Biwabkos Consultants, LLC

RF Safety and NIER Analysis Report

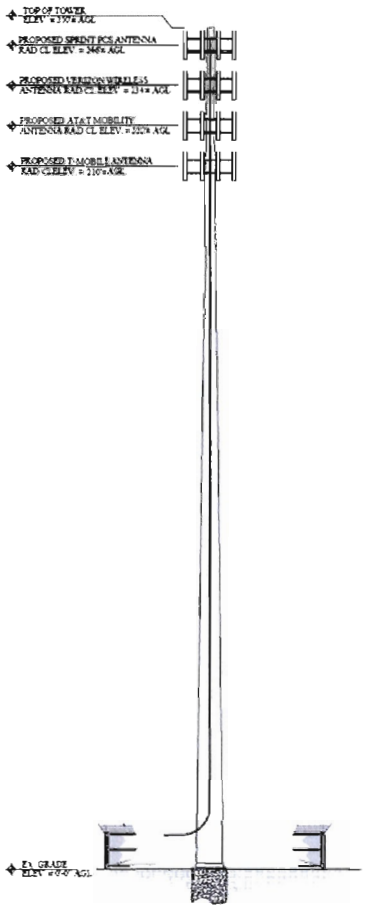
January 8, 2020

Site: RICHARD WALL (876352)

EAST HAMPTON, CT

Prepared for:

CROWN CASTLE



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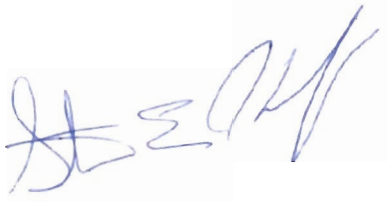
1 Certification

This report, prepared by Biwabkos Consultants LLC for **Crown Castle**, is intended to document compliance and evaluate power density levels as outlined in the report. The computations, analysis, and resulting report and conclusions were based on applicable FCC guidelines and regulations for maximum permissible exposure to humans consistent with FCC OET Bulletin 65, Edition 97-01.

Additionally, Biwabkos Consultants LLC certifies that the assumptions are valid and that the data used within Biwabkos Consultants' control are accurate, including information collected as part of Biwabkos Consultants' field surveys (if applicable). Biwabkos Consultants LLC does not however certify the accuracy or correctness of any data provided to Biwabkos Consultants LLC for this analysis and report by Crown Castle.

I certify that the attached RF exposure analysis and report is correct to the best of my knowledge, and all calculations, assumptions and conclusions are based on generally acceptable engineering practices:

Report Prepared By
David Dodson, RF Engineer
01/08/2020



Report Reviewed By
Steven Kennedy, Engineering Manager
1/10/2020

2 Executive Summary

This report provides the results of an RF power density analysis performed for **Crown Castle** at site **RICHARD WALL (876352)** in accordance with the Federal Communications Commission (FCC) rules and regulations for RF emissions described in OET Bulletin 65, Edition 97-01.

This report addresses RF safety for two classified groups defined by OET Bulletin 65: Occupational/ Controlled and General Population/ Uncontrolled. Based on the analysis, this site will be **Compliant** with FCC rules and regulations and Crown Castle Signage and Barrier Policy since the mitigation details provided in Table 1 are implemented.

Minimum Required For Compliance							
Mitigation Information							
	Notice	**Caution**	**Warning**	**Guidelines**	**Site Info**	**Barrier**	**Marker**
Access Point							
Alpha							
Beta							
Gamma							
Delta							
Omni							

Notes/ Additional Compliance Requirements(s):
No Mitigation Required

Table 1: Mitigation Requirements for Compliance

2.1 Conclusion and Recommendations:

- The results of the analysis indicate that the power density levels in the generally accessible areas on the Ground level will not exceed the FCC's MPE limit for both General Population and Occupational environment.
- The max theoretical % MPE (Occupational) is 1.9%.
- No mitigation is required.
- This site will operate in general compliance with FCC OET Bulletin 65 and Crown Castle's Signage and Barrier policy.

