Attachment D - 4

RF Safety Report

Fox Hill Telecom

Radio Frequency Safety Survey Report Prediction (RF

AT&T Wireless Monopine Facility

TOWN OF MAMMOTH LAKES
RECEIVED
7/20/2023

Site ID: CSL04615
Site Name: CSL04615
FA: 11553744
USID: 312847
PACE #: MRLOS071118

Address: 1574 Old Mammoth Road
Mammoth Lakes, CA 93546

County: Mono County
Latitude: 37.629606
Longitude: -118.978303
Site Structure Type: Monopine

Report Date: 1/6/2023

M-RFSC: Essie Polard

Prepared For: SFC Communications, Inc dba Eukon Group
65 Post, Suite 1000
Irvine, CA 92618

Report Author: Erin Mahaney
Report Reviewer: Scott Heffernan
Fox Hill Project Number: 222119

Compliance Status:

AT&T will be compliant with FCC Regulations upon installation of recommended mitigation measures as presented in Section 3.0 of this report.

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Table of Contents

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1.0 Introduction

Fox Hill Telecom, Inc. has been contracted by AT&T to produce a theoretical assessment of the potential radio frequency emissions at the proposed AT&T monopine site. FCC OET Bulletin 65 – Edition 97-01 recommends that theoretical calculations should be done to yield a worst-case scenario. This theoretical analysis will provide a worst-case assessment of potential emissions and will assume all transmitters are operating at highest capacity and power. This will provide AT&T with a guideline of how to proceed with mitigating the site to ensure the site will be compliant with FCC regulations at any instance.

Many licensed wireless system operators are required to perform periodic assessments of potential impacts to humans due to radio frequency emissions from active transmitters at the site. The Federal Communications Commission ("FCC") considers two levels of standards based on access controls to the site and the level of knowledge of the effects of radio frequency to humans.

A controlled/occupational environment assumes that anyone accessing the site is fully trained in RF safety and is aware of the effects of the exposure to radio frequency emissions to humans,

An uncontrolled/general population environment assumes that access is not restricted to RF trained individuals and other members of the general population may be able to access the site for any reason, occupation or otherwise.

2.0 Site Information

AT&T has provided the following documents to use in the analysis of this site.

- **RFDS:** LOS-ANGELES_L.A._CSL04615_2023-New-Site_LTE_ja628x_3551A0TJF4_11553744_312847_12-09-2021_Final-Approved_v1.00
    - **RFDS ID:** 4902165
- **CDs:** CSL04615 - 100ZD - REV 0 - NSB - 10-26-22

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3.0 Results Snapshot and Mitigation Measures

Based on the theoretical modeling analysis performed, there are no areas at this site that exceed the FCC's General Public and Occupational limits. All areas of concern extend into free space. AT&T must ensure proper mitigation is installed at the site in order to bring the site into compliance.

Section 7.0 will show the areas of exposure, if any, at each AT&T Sector.

Signage and barriers are the primary means of mitigating access to accessible areas of exposure. A site scaled map can be found in section 4.0 which details the locations where mitigation should be installed to bring the site into compliance with FCC regulations.

Below is a summary of **recommended mitigation** at this AT&T facility.

<u>Access:</u>

- Caution 2B sign required at base of monopine near climbing ladder.

<u>Sector A:</u>

- No signage required

<u>Sector B:</u>

- No signage required

<u>Sector C:</u>

- No signage required

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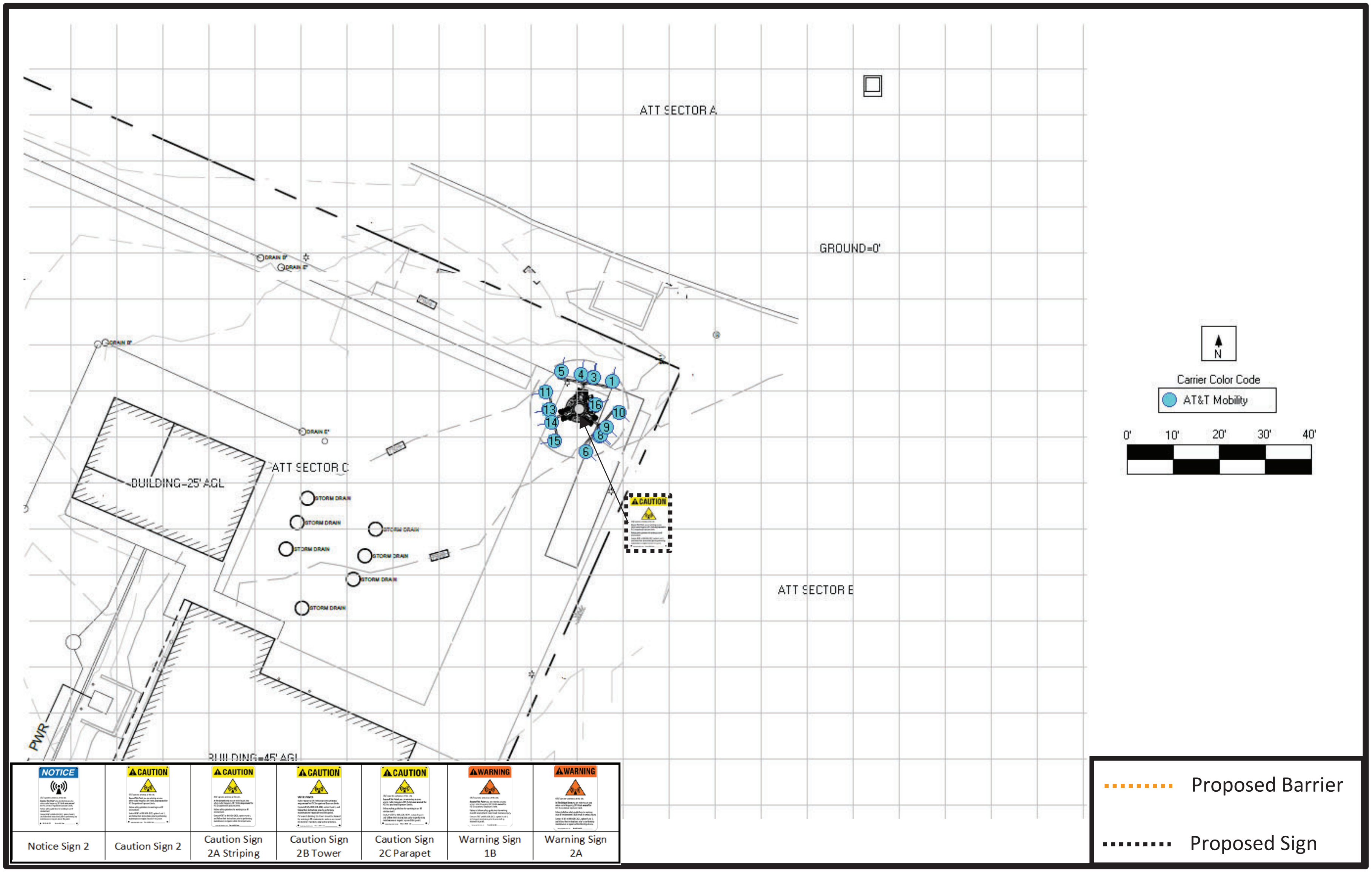
4.0 Site Map



ATT SECTOR A
GROUND=0'
ATT SECTOR C
BUILDING=25' AGL
STORM DRAIN
ATT SECTOR B
BUILDING=45' AGL
PWR
N
Carrier Color Code
AT&T Mobility
0'
10'
20'
30'
40'
CAUTION
NOTICE
WARNING
Notice Sign 2
Caution Sign 2
Caution Sign 2A Striping
Caution Sign 2B Tower
Caution Sign 2C Parapet
Warning Sign 1B
Warning Sign 2A
Proposed Barrier
Proposed Sign

5.0 Antenna Inventory

Antenna ID	Operator	Antenna Make and Model	Type	Freq (MHz)	Input Power (Watts)	# of TX	ERP (Watts)	Azimuth (°)	Gain (dBd)	BW (°)	Length (ft)	x	y
1	AT&T Mobility	Commscope NNH4-65C-R6-V3	Panel	LTE 700 B17	40	4	3035	10	12.78	75	8.00	128	62.2
1	AT&T Mobility	Commscope NNH4-65C-R6-V3	Panel	5G 850	40	4	3460	10	13.35	72	8.00	128	62.2
1	AT&T Mobility	Commscope NNH4-65C-R6-V3	Panel	LTE 1900	40	4	5116	10	15.05	60	8.00	128	62.2
1	AT&T Mobility	Commscope NNH4-65C-R6-V3	Panel	LTE 1900	40	4	5116	10	15.05	60	8.00	128	62.2
2	AT&T Mobility	Integrated RRU AIR6419 B77G	Panel	5G B77G 3500	54.22	1	11994	10	23.45	13	2.43	124	61.4
3	AT&T Mobility	Integrated RRU AIR6449 B77D	Panel	5G CBAND 3700	108.4	1	23982	10	23.45	11.7	2.76	124	61.4
4	AT&T Mobility	CCI OPA65R-BU8DA-K	Panel	LTE 700 B14	40	4	3305	10	13.15	61	8.00	122	60.7
4	AT&T Mobility	CCI OPA65R-BU8DA-K	Panel	LTE 2100	40	4	5741	10	15.55	71	8.00	122	60.7
5	AT&T Mobility	CCI OPA65R-BU8DA-K	Panel	LTE 2300	25	4	3427	10	15.35	50	8.00	117	60.1
6	AT&T Mobility	Commscope NNH4-65C-R6-V3	Panel	LTE 700 B17	40	4	3035	130	12.78	75	8.00	123	77.6
6	AT&T Mobility	Commscope NNH4-65C-R6-V3	Panel	5G 850	40	4	3460	130	13.35	72	8.00	123	77.6
6	AT&T Mobility	Commscope NNH4-65C-R6-V3	Panel	LTE 1900	40	4	5116	130	15.05	60	8.00	123	77.6
6	AT&T Mobility	Commscope NNH4-65C-R6-V3	Panel	LTE 1900	40	4	5116	130	15.05	60	8.00	123	77.6
7	AT&T Mobility	Integrated RRU AIR6419 B77G	Panel	5G B77G 3500	54.22	1	11994	130	23.45	13	2.43	126	74.2
8	AT&T Mobility	Integrated RRU AIR6449 B77D	Panel	5G CBAND 3700	108.4	1	23982	130	23.45	11.7	2.76	126	74
9	AT&T Mobility	CCI OPA65R-BU8DA-K	Panel	LTE 700 B14	40	4	3305	130	13.15	61	8.00	127	72.3
9	AT&T Mobility	CCI OPA65R-BU8DA-K	Panel	LTE 2100	40	4	5741	130	15.55	71	8.00	127	72.3
10	AT&T Mobility	CCI OPA65R-BU8DA-K	Panel	LTE 2300	25	4	3427	130	15.35	50	8.00	130	69.1
11	AT&T Mobility	Commscope NNH4-65C-R6-V3	Panel	LTE 700 B17	40	4	3035	260	12.78	75	8.00	114	64.6
11	AT&T Mobility	Commscope NNH4-65C-R6-V3	Panel	5G 850	40	4	3460	260	13.35	72	8.00	114	64.6
11	AT&T Mobility	Commscope NNH4-65C-R6-V3	Panel	LTE 1900	40	4	5116	260	15.05	60	8.00	114	64.6
11	AT&T Mobility	Commscope NNH4-65C-R6-V3	Panel	LTE 1900	40	4	5116	260	15.05	60	8.00	114	64.6
12	AT&T Mobility	Integrated RRU AIR6419 B77G	Panel	5G B77G 3500	54.22	1	11994	260	23.45	13	2.43	114	68.4
13	AT&T Mobility	Integrated RRU AIR6449 B77D	Panel	5G CBAND 3700	108.4	1	23982	260	23.45	11.7	2.76	115	68.4
14	AT&T Mobility	CCI OPA65R-BU8DA-K	Panel	LTE 700 B14	40	4	3305	260	13.15	61	8.00	115	71.2
14	AT&T Mobility	CCI OPA65R-BU8DA-K	Panel	LTE 2100	40	4	5741	260	15.55	71	8.00	115	71.2

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Antenna ID	Operator	Antenna Make and Model	Type	Freq (MHz)	Input Power (Watts)	# of TX	ERP (Watts)	Azimuth (°)	Gain (dBd)	BW (°)	Length (ft)	x	y
15	AT&T Mobility	CCI OPA65R-BU8DA-K	Panel	LTE 2300	25	4	3427	260	15.35	50	8.00	116	75.3
16	AT&T Mobility	4' Microwave	Dish	LTE 18000	1	1	19717	70	42.95	0.9	4.00	125	67.4

Antenna ID	Operator	Ant Z Value Ground Level (ft)	Ant Z Value Adjacent Building Level 25 (ft)	Ant Z Value Adjacent Building Level 45 (ft)	Ant Z Value Antenna Face
1	AT&T Mobility	66.00	41.00	21.00	0
2	AT&T Mobility	71.54	46.54	26.54	0
3	AT&T Mobility	67.87	42.87	22.87	0
4	AT&T Mobility	66.00	41.00	21.00	0
5	AT&T Mobility	66.00	41.00	21.00	0
6	AT&T Mobility	66.00	41.00	21.00	0
7	AT&T Mobility	71.54	46.54	26.54	0
8	AT&T Mobility	67.87	42.87	22.87	0
9	AT&T Mobility	66.00	41.00	21.00	0
10	AT&T Mobility	66.00	41.00	21.00	0
11	AT&T Mobility	66.00	41.00	21.00	0
12	AT&T Mobility	71.54	46.54	26.54	0
13	AT&T Mobility	67.87	42.87	22.87	0
14	AT&T Mobility	66.00	41.00	21.00	0
15	AT&T Mobility	66.00	41.00	21.00	0
16	AT&T Mobility	53.00	28.00	8.00	0

*The Z values refer to the distance from the bottom of the antenna to the referenced level.

**The z value of the AIR antenna was adjusted to 0 when bottom tip is between 0 and 8 feet from referenced level for the most conservative results.

