



WATERFORD

Radio Frequency Emissions Compliance Report For Dish Wireless

Site Name:	SFSFO00173A	Site Structure Type:	Monopine
Address:	919 Hamlin Court	Latitude:	37.400861
	Sunnyvale, CA 94089	Longitude:	-122.030222
Report Date:	August 22, 2022	Project:	Modification

Compliance Statement

Based on information provided by Dish Wireless, on-site baseline measurements, and predictive modeling, the SFSFO00173A installation proposed by Dish Wireless will be compliant with Radiofrequency Radiation Exposure Limits of 47 C.F.R. §§ 1.1307(b)(3) and 1.1310. RF alerting signage and restricting access to the Monopine to authorized climbers that have completed RF safety training is required for Occupational environment compliance. The proposed operation will not expose members of the General Public to hazardous levels of RF energy at ground level or in adjacent buildings.

Certification

I, David H. Kiser, am the reviewer and approver of this report and am fully aware of and familiar with 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, specifically in accordance with FCC's OET Bulletin 65. I have reviewed this Radio Frequency Exposure Assessment report and believe it to be both true and accurate to the best of my knowledge.



David H. Kiser, P.E.
Registered Professional Engineer (Electrical)
State of California, 21542, Expires 6/30/2024
Date: 2022-August-30

General Summary

The compliance framework is derived from the Federal Communications Commission (FCC) Rules and Regulations for preventing human exposure in excess of the applicable Maximum Permissible Exposure ("MPE") limits. At any location at this site, the power density resulting from each transmitter may be expressed as a percentage of the frequency-specific limits and added to determine if 100% of the exposure limit has been exceeded. The FCC Rules define two tiers of permissible exposure differentiated by the situation in which the exposure takes place and/or the status of the individuals who are subject to exposure. General Population / Uncontrolled exposure limits apply to those situations in which persons may not be aware of the presence of electromagnetic energy, where exposure is not employment-related, or where persons cannot exercise control over their exposure. Occupational / Controlled exposure limits apply to situations in which persons are exposed as a consequence of their employment, have been made fully aware of the potential for exposure, and can exercise control over their exposure. Based on the criteria for these classifications, the FCC General Population limit is considered to be a level that is safe for continuous exposure time. The FCC General Population limit is 5 times more restrictive than the Occupational limits.

In situations where the predicted MPE exceeds the General Population threshold in an accessible area as a result of emissions from multiple transmitters, FCC licensees that contribute greater than 5% of the aggregate MPE share responsibility for mitigation.

Table 1: FCC Limits

Frequency (MHz)	<i>Limits for General Population/ Uncontrolled Exposure</i>		<i>Limits for Occupational/ Controlled Exposure</i>	
	Power Density (mW/cm ²)	Averaging Time (minutes)	Power Density (mW/cm ²)	Averaging Time (minutes)
30-300	0.2	30	1	6
300-1500	f/1500	30	f/300	6
1500-100,000	1.0	30	5.0	6

f=Frequency (MHz)

Based on the computational guidelines set forth in FCC OET Bulletin 65, Waterford Consultants, LLC has developed software to predict the overall Maximum Permissible Exposure possible at any location given the spatial orientation and operating parameters of multiple RF sources. The power density in the Far Field of an RF source is specified by OET-65 Equation 5 as follows:

$$S = \frac{EIRP}{4 \cdot \pi \cdot R^2} \text{ (mW/cm}^2\text{)}$$

where EIRP is the Effective Radiated Power relative to an isotropic antenna and R is the distance between the antenna and point of study. Additionally, consideration is given to the manufacturers' horizontal and vertical antenna patterns as well as radiation reflection. At any location, the predicted power density in the Far Field is the spatial average of points within a 0 to 6-foot vertical profile that a person would occupy. Near field power density is based on OET-65 Equation 20 stated as

$$S = \left(\frac{180}{\theta_{BW}} \right) \cdot \frac{100 \cdot P_{in}}{\pi \cdot R \cdot h} \text{ (mW/cm}^2\text{)}$$

where P_{in} is the power input to the antenna, θ_{BW} is the horizontal pattern beamwidth and h is the aperture length.

Some antennas employ beamforming technology where RF energy allocated to each customer device is dynamically directed toward their location. In the analysis presented herein, predicted exposure levels are based on all beams at full utilization (i.e. full power) simultaneously focused in any direction. As this condition is unlikely to occur, the actual power density levels at ground and at adjacent structures are expected to be less than the levels reported below. These theoretical results represent maximum-case predictions as all RF emitters are assumed to be operating at 100% duty cycle.

Analysis

A detailed summary of cumulative measurement results is provided in Appendix B. A photo summary of the site conditions during the survey is provided in Appendix C.

Dish Wireless proposes the following installation at this location:

- INSTALL (3) PROPOSED PANEL ANTENNAS (1 PER SECTOR).
- INSTALL (6) PROPOSED RRUS (2 PER SECTOR).

The antennas will be mounted on a 67 Monopine with centerlines 39' above ground level. Proposed antenna operating parameters are listed in Appendix A. Other appurtenances such as GPS antennas, RRUs and hybrid cable below the antennas are not sources of RF emissions. Panel antennas have been installed at this site by other wireless operators. Operating parameters for these antennas considered in this analysis are also listed in Appendix A.

