COUNTY OF SAN MATEO
PLANNING AND BUILDING DEPARTMENT

DATE: August 18, 2022

TO: ZHO Hearing Officer

FROM: Planning Staff

SUBJECT: Consideration of Use Permit Renewal, pursuant to Section 6500 of the San Mateo County Zoning Regulations, to allow the continued operation of a cellular facility, located west of Junipero Serra Highway and the Upper Crystal Springs Reservoir, south of Highway 92, in the unincorporated area of San Mateo County.

County File Number: PLN 2022-00093 (T-Mobile/City and County of San Francisco Water Department

PROPOSAL

The applicant is seeking a Use Permit renewal to allow for the continued operation of a cellular facility. The facility currently consists of one 30-foot-high monopole with one 4 feet 3-inch-tall antenna which is mounted flush to the top of the pole. There is an existing equipment cabinet, a Generac 25 kw diesel generator, an automatic transfer switch, and a power and telco rack mounted at ground level on individual cement slabs. The associated equipment is enclosed by an existing fence within a 321 sq. ft. lease area, which is located approximately 50 feet away from the monopole. The site of the cellular facility is located within the Junipero Serra (1-280) State Scenic Corridor. This cellular facility provides wireless communication to carriers of T-Mobile along the Highway 92 corridor and State Routes 35 and 280.

RECOMMENDATION

Approve the Use Permit renewal, County File Number PLN 2002-00093, by making the required findings and adopting the conditions of approval listed in Attachment A.

BACKGROUND

Report Prepared By: Katheryne Castro Rivera, Project Planner, Telephone 650/599-1554

Appellant: N/A

Applicant/Owner: T-Mobile/City and County of San Francisco Water Department

Public Notification: Ten (10) day advanced notification for the hearing was mailed to property owners within 300 feet of the project parcel and a notice for the hearing posted in a newspaper San Mateo Times of general public circulation.

Location: San Francisco Water Department Watershed and San Francisco State Fish and Game Refuge, west of Junipero Serra Highway and the Upper Crystal Springs Reservoir, south of Highway 92, in unincorporated San Mateo County.

APN(s): 093-080-010

Size: Approximately 574 acres

Existing Zoning: RM (Resource Management)

General Plan Designation: General Open Space

Local Coastal Plan Designation: N/A

Sphere-of-Influence: None

Williamson Act: N/A

Existing Land Use: T-Mobile Cellular Facility, San Francisco Water Department Watershed and San Francisco State Fish and Game Refuge. Two water tanks exist on-site.

Water Supply: Not applicable

Sewage Disposal: Not applicable

Flood Zone: FEMA Flood Insurance Rate Map designation indicates parcel as Zone C, Area of Minimal Flooding; Community Panel No. 06081C0165E, dated October 16, 2012.

Environmental Evaluation: Categorically exempt under provisions of Class 1, Section 15301 of the California Environmental Quality Act Guidelines, Existing Facilities.

Setting: The project is west of Junipero Serra Highway and the Upper Crystal Springs Reservoir, south of Highway 92 in unincorporated Skyline. The property is improved with two existing water tanks in addition to the existing cellular facility. A dirt road provides access from Highway 92, heading south through the San Francisco Watershed, to the site. The area is covered with mature native trees and shrubs.

Chronology:

Date		Action
February 21, 2002	-	Original Use Permit Application Received
September 25, 2002	-	Zoning Hearing Officer Approved Use Permit Application
September 27, 2007	-	Use Permit Renewal Application Received
July 17, 2008	-	Zoning Hearing Officer Approved Use Permit Renewal Application
August 9, 2011	-	Minor Modification to allow the replacement of one equipment cabinet approved
April 1, 2021	-	Use Permit Renewal Application Received
May 7, 2021	-	Minor Modification to allow the addition of an emergency generator approved
May 7, 2022	-	Project Deemed Complete
August 18, 2022	-	Zoning Hearing Officer Meeting

DISCUSSION

A. KEY ISSUES

1. Conformance with the General Plan

The project continues to conform with the applicable General Plan policies for Visual Quality and Land Use as no physical changes to the existing facility are proposed. The monopole and antenna are painted a dark green color which helps the equipment to blend in with the surrounding environment and minimizes visual impacts. The requirement to maintain the color conformance continues to be a condition of approval. The facility is not visible from the scenic highways given the long distance between the site and public viewpoints and existing mature vegetation.

2. Compliance with Zoning Regulations

The project site is located within the RM (Resource Management) zoning district. The existing wireless telecommunication facility is operating under a previously approved Use Permit and no physical changes are proposed. No

complaints regarding the project have been received. The project remains consistent with the RM zoning district requirements.

3. Compliance with Wireless Telecommunications Facilities Ordinance (WTF)

Staff has determined that the project complies with the applicable standards of the Wireless Telecommunication Facilities (WTF) Ordinance, as discussed below:

a. Development and Design Standards

Section 6512.2 of the WTF ordinance discusses location, minimizing visual impacts, maximum height, and future co-location of wireless facilities. The location of the T-Mobile facility on an existing monopole helps to minimize negative visual impacts, maximum height, because it utilizes an existing utility structure rather than installing an entirely new support structure. Based on the Radio Frequency emissions analysis submitted by Hammet & Eddison, Inc., composite exposure levels are at a maximum of 0.45% percent of the Federal Communications Commission (FCC) public exposure limit at ground level.