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6.0 RoofMaster™ Export File

Ant Num	ID	Name	(MHz) Freq	EIRP	ERP	Mfg	Model	(ft) X	(ft) Y	(ft) Z	Antenna Type	Aperture Size	Gain in dbd	Orientation	ON flag	Horizontal Beam Width	Downtilt	Length	Screen Orientation
1	1	AT&T Mobility	700	4979	3035	COMMSCOPE	NNH4-65C-R6-V3 04DT 700	128.3	62.2	69.9			12.78	10.00	ON•	75	0	2.4384	10
1	2	AT&T Mobility	850	5676	3460	COMMSCOPE	NNH4-65C-R6-V3 04DT 850	128.3	62.2	69.9			13.35	10.00	ON•	72	0	2.4384	10
1	3	AT&T Mobility	1900	8394	5116	COMMSCOPE	NNH4-65C-R6-V3 02DT 1900	128.3	62.2	69.9			15.05	10.00	ON•	60	0	2.4384	10
1	4	AT&T Mobility	1900	8394	5116	COMMSCOPE	NNH4-65C-R6-V3 02DT 1900	128.3	62.2	69.9			15.05	10.00	ON•	60	0	2.4384	10
2	5	AT&T Mobility	3500	19678	11994	Integrated RRU	SON AIR6419 TB 05.17.21 3500 AT&T	124.1	61.4	72.7			23.45	10.00	ON•	13	0	0.74	10
3	6	AT&T Mobility	3700	39344	23982	Integrated RRU	SON AIR6449 NR TB 05.17.21 3700 AT&T	124.3	61.4	69.3			23.45	10.00	ON•	11.7	0	0.84	10
4	7	AT&T Mobility	700	5422	3305	CCI	OPA65R-BU8D 02DT 700	121.5	60.7	69.9			13.15	10.00	ON•	61	0	2.4384	10
4	8	AT&T Mobility	2100	9419	5741	CCI	OPA65R-BU8D 02DT 2100	121.5	60.7	69.9			15.55	10.00	ON•	71	0	2.4384	10
5	9	AT&T Mobility	2300	5622	3427	CCI	OPA65R-BU8D 02DT 2300	117.2	60.1	69.9			15.35	10.00	ON•	50	0	2.4384	10
6	10	AT&T Mobility	700	4979	3035	COMMSCOPE	NNH4-65C-R6-V3 04DT 700	122.6	77.6	69.9			12.78	130.00	ON•	75	0	2.4384	130
6	11	AT&T Mobility	850	5676	3460	COMMSCOPE	NNH4-65C-R6-V3 04DT 850	122.6	77.6	69.9			13.35	130.00	ON•	72	0	2.4384	130
6	12	AT&T Mobility	1900	8394	5116	COMMSCOPE	NNH4-65C-R6-V3 02DT 1900	122.6	77.6	69.9			15.05	130.00	ON•	60	0	2.4384	130
6	13	AT&T Mobility	1900	8394	5116	COMMSCOPE	NNH4-65C-R6-V3 02DT 1900	122.6	77.6	69.9			15.05	130.00	ON•	60	0	2.4384	130
7	14	AT&T Mobility	3500	19678	11994	Integrated RRU	SON AIR6419 TB 05.17.21 3500 AT&T	125.6	74.2	72.7			23.45	130.00	ON•	13	0	0.74	130
8	15	AT&T Mobility	3700	39344	23982	Integrated RRU	SON AIR6449 NR TB 05.17.21 3700 AT&T	125.8	74	69.3			23.45	130.00	ON•	11.7	0	0.84	130
9	16	AT&T Mobility	700	5422	3305	CCI	OPA65R-BU8D 02DT 700	127.1	72.3	69.9			13.15	130.00	ON•	61	0	2.4384	130
9	17	AT&T Mobility	2100	9419	5741	CCI	OPA65R-BU8D 02DT 2100	127.1	72.3	69.9			15.55	130.00	ON•	71	0	2.4384	130
10	18	AT&T Mobility	2300	5622	3427	CCI	OPA65R-BU8D 02DT 2300	129.8	69.1	69.9			15.35	130.00	ON•	50	0	2.4384	130
11	19	AT&T Mobility	700	4979	3035	COMMSCOPE	NNH4-65C-R6-V3 04DT 700	113.8	64.6	69.9			12.78	260.00	ON•	75	0	2.4384	260
11	20	AT&T Mobility	850	5676	3460	COMMSCOPE	NNH4-65C-R6-V3 04DT 850	113.8	64.6	69.9			13.35	260.00	ON•	72	0	2.4384	260
11	21	AT&T Mobility	1900	8394	5116	COMMSCOPE	NNH4-65C-R6-V3 02DT 1900	113.8	64.6	69.9			15.05	260.00	ON•	60	0	2.4384	260
11	22	AT&T Mobility	1900	8394	5116	COMMSCOPE	NNH4-65C-R6-V3 02DT 1900	113.8	64.6	69.9			15.05	260.00	ON•	60	0	2.4384	260
12	23	AT&T Mobility	3500	19678	11994	Integrated RRU	SON AIR6419 TB 05.17.21 3500 AT&T	114.4	68.4	72.7			23.45	260.00	ON•	13	0	0.74	260
13	24	AT&T Mobility	3700	39344	23982	Integrated RRU	SON AIR6449 NR TB 05.17.21 3700 AT&T	114.7	68.4	69.3			23.45	260.00	ON•	11.7	0	0.84	260
14	25	AT&T Mobility	700	5422	3305	CCI	OPA65R-BU8D 02DT 700	115.1	71.2	69.9			13.15	260.00	ON•	61	0	2.4384	260
14	26	AT&T Mobility	2100	9419	5741	CCI	OPA65R-BU8D 02DT 2100	115.1	71.2	69.9			15.55	260.00	ON•	71	0	2.4384	260
15	27	AT&T Mobility	2300	5622	3427	CCI	OPA65R-BU8D 02DT 2300	115.7	75.3	69.9			15.35	260.00	ON•	50	0	2.4384	260
16	28	AT&T Mobility	18000	32347	19717	GENERIC	MICROWAVE 4FT 18000	124.7	67.4	55			42.95	70.00	ON•	0.9	0	1.2192	70

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7.0 Results and Compliance Recommendations

Based on the theoretical modeling analysis performed, there are no areas at this site that exceed the FCC's General Public and Occupational limits. All areas of concern extend into free space. AT&T must ensure proper mitigation is installed at the site in order to bring the site into compliance.

AT&T Results:

At the **ground level (0' AGL**), the maximum power density value (% MPE) calculated for AT&T's antennas is **4.01 %** of the FCC's allowable limit for General Population exposure to radio frequency emissions (**0.80 %** of the FCC's allowable Occupational limit).

At the **adjacent building level (25' AGL**), the maximum power density value (% MPE) calculated for AT&T's antennas is **9.70 %** of the FCC's allowable limit for General Population exposure to radio frequency emissions (**1.94 %** of the FCC's allowable Occupational limit).

At the **adjacent building level (45' AGL**), the maximum power density value (% MPE) calculated for AT&T's antennas is **40.30 %** of the FCC's allowable limit for General Population exposure to radio frequency emissions (**8.06 %** of the FCC's allowable Occupational limit).

At the **antenna face level,** the maximum power density value (% MPE) calculated for AT&T's antennas is **22,535.01 %** of the FCC's allowable limit for General Population exposure to radio frequency emissions (**4,507.00 %** of the FCC's allowable Occupational limit).

AT&T will be compliant with the installation of recommended mitigation measures. Each sector is broken down below.

Sector A:

The maximum power density value (% MPE) calculated for **AT&T's Sector A antennas** on the ground level is **4.01 %** of the FCC's allowable limit for General Population exposure to radio frequency emissions (**0.80 %** of the FCC's allowable Occupational limit).

There are no accessible areas at any forementioned level that exceed the FCC's General Population or Occupational limit for exposure to radio frequency emissions in front of the Sector A antennas. All areas of concern extend into free space.

Sector B:

The maximum power density value (% MPE) calculated for **AT&T's Sector B antennas** on the ground level is **4.01 %** of the FCC's allowable limit for General Population exposure to radio frequency emissions (**0.80 %** of the FCC's allowable Occupational limit).

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There are no accessible areas at any forementioned level that exceed the FCC's General Population or Occupational limit for exposure to radio frequency emissions in front of the Sector B antennas. All areas of concern extend into free space.

<u>Sector C:</u>

The maximum power density value (% MPE) calculated for **AT&T's Sector C antennas** on the ground level is **4.01 %** of the FCC's allowable limit for General Population exposure to radio frequency emissions (**0.80 %** of the FCC's allowable Occupational limit).

There are no accessible areas at any forementioned level that exceed the FCC's General Population or Occupational limit for exposure to radio frequency emissions in front of the Sector C antennas. All areas of concern extend into free space.

The FCC mandates that if a site is found to be out of compliance with regard to emissions that any system operator contributing 5% or more to areas exceeding the FCC's allowable limits, as outlined in this report, will be responsible for bringing the site into compliance.

There are no other carriers on site.

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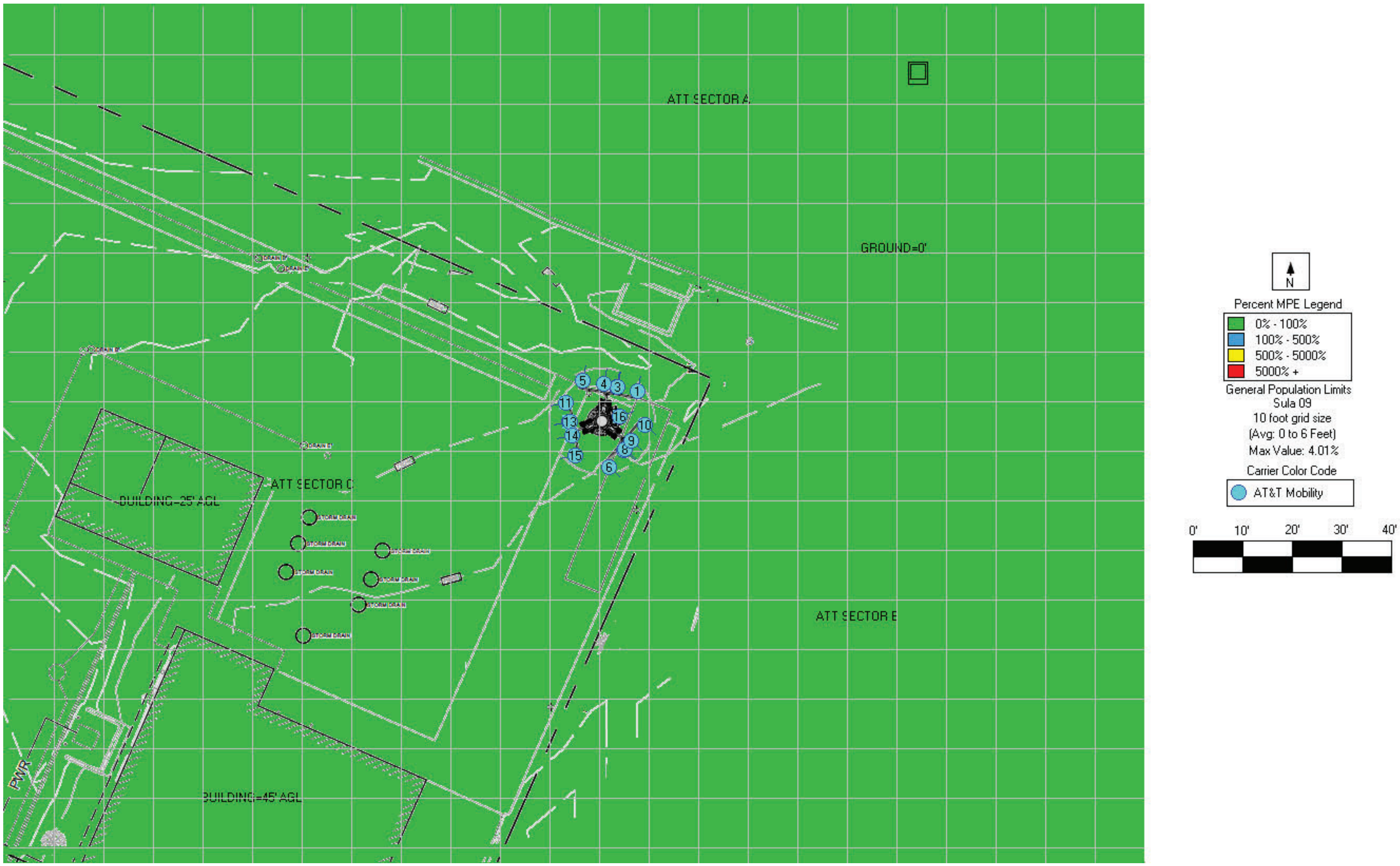
MPE Contribution AT&T Antennas Ground Level (0' AGL)



The anticipated % MPE for the AT&T antennas at the **ground level (0')** is **4.01 %** of the FCC's allowable limit for General Population

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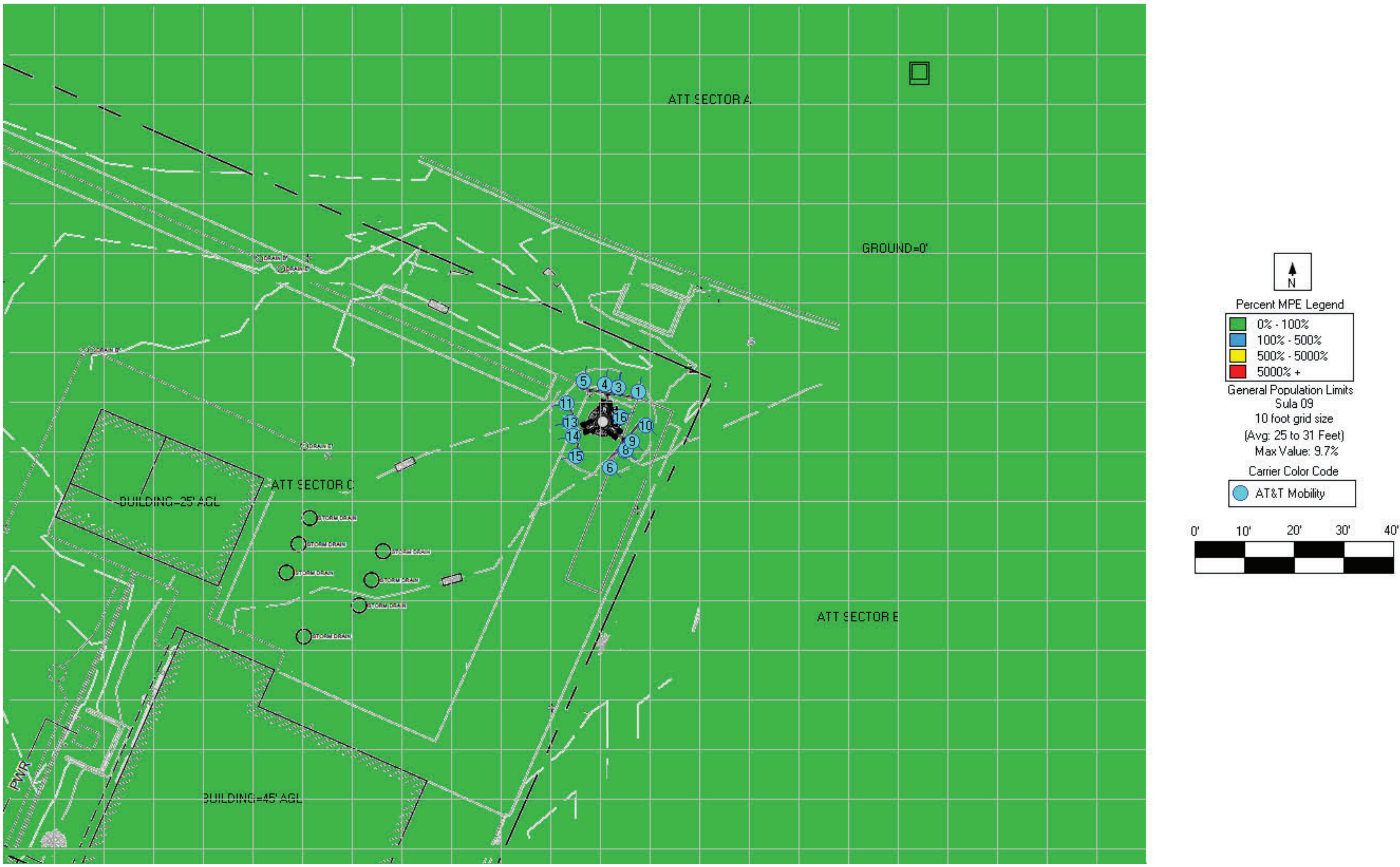
MPE Contribution AT&T Antennas Adjacent Building Level (25’ AGL)