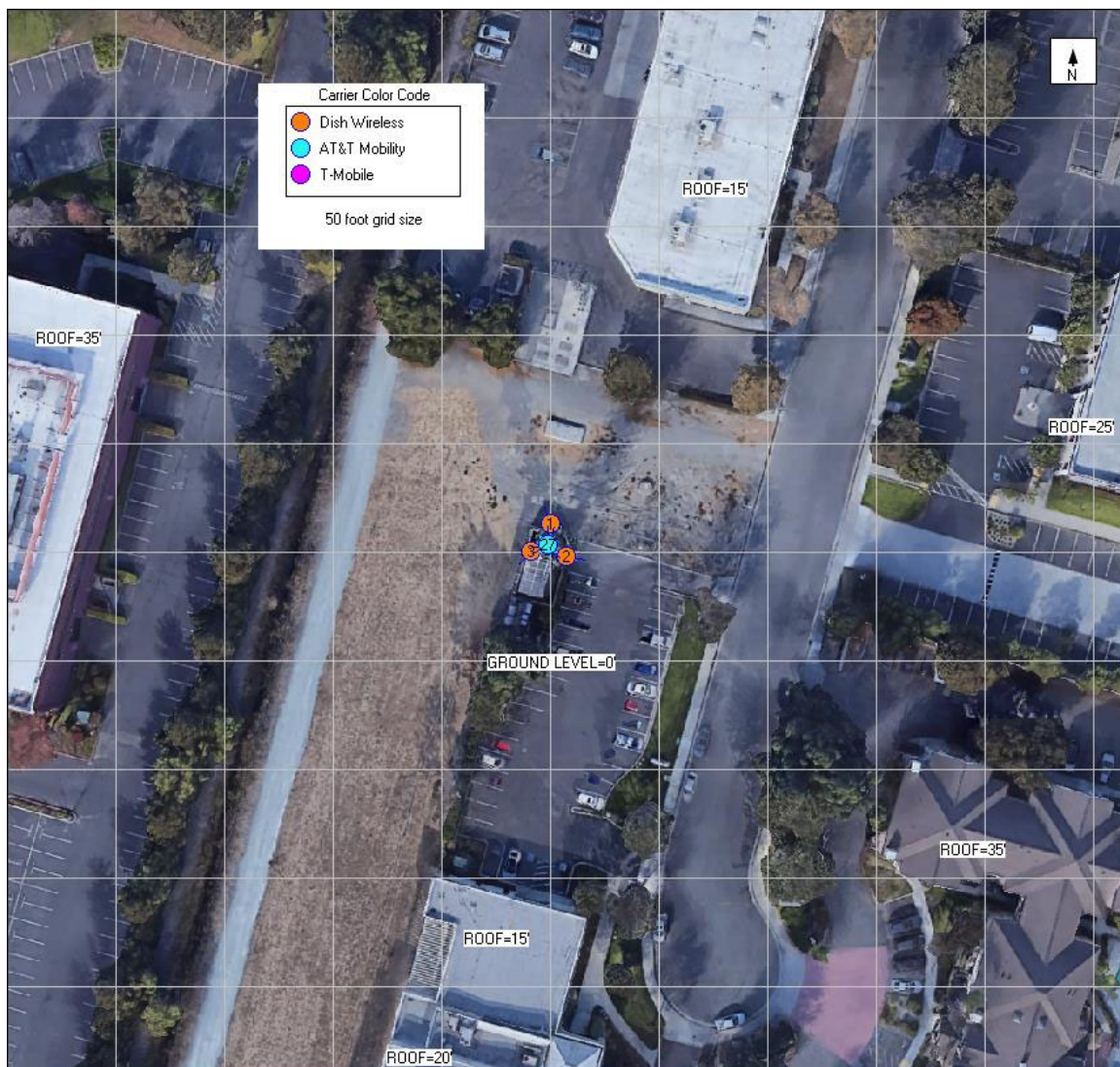


Figure 1: Antenna Locations

Power density decreases significantly with distance from any antenna. The panel-type antennas to be employed at this site are highly directional by design and the orientation in azimuth and mounting elevation, as documented, serves to reduce the potential to exceed MPE limits at any location other than directly in front of the antennas. For accessible areas at ground level, the maximum predicted power density level resulting from all Dish Wireless operations is 3.36% of the FCC General Population limits. Based on the operating parameters in Appendix A, the cumulative power density level at this location from all antennas is 7.916% of the FCC General Population limits. Incident at adjacent buildings depicted in Figure 1.1, the maximum predicted power density level resulting from all Dish Wireless operations is 16.1246% of the FCC General Population limits. Based on the operating parameters in Appendix A, the cumulative power density level at this location from all antennas is 72.7763% of the FCC General Population limits. The proposed operation will not expose members of the General Public to hazardous levels of RF energy at ground level or in adjacent buildings.

The following plots show the cumulative spatial average predicted power density levels in the reference plane indicated as a percentage of the General Public Limits. Please note that 100% of the General Public Limits corresponds to 20% of the Occupational Limits. The reference plane for the plot is indicated in the caption and legend. For example, "Avg 15 to 21 Feet" refers to the spatial average predicted power density level between 15 and 21 feet above the referenced level.