T-Mobile has indicated that there are no other carriers located on the site and that no further expansion is planned or anticipated at this time.

b. Performance Standards

In compliance with Sections 6512.2 and 6512.5 of the WTF Ordinance, the existing facility has maintained a valid FCC license.

Staff is unaware of any other cellular carriers proposing to co-locate on or adjacent to the existing monopole and no requests to intensify the use of this facility have been made.

4. Conformance with Use Permit Findings

In order to approve the Subject Use Permit Renewal, the Zoning Hearing Officer must make the following findings:

a. *That the establishment, maintenance and/or conducting of the use will not, under the circumstances of the particular case, result in a significant adverse impact to coastal resources, or be detrimental to the public welfare or injurious to property or improvements in the neighborhood.*

The subject antenna facility has been in operation since 2002, is not located in the Coastal Zone, and has not resulted in any adverse impacts to the surrounding area. The radio frequency analysis submitted with the Use Permit renewal application indicates that the facility continues to comply with the FCC's current prevailing standards for limiting human exposure to RF energy. As this is an unmanned communication facility, the operation does not create additional traffic, noise, or intensity of use of the property.

b. That the telecommunication facilities are necessary for the public health, safety, convenience or welfare of the community.

Staff found that the continued operation of the existing cellular facility at this location will allow for continued cellular communication coverage for private citizens and businesses. The existing wireless telecommunication facility has been in existence for many years and the community has come to rely on the coverage provided by this site. The site facilitates both routine daily conversation but also communication services in emergency situations.

5. Conformance with Conditions of Last Use Permit Approvals

Staff has reviewed the previous Use Permit conditions of approval for this permit, last approved July 17, 2008, and have determined that the project is in compliance with all previous conditions, see Attachment E. No physical changes are proposed as part of the renewal. Previous conditions that remain relevant, are included in Attachment A of this staff report.

B. ENVIRONMENTAL REVIEW

The project is categorically exempt pursuant per Section 15301, Class 1, of the CEQA Guidelines for the continued operation of existing public or private facilities involving no alterations or expansion of use as no physical changes are proposed.

C. REVIEWING AGENCIES

Building Inspection Section
Cal-Fire Department
National Park Service (Golden Gate National Recreation Area)
Planning Director, City of San Mateo
Planning Director, City of Belmont

ATTACHMENTS

A. Recommended Findings and Conditions of Approval
B. Location Map
C. Site Plan

D. Equipment Layout Plan
E. Radio Frequency (RF) Report
F. Site Photos

KCR:cmc – KCRGG0242_WCU.DOCX

Attachment A

County of San Mateo
Planning and Building Department

RECOMMENDED FINDINGS AND CONDITIONS OF APPROVAL

Permit or Project File Number: PLN 2002-00093 Hearing Date: August 18, 2022

Prepared By: Katheryne Castro Rivera, Project Planner For Adoption By: Zoning Hearing Officer

RECOMMENDED FINDINGS

1. That the project is categorically exempt under provisions of Class 1, Section 15301 of the California Environmental Quality Act Guidelines, Existing Facilities. The proposed project includes the continued operation of an existing facility.

Regarding the Use Permit, Find:

2. That this telecommunications facility is necessary for the public health, safety, convenience or welfare of the community because the Federal Communications Commission (FCC) has established the desirability and need for mobile and wireless telephone service to facilitate enhanced communication between mobile units. The subject cellular facility provides mobile and wireless services to all carriers of T-Mobile within the area and allows for unobstructed communication and cellular transmission between both private individuals and emergency/official vehicles. The range of personal communication services provided by this facility enhances telephone services in the area and is a necessary component of public health, safety, convenience and welfare. The cellular facility provides an efficient way to access this essential communication component, and thus, can be considered as necessary for the public health, safety, convenience and welfare.

3. That the establishment, maintenance and conducting of the use, as proposed and conditioned, will not, under the circumstances of the particular case, result in a significant adverse impact to coastal resources or be detrimental to the public welfare or injurious to property or improvements in the neighborhood since the project is not located in the Coastal Zone and staff has reviewed the project file, referred the project to appropriate parties for comments, conducted a site inspection, and reviewed previous conditions of approval and finds no issues concerning non-compliance with Zoning Regulations Chapter 24.5 or impacts on neighboring properties in the vicinity. In addition, staff has reviewed the Radio Frequency report evaluating the proposed modifications to the existing cellular facility, and has found that the continued use of the existing facility is in full

conformance with the requirements of the Federal Communications Commission (FCC). The required findings for this project can be made.

RECOMMENDED CONDITIONS OF APPROVAL

Current Planning Section

1. This approval applies only to the proposal, documents and plans described in this report and submitted to and approved by the Zoning Hearing Officer on August 18, 2022. Minor revisions or modifications to the project may be approved by the Community Development Director if they are consistent with the intent of and in substantial conformance with this approval.