3 Introduction

The purpose of this analysis and report is to evaluate the cumulative power density levels of all non-excluded antennas located on the Monopole and identify any areas of concern that require mitigation. This report also assesses the Monopole's compliance with FCC OET Bulletin 65; "Guidelines for Human Exposure to Radio-frequency Electromagnetic Fields".

The power density simulation performed for this site utilized RoofView® analysis software. All antennas were assigned an operating frequency and transmit power and were deemed to be operating at 100% of their rated output power.

3.1 Site Description:

- **Site Name:** RICHARD WALL
- **Street Address:** 8 1/2 LAKEVIEW STREET
  EAST HAMPTON, CT 06424
- **Latitude:** 41° 34' 56.92" N
- **Longitude:** 72° 29' 35.29" W
- **Structure Type:** Monopole
- **Structure Height:** 250' AGL
- **BTS Equipment Location**: Within the shelters inside the fenced-in compound.
- **Co-Locators/ Other Antennas**: Total of (3) co-locators and (24) antennas
- **Access**: Access is through a locked gate on the east side of the fenced-in compound.
- **Other Notes**: There are no other adjacent structures where the General Population would get within an unsafe distance.

3.2 Site Configuration Being Modeled:

- This site has (3) carriers with (3) sectors each
- There is a total of (24) antennas
- Each sector supports various LTE carriers including, but not limited to 700 MHz, 850 MHz, 1900 MHZ, 2100 MHZ frequencies.
- All LTE supports MIMO.

3.3 Assumptions:

- The fenced-in compound will remain locked and is not accessible to the General Population.

4 Predictive Analysis Details:

For purposes of this analysis, RoofView® was configured to provide an output based on the appropriate MPE limit(s) published in the FCC's guidelines. The antenna information was loaded into RoofView®, an MPE predictive analysis tool by Richard Tell and Associates, Inc.

4.1 Analysis Locations:

Number of Elevations Analyzed: 1

- The Ground level is accessible to the General Population outside the fenced-in compound and is accessible to the Occupational population within the fenced-in compound.

