



# CITY OF SUNNYVALE REPORT ADMINISTRATIVE HEARING

February 24, 2010

**File Number:** 2009-0681

**Permit Type:** Special Development Permit

**Location:** 100 Mathilda Place (near Evelyn Ave.) (209-07-024)

**Applicant/Owner:** Clearwire LLC / SPF Mathilda LLC

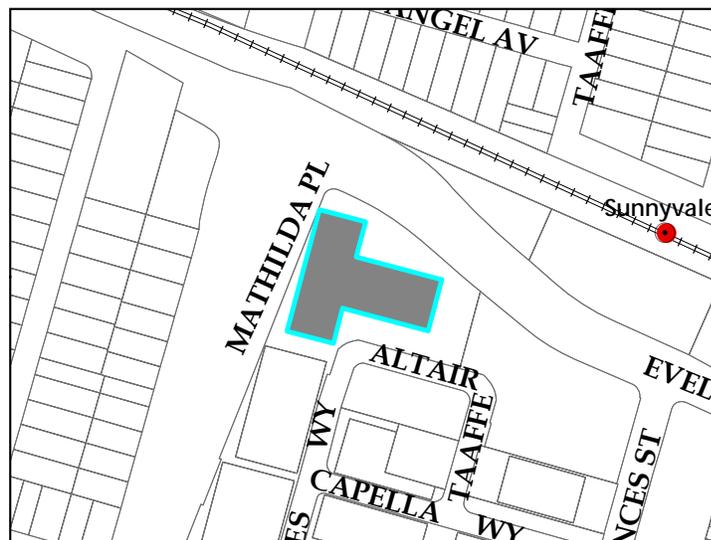
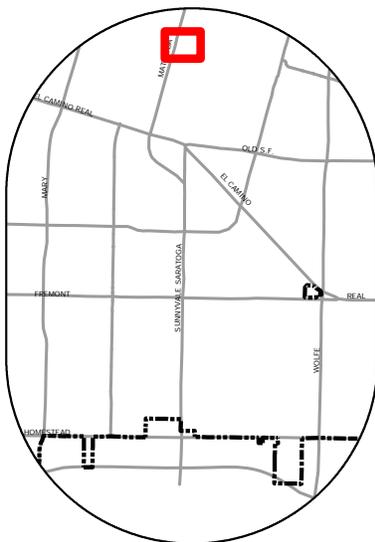
**Staff Contact:** Noren Caliva, Assistant Planner, (408) 730-7637

**Project Description:** To allow a second wireless telecommunications carrier including three panel antennas and six microwave dishes screened behind an existing roof parapet with associated ground equipment on top of a six story office building.

**Reason for Permit:** A Special Development Permit is required for any telecommunications facility that proposes collocation two or more facilities or users on an existing site.

**Issues:** Visual impacts.

**Recommendation:** Approval



500

Feet

**PROJECT DESCRIPTION**

	<b>Existing</b>	<b>Proposed</b>
General Plan:	Downtown Specific Plan	Same
Zoning District:	DSP – Block 1	Same
Building Height:	105'	Same

Previous Planning Projects related to subject Application.

MPP 2009-0520 – A Miscellaneous Plan Permit (MPP) was approved by staff on August 31, 2009 to allow the first wireless telecommunication carrier (T-Mobile) at the subject building. The project included 16 facade-mounted antennas to be incorporated into existing architectural elements on the building.

**Project Background:** The original project was scheduled for Administrative Hearing on December 16, 2009, which consisted of a new 5-foot tall building extension that would house the proposed equipment. Due to an unfavorable staff recommendation, the applicant requested an indefinite extension to consider alternative designs. This staff report presents the applicant's most currently proposed design.

**Facility Purpose:** The proposed project is to allow a second carrier to add three panel antennas and six microwave dishes on top of a six-story office building (Sunnyvale City Center, formerly Mozart Development). Microwave dishes are necessary to the wireless services that Clearwire provides, as they link all Clearwire sites together by providing point-to-point connections. No deviations from the Sunnyvale Municipal Code are requested.

**Design:** The building is located on the southeast corner of Mathilda Place and W. Evelyn Avenue, and is visible from the Mathilda Avenue overpass. Two microwave dishes would be added within a building tower along the west elevation, which currently houses T-Mobile equipment. The four remaining microwave dishes and three antennas would be mounted behind an existing mechanical screen wall on the eastern part of the building. The glass and wall materials for screening would be RF (radio frequency) transparent and designed to match existing colors and textures.