The anticipated % MPE for the AT&T antennas at the **adjacent building level (25’)** is **9.70 %** of the FCC’s allowable limit for General Population

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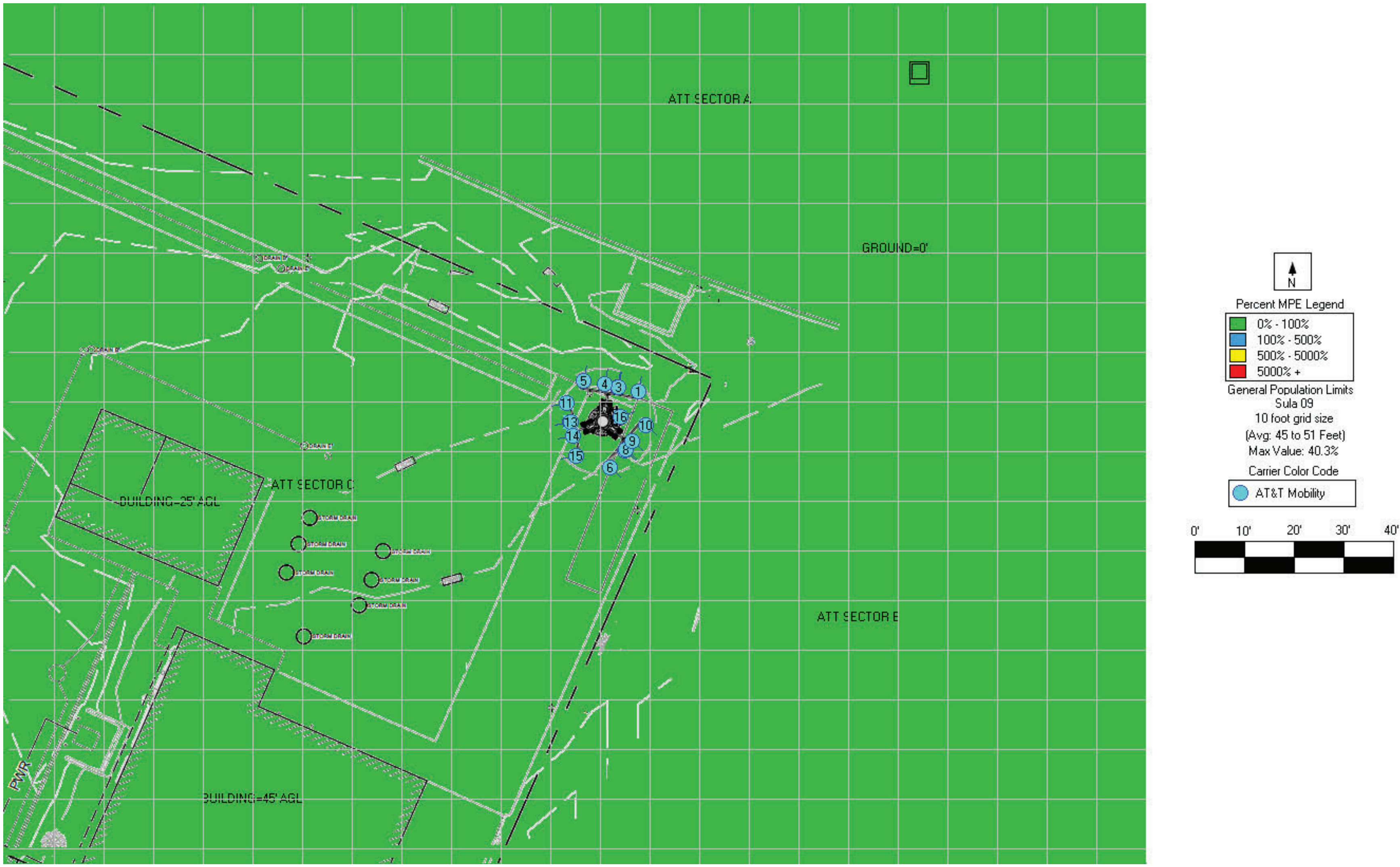
MPE Contribution AT&T Antennas Adjacent Building Level (45' AGL)



The anticipated % MPE for the AT&T antennas at the **adjacent building level (45')** is **40.30 %** of the FCC's allowable limit for General Population

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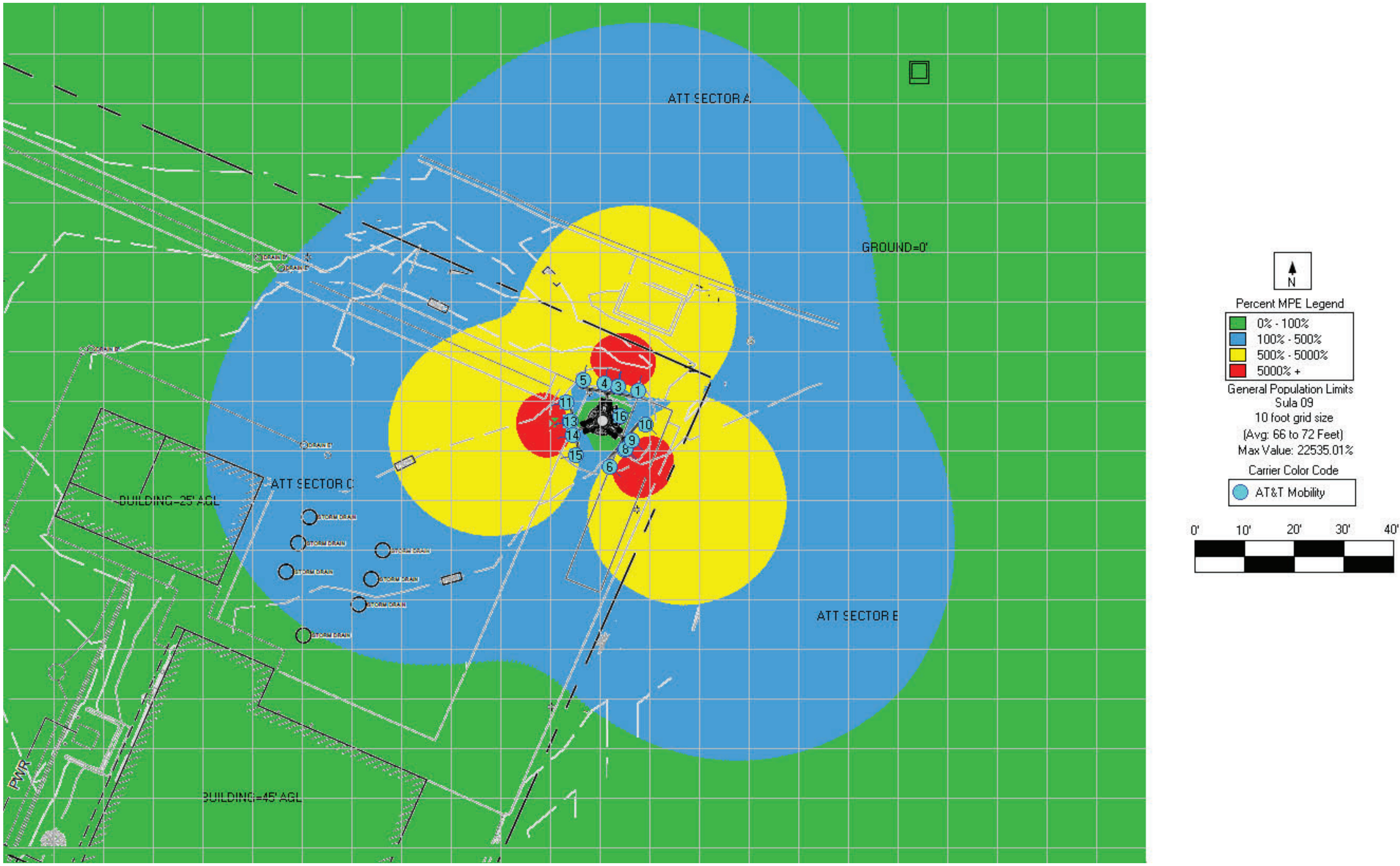
MPE Contribution AT&T Antennas Antenna Face Level



The anticipated % MPE for the AT&T antennas at the **antenna face level** is **22,535.01 %** of the FCC's allowable limit for General Population

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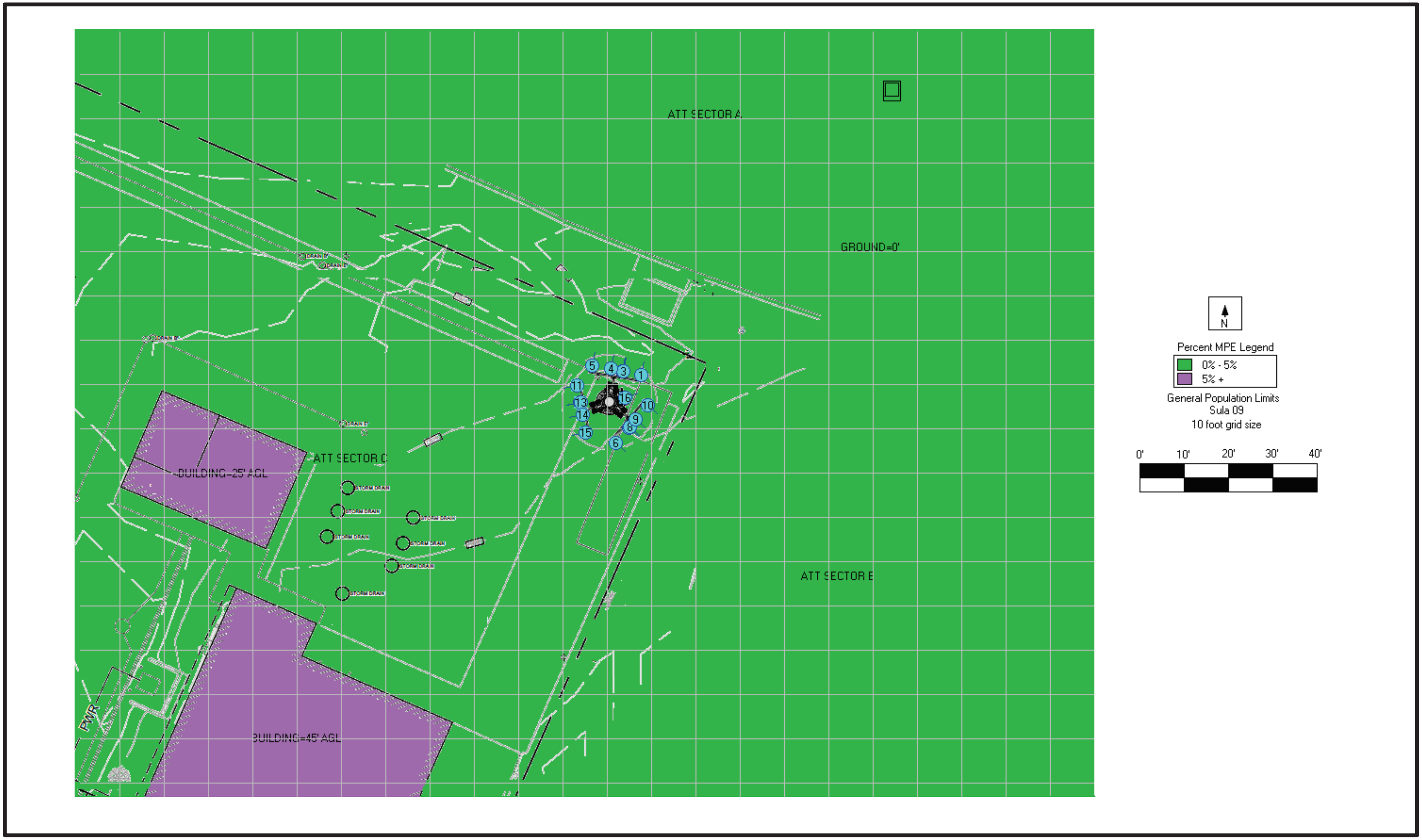
5% MPE Contribution AT&T Antennas



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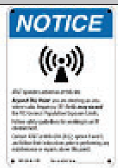
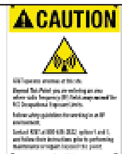
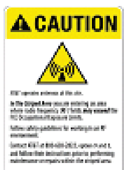
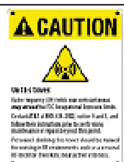
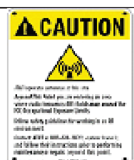
8.0 AT&T Signage Policy

Sign	Description
	Notice Sign 2 Used to alert individuals that they are entering an area that may exceed either the FCC's General Population emissions limits.
	Caution Sign 2 Used to alert individuals that they are entering an area that may exceed the FCC's Occupational emissions limit.
	Caution Sign 2A Striping Used to alert individuals that they are entering an area that may exceed the FCC's Occupational emissions limit. To be used when physical barriers are unable to be mounted on a rooftop per landlord or structural restrictions
	Caution Sign 2B Tower Used to alert individuals that they are entering an area that may exceed the FCC's Occupational emissions limit. To be placed at the base of tower and monopole sites.
	Caution Sign 2C Parapet (5" x 7") Used to alert individuals that they are entering an area that may exceed the FCC's Occupational emissions limit. To be placed on parapet behind antennas for façade mounted sectors
	Warning Sign 1B Used to inform individuals that they are entering an area that may exceed the FCC's Occupational emissions limit by a factor of 10 or greater. Shall be used when barriers are present or will be deployed around AT&T antennas
	Warning Sign 2A Used to inform individuals that they are entering an area that may exceed the FCC's Occupational emissions limit by a factor of 10 or greater. Shall be used in lieu of barriers along with striping when barriers are not allowed

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9.0 Fall Arrest and Parapet Information

As per AT&T barrier policy, rooftop edges that are protected with a 39-inch parapet wall or guardrail are safe for work activity within six (6) feet of the edge. OSHA has stated that an existing 39-inch guardrail or parapet provides sufficient protection for employees. The height of the top rail or equivalent component of guardrail systems in new construction shall be at least 42 inches above the walking or working surface. It should also be noted that the height of the parapet or guardrail may be reduced to no less than 30 inches at any point provided the sum of the depth (horizontal distance) of the top edge, and the height of the top edge (vertical distance from the work surface to the top edge of the top member, is at least 48 inches. If there is no reason for working atop the roof, then edge protection is not required. In addition, workers may use personnel lifts or temporary fall protection measures to perform work within 6 feet of the roof edge in place of permanent edge protection. Reference: 29 CFR 1910.28, 29 CFR 1910.23 (NPRM-1990); OSHA Letters of Interpretation 2/9/83 and 3/8/9

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10.0 FCC Guidelines

All power density values used in this report were analyzed as a percentage of current Maximum Permissible Exposure (% MPE) as listed in the FCC OET Bulletin 65 Edition 97-01and ANSI/IEEE Std C95.1. The FCC regulates Maximum Permissible Exposure in units of microwatts per square centimeter (µW/cm2). The number of µW/cm2 calculated at each sample point is called the power density. The exposure limit for power density varies depending upon the frequencies being utilized. Wireless Carriers and Paging Services use different frequency bands each with different exposure limits, therefore it is necessary to report results and limits in terms of percent MPE rather than power density.