4.2 Antenna Inventory:

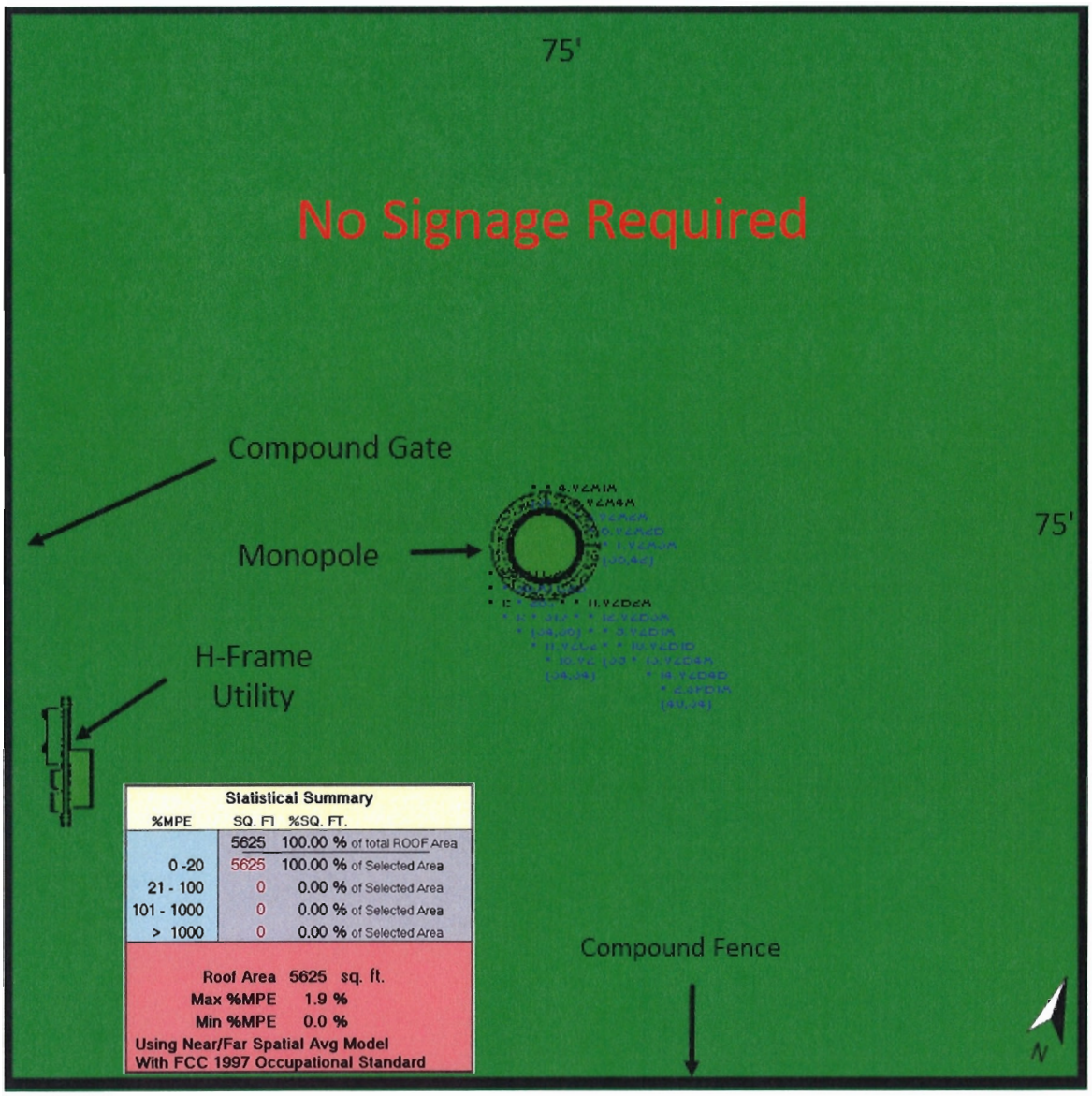
The following table contains the technical data used to simulate the power density that may be encountered with all antennas simultaneously operating at full rated power with the exception of any excluded antennas cited in this document. If Co-Locator antennas exist and specific antenna details could not be secured, generic antennas, frequencies, and Tx powers were used for modeling. The assumptions used are based on past experience with communications carriers.

