
Small Cell Height & Base Size Analysis

Analysis on Height and Base Size of
deployments

15 October 2019

Analysis & Assumptions

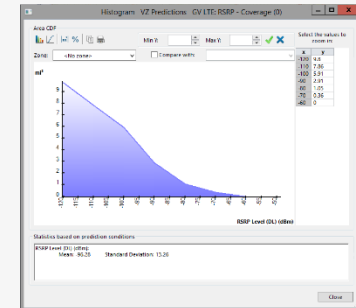
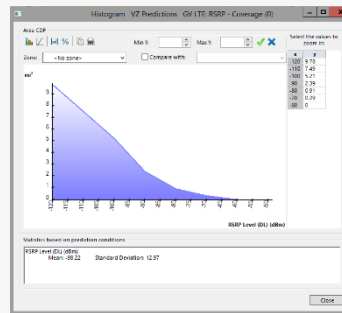
- Analyzed Greenwood Village based on 4G needs for coverage of small cells (AWS frequency)
- Propagation models were run to determine the difference between bases (equipment we can deploy) and heights of the antennas
 - Made an effort to keep sites on arterial streets to reduce residential needs
 - Goal of analysis was to determine the **# of sites needed by adjusting height and base size** while achieving the same coverage

Height & Base Comparison for 4G

40' Height

30' Height

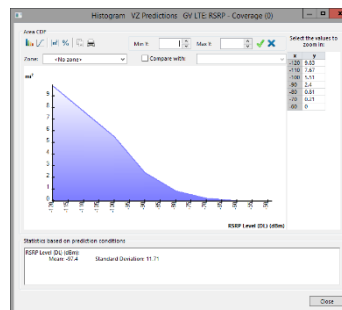
20" Base



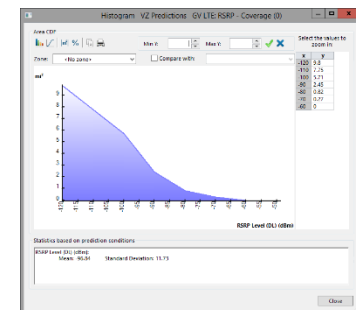
Standard

23% Increase in Site count

16" Base*



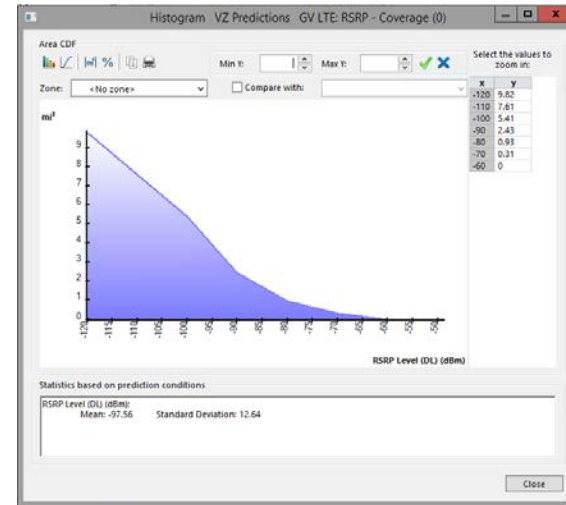
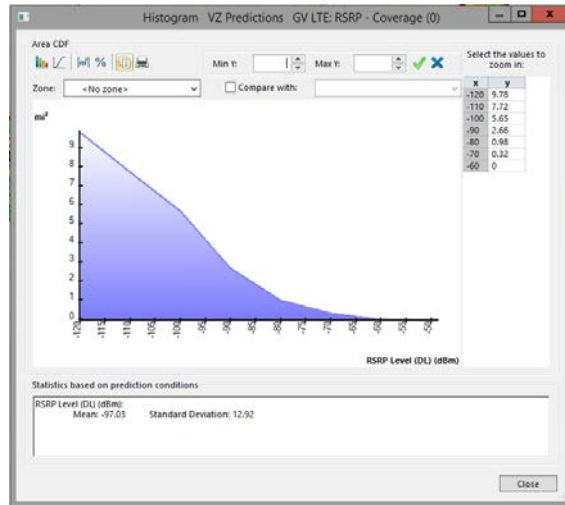
82% Increase in site count



123% Increase in Site count

* Limits potential for future technology

Mixed Height for Commercial / Residential



Arterial streets:

- 20" base
- 40' height

Residential streets:

- 20" base
- 30' height

17% increase in site count from standard

Arterial streets:

- 20" base
- 40' height

Residential streets:

- **16" base**
- 30' height

41% increase in site count from standard

Generations of Cellular Technology

Generation	Technology	Band (MHz) (VZW)
1G	Analog	850
2G	Digital	850
3G	EVDO (Data Only)	850 + 1900
4G	LTE (Voice & Data)	700 + 1900 + 2100
5G	5G (Really Fast Data)	27,000

Denver Small Cell



Denver Small Cell



Denver 5G Small Cell



Macro Site Examples

Traditional Tower



Macro Site Examples

Silo



Macro Site Examples

Monopine Site



Macro Site Examples

Canister Site



VZW In House Report (Monopole)



Radio Frequency (RF) Emissions: Record of FCC Compliance

COMPLIANCE STATUS

APPROVED

Site Information

Site Name	Genesee	Site Type	Macrocell	Structure Type	Monopole
Address	492 Blueridge Drive	City	Golden	State	CO Zip 80401
Engineer	David Born	Engineer Phone	303-829-0002	Sub-Market	Mountain

Service Antenna Data

*NOTE: 'ACL' represents the antenna centerline above ground-level.

Band	Technology	Antenna Manufacturer	Antenna Model	Power/Channel (watts)	# Channels	Loss (dB)	ACL (ft)*
700 MHz	LTE	COMMSCOPE	5C-R2B_PORT 1 +45_07DT_0752 (152	40	4	0.3	65
Cellular	CDMA						
Cellular	LTE	COMMSCOPE	5C-R2B_PORT 1 +45_07DT_0850 (152	40	4	0.3	65
PCS	CDMA						
PCS	LTE	COMMSCOPE	5C-R2B_PORT 3 +45_03DT_1950 (152	32	4	0.3	65
AWS	LTE	COMMSCOPE	5C-R2B_PORT 3 +45_03DT_2110 (152	53.3	4	0.3	65
Unlicensed	LTE						

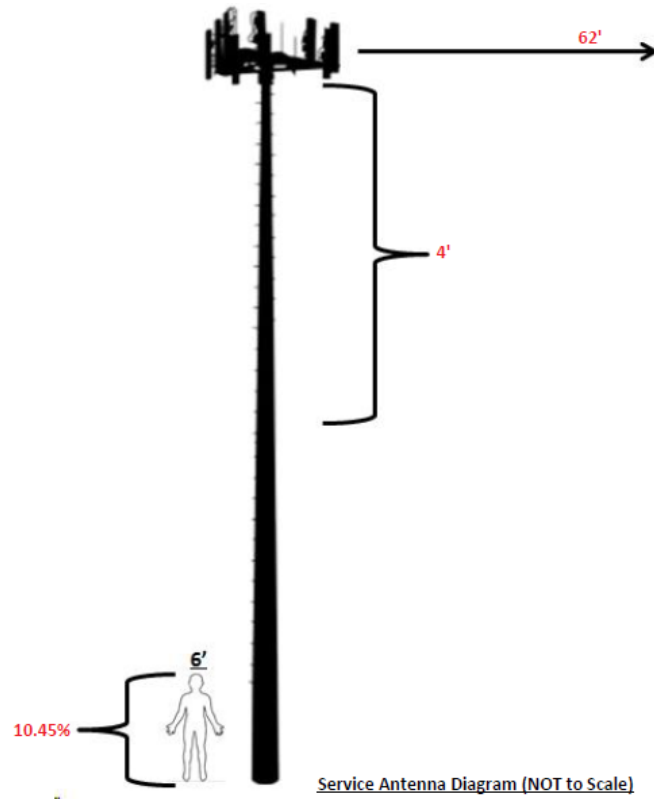


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VZW In House Report (Monopole)

Site Information

Site Name	Genesee	Site Type	Macrocell	Structure Type	Monopole		
Address	492 Blueridge Drive	City	Golden	State	CO	Zip	80401
Engineer	David Born	Engineer Phone	303-829-0002	Sub-Market	Mountain		



VZW In House Report (Monopole)