All results were compared to the FCC (Federal Communications Commission) radio frequency exposure rules, 47 CFR 1.1307(b)(1) – (b)(3), to determine compliance with the Maximum Permissible Exposure (MPE) limits for General Population/Uncontrolled environments as defined below.

General Population/Uncontrolled exposure limits apply to situations in which the general Population may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Therefore, members of the general Population would always be considered under this category when exposure is not employment related, for example, in the case of a telecommunications tower that exposes persons in a nearby residential area.

General Population exposure to radio frequencies is regulated and enforced in units of microwatts per square centimeter (µW/cm2). The general population exposure limit for the 700 MHz and 800 MHz Bands is approximately 467 µW/cm2 and 567 µW/cm2 respectively, and the general population exposure limit for the 1900 MHz PCS band, 2100 MHz AWS band, 2300 MHz WCS band and 3600 MHz C-band is 1000 µW/cm2 (1mw/cm^2). Because each carrier will be using different frequency bands, and each frequency band has different exposure limits, it is necessary to report percent of MPE rather than power density.

Occupational/Controlled exposure limits apply to situations in which persons are exposed as a consequence of their employment and in which those persons who are exposed have been made fully aware of the potential for exposure, have been properly trained in RF safety and can exercise control over their exposure. Occupational/Controlled exposure limits also apply where exposure is of a transient nature as a result of incidental passage through a location where exposure levels may be above general population/uncontrolled limits (see below), as long as the exposed person has been made fully aware of the potential for exposure, have been trained in RF safety and can exercise control over his or her exposure by leaving the area or by some other appropriate means. The Occupational/Controlled exposure limits all utilized frequency bands is five (5) times the FCC's General Population / Uncontrolled exposure limit.

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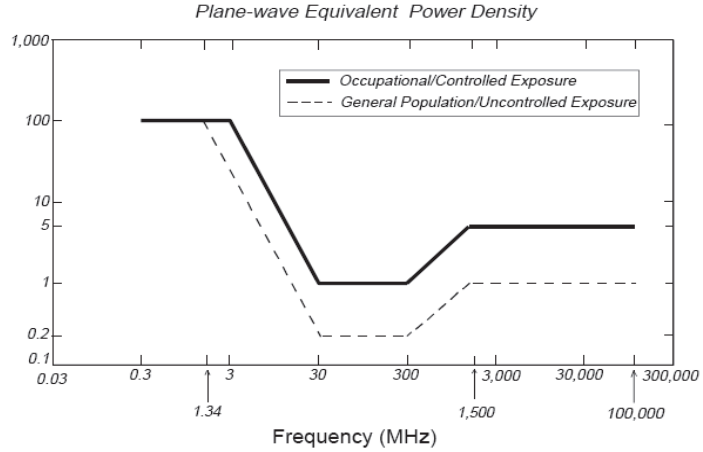
Table 1: Limits for Maximum Permissible Exposure (MPE)				
(A) Limits for Occupational/Controlled Exposure				
Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time [E]^2, [H]^2, or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f^2)*	6
30-300	61.4	0.163	1.0	6
300-I,500	--	--	f/300	6
1,500-100,000	--	--	5	6
(B) 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)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f^2)*	30
30-300	27.5	0.073	0.2	30
300-I,500	--	--	f/1,500	30
1,500-100,000	--	--	1.0	30

f = Frequency in (MHz)

* Plane-wave equivalent power density

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

Plane-wave Equivalent Power Density



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11.0 Calculation Methodology

Fox Hill Telecom has performed theoretical calculations on all transmission equipment located on this facility. All calculations have been performed using Waterford Consultants' RoofMaster™ 2020 Version 35.5.26.2022. RoofMaster™ employs several power density prediction models based on the computational approaches set forth in the Federal Communications Commission's Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, OET Bulletin 65 utilizing both cylindrical and far-field modelling (calculated using antenna manufacturers pattern data).

For this analysis, power density calculations were performed by Fox Hill Telecom on two antenna models including a static beam antenna used for the UMTS and 4G radios and a dynamic beam-forming antenna for the 5G radio broadcast. The static beam results in a fixed coverage area based upon the electrical characteristics of the antenna as specified by the antenna manufacturer. The dynamic beam-forming antenna functions by allowing the carrier to shift a narrow "talk channel" beam to each user in the antennas service area for the provision of service to the user's device by varying the phase of transmission by each active element in the element array inside the antenna to produce the desired resulting vector for the narrow beam. This allows greater gain in a given direction while producing intentional nulls in non-service areas to produce greater signal quality.

For the power density calculations for the UMTS / 4G static beam antennas the Cylindrical (Sula9) model was used to allow for a more pessimistic approach resulting from the transmission power being captured within the 3dB power roll off points of the antennas horizontal pattern. Calculations performed for the narrow beam 5G Traffic Beams were performed using a Far Field model based upon the antenna manufacturers antenna pattern data for both horizontal and vertical gain values. The selection of the Far Field model was done to prevent large overprediction areas of power density values close in to the antenna resulting from the extremely narrow window produced by the 3db power roll off points which define the power spreading area with a Cylindrical Model. Both models are discussed in further detail below.

A statistical factor which reduces the transmit power of the 5G beam forming antennas identified in this report to 32% of maximum theoretical transmit power for this antenna was used in the outlined calculations. This factor was utilized to account for the spatial distribution of users, network utilization, time division duplexing, and scheduling time typically experienced in these dynamic radio environments. This power factor more accurately predicts the emitted radio frequency energy in any given direction based upon test results from the antenna system manufacturers and AT&T recommends the use of this factor based on this guidance from its antenna system manufacturers as well as supporting international industry standards, industry publications, and its extensive experience.

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The Cylindrical Model Implementation (Sula9)

In OET-65, the Cylindrical Model is presented as an approach to determine the spatially averaged power density in the near field directly in front of an antenna. In order to implement this model in all directions, RoofMaster™ utilizes the antenna manufacturer horizontal pattern data. Additionally, RoofMaster™ incorporates factors that reduce the power density by the inverse square of horizontal and vertical distance beyond the near field region.

Power density is calculated as follows:

$$S = \left(\left(\frac{360}{Beamwidth}\right)\frac{P_{in}G_H H_r V_r}{2\pi Rh}\right)\frac{\mu W}{cm^2}$$

- S is the spatially averaged power density value
- R is the horizontal distance meters to the study point
- h is the aperture length in meters
- P_{in} is power into the antenna input port in Watts
- RoofMaster™ Implementation:
    - G_H is gain offset to study point as specified in manufacturer horizontal pattern
    - P_{in} is adjusted by the portion of the antenna aperture in the 0-6 ft vertical study zone
    - H_r accounts for $1/R^2$ Far Field roll off which starts at 2xh
    - V_r accounts for 1/ (vertical distance)^2 roll off from antenna bottom to the top of the 0-6ft study zone (or antenna top to bottom of 0-6ft study zone)

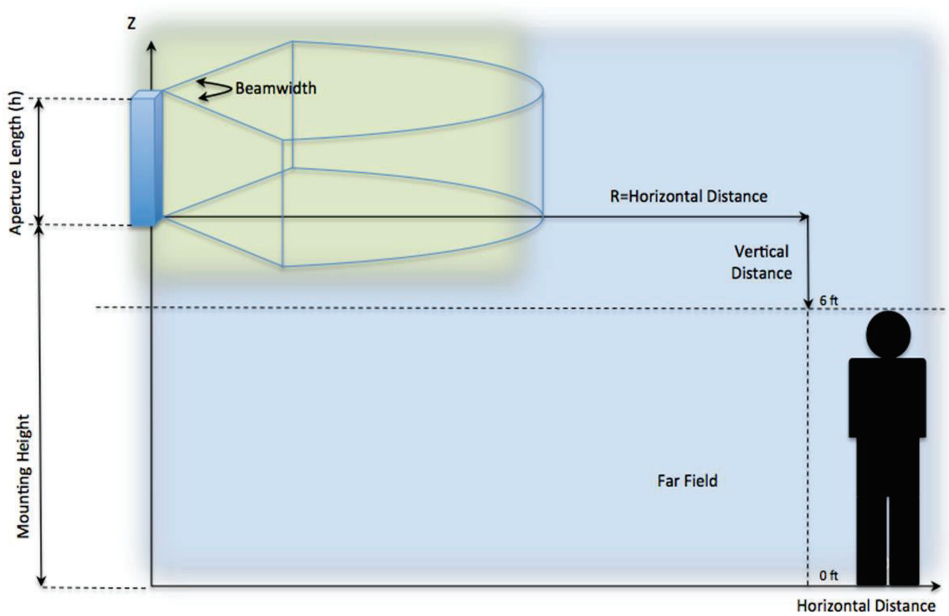

Figure 1: Cylindrical Model Implementation.

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The Far Field Model

In OET-65, a far field model is presented to calculate the spatial peak power density. The RoofMaster™ implementation of this model incorporates antenna manufacturer's horizontal and vertical pattern data to determine the power density in all directions. Power density is calculated as follows:

$$S = \frac{13.05 P_{in} G}{R^2} \frac{\mu W}{cm^2}$$

- Does not include 100% reflection factor
- P_{in} is Watts
- R is meters to study point
- G is gain to study point as specified in manufacturer horizontal and vertical patterns

A worst-case prediction is described in OET-65 where field strength may double due to 100% reflection of the incoming radiation. Considering an EPA recommendation that a multiplier of 1.6 is a more realistically representation of this effect is rewritten as follow:

$$S_{FF} = \frac{33.4 \cdot P_{in} \cdot G_{dBd}}{R^2} \quad (\mu W/cm^2)$$

This model yields the power density at a single point in space. In order to determine the spatial power density for comparison to the FCC limits, the average of several points calculated within the human profile (0 to 6 feet) must be conducted.

RoofMaster™ calculates seven power density values between 0 and 6 feet above the specified study plane and performs a linear spatial average.

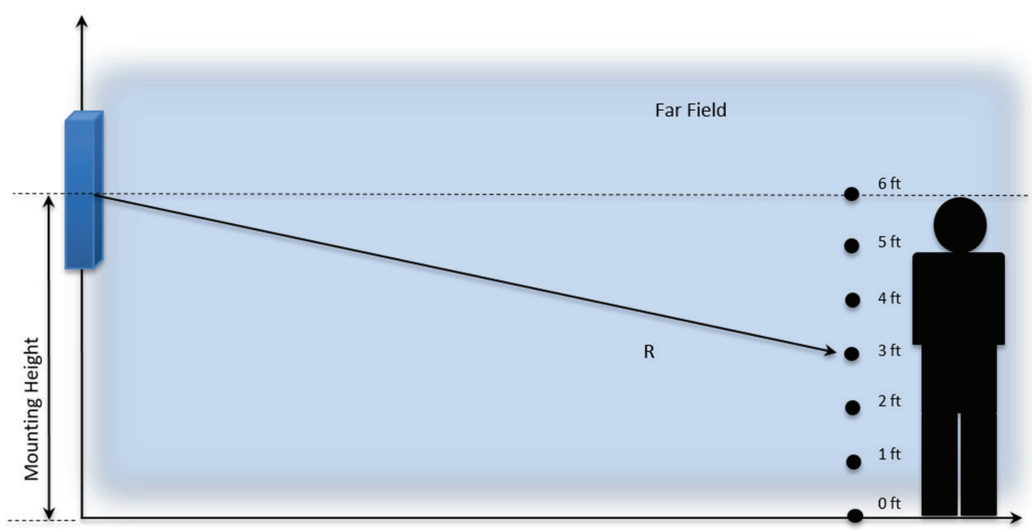

Figure 2 Far Field Model Implementation.

Predicted power densities are displayed as a percentage of the applicable FCC standards

12.0 Certifications

I, Erin Mahaney, preparer of this report certify that I am fully trained and aware of the Rules and Regulations of both the Federal Communications Commissions (FCC) and the Occupational Safety and Health Administration (OSHA) with regard to Human Exposure to Radio Frequency Radiation. I have been trained in the procedures and requirements outlined in AT&T's RF Exposure: Responsibilities, Procedures & Guidelines document.

1/6/2023

I, Scott Heffernan, reviewer and approver of this report certify that I am fully trained and aware of the Rules and Regulations of both the Federal Communications Commissions (FCC) and the Occupational Safety and Health Administration (OSHA) with regard to Human Exposure to Radio Frequency Radiation. I have been trained in the procedures and requirements outlined in AT&T's RF Exposure: Responsibilities, Procedures & Guidelines document.