ID	Name	(MHz) Freq	Trans Power	Trans Count	Other Loss	Calc Power	Mfg	Model	Height (ft) Ground	Type	(ft) Aper	dBd Gain	BWdth Pt Dir
SPA1A	C1900	1950	20	3	0.5	53.5	RFS	APXVSPP18-C-A20	243.0	X-Pole	6	15.9	65;0
SPB1A	C1900	1950	20	3	0.5	53.5	RFS	APXVSPP18-C-A20	243.0	X-Pole	6	15.9	65;120
SPC1A	C1900	1950	20	3	0.5	53.5	RFS	APXVSPP18-C-A20	243.0	X-Pole	6	15.9	65;220
VZA1A	C850	850	20	4	0.5	71.3	Andrew	DB846F65ZAXY	231.0	Diplole	6	14.8	65;0
VZA2A	L1900	1960	30	4	0.5	107.0	Amphenol	BXA-171063-12BF	231.0	X-Pole	5.975	16.5	65;0
VZA2B	L2100	2150	40	4	0.5	142.6	Amphenol	BXA-171063-12BF	231.0	X-Pole	5.975	16.9	60;0
VZA3A	L700	730	30	2	0.5	53.5	Amphenol	BXA-70063-6CF	231.0	X-Pole	5.916666667	14.0	65;0
VZA4A	C850	850	20	4	0.5	71.3	Andrew	DB846F65ZAXY	231.0	Diplole	6	14.8	65;0
VZB1A	C850	850	20	4	0.5	71.3	RFS	APL866513-42T0	232.0	Dipole	4	13.0	65;120
VZB1B	L700	730	30	2	0.5	53.5	RFS	APL866513-42T0	232.0	Dipole	4	13.0	65;120
VZB2A	L1900	1960	30	4	0.5	107.0	Amphenol	BXA-171063-8BF	232.0	X-Pole	4.041666667	14.9	65;120
VZB3A	L2100	2150	40	4	0.5	142.6	Amphenol	BXA-171063-8BF	232.0	X-Pole	4.041666667	15.3	60;120
VZB4A	C850	850	20	4	0.5	71.3	RFS	APL866513-42T0	232.0	Dipole	4	13.0	65;240
VZB4B	L700	730	30	2	0.5	53.5	RFS	APL866513-42T0	232.0	Dipole	4	13.0	65;240
VZC1A	C850	850	20	4	0.5	71.3	Andrew	DB846F65ZAXY	231.0	Diplole	6	14.8	65;240
VZC2A	L1900	1960	30	4	0.5	107.0	Amphenol	BXA-171063-12BF	231.0	X-Pole	5.975	16.5	65;240
VZC2B	L2100	2150	40	4	0.5	142.6	Amphenol	BXA-171063-12BF	231.0	X-Pole	5.975	16.9	60;240
VZC3A	L700	730	30	2	0.5	53.5	Amphenol	BXA-70063-6CF	231.0	X-Pole	5.916666667	14.0	65;23
VZC4A	C850	850	20	4	0.5	71.3	Andrew	DB846F65ZAXY	231.0	Diplole	6	14.8	65;23
ATA1A	G850	850	20	2	0.5	35.7	Powerwave	7770-00	219.7	Quadport	4.583333333	11.4	85;23
ATA2A	L700	730	40	1	0.5	35.7	KMW	AM-X-CD-16-65	218.0	Quadport	6	13.4	65;23
ATA2B	L2100	2120	40	4	0.5	142.6	KMW	AM-X-CD-16-65	218.0	Quadport	6	15.0	69;23
ATA3A	G850	850	20	2	0.5	35.7	Powerwave	7770-00	218.1	Quadport	4.583333333	11.4	85;23
ATB1A	G850	850	20	2	0.5	35.7	Powerwave	7770-00	218.0	Quadport	4.583333333	11.4	85;141
ATB2A	L700	730	40	1	0.5	35.7	KMW	AM-X-CD-16-65	219.7	Quadport	6	13.4	65;141
ATB2B	L2100	2120	40	4	0.5	142.6	KMW	AM-X-CD-16-65	219.7	Quadport	6	15.0	69;141
ATB3A	G850	850	20	2	0.5	35.7	Powerwave	7770-00	218.0	Quadport	4.583333333	11.4	85;141
ATC1A	G850	850	20	2	0.5	35.7	Powerwave	7770-00	218.1	Quadport	4.583333333	11.4	85;264
ATC2A	L700	730	40	1	0.5	35.7	KMW	AM-X-CD-16-65	218.0	Quadport	6	13.4	65;264
ATC2B	L2100	2120	40	4	0.5	142.6	KMW	AM-X-CD-16-65	218.0	Quadport	6	15.0	69;264
ATC3A	G850	850	20	2	0.5	35.7	Powerwave	7770-00	219.7	Quadport	4.583333333	11.4	85;264

Table 2- Antenna Inventory

4.3 RF Emissions Diagram(s)- All Transmitters:

The following Diagram(s) represent the theoretical spatially averaged Maximum Permissible Exposure (MPE) percentages that are expected for each study's elevation from all Transmitters.



Green	≤ 20% Occupational Limit (≤ 100% General Population Limit)
Blue	> 20% through 100% Occupational Limit (> 100% General Population Limit)
Yellow	> 100% through 1000% Occupational Limit
Red	> 1000% Occupational Limit