Site Information

Site Name	Genesee	Site Type	Macrocell	Structure Type	Monopole
Address	492 Blueridge Drive	City	Golden	State	CO Zip 80401
Engineer	David Born	Engineer Phone	303-829-0002	Sub-Market	Mountain

Outstanding Requirements - MUST Be Implemented PRIOR To Site Activation

							
	HOTSPOT	NOTICE	CAUTION	WARNING	RF GUIDELINES	INFORMATION	LL LETTER
SERVICE							
DONOR							
ACCESS POINT(S)							

3rd Party Emissions Report (Rooftop)



Radio Frequency Exposure FCC Compliance Assessment

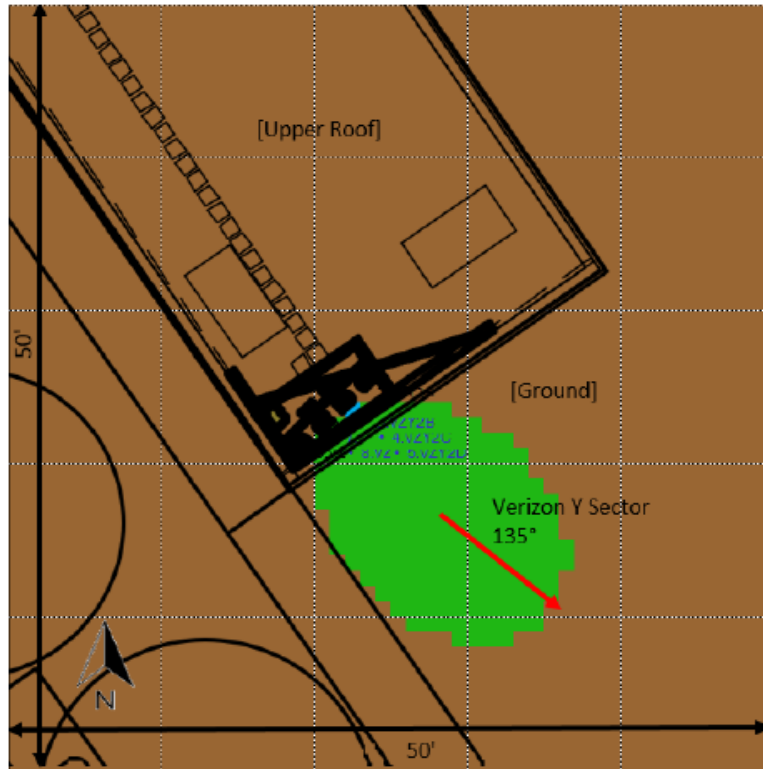
☒ Pre-Activation ☐ Post-Activation

SITE-SPECIFIC-INFORMATION			
Site Name	DEN Marvin	Multi-Licensee Facility	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
Street Address	1805 Washington Avenue	Is Verizon a Significant Contributor to <u>Co-Locator</u> Areas Requiring Mitigation?	<input type="checkbox"/> YES <input type="checkbox"/> NO
City, State, Zip	Golden, CO 80401		<input checked="" type="checkbox"/> N/A
Verizon's Max % MPE (Measured - Occupational)		Verizon's Max % MPE (Predictive - Occupational)	720.2%
Structure Type	Rooftop	Assessment Date	
Broadcast (AM/FM/TV) Co-Locators	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	Assessment Purpose	NSB
Total Access Points	(TBD)	Total Report Revisions	
Original Report Date	06/04/18	Report Revision Date	
Compliance Status	<input type="checkbox"/> COMPLIANT AS DESIGNED <input type="checkbox"/> COMPLIANT PER RF SAFETY PLAN SUBMISSION <input checked="" type="checkbox"/> MITIGATION IS REQUIRED		



3rd Party Emissions Report (Rooftop)

Reference Plane: Ground Level (Y Sector)



0% - 1% Occ. MPE 1% - 20% Occ. MPE 20% - 100% Occ. MPE
≥ 100% Occ. MPE ≥ MPE 1000% Occ. MPE

10' x 10' grid

Reference Plane: Upper Roof Level (Y Sector)