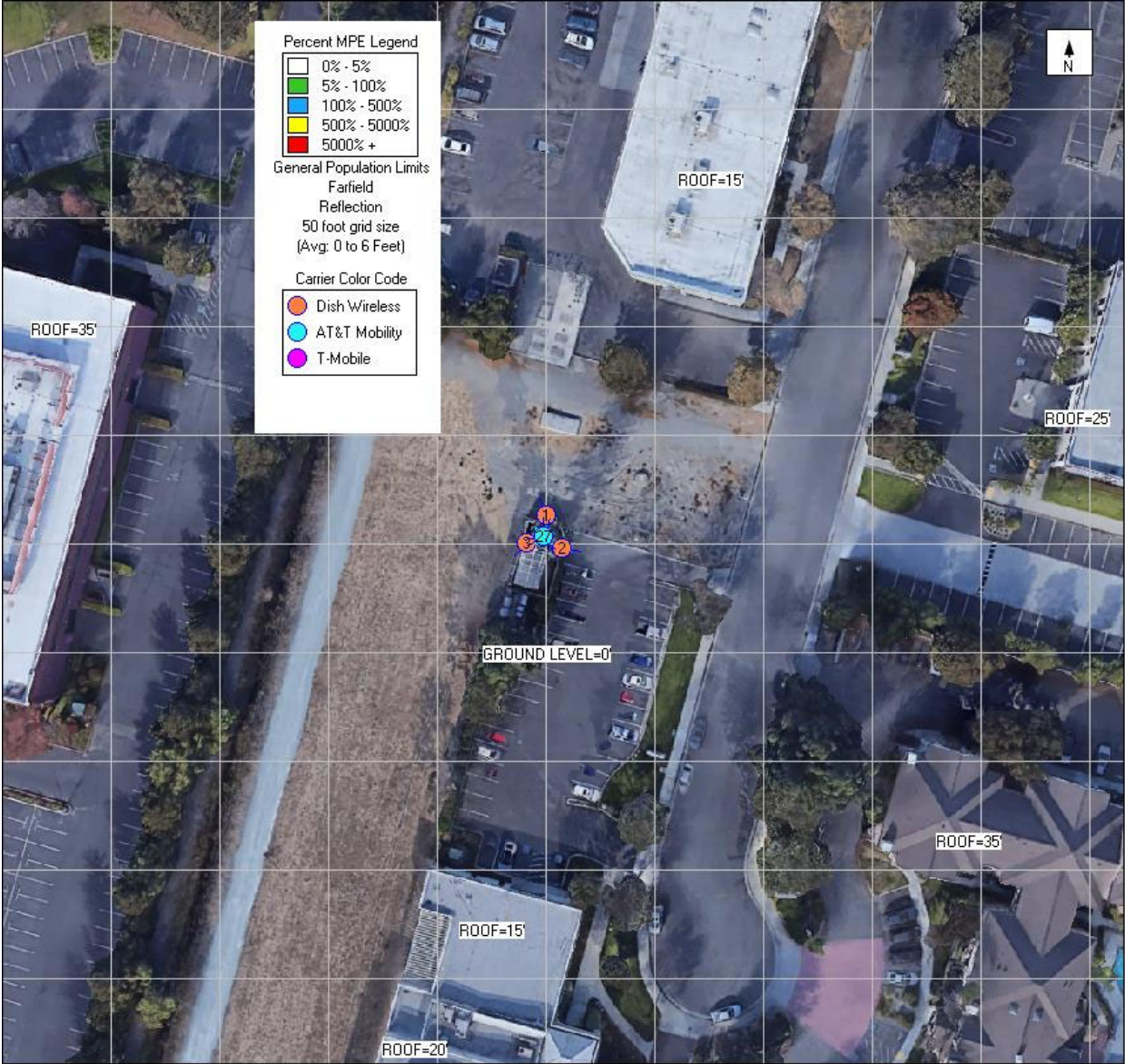


Figure 1.2: Ground 0' level



Figure 1.2: Ground 0' level (All Carrier)

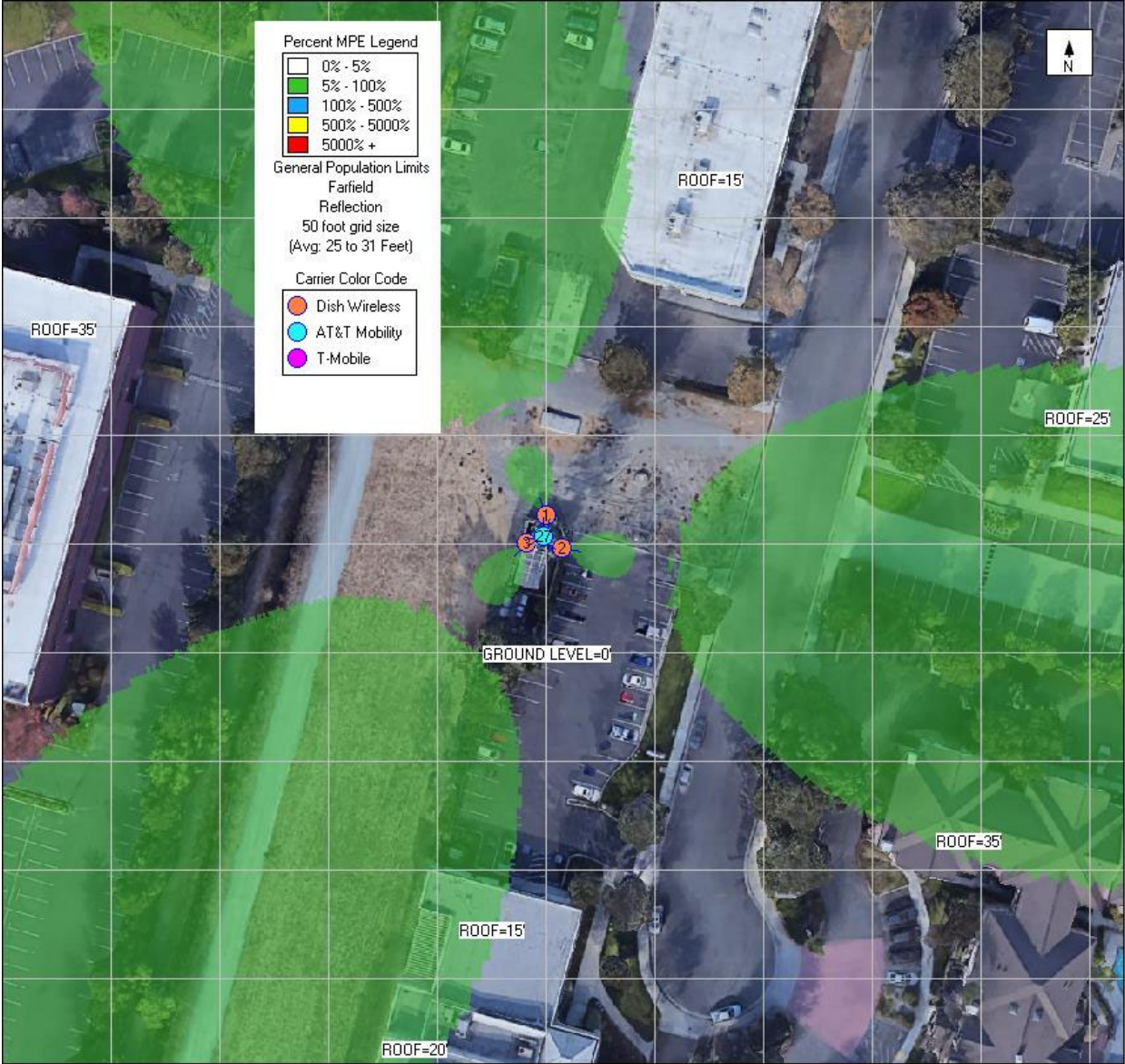


Figure 1.3: Adjacent Building 25' level



Figure 1.3: Adjacent Building 25' level (All Carrier)