Diagram 1- MPE% for Ground Level

5 Signage/ Mitigation:

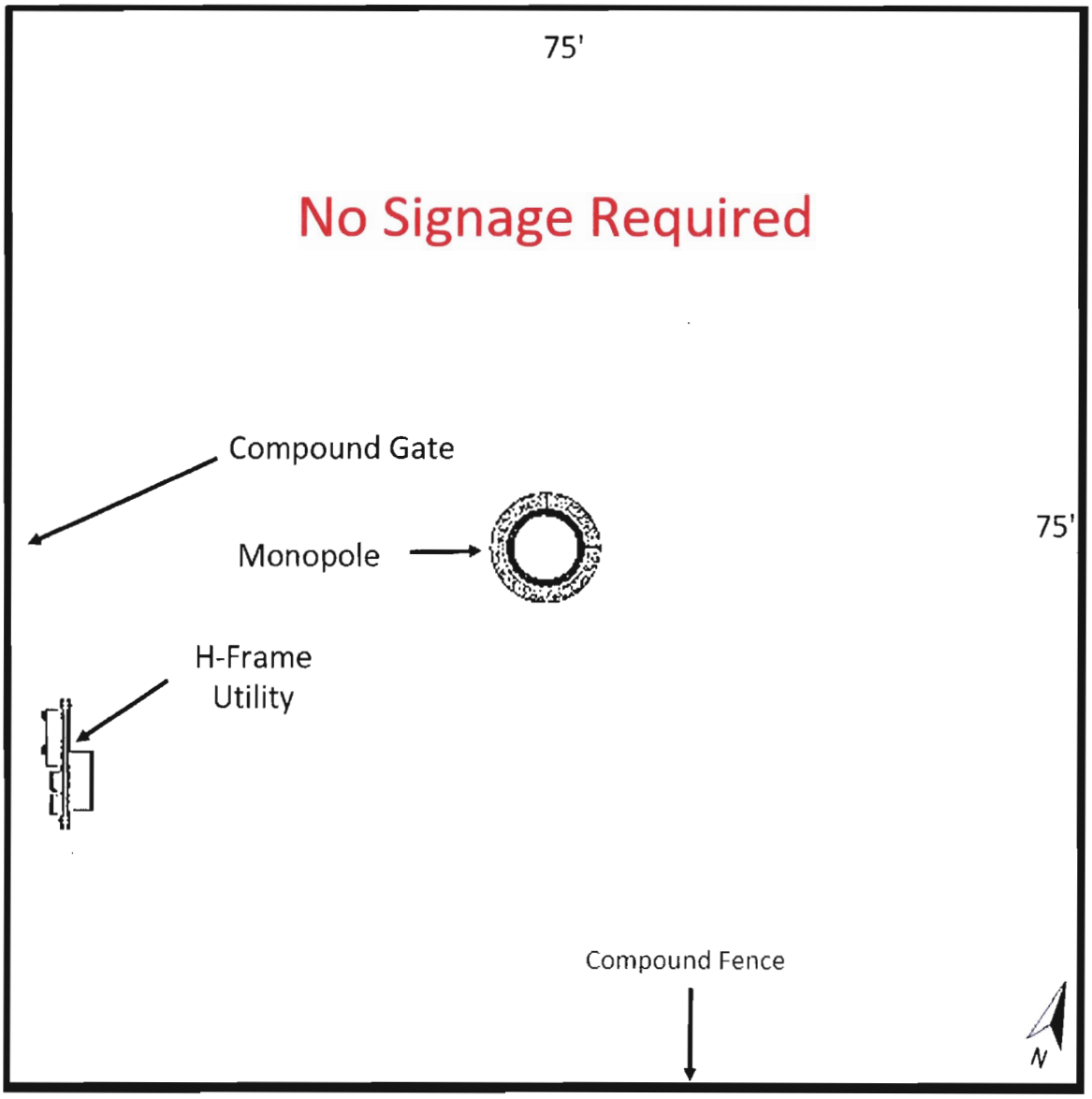
5.1 Signage/ Barrier Detail

Minimum Required For Compliance							
Mitigation Information							
	Notice	Caution	Warning	Guidelines	Site Info	Barrier	Marker
Access Point							
Alpha							
Beta							
Gamma							
Delta							
Omni							

Table 3-Mitigation Requirements for Compliance

Notes/ Additional Mitigation Details from Audit:
No Mitigation Required

5.2 Signage/ Barrier Diagram



6 Conclusions and Recommendations:

- The results of the analysis indicate that the power density levels in the generally accessible areas on the Ground level will not exceed the FCC's MPE limit for both General Population and Occupational environment.
- The max theoretical % MPE (Occupational) is 1.9%.
- No mitigation is required.
- This site will operate in general compliance with FCC OET Bulletin 65 and Crown Castle' Signage and Barrier policy.