1/6/2023

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Fox Hill Telecom

CO-LOCATION INTERFERENCE ANALYSIS REPORT

AT&T
CSL04615
Mammoth Lakes Fire Protection District

TOWN OF MAMMOTH LAKES
RECEIVED
9/22/2023

1574 Old Mammoth Lakes Road
Mammoth Lakes, CA 93546

Delivered: September 19, 2023

Fox Hill Telecom Project Number: 230987

Prepared by:
Fox Hill Telecom, Inc
79 Fox Hill Drive
Holden, MA 01520

Professional Engineer Review Stamp

REGISTERED PROFESSIONAL ENGINEER
MICHAEL A. McGUIRE
E18898
EXP. 30SEP23
ELECTRICAL
STATE OF CALIFORNIA

sealed 20sep2023

Table of Contents

1.0 Executive Summary

This report presents a radio frequency interference (RFI) analysis which was performed on the **AT&T CSL04615_Mammoth Lakes Fire (Mammoth Lakes CA)** site. The RFI analysis consists of transmitter noise, receiver desensitization, intermodulation, harmonic and transmitter spurious output interference. The report consists of Sections that provide details of the communications site, antenna systems, operational frequencies and each interference analysis mode.

A summary of the interference analysis results is depicted in the following Table.

Interference Analysis Mode	Type Mix	Status	Summary	Worst-Case Margin (dB)
Transmitter Noise	N/A	Passed	No Interference was predicted	**17.1**
Receiver Desensitization	N/A	Passed	No Interference was predicted	**32.3**
Transmitter Intermodulation	1 Tx	Passed	No Interference was predicted	N/A
Transmitter Intermodulation	2 Tx	Passed	No Interference was predicted	N/A
Transmitter Intermodulation	3 Tx	Passed	No Interference was predicted	N/A
Transmitter Intermodulation	4 Tx	Passed	No Interference was predicted	N/A
Transmitter Intermodulation	5 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	1 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	2 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	3 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	4 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	5 Tx	Passed	No Interference was predicted	N/A
Transmitter Harmonics	N/A	Passed	No Interference was predicted	N/A
Transmitter Spurious Output	N/A	Passed	No Interference was predicted	N/A

The analysis was performed with the setup options depicted in the Table below.

Analysis	Description
Receiver Performance	Receiver Sensitivity Threshold
Receiver Bandwidth	Receiver Dependent
Antenna Patterns Considered	Yes
Measured Antenna Isolation Data	No
Filters/Multicouplers Considered	Yes
Number of Simultaneous Transmitters Mixed	5
Highest Intermodulation Order Tested	7
Condense Intermodulation Hit Quantity	Yes - 1000/Order
TX IM Bandwidth Multiplication	No
Tx/Rx Systems Excluded	None
Site File Name	AT&T CSL04615_Mammoth Lakes Fire.dta
Report File Name	AT&T CSL04615_Mammoth Lakes Fire.docx
WirelessSiteRFI Software Version	10.1.20C

2.0 Site Description

The communication systems located at this site are described in this section as well as the configuration of the antenna systems.

The site parameters are:

Site Name:	**AT&T CSL04615_Mammoth Lakes Fire (Mammoth Lakes CA)**
Owner:	Mammoth Lakes Fire Protection District
Site Description:	Monopine Facility
Address:	1574 Old Mammoth Road, Mammoth Lakes, CA 93546
Latitude:	37.630061 N
Longitude:	-118.977772 W
Elevation:	7925.9 feet AMSL

Notes: This analysis was performed between the **AT&T** proposed radio systems to be installed on a tower facility at the **Mammoth Lakes Fire Protection District** property at **1574 Old Mammoth Road** in **Mammoth Lakes**, **CA** and several radio systems owned and operated by the Mammoth Lakes municipal public safety agencies as well as county and state agencies. The radio system data for the entities that requested to be considered in this study are listed in the Communications Systems table in Section 2.1 and further detailed in the following sections.

The radio systems provided by the **Mammoth Lakes Fire Protection District** are located at facilities in various locations around the county. To produce a worst-case isolation scenario, it was assumed that all radio systems provided by the **Mammoth Lakes Fire Protection District** were located on the rooftop of the 35-foot fire department building located on the subject property. Since many of these radio systems are located at further distances from the proposed AT&T tower facility, the isolation between these systems will be greater than detailed in this report which should result in a further reduction in interference potential.

The scope of this analysis was limited to the proposed **AT&T** radio systems to be installed at the proposed tower facility on the subject property as well as the systems and data provided by the **Mammoth Lakes Fire Protection District**.

2.1 Communications Systems

System	Provider	Technology	Frequency Band
1	AT&T	LTE	700 MHz Band
2	AT&T	5G	850 MHz - Cellular Band
3	AT&T	LTE	1900 MHz PCS
4	AT&T	5G	C Band
5	AT&T	5G	DoD Band - B77D
6	AT&T	LTE / Band 14	700 MHz Band (Band 14)
7	AT&T	LTE	2100 MHz AWS
8	AT&T	LTE	2300 MHz WCS
9	AT&T	Microwave	11 GHz Microwave
10	County Fire - Mono Co Fire Dispatch (Channel 1)	FM Land Mobile	150 - 174 MHz - Land Mobile
11	CMD Lincoln - MLFD Command Lincoln (Channel #2)	FM Land Mobile	150 - 174 MHz - Land Mobile
12	MLFD TAC 3 (Channel #3)	FM Land Mobile	150 - 174 MHz - Land Mobile
13	USFS INF_INF North (Channel #5)	FM Land Mobile	150 - 174 MHz - Land Mobile
14	MLPD - MLPD Dispatch (Channel #4)	FM Land Mobile	150 - 174 MHz - Land Mobile
15	CLEMARS - CA Law Enf Mutual Aid (Channel #14)	FM Land Mobile	150 - 174 MHz - Land Mobile

2.2 Antenna Systems

Ant #	Mfg	Antenna Model	Gain (dBd)	Hgt (ft)	Orient (deg)	Sector	Ant Use	Transmission Line Type	Line Loss (/100')	Line Length (ft)
1	Commscope	NNH4-65C-R6-V3	14.91	70	10	A	Dplx	1/2 in. Foam	0.5	10
2	Commscope	NNH4-65C-R6-V3	14.91	70	130	B	Dplx	1/2 in. Foam	0.5	10
3	Commscope	NNH4-65C-R6-V3	14.91	70	260	C	Dplx	1/2 in. Foam	0.5	10
4	Ericsson	AIR6449_B77D	23.4	69.3	10	A	Dplx	1/2 in. Foam	0.5	10
5	Ericsson	AIR6449_B77D	23.4	69.3	130	A	Dplx	1/2 in. Foam	0.5	10
6	Ericsson	AIR6449_B77D	23.4	69.3	260	A	Dplx	1/2 in. Foam	0.5	10
7	Ericsson	AIR6419_B77G	23.4	66.1	10	C	Dplx	1/2 in. Foam	0.5	10
8	Ericsson	AIR6419_B77G	23.4	66.1	130	A	Dplx	1/2 in. Foam	0.5	10
9	Ericsson	AIR6419_B77G	23.4	66.1	260	B	Dplx	1/2 in. Foam	0.5	10
10	CCI	OPA65R-BU8DA-K	13	70	10	A	Dplx	1/2 in. Foam	0.5	10
11	CCI	OPA65R-BU8DA-K	13	70	130	B	Dplx	1/2 in. Foam	0.5	10
12	CCI	OPA65R-BU8DA-K	13	70	260	C	Dplx	1/2 in. Foam	0.5	10
13	CCI	OPA65R-BU8DA-K	15.3	70	10	A	Dplx	1/2 in. Foam	0.5	10
14	CCI	OPA65R-BU8DA-K	15.3	70	130	B	Dplx	1/2 in. Foam	0.5	10
15	CCI	OPA65R-BU8DA-K	15.3	70	260	C	Dplx	1/2 in. Foam	0.5	10
16	CCI	VHP4-107	38.2	55	100	A	Dplx	1/2 in. Foam	0.5	10
17	Celwave	PD200	5.6	35	0	A	Dplx	7/8 in. Foam	0.45	65
18	Celwave	PD200	5.6	35	0	A	Dplx	7/8 in. Foam	0.45	65
19	Celwave	PD200	5.6	35	0	A	Tx/Rx	7/8 in. Foam	0.45	65
20	Celwave	PD200	5.6	35	0	A	Dplx	7/8 in. Foam	0.45	65
21	Celwave	PD200	5.6	35	0	A	Dplx	7/8 in. Foam	0.45	65
22	Celwave	PD200	5.6	35	0	A	Tx/Rx	7/8 in. Foam	0.45	65

3.0 Transmitter Frequencies

Freq #	Ant #	Provider	Model	Technology	Channel Label	ID	Frequency (MHz)	Power (Watts)	BW (KHz)
1	1	AT&T	Ericsson	LTE	1	A	740.000000	160	10000
2	2	AT&T	Ericsson	LTE	1	B	740.000000	160	10000
3	3	AT&T	Ericsson	LTE	1	C	740.000000	160	10000
4	1	AT&T	Ericsson	LTE / 5G	2	D	875.000000	160	10000
5	2	AT&T	Ericsson	LTE / 5G	2	E	875.000000	160	10000
6	3	AT&T	Ericsson	LTE / 5G	2	F	875.000000	160	10000
7	1	AT&T	Ericsson	LTE	1	G	1955.000000	160	20000
8	2	AT&T	Ericsson	LTE	1	H	1955.000000	160	20000
9	3	AT&T	Ericsson	LTE	1	I	1955.000000	160	20000
10	1	AT&T	Ericsson	LTE	1	J	1985.000000	160	10000
11	2	AT&T	Ericsson	LTE	1	K	1985.000000	160	10000
12	3	AT&T	Ericsson	LTE	1	L	1985.000000	160	10000
13	4	AT&T	Ericsson	5G	C1	M	3870.000000	20	20000
14	4	AT&T	Ericsson	5G	C2	N	3890.000000	20	20000
15	4	AT&T	Ericsson	5G	C3	O	3910.000000	20	20000
16	4	AT&T	Ericsson	5G	C4	P	3930.000000	20	20000
17	4	AT&T	Ericsson	5G	C5	Q	3950.000000	20	20000
18	4	AT&T	Ericsson	5G	C6	R	3970.000000	20	20000
19	5	AT&T	Ericsson	5G	C1	S	3870.000000	20	20000
20	5	AT&T	Ericsson	5G	C2	T	3890.000000	20	20000
21	5	AT&T	Ericsson	5G	C3	U	3910.000000	20	20000
22	5	AT&T	Ericsson	5G	C4	V	3930.000000	20	20000
23	5	AT&T	Ericsson	5G	C5	W	3950.000000	20	20000
24	5	AT&T	Ericsson	5G	C6	X	3970.000000	20	20000
25	6	AT&T	Ericsson	5G	C1	Y	3870.000000	20	20000
26	6	AT&T	Ericsson	5G	C2	Z	3890.000000	20	20000
27	6	AT&T	Ericsson	5G	C3	AA	3910.000000	20	20000
28	6	AT&T	Ericsson	5G	C4	AB	3930.000000	20	20000
29	6	AT&T	Ericsson	5G	C5	AC	3950.000000	20	20000
30	6	AT&T	Ericsson	5G	C6	AD	3970.000000	20	20000
31	7	AT&T	Ericsson	5G	DoD_1	AE	3460.000000	20	20000
32	8	AT&T	Ericsson	5G	DoD_1	AF	3460.000000	20	20000
33	9	AT&T	Ericsson	5G	DoD_1	AG	3460.000000	20	20000
34	7	AT&T	Ericsson	5G	DoD_2	AH	3480.000000	20	20000
35	8	AT&T	Ericsson	5G	DoD_2	AI	3480.000000	20	20000
36	9	AT&T	Ericsson	5G	DoD_2	AJ	3480.000000	20	20000
37	7	AT&T	Ericsson	5G	DoD_3	AK	3500.000000	20	20000
38	8	AT&T	Ericsson	5G	DoD_3	AL	3500.000000	20	20000
39	9	AT&T	Ericsson	5G	DoD_3	AM	3500.000000	20	20000
40	7	AT&T	Ericsson	5G	DoD_4	AN	3520.000000	20	20000
41	8	AT&T	Ericsson	5G	DoD_4	AO	3520.000000	20	20000
42	9	AT&T	Ericsson	5G	DoD_4	AP	3520.000000	20	20000
43	7	AT&T	Ericsson	5G	DoD_5	AQ	3540.000000	20	20000
44	8	AT&T	Ericsson	5G	DoD_5	AR	3540.000000	20	20000
45	9	AT&T	Ericsson	5G	DoD_5	AS	3540.000000	20	20000
46	10	AT&T	Ericsson	LTE	1	AT	763.000000	160	10000
47	11	AT&T	Ericsson	LTE	1	AU	763.000000	160	10000
48	12	AT&T	Ericsson	LTE	1	AV	763.000000	160	10000
49	10	AT&T	Ericsson	LTE	1	AW	2135.000000	160	10000
50	11	AT&T	Ericsson	LTE	1	AX	2135.000000	160	10000
51	12	AT&T	Ericsson	LTE	1	AY	2135.000000	160	10000
52	13	AT&T	Ericsson	LTE	1	AZ	2355.000000	120	10000
53	14	AT&T	Ericsson	LTE	1	BA	2355.000000	120	10000
54	15	AT&T	Ericsson	LTE	1	BB	2355.000000	120	10000
55	16	AT&T	Other	Microwave	MW1	BC	10850.000000	.63	5000
56	17	County Fire - Mono Co Fire Dispatch (Channel 1)	Motorola	FM Land Mobile	CH 1	BD	155.760000	25	11.2

57	18	CMD Lincoln - MLFD Command Lincoln (Channel #2)	Motorola	FM Land Mobile	CH 2	BE	158.985000	25	11.2
58	19	MLFD TAC 3 (Channel #3)	Motorola	FM Land Mobile	CH 3	BF	153.950000	25	11.2
59	20	USFS INF_INF North (Channel #5)	Motorola	FM Land Mobile	CH 5	BG	165.012500	25	11.2
60	21	MLPD - MLPD Dispatch (Channel #4)	Motorola	FM Land Mobile	CH 4	BH	159.012500	25	11.2
61	22	CLEMARS - CA Law Enf Mutual Aid (Channel #14)	Motorola	FM Land Mobile	CH 14	BI	154.920000	25	11.2