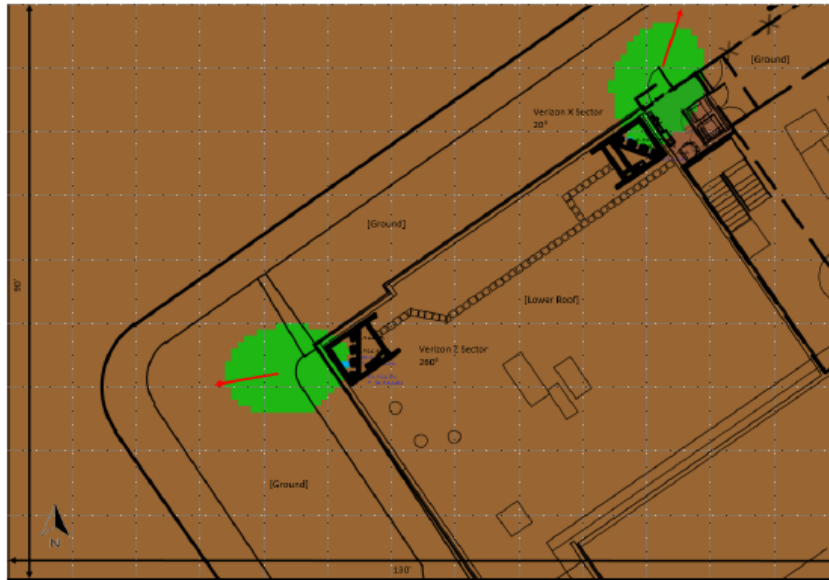


0% - 1% Occ. MPE 1% - 20% Occ. MPE 20% - 100% Occ. MPE
≥ 100% Occ. MPE ≥ MPE 1000% Occ. MPE

10' x 10' grid

3rd Party Emissions Report (Rooftop)

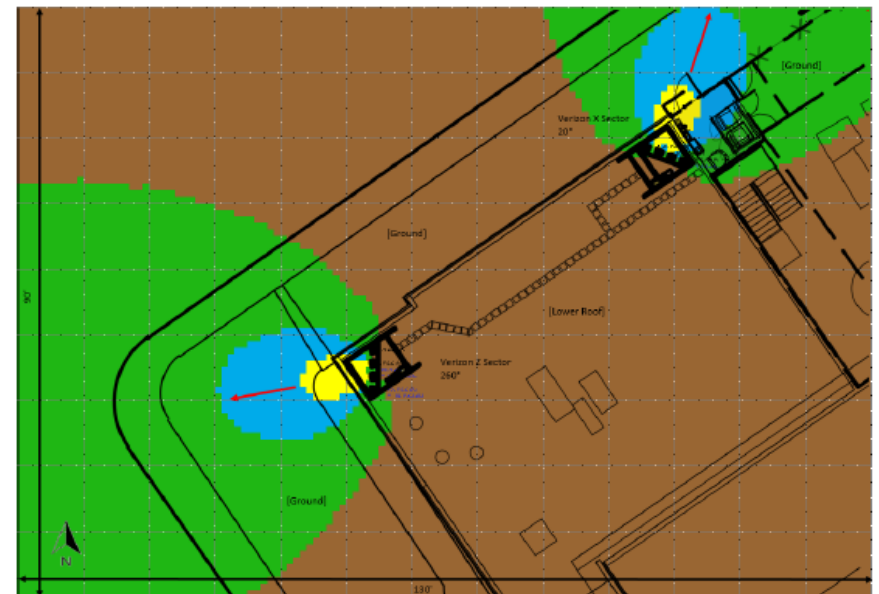
Reference Plane: Ground Level (X & Z Sectors)



0% - 1% Occ. MPE 1% - 20% Occ. MPE 20% - 100% Occ. MPE
≥ 100% Occ. MPE ≥ MPE 1000% Occ. MPE

10' x 10' grid

Reference Plane: Lower Roof Level (X & Z Sectors)



0% - 1% Occ. MPE 1% - 20% Occ. MPE 20% - 100% Occ. MPE
≥ 100% Occ. MPE ≥ MPE 1000% Occ. MPE

10' x 10' grid

3rd Party Emissions Report (Rooftop)