Note: Modifications to the site; and/or increases in channel counts or power levels exceeding those listed in this report will require additional evaluation to determine compliance

7 Appendix A: FCC Compliance and RF Safety Policies

In August of 1997, the FCC published OET Bulletin 65 Edition 97-01 to regulate methods for evaluating compliance with FCC guidelines for human exposure to radiofrequency (RF) electromagnetic fields. The FCC guidelines for human exposure to RF electromagnetic fields incorporate two categories of limits; namely "Controlled" (a.k.a. Occupational) and "Uncontrolled" (a.k.a. General Public). The guidelines offer suggested methods for evaluating fixed RF transmitters to insure that the controlled and uncontrolled limits deemed safe by the FC for human exposure are not exceeded.

OET Bulletin 65 recommended guidelines are intended to allow an applicant to "make a reasonably quick determination as to whether a proposed facility is in compliance with the limits." In addition, the guidelines offer alternate supplementary considerations and procedures such as field measurements and more detailed analysis that should be used for multiple emitter situations.

These guidelines define RF as emissions in the frequency range of 300 kHz to 100 GHz. The FCC define Maximum Permissible Exposure (MPE) limits within this frequency range based on limits recommended by the National Council on Radiation Protection and Measurement, the Institute of Electrical and Electronics Engineers (IEEE), and by the American National Standards Institute (ANSI).

The specific MPE limits defined by the FCC are as follows:

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/f^2*	6
30 - 300	61.4	0.163	1	6
300 - 1,500	-	-	f/300	6
1,500 - 100,000	-	-	5	6

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 - 3.0	614	1.63	100*	30
3.0 - 30	842/f	2.19/f	180/f^2*	30
30 - 300	27.5	0.073	0.2	30
300 - 1,500	-	-	f/1500	30
1,500 - 100,000	-	-	1	30

f = frequency *Plane-wave equivalent power density

The FCC states that "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."

For General Population/ Uncontrolled limits, the FCC states that "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 fully be aware of the potential for exposure or cannot exercise control over their exposure."

For purposes of this analysis, all limits are evaluated against the Power Density limits.

Typical guidelines for determining whether Occupational/ Controlled limits can be applied include insuring the environment (such as a rooftop) as limited/controlled access via locked doors or physical barrier that are preferably controlled by a landlord that is aware of the situation and can inform anyone going through the locked door of the existence of the RF emissions. Such notification/awareness is typically accomplished by means of signage on the door, or other access to the area of concern, as well as signage on or near the antennas. Examples of such signs include the following:

Standards for when to use each of the above signs for Occupational situations are as follows:

No sign required: <20% of Occupational MPE
Blue Sign, Notice: 20% to <100% of MPE
Yellow Sign, Caution: 100% to <1000% of MPE
Red Sign, Warning: >1000% of MPE

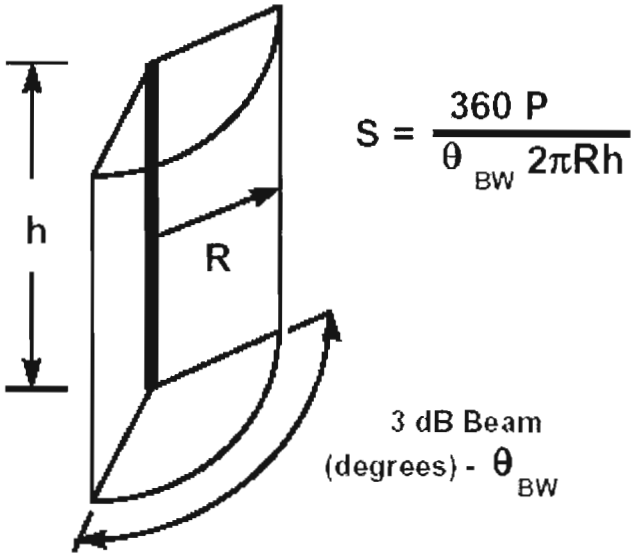
All MPE references are to the FCC Occupational limits.