4.0 Receiver Frequencies

Freq #	Ant #	Provider	Model	Technology	Channel Label	ID	Frequency (MHz)	Sen (dBm)	BW (KHz)
1	1	AT&T	Ericsson	LTE	1	A	710.000000	-110	10000
2	2	AT&T	Ericsson	LTE	1	B	710.000000	-110	10000
3	3	AT&T	Ericsson	LTE	1	C	710.000000	-110	10000
4	1	AT&T	Ericsson	LTE / 5G	2	D	830.000000	-110	10000
5	2	AT&T	Ericsson	LTE / 5G	2	E	830.000000	-110	10000
6	3	AT&T	Ericsson	LTE / 5G	2	F	830.000000	-110	10000
7	1	AT&T	Ericsson	LTE	1	G	1875.000000	-110	20000
8	2	AT&T	Ericsson	LTE	1	H	1875.000000	-110	20000
9	3	AT&T	Ericsson	LTE	1	I	1875.000000	-110	20000
10	1	AT&T	Ericsson	LTE	1	J	1900.000000	-110	10000
11	2	AT&T	Ericsson	LTE	1	K	1900.000000	-110	10000
12	3	AT&T	Ericsson	LTE	1	L	1900.000000	-110	10000
13	4	AT&T	Ericsson	5G	C1	M	3870.000000	-110	20000
14	4	AT&T	Ericsson	5G	C2	N	3890.000000	-110	20000
15	4	AT&T	Ericsson	5G	C3	O	3910.000000	-110	20000
16	4	AT&T	Ericsson	5G	C4	P	3930.000000	-110	20000
17	4	AT&T	Ericsson	5G	C5	Q	3950.000000	-110	20000
18	4	AT&T	Ericsson	5G	C6	R	3970.000000	-110	20000
19	5	AT&T	Ericsson	5G	C1	S	3870.000000	-110	20000
20	5	AT&T	Ericsson	5G	C2	T	3890.000000	-110	20000
21	5	AT&T	Ericsson	5G	C3	U	3910.000000	-110	20000
22	5	AT&T	Ericsson	5G	C4	V	3930.000000	-110	20000
23	5	AT&T	Ericsson	5G	C5	W	3950.000000	-110	20000
24	5	AT&T	Ericsson	5G	C6	X	3970.000000	-110	20000
25	6	AT&T	Ericsson	5G	C1	Y	3870.000000	-110	20000
26	6	AT&T	Ericsson	5G	C2	Z	3890.000000	-110	20000
27	6	AT&T	Ericsson	5G	C3	AA	3910.000000	-110	20000
28	6	AT&T	Ericsson	5G	C4	AB	3930.000000	-110	20000
29	6	AT&T	Ericsson	5G	C5	AC	3950.000000	-110	20000
30	6	AT&T	Ericsson	5G	C6	AD	3970.000000	-110	20000
31	7	AT&T	Ericsson	5G	DoD_1	AE	3460.000000	-110	20000
32	8	AT&T	Ericsson	5G	DoD_1	AF	3460.000000	-110	20000
33	9	AT&T	Ericsson	5G	DoD_1	AG	3460.000000	-110	20000
34	7	AT&T	Ericsson	5G	DoD_2	AH	3480.000000	-110	20000
35	8	AT&T	Ericsson	5G	DoD_2	AI	3480.000000	-110	20000
36	9	AT&T	Ericsson	5G	DoD_2	AJ	3480.000000	-110	20000
37	7	AT&T	Ericsson	5G	DoD_3	AK	3500.000000	-110	20000
38	8	AT&T	Ericsson	5G	DoD_3	AL	3500.000000	-110	20000
39	9	AT&T	Ericsson	5G	DoD_3	AM	3500.000000	-110	20000
40	7	AT&T	Ericsson	5G	DoD_4	AN	3520.000000	-110	20000
41	8	AT&T	Ericsson	5G	DoD_4	AO	3520.000000	-110	20000
42	9	AT&T	Ericsson	5G	DoD_4	AP	3520.000000	-110	20000
43	7	AT&T	Ericsson	5G	DoD_5	AQ	3540.000000	-110	20000
44	8	AT&T	Ericsson	5G	DoD_5	AR	3540.000000	-110	20000
45	9	AT&T	Ericsson	5G	DoD_5	AS	3540.000000	-110	20000
46	10	AT&T	Ericsson	LTE	1	AT	793.000000	-110	10000
47	11	AT&T	Ericsson	LTE	1	AU	793.000000	-110	10000
48	12	AT&T	Ericsson	LTE	1	AV	793.000000	-110	10000
49	10	AT&T	Ericsson	LTE	1	AW	1735.000000	-110	10000
50	11	AT&T	Ericsson	LTE	1	AX	1735.000000	-110	10000
51	12	AT&T	Ericsson	LTE	1	AY	1735.000000	-110	10000
52	13	AT&T	Ericsson	LTE	1	AZ	2310.000000	-110	10000
53	14	AT&T	Ericsson	LTE	1	BA	2310.000000	-110	10000
54	15	AT&T	Ericsson	LTE	1	BB	2310.000000	-110	10000
55	16	AT&T	Other	Microwave	MW1	BC	11675.000000	-83	5000
56	17	County Fire - Mono Co Fire Dispatch (Channel 1)	Motorola	FM Land Mobile	CH 1	BD	153.860000	-116	11.2

57	18	CMD Lincoln - MLFD Command Lincoln (Channel #2)	Motorola	FM Land Mobile	CH 2	BE	155.145000	-116	11.2
58	19	MLFD TAC 3 (Channel #3)	Motorola	FM Land Mobile	CH 3	BF	153.950000	-116	11.2
59	20	USFS INF_INF North (Channel #5)	Motorola	FM Land Mobile	CH 5	BG	173.800000	-116	11.2
60	21	MLPD - MLPD Dispatch (Channel #4)	Motorola	FM Land Mobile	CH 4	BH	155.595000	-116	11.2
61	22	CLEMARS - CA Law Enf Mutual Aid (Channel #14)	Motorola	FM Land Mobile	CH 14	BI	154.920000	-116	11.2

5.0 Transmitter Noise Analysis

Transmitter noise interference occurs because a transmitter radiates energy on its operating frequency as well as frequencies above and below the assigned frequency. The energy that is radiated above and below the assigned frequency is known as sideband noise energy and extends for several megahertz on either side of the operating frequency. This undesired noise energy can fall within the passband of a nearby receiver even if the receiver's operating frequency is several megahertz away. The transmitter noise appears as "on-channel" noise interference and cannot be filtered out at the receiver. It is on the receiver's operating frequency and competes with the desired signal, which in effect, degrades the operational performance.

The analysis predicts each transmitter's noise signal level present at the input of each receiver. It takes into account the transmitter's noise characteristics, frequency separation, power output, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in both systems. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required, if any, to prevent receiver performance degradation caused by transmitter noise interference. The Table below depicts the results of this analysis. For each receiver, the transmitter that has the worst-case impact is displayed. The Signal Margin represents the margin in dB, before the receiver's performance is degraded. A negative number indicates that the performance is degraded and the value indicates how much additional isolation is required to prevent receiver performance degradation.

Receiver Provider	Receive Channel	Receive Frequency (MHz)	Transmitter Provider	Transmit Channel	Transmit Frequency (MHz)	Attn Required (dB)	Attn Provided (dB)	Signal Margin (dB)
AT&T	1	710.000000	AT&T	1	740.000000	48	97	49
AT&T	1	710.000000	AT&T	1	740.000000	48	97	49
AT&T	1	710.000000	AT&T	1	740.000000	48	97	49
AT&T	2	830.000000	AT&T	2	875.000000	51.6	96.8	45.2
AT&T	2	830.000000	AT&T	2	875.000000	51.6	96.8	45.2
AT&T	2	830.000000	AT&T	2	875.000000	51.6	96.8	45.2
AT&T	1	1875.000000	AT&T	1	1955.000000	54.6	96.5	41.9
AT&T	1	1875.000000	AT&T	1	1955.000000	54.6	96.5	41.9
AT&T	1	1875.000000	AT&T	1	1955.000000	54.6	96.5	41.9
AT&T	1	1900.000000	AT&T	1	1985.000000	54.6	96.5	41.9
AT&T	1	1900.000000	AT&T	1	1985.000000	54.6	96.5	41.9
AT&T	1	1900.000000	AT&T	1	1985.000000	54.6	96.5	41.9
AT&T	C1	3870.000000	AT&T	C1	3870.000000	56.6	102	45.4
AT&T	C1	3870.000000	AT&T	C1	3870.000000	56.6	101.8	45.2
AT&T	C2	3890.000000	AT&T	C1	3870.000000	54.4	96.5	42.1
AT&T	C2	3890.000000	AT&T	C2	3890.000000	56.6	102	45.4
AT&T	C2	3890.000000	AT&T	C2	3890.000000	56.6	101.9	45.3
AT&T	C3	3910.000000	AT&T	C2	3890.000000	54.4	96.5	42.1
AT&T	C3	3910.000000	AT&T	C3	3910.000000	56.6	102	45.4
AT&T	C3	3910.000000	AT&T	C3	3910.000000	56.6	101.9	45.3
AT&T	C4	3930.000000	AT&T	C3	3910.000000	54.4	106.9	52.5
AT&T	C4	3930.000000	AT&T	C4	3930.000000	56.6	102	45.4
AT&T	C4	3930.000000	AT&T	C4	3930.000000	56.6	102	45.4

AT&T	C5	3950.000000	AT&T	C4	3930.000000	54.4	106.5	52.1
AT&T	C5	3950.000000	AT&T	C5	3950.000000	56.6	102	45.4
AT&T	C5	3950.000000	AT&T	C5	3950.000000	56.6	102	45.4
AT&T	C6	3970.000000	AT&T	C5	3950.000000	54.4	106.5	52.1
AT&T	C6	3970.000000	AT&T	C6	3970.000000	56.6	102	45.4
AT&T	C6	3970.000000	AT&T	C6	3970.000000	56.6	102	45.4
AT&T	C1	3870.000000	AT&T	C1	3870.000000	56.6	103.6	47
AT&T	C1	3870.000000	AT&T	C1	3870.000000	56.6	102	45.4
AT&T	C2	3890.000000	AT&T	C2	3890.000000	56.6	103.7	47.1
AT&T	C2	3890.000000	AT&T	C2	3890.000000	56.6	102	45.4
AT&T	C3	3910.000000	AT&T	C3	3910.000000	56.6	103.7	47.1
AT&T	C3	3910.000000	AT&T	C3	3910.000000	56.6	102	45.4
AT&T	C4	3930.000000	AT&T	C4	3930.000000	56.6	103.8	47.2
AT&T	C4	3930.000000	AT&T	C4	3930.000000	56.6	102	45.4
AT&T	C5	3950.000000	AT&T	C5	3950.000000	56.6	103.8	47.2
AT&T	C5	3950.000000	AT&T	C5	3950.000000	56.6	102	45.4
AT&T	C6	3970.000000	AT&T	C6	3970.000000	56.6	103.8	47.2
AT&T	C6	3970.000000	AT&T	C6	3970.000000	56.6	102	45.4
AT&T	C1	3870.000000	AT&T	C1	3870.000000	56.6	101.8	45.2
AT&T	C1	3870.000000	AT&T	C1	3870.000000	56.6	102	45.4
AT&T	C2	3890.000000	AT&T	C2	3890.000000	56.6	101.9	45.3
AT&T	C2	3890.000000	AT&T	C2	3890.000000	56.6	102	45.4
AT&T	C3	3910.000000	AT&T	C3	3910.000000	56.6	101.9	45.3
AT&T	C3	3910.000000	AT&T	C3	3910.000000	56.6	102	45.4
AT&T	C4	3930.000000	AT&T	C4	3930.000000	56.6	102	45.4
AT&T	C4	3930.000000	AT&T	C4	3930.000000	56.6	102	45.4
AT&T	C5	3950.000000	AT&T	C5	3950.000000	56.6	102	45.4
AT&T	C5	3950.000000	AT&T	C5	3950.000000	56.6	102	45.4
AT&T	C6	3970.000000	AT&T	C6	3970.000000	56.6	102	45.4
AT&T	C6	3970.000000	AT&T	C6	3970.000000	56.6	102	45.4
AT&T	DoD_1	3460.000000	AT&T	C1	3870.000000	45.6	154.2	108.6
AT&T	DoD_1	3460.000000	AT&T	DoD_1	3460.000000	56.6	101.7	45.1
AT&T	DoD_1	3460.000000	AT&T	DoD_1	3460.000000	56.6	102.3	45.7
AT&T	DoD_1	3460.000000	AT&T	DoD_1	3460.000000	56.6	103.6	47
AT&T	DoD_1	3460.000000	AT&T	DoD_1	3460.000000	56.6	101.7	45.1
AT&T	DoD_1	3460.000000	AT&T	DoD_1	3460.000000	56.6	100.5	43.9
AT&T	DoD_1	3460.000000	AT&T	DoD_1	3460.000000	56.6	100.5	43.9
AT&T	DoD_1	3460.000000	AT&T	DoD_1	3460.000000	56.6	101.7	45.1
AT&T	DoD_2	3480.000000	AT&T	DoD_1	3460.000000	54.4	111	56.6
AT&T	DoD_2	3480.000000	AT&T	DoD_2	3480.000000	56.6	101.7	45.1
AT&T	DoD_2	3480.000000	AT&T	DoD_2	3480.000000	56.6	102.3	45.7
AT&T	DoD_2	3480.000000	AT&T	DoD_2	3480.000000	56.6	103.6	47
AT&T	DoD_2	3480.000000	AT&T	DoD_2	3480.000000	56.6	101.7	45.1
AT&T	DoD_2	3480.000000	AT&T	DoD_2	3480.000000	56.6	100.5	43.9
AT&T	DoD_2	3480.000000	AT&T	DoD_2	3480.000000	56.6	100.5	43.9
AT&T	DoD_2	3480.000000	AT&T	DoD_2	3480.000000	56.6	101.7	45.1
AT&T	DoD_3	3500.000000	AT&T	DoD_2	3480.000000	54.4	101	46.6
AT&T	DoD_3	3500.000000	AT&T	DoD_3	3500.000000	56.6	101.7	45.1
AT&T	DoD_3	3500.000000	AT&T	DoD_3	3500.000000	56.6	102.4	45.8
AT&T	DoD_3	3500.000000	AT&T	DoD_3	3500.000000	56.6	103.7	47.1
AT&T	DoD_3	3500.000000	AT&T	DoD_3	3500.000000	56.6	101.7	45.1
AT&T	DoD_3	3500.000000	AT&T	DoD_3	3500.000000	56.6	100.6	44
AT&T	DoD_3	3500.000000	AT&T	DoD_3	3500.000000	56.6	100.6	44
AT&T	DoD_3	3500.000000	AT&T	DoD_3	3500.000000	56.6	101.7	45.1
AT&T	DoD_4	3520.000000	AT&T	DoD_3	3500.000000	54.4	101	46.6
AT&T	DoD_4	3520.000000	AT&T	DoD_4	3520.000000	56.6	101.7	45.1
AT&T	DoD_4	3520.000000	AT&T	DoD_4	3520.000000	56.6	102.4	45.8
AT&T	DoD_4	3520.000000	AT&T	DoD_4	3520.000000	56.6	103.7	47.1
AT&T	DoD_4	3520.000000	AT&T	DoD_4	3520.000000	56.6	101.7	45.1
AT&T	DoD_4	3520.000000	AT&T	DoD_4	3520.000000	56.6	100.6	44
AT&T	DoD_4	3520.000000	AT&T	DoD_4	3520.000000	56.6	100.6	44
AT&T	DoD_4	3520.000000	AT&T	DoD_4	3520.000000	56.6	101.7	45.1
AT&T	DoD_5	3540.000000	AT&T	DoD_4	3520.000000	54.4	101	46.6
AT&T	DoD_5	3540.000000	AT&T	DoD_5	3540.000000	56.6	101.7	45.1
AT&T	DoD_5	3540.000000	AT&T	DoD_5	3540.000000	56.6	102.5	45.9
AT&T	DoD_5	3540.000000	AT&T	DoD_5	3540.000000	56.6	103.8	47.2