2. The Use Permit shall be valid for a period of ten (10) years from the date of approval, August 18, 2032. The applicant shall apply for renewal of the Use Permit and pay applicable renewal fees six (6) months prior to expiration.
3. Any change in use or intensity shall require an amendment to the Use Permit. Amendment to this Use Permit requires an application for amendment, payment of applicable fees, and consideration at a public hearing.

4. The applicant shall maintain approval from the FCC and the PUC with regard to the operation of this facility. The applicant, upon request by the Planning Department, shall submit proof of approval. If these approvals are ever revoked, the applicant shall inform the Community Development Director of the revocation, at which time an administrative review will commence.

5. The applicant is required to monitor the noise level at the site so that the proposed construction activity will not exceed 80-dBA level at any one moment.

6. The installation shall be removed in its entirety at that time when this technology becomes obsolete, or this facility is no longer needed.

7. If any modifications are made to the site, including the addition of new equipment cabinets, a building permit shall be issued prior to construction. Any new cabinets shall be painted to match the existing cabinets.

8. This permit does not allow for the removal of any trees. Removal of any tree with a diameter greater than 12 inches as measured 4.5 feet above the ground shall require a separate tree removal permit.

County Fire Authority (Cal-Fire)

9. A copy of all keys to the locks on the access gate shall be provided to the Fire Marshal's Office. If at any time the locks are changed, the Fire Department shall be notified, and a copy of any new keys shall be provided.

National Park Service (Golden Gate National Recreation Area)

10. Any future modifications of the site shall adhere to the drainage design, approved during the initial construction of the cellular facility. The site shall be maintained to prevent erosion from water streaming around the equipment pads and skirt down the hillside.

11. In the event of collocation by a second carrier, the height of the existing monopole shall not be increased to more than 32 feet.

12. The applicant shall install permanent warning signage on the existing fencing surrounding the equipment associated with this cellular facility. The applicant shall submit photographs confirming the compliance with this condition at the time of submittal at each Use Permit renewal application.