An antenna cabinet, global positioning system (GPS) antenna and transformer would also be installed behind the mechanical screen wall. No generators are proposed as part of this project. All new equipment would be fully screened behind existing architectural elements of the building.

**Radio Frequency (RF) Emissions Exposure:** The Federal Communications Commission (FCC) is the final authority on safety of telecommunications facilities. If the FCC has determined the facility to be in compliance with federal standards, the City is not permitted to make additional judgments on health and safety issues. The application can be reviewed by the City for compliance with design and location criteria only. The attached RF Emissions report

(Attachment E) finds that the individual exposure level anywhere on the ground for all new Clearwire equipment will be 0.017% of the limit for general public exposure and 0.043% for all carriers on-site (3.4% from any nearby buildings). These results indicate the RF emissions are considered safe for inhabited areas.

**Public Contact:** 204 notices were sent to surrounding property owners and neighborhood associations adjacent to subject site in addition to standard noticing practice. No letters were received.

**Environmental Determination:** A Categorical Exemption Class 1 (minor modifications to existing facilities) relieves this project from CEQA provisions.

### **FINDINGS - USE PERMIT**

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In order to approve the Special Development Permit, the following findings must be made:

1. The proposed use attains the objectives and purposes of the General Plan of the City of Sunnyvale.

There are three policies and action statements that relate to the proposed application.

- **Telecommunications Policy** Action Statement A.1.e- Support retention of local zoning authority for cellular towers, satellite dish antennas, and other telecommunications equipment, facilities and structures.
- **Land Use and Transportation Sub-Element N1.3.** Promote an attractive and functional commercial environment.
- **Land Use and Transportation Sub-Element N1.5** Establish and monitor standards for community appearance and property maintenance.

The proposed project is consistent with the objectives of the General Plan in that the proposed project takes advantage of a collocation opportunity, while maintaining the architectural character of the existing office building. Standard conditions of approval will ensure that the standards for community appearance are also maintained.

**Staff was able to make this finding.**

2. The proposed use ensures that the general appearance of proposed structures, or the uses to be made of the property to which the application refers, will not impair the orderly development of, or the existing uses being made of, adjacent properties.

All new equipment will be fully screened behind the existing building, and will not be visible from any street frontages or buildings.

**Staff was able to make this finding.**

**ALTERNATIVES:**

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1. Approve the Special Development Permit with attached conditions.
2. Approve the Special Development Permit with modified conditions.
3. Deny the Special Development Permit.

**RECOMMENDATION**

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Alternative 1.

Reviewed by:

**Shaunn Mendrin**

Senior Planner

Prepared by: Noren Caliva

Attachments:

- A. Standard Requirements and Recommended Conditions of Approval
- B. Site and Architectural Plans
- C. Photosimulations
- D. Letter from the Applicant including Justifications
- E. RF Emissions Report

## **Standard Requirements**

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The following is a list of standard requirements. This list is intended to assist the applicant and public in understanding basic related requirements, and is not intended as an exhaustive list. These requirements cannot be waived or modified.

- A. **Testing Within 15 Days:** The applicant shall test any wireless telecommunications site installed in the City of Sunnyvale within 15 days of operating the tower. The test shall confirm that any Emergency 911 wireless call made through the wireless telecommunications site shall provide Enhanced 911 capability (including phase 2 information when available from the caller's device) and direct the call to the City of Sunnyvale Department of Public Safety dispatcher, ensuring phase 2 information is transferred. If the call is to be directed elsewhere pursuant to State and Federal law the applicant shall ensure that the Enhanced 911 information transfers to that dispatch center. This capability shall be routinely tested to ensure compliance as long as the approved wireless telecommunications site is in service.
- B. **Permit Expiration:** The Special Development Permit for the use shall expire if the use is discontinued for a period of one year or more.
- C. **Permit Lapse if not Exercised (Ordinance 2895-09):** The Special Development Permit shall be valid for three (3) years from the date of approval by the final review authority (as adopted by City Council on April 21, 2009, RTC 09-094). Extensions of time may be considered, for a maximum of two one year extensions, if applied for and approved prior to the expiration of the permit approval. If the approval is not exercised within this time frame, the permit is null and void.
- D. **Building Permits:** Obtain Building Permits.
- E. **Certification:** Before January 31 of each even numbered year following the issuance of any authorizing establishment of a wireless telecommunication facility, an authorized representative for each wireless carrier providing service in the City of Sunnyvale shall provide written certification to the City executed under penalty of perjury that (i) each facility is being operated in accordance with the approved local and federal permits and includes test results that confirm the facility meets city noise requirements and federal RF emissions standards; (ii) each facility complies with the then-current general and design standards and is in compliance with the approved plans; (iii) whether the facility is currently being used by the owner or operator; and (iv) the basic contact and site information supplied by the owner or operator is current.
- F. **Renewal:** Every owner or operator of a wireless telecommunication facility shall renew the facility permit at least every ten (10) years from