AT&T	DoD_5	3540.000000	AT&T	DoD_5	3540.000000	56.6	101.7	45.1
AT&T	DoD_5	3540.000000	AT&T	DoD_5	3540.000000	56.6	100.7	44.1
AT&T	DoD_5	3540.000000	AT&T	DoD_5	3540.000000	56.6	100.7	44.1
AT&T	DoD_5	3540.000000	AT&T	DoD_5	3540.000000	56.6	101.7	45.1
AT&T	1	793.000000	AT&T	1	763.000000	58.3	97	38.7
AT&T	1	793.000000	AT&T	1	763.000000	58.3	97	38.7
AT&T	1	793.000000	AT&T	1	763.000000	58.3	97	38.7
AT&T	1	1735.000000	AT&T	1	1955.000000	54.6	172.2	117.6
AT&T	1	1735.000000	AT&T	1	1955.000000	54.6	169.5	114.9
AT&T	1	1735.000000	AT&T	1	1955.000000	54.6	172.9	118.3
AT&T	1	2310.000000	AT&T	1	2355.000000	53.4	96.5	43.1
AT&T	1	2310.000000	AT&T	1	2355.000000	53.4	96.5	43.1
AT&T	1	2310.000000	AT&T	1	2355.000000	53.4	96.5	43.1
AT&T	MW1	11675.000000	AT&T	MW1	10850.000000	3.6	100.8	97.2
County Fire - Mono Co Fire Dispatch (Channel 1)	CH 1	153.860000	County Fire - Mono Co Fire Dispatch (Channel 1)	CH 1	155.760000	61.1	96.3	35.2
County Fire - Mono Co Fire Dispatch (Channel 1)	CH 1	153.860000	MLFD TAC 3 (Channel #3)	CH 3	153.950000	79.8	107.8	28
CMD Lincoln - MLFD Command Lincoln (Channel #2)	CH 2	155.145000	County Fire - Mono Co Fire Dispatch (Channel 1)	CH 1	155.760000	73.7	105	31.3
CMD Lincoln - MLFD Command Lincoln (Channel #2)	CH 2	155.145000	CLEMARS - CA Law Enf Mutual Aid (Channel #14)	CH 14	154.920000	78.9	101.9	23
MLFD TAC 3 (Channel #3)	CH 3	153.950000	CLEMARS - CA Law Enf Mutual Aid (Channel #14)	CH 14	154.920000	69.7	98.8	29.1
USFS INF_INF North (Channel #5)	CH 5	173.800000	USFS INF_INF North (Channel #5)	CH 5	165.012500	39.2	75	35.8
MLPD - MLPD Dispatch (Channel #4)	CH 4	155.595000	County Fire - Mono Co Fire Dispatch (Channel 1)	CH 1	155.760000	79.3	96.4	17.1
MLPD - MLPD Dispatch (Channel #4)	CH 4	155.595000	CLEMARS - CA Law Enf Mutual Aid (Channel #14)	CH 14	154.920000	72.8	96.7	23.9
CLEMARS - CA Law Enf Mutual Aid (Channel #14)	CH 14	154.920000	County Fire - Mono Co Fire Dispatch (Channel 1)	CH 1	155.760000	70.9	100.2	29.3

Analysis Results: No transmitter noise interference problems were predicted that were determined to be system performance limiting to any operators analyzed in this report. All calculations yielded results that determined, based upon the listed configurations, that there was adequate isolation between all analyzed transmitters and receivers either through physical separation, antenna broadcast pattern gain roll off or filtering and isolation devices considered to be part of the standard transmitter / receiver configuration deployed by the equipment manufacturers listed as part of this analysis.

6.0 Receiver Desensitization Analysis

Receiver desensitization interference occurs when an undesired signal from a nearby "off-frequency" transmitter is sufficiently close to a receiver's operating frequency. The signal may get through the RF selectivity of the receiver. If this undesired signal is of sufficient amplitude, the receiver's critical voltage and current levels are altered and the performance of the receiver is degraded at its operating frequency. The gain of the receiver is reduced, thereby reducing the performance of the receiver.

A transmitter can be operating several megahertz away from the receiver frequency and/or its antenna can be located several thousand feet from the receiver's antenna and still cause interference.

The analysis predicts each transmitter's signal level present at the input of each receiver. It takes into account the transmitter's power output, frequency separation, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in both systems. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required, if any, to prevent receiver performance degradation caused by receiver desensitization interference. The Table below depicts the results of this analysis. For each receiver, the transmitter that has the worst-case impact is displayed. The Signal Margin represents the margin in dB, before the receiver's performance is degraded. A negative number indicates that the performance is degraded and the value indicates how much additional isolation is required to prevent receiver performance degradation.

Receiver Provider	Receive Channel	Receive Frequency (MHz)	Transmitter Provider	Transmit Channel	Transmit Frequency (MHz)	Attn Required (dB)	Attn Provided (dB)	Signal Margin (dB)
AT&T	1	710.000000	AT&T	1	740.000000	16	97	81
AT&T	1	710.000000	AT&T	1	740.000000	16	97	81
AT&T	1	710.000000	AT&T	1	740.000000	16	97	81
AT&T	2	830.000000	AT&T	2	875.000000	23.6	96.8	73.2
AT&T	2	830.000000	AT&T	2	875.000000	23.6	96.8	73.2
AT&T	2	830.000000	AT&T	2	875.000000	23.6	96.8	73.2
AT&T	1	1875.000000	AT&T	1	1955.000000	19	96.5	77.5
AT&T	1	1875.000000	AT&T	1	1955.000000	19	96.5	77.5
AT&T	1	1875.000000	AT&T	1	1955.000000	19	96.5	77.5
AT&T	1	1900.000000	AT&T	1	1985.000000	19	96.5	77.5
AT&T	1	1900.000000	AT&T	1	1985.000000	19	96.5	77.5
AT&T	1	1900.000000	AT&T	1	1985.000000	19	96.5	77.5
AT&T	C1	3870.000000	AT&T	C1	3870.000000	24	102	78
AT&T	C1	3870.000000	AT&T	C1	3870.000000	24	101.8	77.8
AT&T	C2	3890.000000	AT&T	C1	3870.000000	19	96.5	77.5
AT&T	C2	3890.000000	AT&T	C2	3890.000000	24	102	78
AT&T	C2	3890.000000	AT&T	C2	3890.000000	24	101.9	77.9
AT&T	C3	3910.000000	AT&T	C2	3890.000000	19	96.5	77.5
AT&T	C3	3910.000000	AT&T	C3	3910.000000	24	102	78
AT&T	C3	3910.000000	AT&T	C3	3910.000000	24	101.9	77.9
AT&T	C4	3930.000000	AT&T	C3	3910.000000	19	96.5	77.5
AT&T	C4	3930.000000	AT&T	C4	3930.000000	24	102	78
AT&T	C4	3930.000000	AT&T	C4	3930.000000	24	102	78

AT&T	C5	3950.000000	AT&T	C4	3930.000000	19	96.5	77.5
AT&T	C5	3950.000000	AT&T	C5	3950.000000	24	102	78
AT&T	C5	3950.000000	AT&T	C5	3950.000000	24	102	78
AT&T	C6	3970.000000	AT&T	C5	3950.000000	19	96.5	77.5
AT&T	C6	3970.000000	AT&T	C6	3970.000000	24	102	78
AT&T	C6	3970.000000	AT&T	C6	3970.000000	24	102	78
AT&T	C1	3870.000000	AT&T	C1	3870.000000	24	103.6	79.6
AT&T	C1	3870.000000	AT&T	C1	3870.000000	24	102	78
AT&T	C2	3890.000000	AT&T	C2	3890.000000	24	103.7	79.7
AT&T	C2	3890.000000	AT&T	C2	3890.000000	24	102	78
AT&T	C3	3910.000000	AT&T	C3	3910.000000	24	103.7	79.7
AT&T	C3	3910.000000	AT&T	C3	3910.000000	24	102	78
AT&T	C4	3930.000000	AT&T	C4	3930.000000	24	103.8	79.8
AT&T	C4	3930.000000	AT&T	C4	3930.000000	24	102	78
AT&T	C5	3950.000000	AT&T	C5	3950.000000	24	103.8	79.8
AT&T	C5	3950.000000	AT&T	C5	3950.000000	24	102	78
AT&T	C6	3970.000000	AT&T	C6	3970.000000	24	103.8	79.8
AT&T	C6	3970.000000	AT&T	C6	3970.000000	24	102	78
AT&T	C1	3870.000000	AT&T	C1	3870.000000	24	101.8	77.8
AT&T	C1	3870.000000	AT&T	C1	3870.000000	24	102	78
AT&T	C2	3890.000000	AT&T	C2	3890.000000	24	101.9	77.9
AT&T	C2	3890.000000	AT&T	C2	3890.000000	24	102	78
AT&T	C3	3910.000000	AT&T	C3	3910.000000	24	101.9	77.9
AT&T	C3	3910.000000	AT&T	C3	3910.000000	24	102	78
AT&T	C4	3930.000000	AT&T	C4	3930.000000	24	102	78
AT&T	C4	3930.000000	AT&T	C4	3930.000000	24	102	78
AT&T	C5	3950.000000	AT&T	C5	3950.000000	24	102	78
AT&T	C5	3950.000000	AT&T	C5	3950.000000	24	102	78
AT&T	C6	3970.000000	AT&T	C6	3970.000000	24	102	78
AT&T	C6	3970.000000	AT&T	C6	3970.000000	24	102	78
AT&T	DoD_1	3460.000000	AT&T	DoD_1	3460.000000	24	101.7	77.7
AT&T	DoD_1	3460.000000	AT&T	DoD_1	3460.000000	24	101.7	77.7
AT&T	DoD_1	3460.000000	AT&T	DoD_1	3460.000000	24	101.7	77.7
AT&T	DoD_2	3480.000000	AT&T	DoD_2	3480.000000	24	101.7	77.7
AT&T	DoD_2	3480.000000	AT&T	DoD_2	3480.000000	24	101.7	77.7
AT&T	DoD_2	3480.000000	AT&T	DoD_2	3480.000000	24	101.7	77.7
AT&T	DoD_3	3500.000000	AT&T	DoD_3	3500.000000	24	101.7	77.7
AT&T	DoD_3	3500.000000	AT&T	DoD_3	3500.000000	24	101.7	77.7
AT&T	DoD_3	3500.000000	AT&T	DoD_3	3500.000000	24	101.7	77.7
AT&T	DoD_4	3520.000000	AT&T	DoD_4	3520.000000	24	101.7	77.7
AT&T	DoD_4	3520.000000	AT&T	DoD_4	3520.000000	24	101.7	77.7
AT&T	DoD_4	3520.000000	AT&T	DoD_4	3520.000000	24	101.7	77.7
AT&T	DoD_5	3540.000000	AT&T	DoD_5	3540.000000	24	101.7	77.7
AT&T	DoD_5	3540.000000	AT&T	DoD_5	3540.000000	24	101.7	77.7
AT&T	DoD_5	3540.000000	AT&T	DoD_5	3540.000000	24	101.7	77.7
AT&T	1	793.000000	AT&T	1	763.000000	22.3	97	74.7
AT&T	1	793.000000	AT&T	1	763.000000	22.3	97	74.7
AT&T	1	793.000000	AT&T	1	763.000000	22.3	97	74.7
AT&T	1	1735.000000	AT&T	1	1955.000000	19	172.2	153.2
AT&T	1	1735.000000	AT&T	1	1955.000000	19	169.5	150.5
AT&T	1	1735.000000	AT&T	1	1955.000000	19	172.9	153.9
AT&T	1	2310.000000	AT&T	1	2355.000000	17.8	96.5	78.7
AT&T	1	2310.000000	AT&T	1	2355.000000	17.8	96.5	78.7
AT&T	1	2310.000000	AT&T	1	2355.000000	17.8	96.5	78.7
AT&T	MW1	11675.000000	AT&T	MW1	10850.000000	32	100.8	68.8
County Fire - Mono Co Fire Dispatch (Channel 1)	CH 1	153.860000	County Fire - Mono Co Fire Dispatch (Channel 1)	CH 1	155.760000	42.3	96.2	53.9
County Fire - Mono Co Fire Dispatch (Channel 1)	CH 1	153.860000	MLFD TAC 3 (Channel #3)	CH 3	153.950000	64	97.8	33.8

CMD Lincoln - MLFD Command Lincoln (Channel #2)	CH 2	155.145000	CLEMARS - CA Law Enf Mutual Aid (Channel #14)	CH 14	154.920000	63.5	101.9	38.4
MLFD TAC 3 (Channel #3)	CH 3	153.950000	CLEMARS - CA Law Enf Mutual Aid (Channel #14)	CH 14	154.920000	55.8	98.8	43
USFS INF_INF North (Channel #5)	CH 5	173.800000	USFS INF_INF North (Channel #5)	CH 5	165.012500	4.5	75	70.5
MLPD - MLPD Dispatch (Channel #4)	CH 4	155.595000	County Fire - Mono Co Fire Dispatch (Channel 1)	CH 1	155.760000	63.7	96.4	32.7
CLEMARS - CA Law Enf Mutual Aid (Channel #14)	CH 14	154.920000	County Fire - Mono Co Fire Dispatch (Channel 1)	CH 1	155.760000	57.9	90.2	32.3

Analysis Results: No receiver desensitization interference problems were predicted that were determined to be system performance limiting to any operators analyzed in this report. All calculations yielded results that determined, based upon the listed configurations, that there was adequate isolation between all analyzed transmitters and receivers either through physical separation, antenna broadcast pattern gain roll off or filtering and isolation devices considered to be part of the standard transmitter / receiver configuration deployed by the equipment manufacturers listed as part of this analysis.