8 Appendix B: Overview of RoofView® Functions and Assumptions

RoofView® is a tool developed and supported by Richard Tell Associates, Inc. to be used for analysis of RF field levels at telecommunications sites produced by antennas of the type commonly used in cellular, paging, SMR, PCS and two-way radio communications services. Although its name suggests that the tool is only for use in evaluating emissions for roof top applications, it can also be used to evaluate ground level effects of tower facilities.

RoofView® allows the user to apply near field, far field, or a combination of near and far field computational methods as desired by the user. For this analysis, near field computations are used for areas within the near field, and far field computations are used beyond the near field. Specific break points are dynamic, based on the aperture of the antenna being analyzed.

The near field methodology is based on a cylindrical model that assumes the power into an antenna is distributed as a cylinder around the aperture of the antenna. Research by Richard Tell Associates, Inc. found that using such a model, along with corrections for height and antenna pattern, is very accurate, if not slightly conservative in estimating RF exposure. FCC Bulletin 65 recognizes the use of the cylindrical model for near field calculations. The following picture and corresponding equation summarizes the computations used by RoofView® on a bin-by-bin basis when the near field method is used:



$$S = \frac{360\ P}{\theta_{BW}\ 2\pi Rh}$$

Each bin's results are then also adjusted by spatially averaging the portion of a 6 foot tall human that intercepts the aperture over 6 feet. Once the antenna is completely above (or below) the height that corresponds to a 6 foot tall human, the cylindrical results are reduced

to 10% of their results and then dissipated inversely in proportion to the square of the distance.

Once bins being analyzed fall outside of the near field (as determined by a method and variable that is user-selectable; see below for method and variable used in this analysis), a far-field spatial average is calculated. Spatially averaged power density in the far-field is calculated by reducing the spatially averaged power density inversely, by the square of the distance from the antenna(s).

There are several input variables to RoofView® that can impact the results produced when evaluating specific cell sites. Those variables are summarized accordingly:

Standard
FCC 1997 Occupational (default)
FCC 1997 General Population (as applicable)

Model
Near/Far Spatial Average

Uptime
100% (vary as applicable)

Near/Far Field Transition Method
X ApHt

Near/Far Field Transition At Ht Factor
1.5

9 References

FCC (1997). "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields"; Federal Communications Commission; Office of Engineering and Technology, OET Bulletin 65, Edition 97-01, August.

Richard Tell Associates, Inc. (2003). RoofView® User Guide Version 4.15, Richard Tell Associates, Inc., February 10, 2003.

10 Limited Warranty

Biwabkos Consultants LLC warrants that this analysis was performed in good faith using the methodologies and assumptions covered in this report and that data used for the analysis and report were obtained by Biwabkos Consultants LLC employees or representatives via site surveys or research of Crown Castle' available information. In the event that specific third party details were not available, best efforts were made to use assumptions that are based on industry experience of various carriers' standards without violating any confidential information obtained under non-disclosure terms.

Biwabkos Consultants LLC also warrants that this analysis was performed in accordance with industry acceptable standards and methods.

There are no other warranties, express or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose, relating to this agreement or to the services rendered by Biwabkos Consultants hereunder. In no event shall Biwabkos Consultants be held liable to Crown Castle, or to any third party, for any indirect, special, incidental, or consequential damages, including but not limited to loss of profits, loss of data, loss of good will, and increased expenses. In no event shall Biwabkos Consultants be liable to Crown Castle for damages, whether based in contract, tort, negligence, strict liability, or otherwise, exceeding the amount payable hereunder for the services giving rise to such liability.