the date of initial approval. If a permit or other entitlement for use is not renewed, it shall automatically become null and void without notice or hearing ten (10) years after it is issued, or upon cessation of use for more than a year and a day, whichever comes first. Unless a new use permit or entitlement of use is issued, within one hundred twenty (120) days after a permit becomes null and void all improvements, including foundations and appurtenant ground wires, shall be removed from the property and the site restored to its original pre-installation condition within one hundred eighty (180) days of nonrenewal or abandonment.

- G. **Minimize Noise:** The facility shall be operated in such a manner so as to minimize any possible disruption caused by noise. Backup generators shall only be operated during periods of power outages, and shall not be tested on weekends or holidays, or between the hours of 10:00 p.m. and 7:00 a.m. on weekday nights. At no time shall equipment noise from any source exceed an exterior noise level of 60 dB at the property line.
- H. **Comply with Applicable Regulations:** The facility must comply with any and all applicable regulations and standards promulgated or imposed by any state or federal agency, including but not limited to the Federal Communications Commission and Federal Aviation Agency.
- I. **RF Emissions:** Certification must be provided that the proposed facility will at all times comply with all applicable health requirements and standards pertaining to RF emissions.
- J. **Business License:** The owner or operator of the facility shall obtain and maintain current at all times a business license as issued by the city.
- K. **Maintain Current Information:** The owner or operator shall maintain, at all times, a sign mounted on the outside fence showing the operator name, site number and emergency contact telephone number. The owner or operator of the facility shall also submit and maintain current at all times basic contact and site information on a form to be supplied by the city. The applicant shall notify city of any changes to the information submitted within thirty (30) days of any change, including change of the name or legal status of the owner or operator. This information shall include, but is not limited to the following:
  - i. Identity, including name, address and telephone number, and legal status of the owner of the facility including official identification numbers and FCC certification, and if different from the owner, the identity and legal status of the person or entity responsible for operating the facility.
  - ii. Name, address and telephone number of a local contact person for emergencies.
  - iii. Type of service provided.

- L. **Good Repair:** All facilities and related equipment, including lighting, fences, shields, cabinets, and poles, shall be maintained in good repair, free from trash, debris, litter and graffiti and other forms of vandalism, and any damage from any cause shall be repaired as soon as reasonably possible so as to minimize occurrences of dangerous conditions or visual blight. Graffiti shall be removed from any facility or equipment as soon as practicable, and in no instance more than forty-eight (48) hours from the time of notification by the city.
- M. **Responsibility to Maintain:** The owner or operator of the facility shall routinely and regularly inspect each site to ensure compliance with the standards set forth in the Telecommunications Ordinance.
- N. **Hold Harmless:** The wireless telecommunication facility provider shall defend, indemnify, and hold harmless the city or any of its boards, commissions, agents, officers, and employees from any claim, action or proceeding against the city, its boards, commission, agents, officers, or employees to attack, set aside, void, or annul, the approval of the project when such claim or action is brought within the time period provided for in applicable state and/or local statutes. The city shall promptly notify the provider(s) of any such claim, action or proceeding. The city shall have the option of coordinating in the defense. Nothing contained in this stipulation shall prohibit the city from participating in a defense of any claim, action, or proceeding if the city bears its own attorney's fees and costs, and the city defends the action in good faith.
- O. **Liability:** Facility lessors shall be strictly liable for any and all sudden and accidental pollution and gradual pollution resulting from their use within the city. This liability shall include cleanup, intentional injury or damage to persons or property. Additionally, lessors shall be responsible for any sanctions, fines, or other monetary costs imposed as a result of the release of pollutants from their operations. Pollutants include any solid, liquid, gaseous or thermal irritant or contaminant, including smoke, vapor, soot, fumes, acids, alkalis, chemicals, and waste. Waste includes materials to be recycled, reconditioned or reclaimed.
- P. **No Interference with City Communication Systems:** The facility operator shall be strictly liable for interference caused by the facility with city communication systems. The operator shall be responsible for all labor and equipment costs for determining the source of the interference, all costs associated with eliminating the interference, (including but not limited to filtering, installing cavities, installing directional antennas, powering down systems, and engineering analysis), and all costs arising from third party claims against the city attributable to the interference.
- Q. **No Threat to Public Health:** The facility shall not be sited or operated in such a manner that is poses, either by itself or in combination with other such facilities, a potential threat to public health. To that end, the