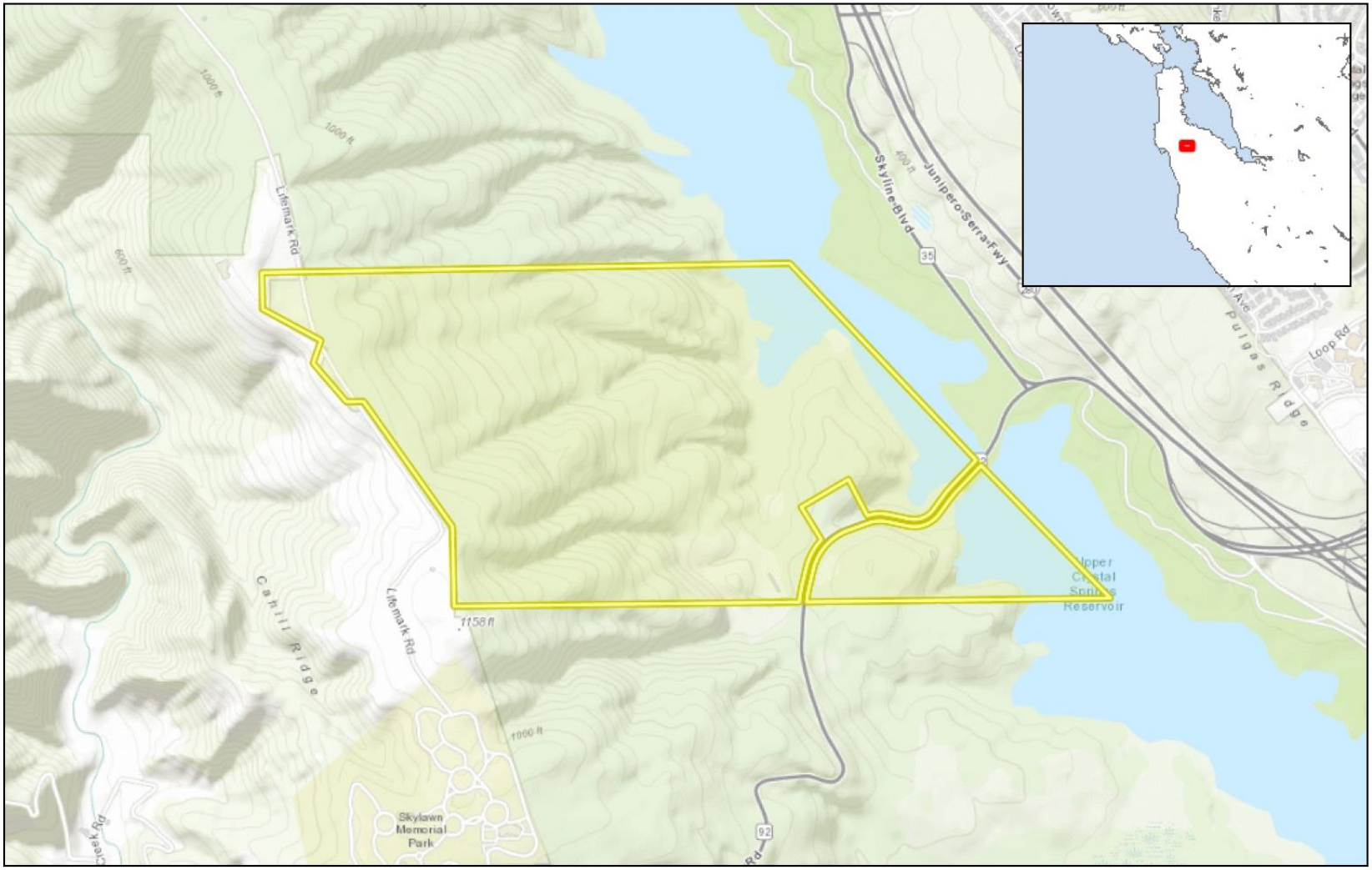
KCR:cmc – KCRGG0242_WCU.DOCX

COUNTY OF SAN MATEO - PLANNING AND BUILDING DEPARTMENT

ATTACHMENT B

San Mateo County

APN: 093-080-010 Map



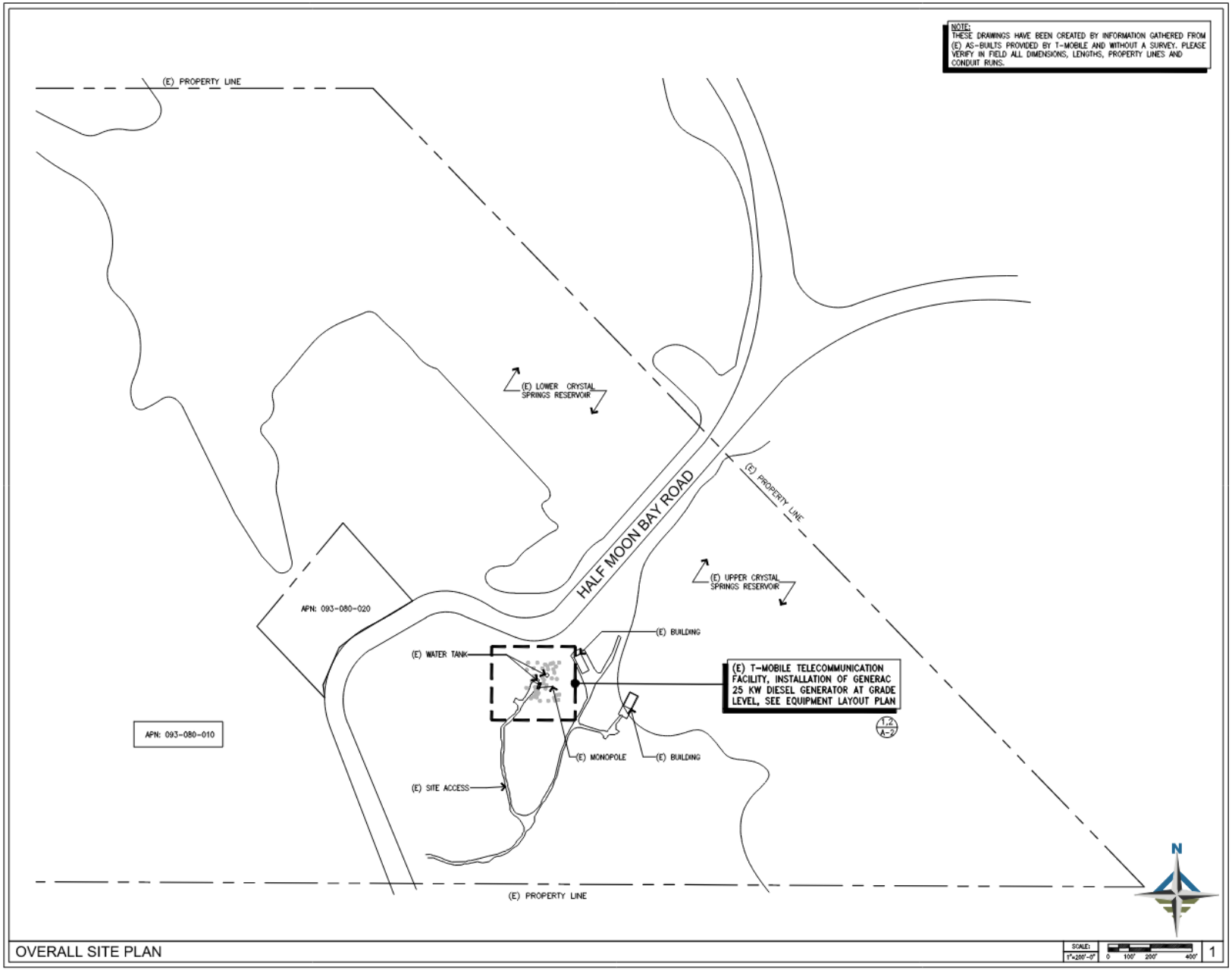
0.69 0 0.34 0.69 Miles

WGS_1984_Web_Mercator_Auxiliary_Sphere

1: 21,812

COUNTY OF SAN MATEO - PLANNING AND BUILDING DEPARTMENT

ATTACHMENT C


NOTE:
THESE DRAWINGS HAVE BEEN CREATED BY INFORMATION GATHERED FROM (E) AS-BUILTS PROVIDED BY T-MOBILE AND WITHOUT A SURVEY. PLEASE VERIFY IN FIELD ALL DIMENSIONS, LENGTHS, PROPERTY LINES AND CONDUIT RUNS.
(E) PROPERTY LINE
(E) LOWER CRYSTAL SPRINGS RESERVOIR
HALF MOON BAY ROAD
(E) PROPERTY LINE
(E) UPPER CRYSTAL SPRINGS RESERVOIR
APN: 093-080-020
(E) BUILDING
(E) WATER TANK
(E) T-MOBILE TELECOMMUNICATION FACILITY, INSTALLATION OF GENERAC 25 KW DIESEL GENERATOR AT GRADE LEVEL, SEE EQUIPMENT LAYOUT PLAN
1/2
A-2
APN: 093-080-010
(E) MONOPOLE
(E) BUILDING