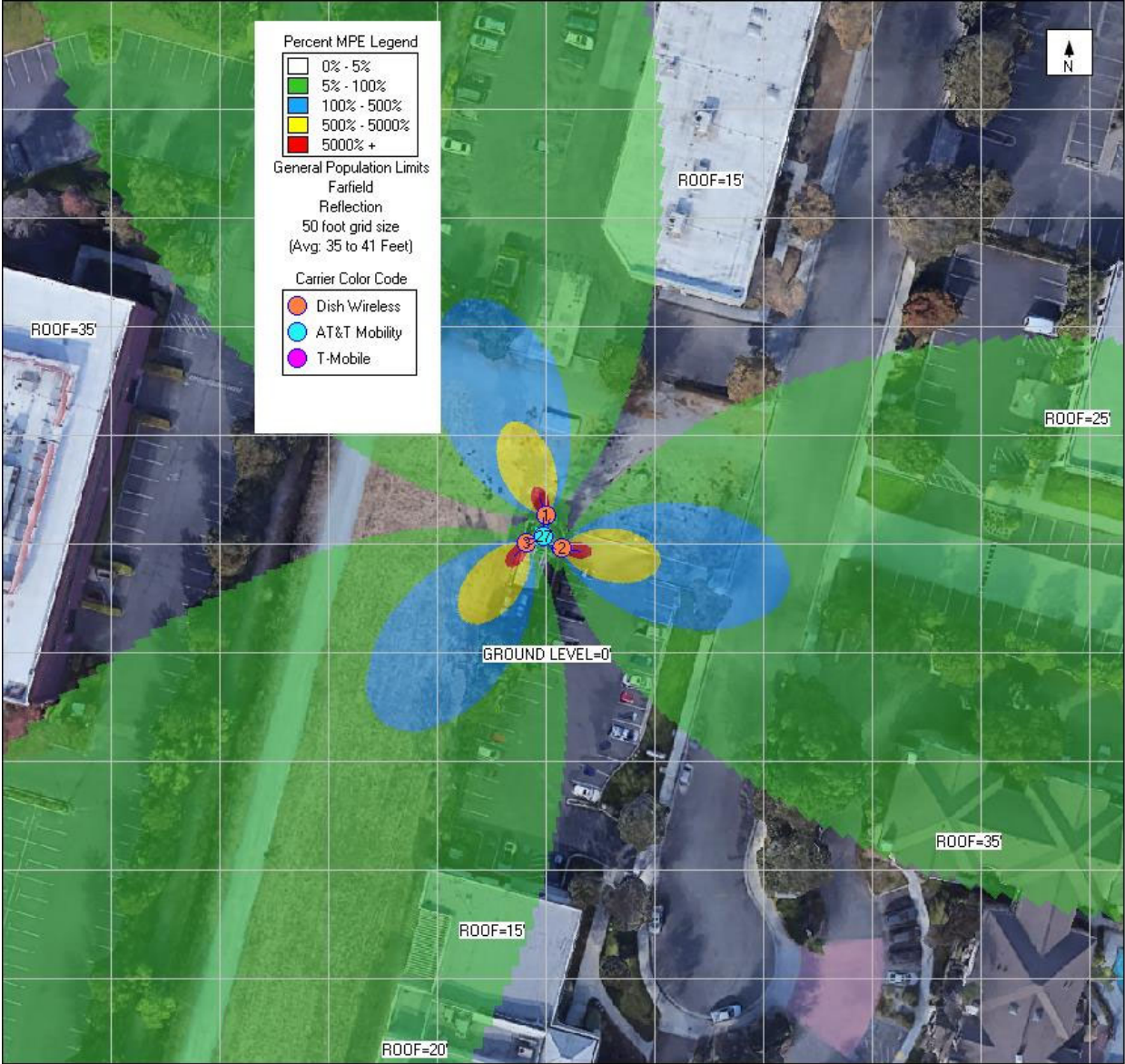


Figure 1.4: Adjacent Building 35' level

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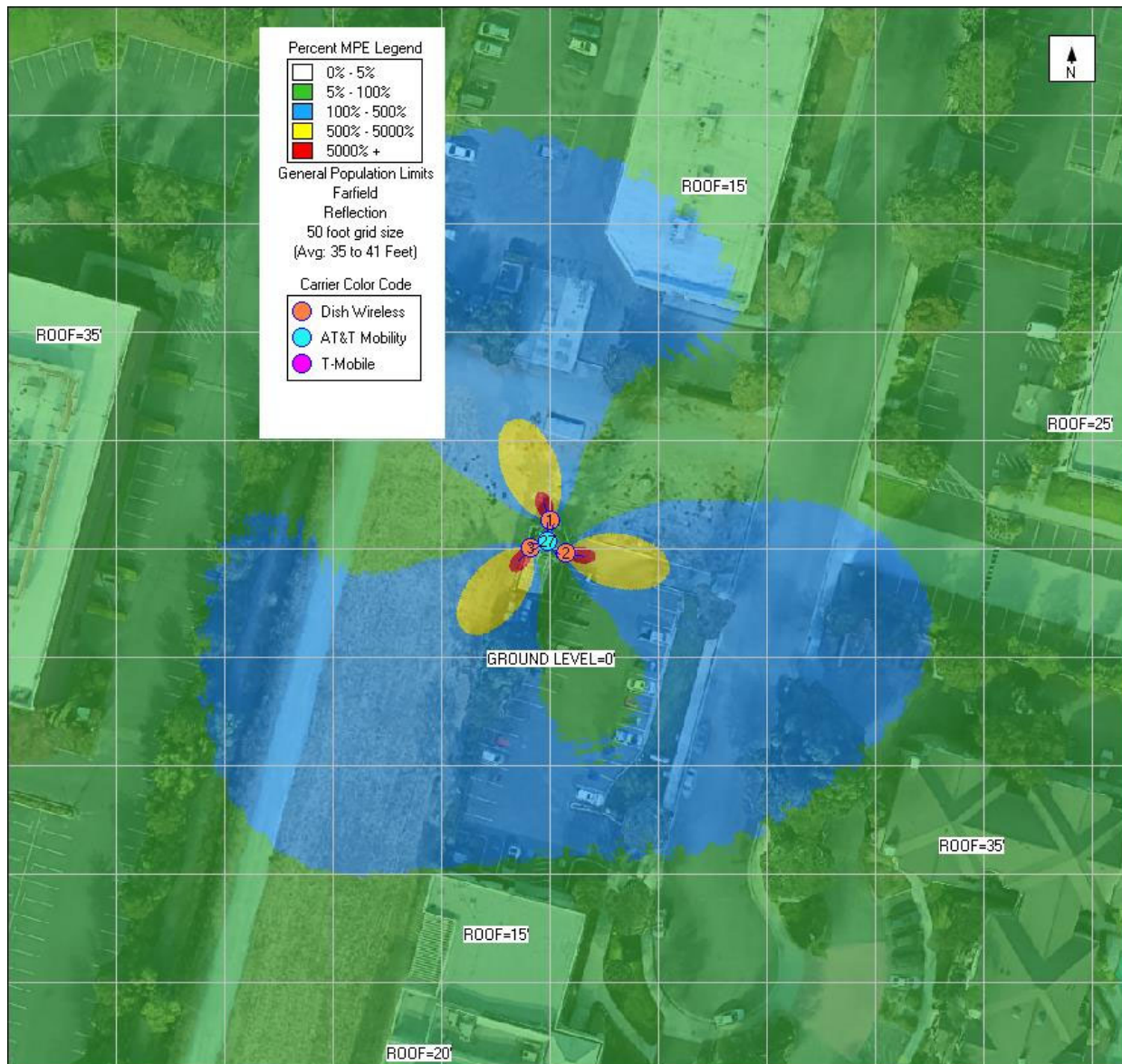
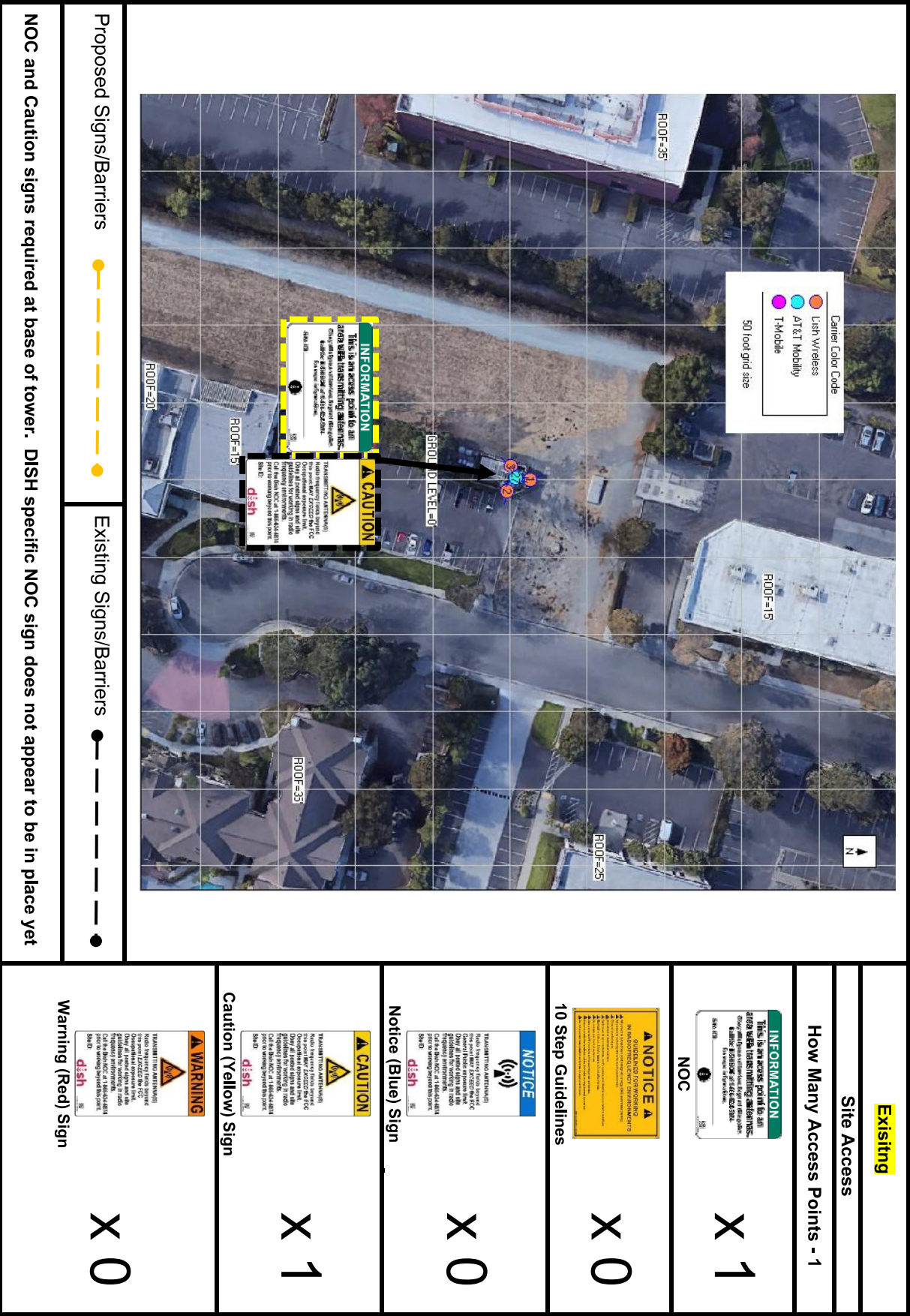


Figure 1.4: Adjacent Building 35' level (All Carrier)

Waterford Consultants, LLC recommends posting RF alerting signage with contact information (Caution) near the antennas at the proposed Monopine to inform authorized climbers of potential conditions near the antennas. These recommendations are depicted in Figure 2.