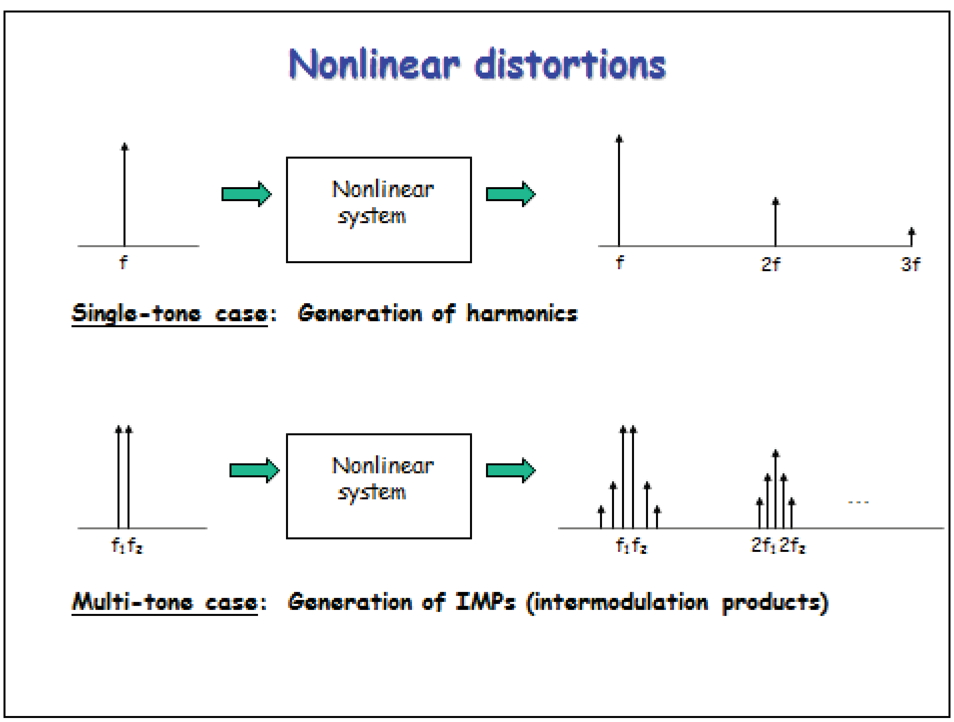
7.0 Intermodulation Interference Analysis

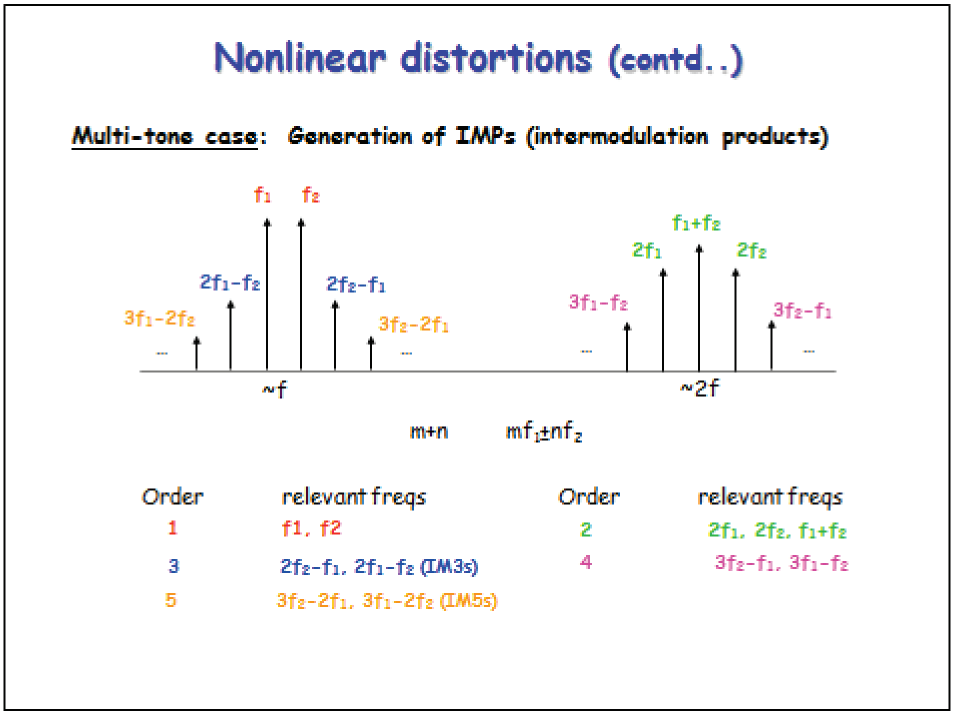
There are three basic categories of Intermodulation (IM) interference. They are receiver produced, transmitter produced, and "other" radiated IM. Transmitter produced IM is the result of one or more transmitters impressing a signal in the non-linear final output stage circuitry of another transmitter, usually via antenna coupling. The IM product frequency is then re-radiated from the transmitter's antenna. Receiver produced IM is the result of two or more transmitter signals mixing in a receiver RF amplifier or mixer stage when operating in a non-linear range.

"Other" radiated IM is the result of transmitter signals mixing in other non-linear junctions. These junctions are usually metallic, such as rusty bolts on a tower, dissimilar metallic junctions, or other non-linear metallic junctions in the area. IM products can also be caused by non-linearity in the transmission system such as antenna, transmission line, or connectors.

Communication sites with co-located transmitters usually have RF coupling between each transmitter and antenna system. This results in the signals of each transmitter entering the nonlinear final output (PA) circuitry of the other transmitters. When intermodulation (IM) products are created in the output circuitry and they fall within the passband of the final amplifier, the IM products are re-radiated and may interfere with receivers at the same site or at other nearby sites. Additionally, these strong transmitter signals may directly enter a receiver and drive the RF amplifier into a nonlinear operation, or if not filtered effectively by the receiver input circuitry, these signals could mix in the nonlinear circuitry of the receiver front-end or mixer, creating IM products directly in the receiver.

The frequencies of IM mixing are known as nonlinear distortions. The images below depict how these IM products are derived when passing through a nonlinear junction/system.





Below are the mathematical formulae for common IM products. IM products are classified by their "order" (2nd, 3rd, 4th, ...Nth). Some of the more common forms of mixing are illustrated in the following examples. Note that the "A", "B", and "C" designations are the mixing frequencies. The numerical number assigned to the letter designation indicates the harmonic relationship of the frequency. Thus, 2A means the 2nd harmonic of frequency A.

Order	Mixing Formulae
First	A=B, A=C, etc.
Second	A ± B, A ± C, etc.
Third	A + B - C, A ± 2B, 2A ± B, etc.
Fourth	A ± 3B, 2A ± 2B, 3A ± B, etc.
Fifth	A ± 4B, 2A ± 3B, 3A ± 2B, 4A ± B, etc.
Sixth	A ± 3B ± 2C, 2A ± 2B ± 2C, 3A ± 2B ± C, etc.
Seventh	A ± 6B, 2A ± 5B, 3A ± 4B, 4A ± 3B, 5A ± 2B, etc.
Eighth	A ± 7B, 2A ± 6B, 3A ± 5B, 4A ± 4B, 5A ± 3B, 6A ± 2B, etc.
Ninth	A ± 8B, 2A ± 7B, 3A ± 6B, 4A ± 5B, 5A ± 4B, 6A ± 3B, etc.

The above IM product formulae are just a few of the many possible combinations. When there are four frequencies involved at one time, the mixing possibilities increase tremendously. Not all of the mixing possibilities are significant in creating interference signals. Some fall “out-of-band” of the receiver and the higher order IM products are usually weaker in signal strength.

7.1 Transmitter Generated Intermodulation Analysis

Intermodulation in transmitters occurs when a signal from another transmitter is impressed on the nonlinear final output stage circuitry, usually via antenna coupling. The power level of the IM product is determined by the power level of the incoming extraneous signal from another transmitter and by a conversion loss factor. The conversion loss factor takes into account the mixing efficiency of the transmitter's final output stage. Conversion loss differs with transmitter design, adjustment, frequency separation of the source signals, and with the order of the IM product.

The analysis calculates all possible IM product frequencies that could potentially interfere with receivers at the communications site based on each receiver's individual bandwidth. It then predicts each IM signal level present at the input of each affected receiver. For each IM frequency, the analysis considers all possible sources of IM generation in the transmitters. For example, if there are four transmitters involve, the analysis will calculate the IM signal level that would be generated in each transmitter. For this example, that would be four possible mixing conditions.

The analysis takes into account the transmitter's power output, modulation bandwidth, conversion losses, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in each system. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required to prevent receiver performance degradation for each IM interference signal that occurs. Receivers experiencing transmitter generated intermodulation interference are depicted in the following Table.

Tx 1 Source Mix Tx		Tx 2 Source		TX 3 Source		Tx 4 Source		Tx 5 Source		Intermod Hit		Affected Receiver		Attn Need (dB)
ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	Freq (MHz)	Ord	ID	Freq (MHz)	
None														

Analysis Results: The above table lists any transmitter generated IM product that is determined to have potential to noticeably degrade the system performance to any receive systems analyzed as part of this study. Based upon the listed configurations for transmitters, receivers, antenna models, antenna patterns and equipment filtering and isolation specifications it has been determined that no transmitter generated intermodulation interference problems were predicted that have the potential to be system performance limiting to any receivers analyzed in this report. While there are thousands of potential IM product combinations based upon the large number of transmitters located at this facility, all potential products produced yielded values that were below the limit where any noticeable degradation to system performance would be experienced.

7.2 Receiver Generated Intermodulation Analysis

Within a receiver, when two or more strong off-channel signals enter and mix in the receiver and one of the IM product frequencies created coincides with the receiver operating frequency, potential interference results. This internal IM mixing process takes place in the receiver's RF amplifier when it operates in a nonlinear range and/or in the first mixer, which, of course, has been designed to operate as a nonlinear device.

Receivers have a similar conversion loss type factor and receiver performance is commonly described in terms of conversion loss with respect to the 2A - B type products. Here, conversion loss is the ratio of a specified level of A and B to the level of the resulting IM product, when the product is viewed as an equivalent on-channel signal. Receiver conversion loss varies with input levels, AGC action, and product order.

The analysis calculates all possible IM product frequencies that could potentially interfere with receivers at the communications site based on each receiver's individual bandwidth. It then predicts each IM signal level present at the input of each affected receiver. For each IM frequency, the analysis considers that the IM signal is generated directly in the receiver.

The analysis takes into account the transmitter's power output, modulation bandwidth, conversion losses, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in each system. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required to prevent receiver performance degradation for each IM interference signal that occurs. Receivers experiencing receiver generated intermodulation interference are depicted in the following Table.

Tx 1 Source		Tx 2 Source		TX 3 Source		Tx 4 Source		Tx 5 Source		Intermod Hit		Affected Receiver		Attn Need (dB)
ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	Freq (MHz)	Ord	ID	Freq (MHz)	
None														

Analysis Results: The above table lists any receiver generated IM product that is determined to have potential to noticeably degrade the system performance to any receive systems analyzed as part of this study. Based upon the listed configurations for transmitters, receivers, antenna models, antenna patterns and equipment filtering and isolation specifications it has been determined that no receiver generated intermodulation interference problems were predicted that have the potential to be system performance limiting to any operators analyzed in this report.

8.0 Transmitter Harmonic Output Interference Analysis

Transmitter harmonic interference is due to non-linear characteristics in a transmitter. The harmonics are typically created due to frequency multipliers and the non-linear design of the final output stage of the transmitter. If the harmonic signal falls within the passband of a nearby receiver and the signal level is of sufficient amplitude, it can degrade the performance of the receiver.

The analysis takes into account the transmitter's harmonic characteristics, output level, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in each system. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required to prevent receiver performance degradation for any harmonics that fall within a receiver's passband. Receivers experiencing transmitter harmonic interference are depicted in the following Table.

Transmitter		Harmonic		Affected Receiver		Attn Needed (dB)
ID	Frequency (MHz)	Frequency (MHz)	Order	ID	Frequency (MHz)	
None						

Analysis Results: No transmitter generated harmonic interference problems were predicted that have the potential to be system performance limiting to any operators analyzed in this report. The calculations to determine harmful out of band harmonics assumed that proper bandpass filtering was utilized to severely reduce these harmonics to levels below those that could be system performance limiting to any receivers analyzed as part of this analysis.

9.0 Transmitter Spurious Output Interference Analysis

Transmitter spurious output interference can be attributed to many different factors in a transmitter. The generation of spurious frequencies could be due to non-linear characteristics in a transmitter or possibly the physical placement of components and unwanted coupling. If a spurious signal falls within the passband of a nearby receiver and the signal level is of sufficient amplitude, it can degrade the performance of the receiver.

The analysis takes into account a transmitter's spurious output specification, output levels, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in each system. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

Note: With the modern design of transmitters, Spurious interference results are rare. Any results in this Report Section could be from Transmitter Noise or Receiver Desense issues. Refer to report Section 5 or 6. Once any TNRD issues are resolved, it should clear up any Spurious Issues being reported.

The analysis determines how much isolation is required to prevent receiver performance degradation for any transmitter spurious signals that fall within a receiver's passband. Receivers experiencing transmitter spurious output interference are depicted in the following Table.

Transmitter		Affected Receiver		Attn Needed (dB)
ID	Frequency (MHz)	ID	Frequency (MHz)	
None				

Analysis Results: No transmitter generated spurious emission interference problems were predicted that have the potential to be system performance limiting to any operators analyzed in this report. The calculations to determine harmful off channel emissions assumed that proper bandpass filtering was utilized to severely reduce these products to levels below those that could be system performance limiting to any receivers analyzed as part of this analysis.

10.0 Summary & limitations

Based upon the data received regarding the proposed radio equipment to be utilized by **AT&T** and the existing radio systems provided by the **Mammoth Lakes Fire Protection District**, there should not be any negative impact to the performance of any radio systems proposed or existing detailed in this report from the proposed **AT&T** installation based upon calculations performed utilizing the radio configurations described in this report.

This analysis was performed solely based upon radio configuration data provided by **AT&T** and the **Mammoth Lakes Fire Protection District**. In certain instances, where assumptions were required, industry standard values were utilized for variables such as transmission power levels, filter response curves, combining schemes and other configuration variables if not provided by the parties listed above. The scope of this study was limited to radio systems present in this report exclusively. It does not take into account emissions from additional surrounding radio sources.

As identified in the various sections of this report, the potential is present for certain forms of interference to exist. However, based upon the supplied and assumed radio system configurations, the isolation provided by physical separation, Antenna pattern gain roll off, filtering variables and isolation devices appears adequate to allow these radio systems to co-exist as outlined in the drawings and configuration documents provided by **AT&T** and the **Mammoth Lakes Fire Protection District**.

This analysis was also performed assuming that all radio equipment including lines and antennas are performing to manufacturers specifications. Each system was analyzed assuming proper filtering was used to maintain compliance with all FCC licenses and reduce out of band emissions.