subject facility and the combination of on-site facilities shall not produce at any time power densities in any inhabited area that exceed the FCC's Maximum Permissible Exposure (MPE) limits for electric and magnetic field strength and power density for transmitters or any more restrictive standard subsequently adopted or promulgated by the federal government.

### **Recommended Conditions of Approval**

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In addition to complying with all applicable City, County, State and Federal Statutes, Codes, Ordinances, Resolutions and Regulations, Permittee expressly accepts and agrees to comply with the following conditions of approval of this Permit:

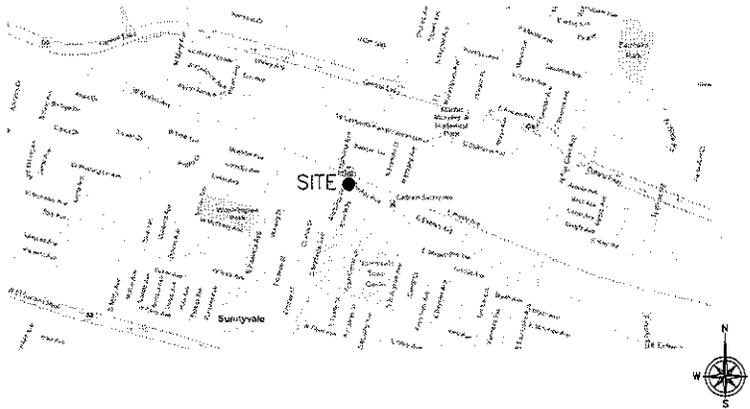
1. **Project Conformance:** Project shall be in conformance with the plans approved at the public hearing(s). Minor changes may be approved by the Director of Community Development, major changes may be approved at a public hearing.
2. **Execute Permit Document:** Execute a Special Development Permit document prior to issuance of the building permit.
3. **Conditions of Approval on Plans:** The Conditions of Approval shall be reproduced on a page of the plans submitted for a Building permit for this project.
4. **RF Emissions Studies:** The applicant shall submit to the Director of Community Development Radio Frequency Emissions at least two reports of field measurements showing: 1.) The ambient level of RF emissions before construction of the facility and 2.) The actual level of emissions after the facility is in place and operating at or near full capacity.
5. **Design:** All new glass and wall RF transparent material shall match the color and texture of existing materials.

# clearw're®

## SUNNYVALE TOWN CENTER CA-SJC0127B

100 MATHILDA PLACE SUNNYVALE, CA 94086

### VICINITY MAP - N.T.S.



### DRIVING DIRECTIONS

FROM: CLEARWIRE REGIONAL OFFICE 2999 OAK ROAD, SUITE 10 WALNUT CREEK, CA 94597 TO: 100 MATHILDA PLACE SUNNYVALE, CA 94086 DISTANCE: 50.14 MILES

