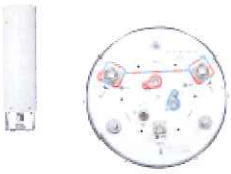

NH360QM-DG-2XR

2-port omni antenna, 2x (698-896 and 1695-2200 MHz), 360° HPBW, 2x RET with manual override, internal diplexer and active GPS L1 band antenna

Electrical Specifications

Frequency Band, MHz	698–806	806–896	1695–1880	1850–1990	1920–2200
Gain, dBi	6.1	7.1	9.7	9.9	9.9
Beamwidth, Horizontal, degrees	360	360	360	360	360
Beamwidth, Vertical, degrees	28.6	25.4	11.2	10.6	10.1
Beam Tilt, degrees	0–20	0–20	0–14	0–14	0–14
USLS (First Lobe), dB	16	15	14	13	13
Isolation, dB	25	25	25	25	25
VSWR | Return Loss, dB	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0
PIM, 3rd Order, 2 x 20 W, dBc	-153	-153	-153	-153	-153
Input Power per Port, maximum, watts	125	125	125	125	125
Polarization	±45°	±45°	±45°	±45°	±45°
Impedance	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm

Electrical Specifications, BASTA*

Frequency Band, MHz	698–806	806–896	1695–1880	1850–1990	1920–2200
Gain by all Beam Tilts, average, dBi	5.4	6.3	9.3	9.4	9.4
Gain by all Beam Tilts Tolerance, dB	±1	±0.7	±0.5	±0.7	±0.7
Gain by Beam Tilt, average, dBi	0 ° | 5.1	0 ° | 6.3	0 ° | 9.2	0 ° | 9.3	0 ° | 9.4
	10 ° | 5.4	10 ° | 6.3	7 ° | 9.3	7 ° | 9.5	7 ° | 9.6
	20 ° | 5.6	20 ° | 6.0	14 ° | 9.2	14 ° | 9.1	14 ° | 9.1
Beamwidth, Vertical Tolerance, degrees	±3.7	±3.2	±0.9	±1.1	±1.1
USLS, beampeak to 20° above beampeak, dB			13	13	13

* CommScope® supports NGMN recommendations on Base Station Antenna Standards (BASTA). To learn more about the benefits of BASTA, download the whitepaper Time to Raise the Bar on BSAs.

General Specifications

Operating Frequency Band	1695 – 2200 MHz | 698 – 896 MHz
Antenna Type	Omni
Band	Multiband
Internal GPS frequency band	1575.42 MHz
Internal GPS VSWR	2.0
Performance Note	Outdoor usage
Total Input Power, maximum	400 W @ 50 °C

Mechanical Specifications

RF Connector Quantity, total	2
RF Connector Interface	7-16 DIN Female
Color	Light gray
GPS Connector Interface	4.1-9.5 DIN Female

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Page 1: Specifications sheet for the proposed Verizon Wireless Small Cell Antenna

Product Specifications

COMMSCOPE®

NH360QM-DG-2XR

GPS Connector Quantity	1
Grounding Type	RF connector inner conductor and body grounded to reflector and mounting bracket
Radiator Material	Aluminum | Low loss circuit board
Radome Material	ASA, UV stabilized
Reflector Material	Aluminum
RF Connector Location	Bottom
RF Connector Quantity, diplexed low and high bands	2
Wind Loading, maximum	225.0 N @ 150 km/h 50.6 lbf @ 150 km/h
Wind Speed, maximum	200 km/h | 124 mph

Dimensions

Length	982.0 mm | 38.7 in
Outer Diameter	305.0 mm | 12.0 in
Net Weight, without mounting kit	15.3 kg | 33.7 lb

Remote Electrical Tilt (RET) Information

Input Voltage	10–30 Vdc
Internal RET	High band (1) | Low band (1)
Power Consumption, idle state, maximum	2.0 W
Power Consumption, normal conditions, maximum	13.0 W
Protocol	3GPP/AISG 2.0 (Multi-RET)
RET Interface	8-pin DIN Male
RET Interface, quantity	1 male