(E) SITE ACCESS
(E) PROPERTY LINE
N
OVERALL SITE PLAN
SCALE: 1"=200'-0"
0 100' 200' 400'
1

COUNTY OF SAN MATEO - PLANNING AND BUILDING DEPARTMENT

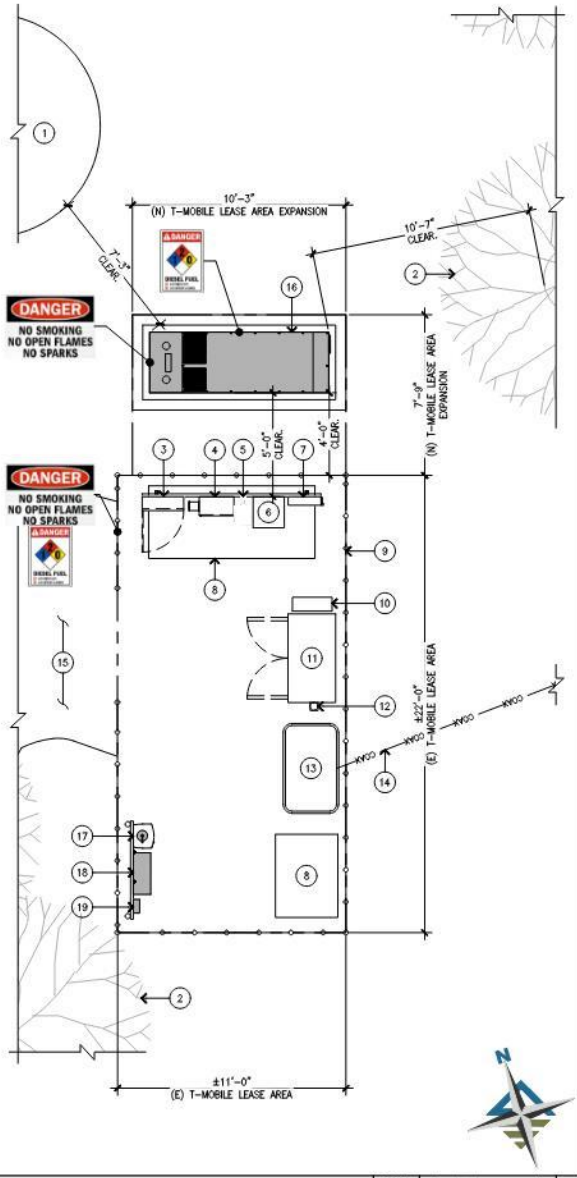
ATTACHMENT D

KEYNOTES:

1. (E) WATER TANK
2. (E) TREE
3. (E) T-MOBILE TELCO CABINET
4. (E) T-MOBILE PPC WITH GEN PLUG
5. (E) SERVICE LIGHT
6. (E) T-MOBILE TRANSFORMER
7. (E) T-MOBILE DISCONNECT SWITCH
8. (E) CONCRETE SLAB
9. (E) 4' HIGH CABLE FENCE
10. (E) T-MOBILE MCPA UNIT
11. (E) T- MOBILE RBS 6102 MUAC CABINET
12. (E) T-MOBILE GPS ANTENNA
13. (E) COAX VAULT
14. (E) COAX TO (E) MONOPOLE
15. (E) DIRT ROAD
16. (N) T-MOBILE GENERAC 25 KW DIESEL GENERATOR WITH TANK (1/2 D-1) (3 D-1) ON (N) CONCRETE SLAB
17. (N) PORTABLE FIRE EXTINGUISHER WITH 18 LBS CAPACITY B:C RATING (4 D-1) INSTALLED INSIDE APPROVED RED CABINET ON (N) H-FRAME
18. (N) T-MOBILE ATS ON (N) H-FRAME (4 D-1)
19. (N) T-MOBILE DISCONNECT SWITCH ON (N) H-FRAME (4 D-1)