1. START AT 2999 OAK RD, WALNUT CREEK GOING TOWARD BART ENTRANCE - GO 0.1 MI
2. TURN RIGHT ON TREAT BLVD - GO 0.3 MI
3. TURN RIGHT ON N MAIN ST - GO 0.2 MI
4. TURN RIGHT TO TAKE RAMP ONTO I-880 S TOWARD OAKLAND/SAN JOSE - GO 35.5 MI
5. TAKE EXIT #12/MISSION BLVD ONTO MISSION BLVD(CA-282 W) TOWARD MISSION BLVD WEST/WARM SPRINGS DISTRICT (I-880)JVC EXTENSION - GO 1.2 MI
6. TAKE LEFT RAMP ONTO I-880 S TOWARD SAN JOSE - GO 3.9 MI
7. TAKE THE MTN VIEW EXIT ONTO CA-237 W - GO 6.5 MI
8. TAKE EXIT #38/SUNNYVALE (US-101 S)/MATHILDA AVE - GO 0.2 MI
9. TURN LEFT ON W MATHILDA AVE - GO 2.0 MI
10. MAKE A U-TURN AT W MCKINLEY AVE ONTO S MATHILDA AVE - GO 0.1 MI
11. BEAR RIGHT ON MATHILDA PL
12. ARRIVE AT 100 MATHILDA PL, SUNNYVALE, ON THE RIGHT

### CODE COMPLIANCE

ALL WORK AND MATERIALS SHALL BE PERFORMED AND INSTALLED IN ACCORDANCE WITH THE CURRENT EDITIONS OF THE FOLLOWING CODES AS ADOPTED BY THE LOCAL GOVERNING AUTHORITIES. NOTHING IN THESE PLANS IS TO BE CONSTRUED TO PERMIT WORK NOT CONFORMING TO THESE CODES.

- |  |  |
|--|--|
| 1. CALIFORNIA ADMINISTRATIVE CODE (INCL TITLE 24 & 25) | 6. ANS/ISA-222-F LIFE SAFETY CODE NFPA-101 |
| 2. 2007 CALIFORNIA BUILDING CODE                       | 7. 2007 CALIFORNIA PLUMBING CODE           |
| 3. CITY/COUNTY ORDINANCES                              | 8. 2007 CALIFORNIA ELECTRICAL CODE         |
| 4. BUILDING OFFICIALS AND CODE ADMINISTRATORS (BOCA)   | 9. LOCAL BUILDING CODE                     |
| 5. MECHANICAL 2007 CALIFORNIA CODE                     |  |

### BUILDING/ SITE DATA LEGEND

**LATITUDE:** 37° 22' 42.15" N (NAD83)  
**LONGITUDE:** 122° 01' 56.85" W (NAD83)  
**ELEVATION:** 96' AMSL (NGVD 28)  
**A.P.N.:** 209-07-024  
**ZONING:** DSP, DOWNTOWN SPECIFIC PLAN  
**PROPOSED USE:** U, UNMANNED  
**TYPE OF CONSTRUCTION:** V  
**LEASE AREA:** 84.2 SQ. FT.  
**HANDICAP REQUIREMENTS:** FACILITY IS UNMANNED AND NOT FOR HUMAN HABITATION. HANDICAPPED ACCESS NOT REQUIRED.  
**TITLE 24 REQUIREMENTS:** FACILITY IS UNMANNED AND NOT FOR HUMAN HABITATION. TITLE 24 IS EXEMPT.

### PROJECT DESCRIPTION

PROPOSED UNMANNED WIRELESS BROADBAND FACILITY INCLUDING THE ADDITION OF (1) EQUIPMENT CABINET, (6) MICROWAVE DISHES, (3) PANEL ANTENNAS, (6) FRUS, AND (1) GPS.

### SIGNATURE BLOCK

VENDOR CM MANAGER	DATE
VENDOR ZONING MANAGER	DATE
VENDOR SAQ MANAGER	DATE
RF MANAGER	DATE
CONSTRUCTION MANAGER	DATE
MICROWAVE MANAGER	DATE

### PROJECT SUMMARY

**PROPERTY OWNER:** MORGAN REAL ESTATE STARS, STE. # 2800 LOS ANGELES, CA 90067 CONTACT: JEFF HUSTON PHONE: (408) 453-7400

**ARCHITECT:** DELTA GROUPS ENGINEERING, INC. 5835 WEST LAS POSITAS, SUITE 403 PLEASANTON, CA 94588 NAME: FRANCIS ONG CONTACT: HAROLD TRIAS PHONE: (925) 488-0115

**APPLICANT:** CLEARWIRE 2999 OAK ROAD, SUITE 10 WALNUT CREEK, CA 94597 CONTACT: TOM DERKAS PHONE: (925) 202-3333

**LEASING MANAGER:** GOODMAN NETWORKS 2603 CAMINO RAMON BISHOP RANCH 3, 2ND FLOOR SAN RAMON, CA 94583 CONTACT: MACKEAVER RIVERS PHONE: (214) 212-8154