Packed Dimensions

Length	1251.0 mm | 49.3 in
Width	427.0 mm | 16.8 in
Depth	407.0 mm | 16.0 in
Shipping Weight	20.6 kg | 45.4 lb

Regulatory Compliance/Certifications

Agency	Classification
RoHS 2011/65/EU	Compliant by Exemption
China RoHS SJ/T 11364-2006	Above Maximum Concentration Value (MCV)
ISO 9001:2008	Designed, manufactured and/or distributed under this quality management system

* Footnotes

Performance Note	Severe environmental conditions may degrade optimum performance

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Page 2: Specifications sheet for the proposed Verizon Wireless Small Cell Antenna

APPENDIX A

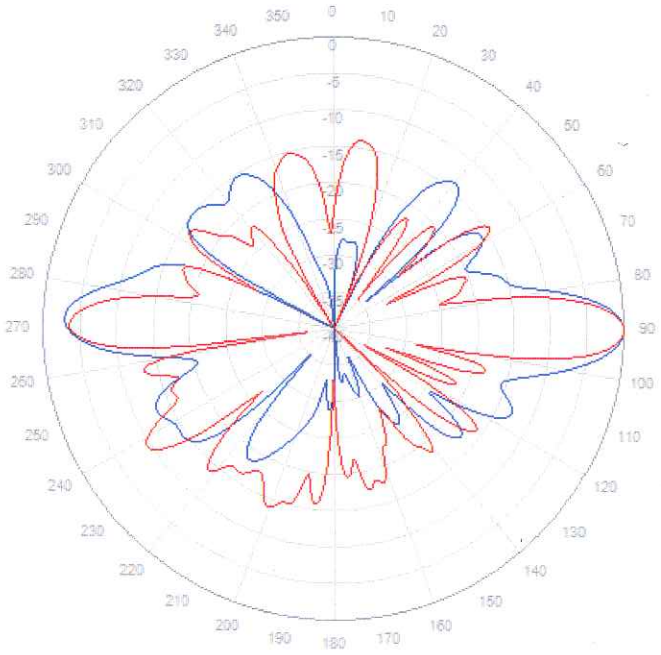
COMMSCOPE®

Base Station Antennas

Model: NH360QM-DG-2XR

Legend

Description	Port	Frequency	Tilt	Cut	Color
Dual Polarization	Port 1 +45	1915	0	V	
Dual Polarization	Port 2 -45	2155	0	V	



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

APPENDIX B

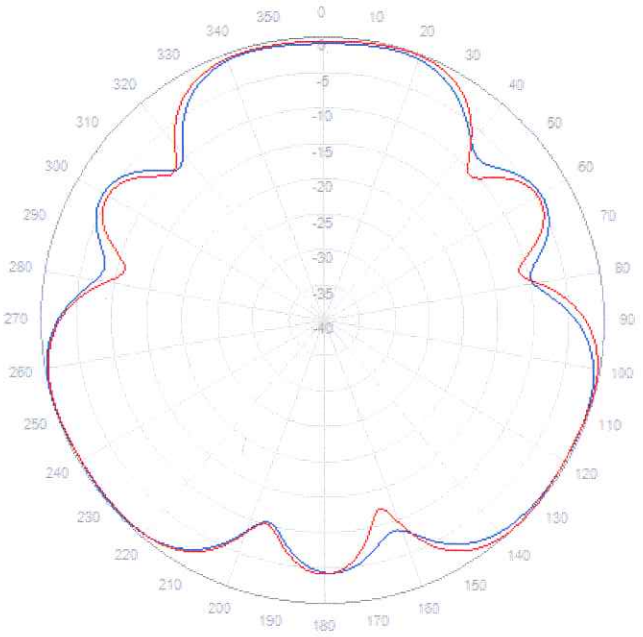
COMMSCOPE®

Base Station Antennas

Model: NH360QM-DG-2XR

Legend

Description	Port	Frequency	Tilt	Cut	Color
Dual Polarization	Port 1 +45	1915	0	H	
Dual Polarization	Port 2 -45	2155	0	H	



Composite Horizontal 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: June 27, 2017

Donald L. Haes, Jr., Ph.D
Certified Health Physicist