<u>Final Compliant Configuration</u>						
	GUIDELINES	NOTICE	CAUTION	WARNING	NOC INFO	BARRIER/MARKER
Access Point(s)	<input checked="" type="checkbox"/> [TBD]	<input type="checkbox"/> []	<input type="checkbox"/> []	<input type="checkbox"/> []	<input checked="" type="checkbox"/> [TBD]	<input type="checkbox"/>
Alpha	<input checked="" type="checkbox"/> [1]	<input type="checkbox"/> []	<input checked="" type="checkbox"/> [1]	<input type="checkbox"/> []	<input type="checkbox"/> []	<input type="checkbox"/>
Beta	<input checked="" type="checkbox"/> [1]	<input type="checkbox"/> []	<input checked="" type="checkbox"/> [1]	<input type="checkbox"/> []	<input type="checkbox"/> []	<input type="checkbox"/>
Gamma	<input checked="" type="checkbox"/> [1]	<input type="checkbox"/> []	<input checked="" type="checkbox"/> [1]	<input type="checkbox"/> []	<input type="checkbox"/> []	<input type="checkbox"/>

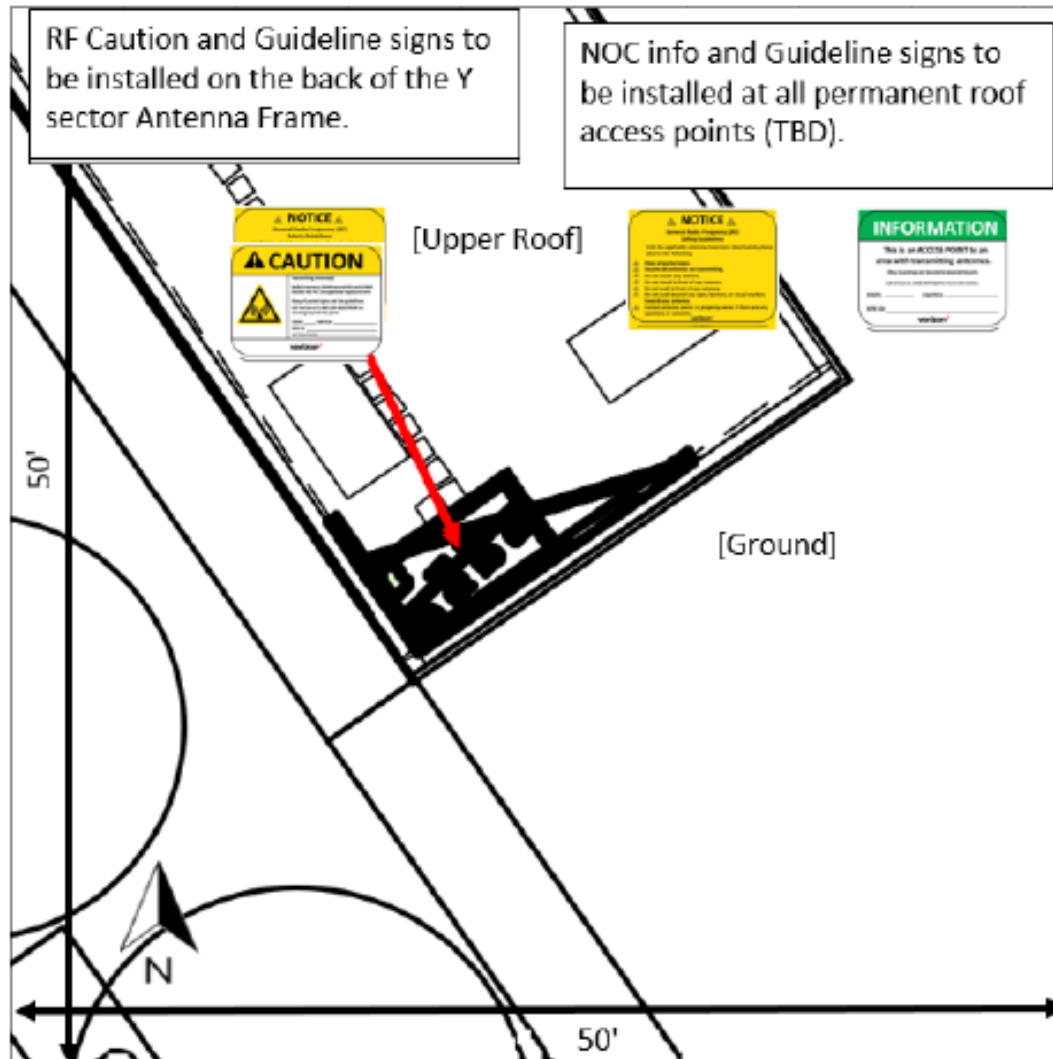
NOTE: The table above represents EVERY compliance item that MUST be implemented at this location; Also in Sec. 4 (B)