Attachment 6 Page 12 of 20 Appendix A: Operating Parameters Considered in this Analysis

Antenna #:	Carrier:	Manufacturer	Pattern:	Band (MHz):	Mech Az (deg):	Mech DT (deg):	H BW (deg):	Length (ft):	TPO (W):	Channels:	Loss (dB):	Gain (dBD):	ERP (W):	EIRP (W):	Rad Center (ft):
1	Dish Wireless	CELLMAX	CMA-UBTULBULBHH-6516-16-21-21 02DT	600	340	0	71	6	30	4	0	12.55	2159	3541	39
1	Dish Wireless	CELLMAX	CMA-UBTULBULBHH-6516-16-21-21 02DT	700	340	0	65	6	40	4	0	13.35	3460	5677	39
1	Dish Wireless	CELLMAX	CMA-UBTULBULBHH-6516-16-21-21 01DT	2100	340	0	67	6	40	4	0	17.75	9531	15636	39
1	Dish Wireless	CELLMAX	CMA-UBTULBULBHH-6516-16-21-21 01DT	2100	340	0	67	6	40	4	0	17.75	9531	15636	39
2	Dish Wireless	CELLMAX	CMA-UBTULBULBHH-6516-16-21-21 02DT	600	100	0	71	6	30	4	0	12.55	2159	3541	39
2	Dish Wireless	CELLMAX	CMA-UBTULBULBHH-6516-16-21-21 02DT	700	100	0	65	6	40	4	0	13.35	3460	5677	39
2	Dish Wireless	CELLMAX	CMA-UBTULBULBHH-6516-16-21-21 01DT	2100	100	0	67	6	40	4	0	17.75	9531	15636	39
2	Dish Wireless	CELLMAX	CMA-UBTULBULBHH-6516-16-21-21 01DT	2100	100	0	67	6	40	4	0	17.75	9531	15636	39
3	Dish Wireless	CELLMAX	CMA-UBTULBULBHH-6516-16-21-21 02DT	600	220	0	71	6	30	4	0	12.55	2159	3541	39
3	Dish Wireless	CELLMAX	CMA-UBTULBULBHH-6516-16-21-21 02DT	700	220	0	65	6	40	4	0	13.35	3460	5677	39
3	Dish Wireless	CELLMAX	CMA-UBTULBULBHH-6516-16-21-21 01DT	2100	220	0	67	6	40	4	0	17.75	9531	15636	39
3	Dish Wireless	CELLMAX	CMA-UBTULBULBHH-6516-16-21-21 01DT	2100	220	0	67	6	40	4	0	17.75	9531	15636	39
4	T-Mobile	RFS	APXVAARR24 43-U-NA20 00DT	600	0	0	67.08	8	40	4	0	13.09	3259	5347	65
4	T-Mobile	RFS	APXVAARR24 43-U-NA20 02DT	1900	0	0	57.81	8	40	4	0	15.29	5409	8874	65
4	T-Mobile	RFS	APXVAARR24 43-U-NA20 00DT	700	0	0	60.94	8	40	4	0	13.17	3320	5447	65
4	T-Mobile	RFS	APXVAARR24 43-U-NA20 02DT	2100	0	0	53.64	8	40	4	0	17.32	8632	14162	65
5	T-Mobile	RFS	APX17DWW-17DWVS-05DT	1900	0	0	65	6.3	30	2	0	17.35	3260	5348	65
6	T-Mobile	ERICSSON	AFR32 02DT	1900	0	0	63	4.7	40	2	0	15.45	2806	4604	65
6	T-Mobile	ERICSSON	AFR32 02DT	2100	0	0	61	4.7	40	2	0	15.85	3077	5048	65
7	T-Mobile	ERICSSON	SON_AIR6488 NR TB 2500 TMO	2500	0	0	13	2.9	90	1	0	20.95	11201	18376	65
7	T-Mobile	ERICSSON	SON_AIR6488 LTE TB 2500 TMO	2500	0	0	13	2.9	90	1	0	20.95	11201	18376	65
8	T-Mobile	RFS	APXVAARR24 43-U-NA20 00DT	600	150	0	67.08	8	40	4	0	13.09	3259	5347	65
8	T-Mobile	RFS	APXVAARR24 43-U-NA20 02DT	1900	150	0	57.81	8	40	4	0	15.29	5409	8874	65
8	T-Mobile	RFS	APXVAARR24 43-U-NA20 00DT	700	150	0	60.94	8	40	4	0	13.17	3320	5447	65
8	T-Mobile	RFS	APXVAARR24 43-U-NA20 02DT	2100	150	0	53.64	8	40	4	0	17.32	8632	14162	65
9	T-Mobile	RFS	APX17DWW-17DWVS-05DT	1900	150	0	65	6.3	30	2	0	17.35	3260	5348	65
10	T-Mobile	ERICSSON	AFR32 02DT	1900	150	0	63	4.7	40	2	0	15.45	2806	4604	65
10	T-Mobile	ERICSSON	AFR32 02DT	2100	150	0	61	4.7	40	2	0	15.85	3077	5048	65