FIRE DEPARTMENT NOTES:

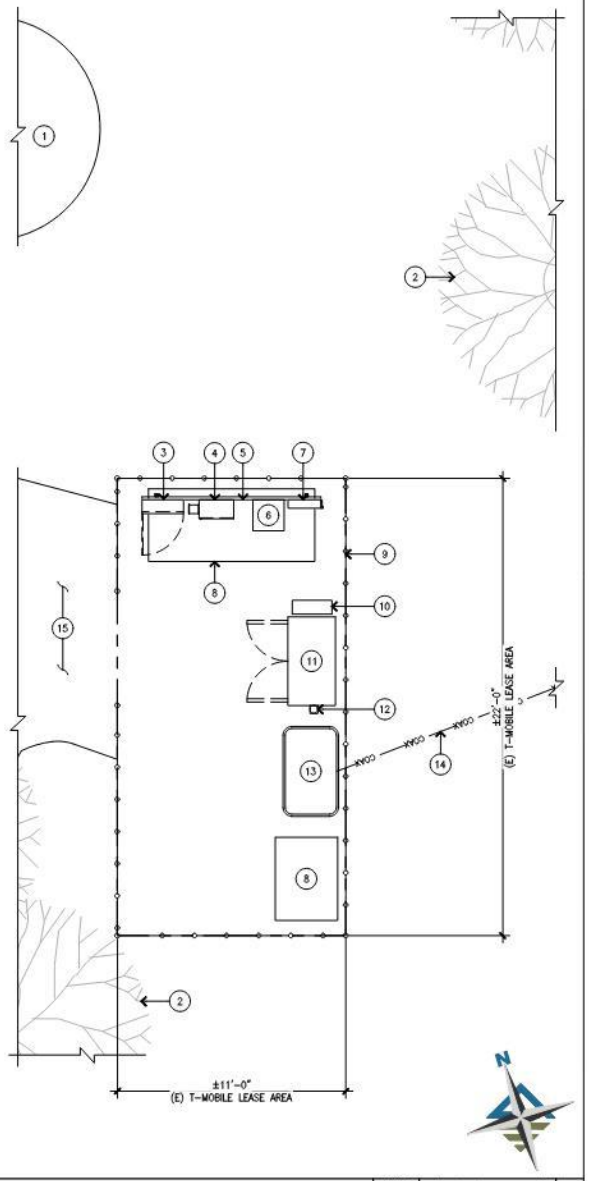
1. AT NO TIME WILL ANY FLAMMABLE OR COMBUSTIBLE LIQUID (e.g. PETROLEUM GASOLINE, DIESEL, OR SIMILAR) WILL BE STORED ON SITE.
2. PROVIDE PORTABLE FIRE EXTINGUISHER WITH 18 LBS CAPACITY AND A B:C RATING. EXTINGUISHER WILL BE PROVIDED IS SUFFICIENT.
3. THE AREA NEEDS TO BE CLEAR OF WEEDS, GRASS, BRUSH, TRASH AND ANY OTHER COMBUSTIBLE MATERIALS WITH A MINIMUM OF TEN (10) FEET IN ALL DIRECTIONS FROM GENERATOR.



(N) EQUIPMENT LAYOUT PLAN

SCALE: 3/8"=1'-0" 0 1' 2' 5'

2



(E) EQUIPMENT LAYOUT PLAN

SCALE: 3/8"=1'-0" 0 1' 2' 5'

1

COUNTY OF SAN MATEO - PLANNING AND BUILDING DEPARTMENT

ATTACHMENT E

Statement of Hammett & Edison, Inc., Consulting Engineers

The firm of Hammett & Edison, Inc., Consulting Engineers, has been retained on behalf of T-Mobile, a personal wireless telecommunications carrier, to evaluate proposed modifications to its existing base station (Site No. SF03224) located at Highway 92 and Cañada Road in Redwood City, California, for compliance with appropriate guidelines limiting human exposure to radio frequency ("RF") electromagnetic fields.

Prevailing Exposure Standards

The U.S. Congress requires that the Federal Communications Commission ("FCC") evaluate its actions for possible significant impact on the environment. In Docket 93-62, effective October 15, 1997, the FCC adopted the human exposure limits for field strength and power density recommended in Report No. 86, "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," published in 1986 by the Congressionally chartered National Council on Radiation Protection and Measurements ("NCRP"). Separate limits apply for occupational and public exposure conditions, with the latter limits generally five times more restrictive. The more recent standard, developed by the Institute of Electrical and Electronics Engineers and approved as American National Standard ANSI/IEEE C95.1-2006, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," includes similar exposure limits. A summary of the FCC's exposure limits is shown in Figure 1. These limits apply for continuous exposures and are intended to provide a prudent margin of safety for all persons, regardless of age, gender, size, or health.