Additional Compliance Requirements(s):

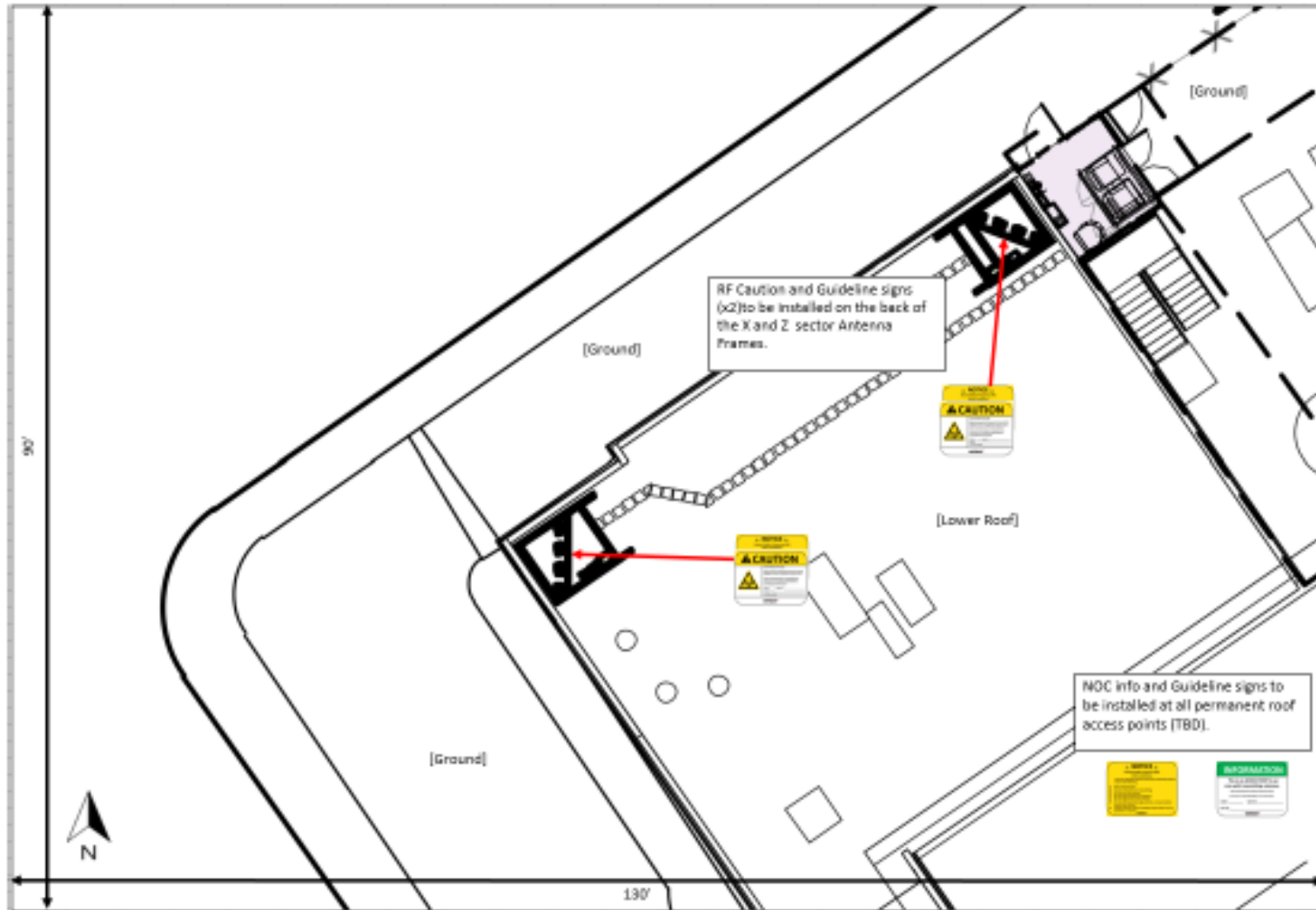
Signage required per the Signage / Barrier Diagram. Mitigation is required per the Signage/Barrier Diagram. A "Site RF Compliance & Information Package" template is to be sent to the property owner due to the antennas being mounted behind RF screens.