Attachment 6
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Antenna #	Carrier:	Manufacturer	Pattern:	Band (MHz):	Mech Az (deg):	Mech DT (deg):	H BW (deg):	Length (ft):	TPO (W):	Channels:	Loss (dB):	Gain (dBD):	ERP (W):	EIRP (W):	Rad Center (ft):
1	T-Mobile	ERICSSON	SON_AIR6488 NR TB 2500 TMO	2500	150	0	13	2.9	90	1	0	20.95	11201	18376	65
2	T-Mobile	ERICSSON	SON_AIR6488 LTE TB 2500 TMO	2500	150	0	13	2.9	90	1	0	20.95	11201	18376	65
3	T-Mobile	RFS	APXVAARR24_43-U-NA20 00DT	600	240	0	67.08	8	40	4	0	13.09	3259	5347	65
12	T-Mobile	RFS	APXVAARR24_43-U-NA20 02DT	1900	240	0	57.81	8	40	4	0	15.29	5409	8874	65
12	T-Mobile	RFS	APXVAARR24_43-U-NA20 00DT	700	240	0	60.94	8	40	4	0	13.17	3320	5447	65
12	T-Mobile	RFS	APXVAARR24_43-U-NA20 02DT	2100	240	0	53.64	8	40	4	0	17.32	8632	14162	65
13	T-Mobile	RFS	APX17DWV-17DWVS-05DT	1900	240	0	65	6.3	30	2	0	17.35	3260	5348	65
14	T-Mobile	ERICSSON	AIR32 02DT	1900	240	0	63	4.7	40	2	0	15.45	2806	4604	65
14	T-Mobile	ERICSSON	AIR32 02DT	2100	240	0	61	4.7	40	2	0	15.85	3077	5048	65
15	T-Mobile	ERICSSON	SON_AIR6488 NR TB 2500 TMO	2500	240	0	13	2.9	60	1	0	20.95	7467	12250	65
15	T-Mobile	ERICSSON	SON_AIR6488 LTE TB 2500 TMO	2500	240	0	13	2.9	90	1	0	20.95	11201	18376	65
16	AT&T	QUINTEL	QD4612-3D V1 02DT	700	20	0	67	4.3	40	4	0	10.0394	1615	2649	55
16	AT&T	QUINTEL	QD4612-3D V1 02DT	850	20	0	56	4.3	40	4	0	10.4057	1757	2882	55
16	AT&T	QUINTEL	QD4612-3D V1 00DT	1900	20	0	52	4.3	40	4	0	14.5888	4603	7551	55
16	AT&T	QUINTEL	QD4612-3D V1 00DT	2300	20	0	48	4.3	25	4	0	15.2532	3352	5499	55
17	AT&T	Ericsson	SON_AIR6419 TB 05.17.21 3500 AT&T	3500	20	0	13	2.4	108.4	1	0	23.45	23990	39358	55
18	AT&T	Ericsson	SON_AIR6449 NR TB 05.17.21 3700 AT&T	3700	20	0	11.7	2.8	108.4	1	0	23.45	23990	39358	55
19	AT&T	QUINTEL	QD4616-7 V1 08DT	700	20	0	65	4.3	40	4	0	10.7732	1912	3136	55
19	AT&T	QUINTEL	QD4616-7 V1 04DT	2100	20	0	64	4.3	60	4	0	15.1845	7919	12992	55
20	AT&T	QUINTEL	QD4612-3D V1 02DT	700	140	0	67	4.3	40	4	0	10.0394	1615	2649	55
20	AT&T	QUINTEL	QD4612-3D V1 02DT	850	140	0	56	4.3	40	4	0	10.4057	1757	2882	55
20	AT&T	QUINTEL	QD4612-3D V1 00DT	1900	140	0	52	4.3	40	4	0	14.5888	4603	7551	55
20	AT&T	QUINTEL	QD4612-3D V1 00DT	2300	140	0	48	4.3	25	4	0	15.2532	3352	5499	55
21	AT&T	Ericsson	SON_AIR6419 TB 05.17.21 3500 AT&T	3500	140	0	13	2.4	108.4	1	0	23.45	23990	39358	55
22	AT&T	Ericsson	SON_AIR6449 NR TB 05.17.21 3700 AT&T	3700	140	0	11.7	2.8	108.4	1	0	23.45	23990	39358	55
23	AT&T	QUINTEL	QD4616-7 V1 08DT	700	140	0	65	4.3	40	2	0	10.7732	956	1568	55
23	AT&T	QUINTEL	QD4616-7 V1 04DT	2100	140	0	64	4.3	60	4	0	15.1845	7919	12992	55
24	AT&T	QUINTEL	QD4612-3D V1 02DT	700	260	0	67	4.3	40	4	0	10.0394	1615	2649	55
24	AT&T	QUINTEL	QD4612-3D V1 02DT	850	260	0	56	4.3	40	4	0	10.4057	1757	2882	55
24	AT&T	QUINTEL	QD4612-3D V1 00DT	1900	260	0	52	4.3	40	4	0	14.5888	4603	7551	55
24	AT&T	QUINTEL	QD4612-3D V1 00DT	2300	260	0	48	4.3	25	4	0	15.2532	3352	5499	55
25	AT&T	Ericsson	SON_AIR6419 TB 05.17.21 3500 AT&T	3500	260	0	13	2.4	108.4	1	0	23.45	23990	39358	55
26	AT&T	Ericsson	SON_AIR6449 NR TB 05.17.21 3700 AT&T	3700	260	0	11.7	2.8	108.4	1	0	23.45	23990	39358	55
27	AT&T	QUINTEL	QD4616-7 V1 08DT	700	260	0	65	4.3	40	2	0	10.7732	956	1568	55
27	AT&T	QUINTEL	QD4616-7 V1 04DT	2100	260	0	64	4.3	60	4	0	15.1845	7919	12992	55

Notes: Table depicts recommended operating parameters for Dish Wireless proposed operations. Collocated antenna parameters based on industry standards.