The most restrictive FCC limit for exposures of unlimited duration to radio frequency energy for several personal wireless services are as follows:

Personal Wireless Service	Approx. Frequency	Occupational Limit	Public Limit
Personal Communication ("PCS")	1,950 MHz	5.00 mW/cm^2	1.00 mW/cm^2
Cellular Telephone	870	2.90	0.58
Specialized Mobile Radio	855	2.85	0.57
[most restrictive frequency range]	30–300	1.00	0.20

General Facility Requirements

Base stations typically consist of two distinct parts: the electronic transceivers (also called "radios" or "channels") that are connected to the traditional wired telephone lines, and the passive antennas that send the wireless signals created by the radios out to be received by individual subscriber units. The transceivers are often located at ground level and are connected to the antennas by coaxial cables about 1 inch thick. Because of the short wavelength of the frequencies assigned by the FCC for

Attachment C

wireless services, the antennas require line-of-sight paths for their signals to propagate well and so are installed at some height above ground. The antennas are designed to concentrate their energy toward the horizon, with very little energy wasted toward the sky or the ground. Along with the low power of such facilities, this means that it is generally not possible for exposure conditions to approach the maximum permissible exposure limits without being physically very near the antennas.

Computer Modeling Method

The FCC provides direction for determining compliance in its Office of Engineering and Technology Bulletin No. 65, "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radio Frequency Radiation," dated August 1997. Figure 2 attached describes the calculation methodologies, reflecting the facts that a directional antenna's radiation pattern is not fully formed at locations very close by (the "near-field" effect) and that at greater distances the power level from an energy source decreases with the square of the distance from it (the "inverse square law"). The conservative nature of this method for evaluating exposure conditions has been verified by numerous field tests.

Site and Facility Description

Based upon information provided by T-Mobile, including drawings by Gemini Consulting Group, dated September 10, 2007, that carrier presently has installed one antenna on an existing 30-foot pole located near the water tanks at the hilltop near the intersection of Highway 92 and Cañada Road in Redwood City. T-Mobile proposes to replace its antenna with two new RFS Model APX16DWV-16DWV directional panel antennas. The antennas would be mounted at an effective height of about 27½ feet above ground and would be oriented with up to 2° downtilt toward 0°T and 100°T. The maximum effective radiated power in any direction would be 1,440 watts, representing three PCS channels operating simultaneously at 480 watts each.

Study Results

For a person anywhere at ground, the maximum ambient RF exposure level due to the proposed T-Mobile operation is calculated to be 0.0045 mW/cm², which is 0.45% of the applicable public exposure limit. The maximum calculated level on the nearby water tank is 32% of the public limit. It should be noted that these results include several "worst-case" assumptions and therefore are expected to overstate actual power density levels.

No Recommended Mitigation Measures

Due to their mounting locations, the T-Mobile antennas are not accessible to the general public, and so no mitigation measures are necessary to comply with the FCC public exposure guidelines. It is

presumed that T-Mobile will, as an FCC licensee, take adequate steps to ensure that its employees or contractors comply with FCC occupational exposure guidelines whenever work is required near the antennas themselves.

Conclusion

Based on the information and analysis above, it is the undersigned's professional opinion that the T-Mobile base station located at Highway 92 and Cañada Road in Redwood City, California, will comply with the prevailing standards for limiting public exposure to radio frequency energy and, therefore, will not for this reason cause a significant impact on the environment. The highest calculated level in publicly accessible areas is much less than the prevailing standards allow for exposures of unlimited duration. This finding is consistent with measurements of actual exposure conditions taken at other operating base stations.

Authorship

The undersigned author of this statement is a qualified Professional Engineer, holding California Registration Nos. E-13026 and M-20576, which expire on June 30, 2009. This work has been carried out by him or under his direction, and all statements are true and correct of his own knowledge except, where noted, when data has been supplied by others, which data he believes to be correct.

REGISTERED PROFESSIONAL ENGINEER
WILLIAM F. HAMMETT
E-13026
M-20576
Exp. 6-30-09
ELECTRICAL
MECHANICAL
STATE OF CALIFORNIA

William F. Hammett, P.E.

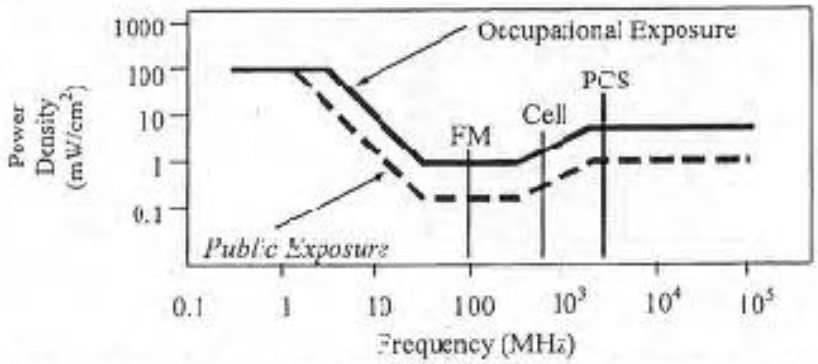
December 20, 2007

FCC Radio Frequency Protection Guide

The U.S. Congress required (1996 Telecom Act) the Federal Communications Commission ("FCC") to adopt a nationwide human exposure standard to ensure that its licensees do not, cumulatively, have a significant impact on the environment. The FCC adopted the limits from Report No. 86, "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," published in 1986 by the Congressionally chartered National Council on Radiation Protection and Measurements ("NCRP"). Separate limits apply for occupational and public exposure conditions, with the latter limits generally five times more restrictive. The more recent standard, developed by the Institute of Electrical and Electronics Engineers and approved as American National Standard ANSI/IEEE C95.1-2006, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," includes similar limits. These limits apply for continuous exposures from all sources and are intended to provide a prudent margin of safety for all persons, regardless of age, gender, size, or health.