Consultant Legal Name	Centerline Solutions	Phone/Fax	303.993.3293/ 303.993.3019
Address	16035 Table Mountain Parkway, Golden, CO 80403		

3rd Party Emissions Report (Rooftop)



3rd Party Emissions Report (Rooftop)



3rd Party Emissions Report (Small Cell)

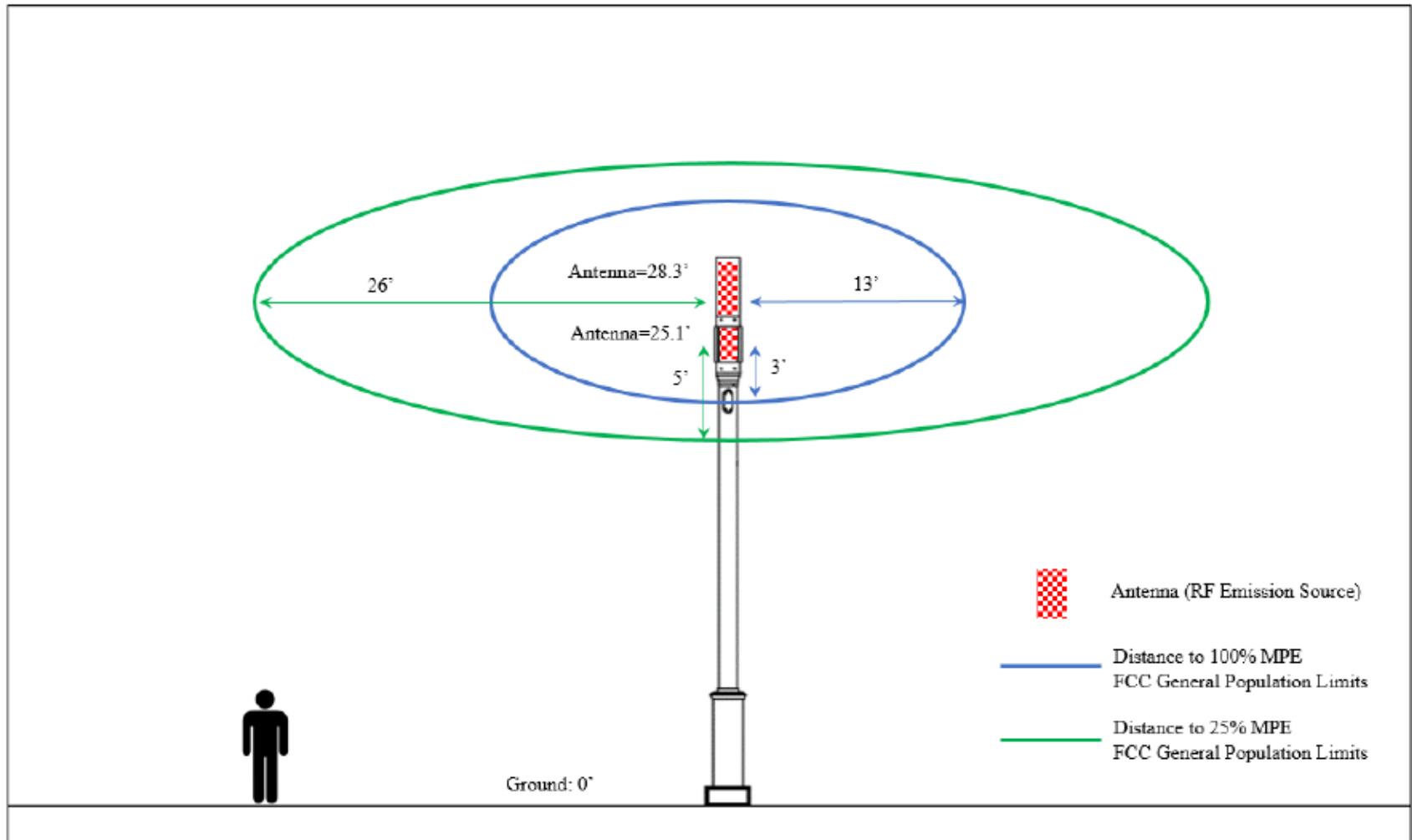


Figure 2: Distances to 100% and 25% MPE Levels (Profile View)

Thank you.