Appendix B: Measurements Summary

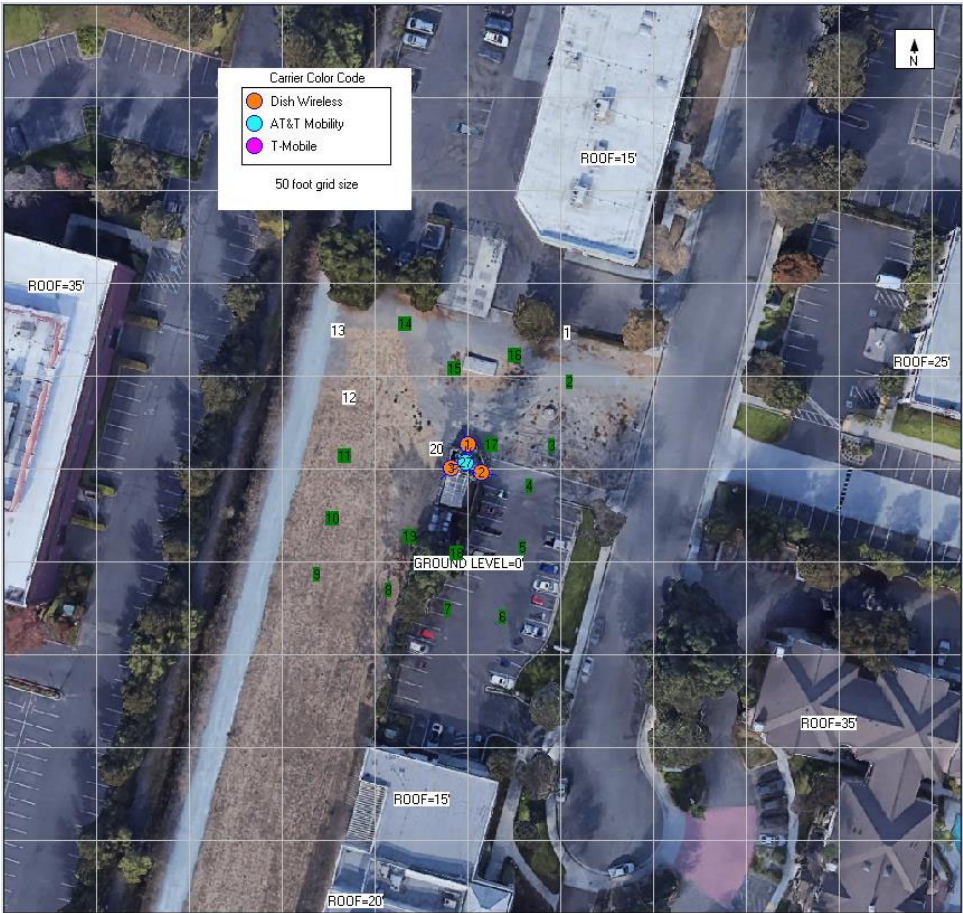


Figure 2: Measurement Locations
Measurement Legend

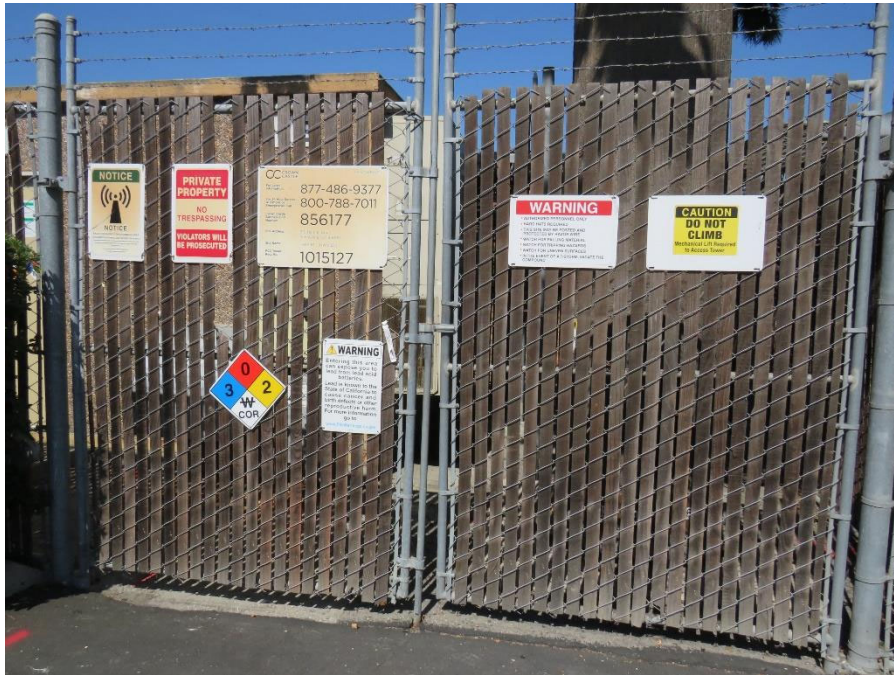
Black	Less than 5% of GP limits
Green	Between 5% and 100% of GP limits
Blue	Above 100% of GP limits, below 500% of GP limits
Yellow	Above 500% of GP limits (Above 100% of Occupational limits)

Measurement Readings are Spatial Average and Maximum as MPE % of the General Public Limits

Loc#	Site Reading		Loc#	Site Reading	
	Avg	Max		Avg	Max
1	3.4390%	3.9360%	2	5.1950%	5.9440%
3	5.1970%	7.2970%	4	5.9800%	7.3500%
5	8.2450%	9.7990%	6	6.4670%	7.5980%
7	5.0710%	7.0050%	8	7.3180%	8.9420%
9	5.7910%	7.0360%	10	7.3960%	8.4210%
11	7.4530%	8.9820%	12	4.8810%	6.0370%
13	4.7350%	5.4970%	14	6.8680%	8.0550%
15	6.1040%	6.9960%	16	5.9090%	8.0110%
17	5.2420%	6.6910%	18	7.0640%	8.0370%
19	7.8180%	9.6930%	20	3.9080%	5.0100%

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Appendix C: Site Photographs



Access



Access

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T-Mobile Alpha Sector Antenna #1 (Front)



T-Mobile Beta Sector Antennas #2 (Front)

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T-Mobile Gamma Sector Antennas #3 (Front)



Equipment Room



AT&T/ T-Mobile Antennas



AT&T/ T-Mobile Antennas

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AT&T/ T-Mobile Antennas

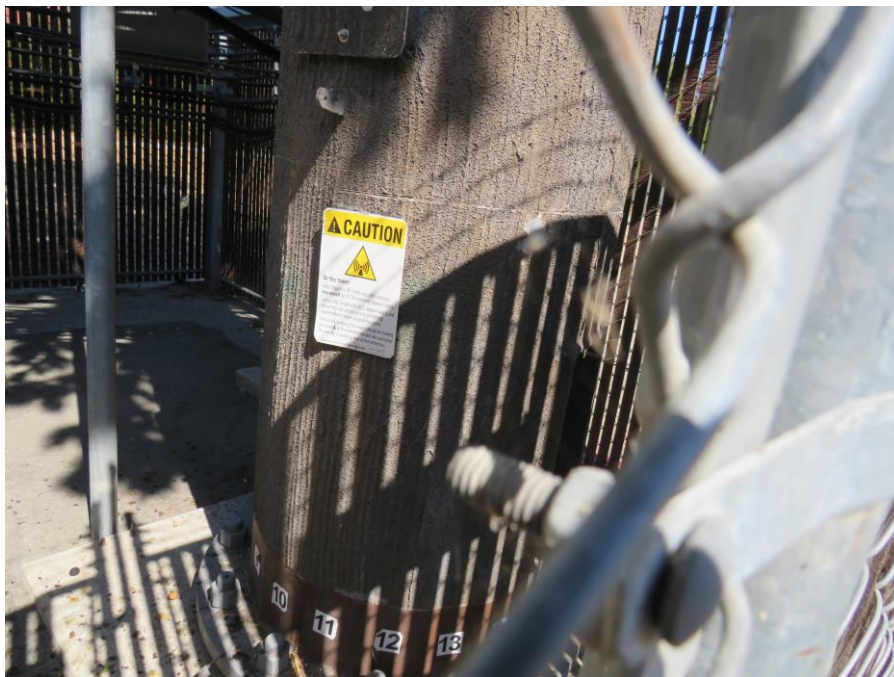


Site Overview North Facing South

SFSFO00173A – Modification.08.22.2022



Site Overview South/West Facing North/East



Signage