As shown in the table and chart below, separate limits apply for occupational and public exposure conditions, with the latter limits (in *italics* and/or dashed) up to five times more restrictive:

Frequency	Electromagnetic Fields (f is frequency of emission in MHz)					
Applicable Range (MHz)	Electric Field Strength (V/m)		Magnetic Field Strength (A/m)		Equivalent Far-Field Power Density (mW/cm^2)	
0.3 – 1.34	614	*614*	1.63	*1.63*	100	*100*
1.34 – 3.0	614	*823.8/f*	1.63	*2.19/f*	100	*180/f^2*
3.0 – 30	1842/f	*823.8/f*	4.89/f	*2.19/f*	900/f^2	*180/f^2*
30 – 300	61.4	*27.5*	0.163	*0.0729*	1.0	*0.2*
300 – 1,500	$3.54\sqrt{f}$	$1.59\sqrt{f}$	$\sqrt{f}/106$	$\sqrt{f}/238$	f/300	*f/1500*
1,500 – 100,000	137	*61.4*	0.364	*0.163*	5.0	*1.0*



Higher levels are allowed for short periods of time, such that total exposure levels averaged over six or thirty minutes, for occupational or public settings, respectively, do not exceed the limits, and higher levels also are allowed for exposures to small areas, such that the spatially averaged levels do not exceed the limits. However, neither of these allowances is incorporated in the conservative calculation formulas in the FCC Office of Engineering and Technology Bulletin No. 65 (August 1997) for projecting field levels. Hammett & Edison has built those formulas into a proprietary program that calculates, at each location on an arbitrary rectangular grid, the total expected power density from any number of individual radio sources. The program allows for the description of buildings and uneven terrain, if required to obtain more accurate projections.

RFRCALC™ Calculation Methodology

Assessment by Calculation of Compliance with FCC Exposure Guidelines

The U.S. Congress required (1996 Telecom Act) the Federal Communications Commission ("FCC") to adopt a nationwide human exposure standard to ensure that its licensees do not, cumulatively, have a significant impact on the environment. The maximum permissible exposure limits adopted by the FCC (see Figure 1) apply for continuous exposures from all sources and are intended to provide a prudent margin of safety for all persons, regardless of age, gender, size or health. Higher levels are allowed for short periods of time, such that total exposure levels averaged over six or thirty minutes, for occupational or public settings, respectively, do not exceed the limits.

Near Field.

Prediction methods have been developed for the near field zone of panel (directional) and whip (omnidirectional) antennas, typical at wireless telecommunications base stations, as well as dish (aperture) antennas, typically used for microwave links. The antenna patterns are not fully formed in the near field at these antennas, and the FCC Office of Engineering and Technology Bulletin No. 65 (August 1997) gives suitable formulas for calculating power density within such zones.

For a panel or whip antenna, power density $S = \frac{180}{\theta_{BW}} \times \frac{0.1 \times P_{net}}{\pi \times D^2 \times h}$, in mW/cm^2,

and for an aperture antenna, maximum power density $S_{max} = \frac{0.1 \times 16 \times \eta \times P_{net}}{\pi \times h^2}$, in mW/cm^2,

where θ_{BW} = half-power beamwidth of the antenna, in degrees, and
P_{net} = net power input to the antenna, in watts,
D = distance from antenna, in meters,
h = aperture height of the antenna, in meters, and
η = aperture efficiency (unitless, typically 0.5-0.8).

The factor of 0.1 in the numerators converts to the desired units of power density.

Far Field.

OET-65 gives this formula for calculating power density in the far field of an individual RF source:

$$\text{power density } S = \frac{2.56 \times 1.64 \times 100 \times RFF^2 \times ERP}{4 \times \pi \times D^2}, \text{ in } mW/cm^2,$$

where ERP = total ERP (all polarizations), in kilowatts,
RFF = relative field factor at the direction to the actual point of calculation, and
D = distance from the center of radiation to the point of calculation, in meters.

The factor of 2.56 accounts for the increase in power density due to ground reflection, assuming a reflection coefficient of 1.6 (1.6 x 1.6 = 2.56). The factor of 1.64 is the gain of a half-wave dipole relative to an isotropic radiator. The factor of 100 in the numerator converts to the desired units of power density. This formula has been built into a proprietary program that calculates, at each location on an arbitrary rectangular grid, the total expected power density from any number of individual radiation sources. The program also allows for the description of uneven terrain in the vicinity, to obtain more accurate projections.

COUNTY OF SAN MATEO - PLANNING AND BUILDING DEPARTMENT

ATTACHMENT F

SF03224A-Site Photos