**ZONING MANAGER:** GOODMAN NETWORKS 2603 CAMINO RAMON BISHOP RANCH 3, 2ND FLOOR SAN RAMON, CA 94583 CONTACT: GORDON BELL PHONE: (530) 647-1932

**STRUCTURAL ENGINEER:** DELTA GROUPS ENGINEERING, INC. 5835 WEST LAS POSITAS, SUITE 403 PLEASANTON, CA 94588 CONTACT: ALBERT TENG PHONE: (949) 622-0333

**CONSTRUCTION MANAGER:** GOODMAN NETWORKS 2603 CAMINO RAMON BISHOP RANCH 3, 2ND FLOOR SAN RAMON, CA 94583 CONTACT: PHONE:

### SHEET INDEX

- |    |                                      |
|----|--------------------------------------|
| T1 | TITLE SHEET                          |
| A1 | OVERALL SITE PLAN                    |
| A2 | EQUIPMENT AREA PLAN & ANTENNA LAYOUT |
| A3 | NORTH & EAST ELEVATIONS              |
| A4 | SOUTH & WEST ELEVATIONS              |

**clearw're**

4400 CARILLON POINT  
KIRKLAND, WA 98033

PROJECT INFORMATION:

**SUNNYVALE TOWN CENTER  
CA-SJC0127B**  
100 MATHILDA PLACE  
SUNNYVALE, CA 94086  
SANTA CLARA COUNTY

CURRENT ISSUE DATE:

1/26/10

ISSUED FOR:

ZD (100%)

REV.: DATE: DESCRIPTION: BY:

1/26/10	ZD (100%)	JUS
1/21/10	ZD (100%)	JUS

PLANS PREPARED BY:

**DELTA GROUPS  
ENGINEERING, INC.**  
CONSULTING ENGINEERS  
5835 WEST LAS POSITAS, SUITE 403  
PLEASANTON, CA 94588  
TEL: (925) 488-0115 FAX: (925) 488-0330

CONSULTANT:

SEAL OF APPROVAL:

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SHEET NUMBER:

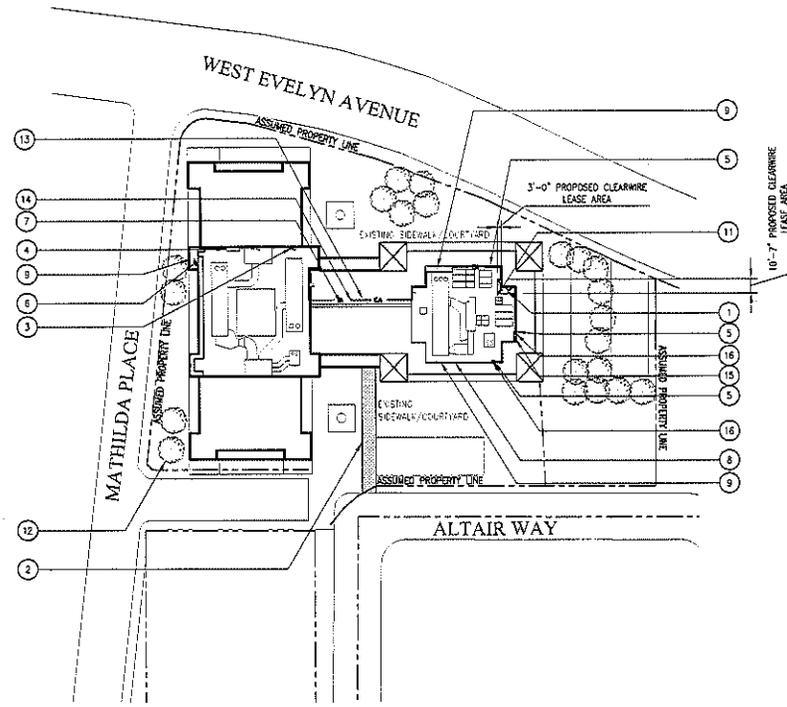
T1

ATTACHMENT B  
Page 1 of 5

**KEY NOTES:**

- 1 PROPOSED LOCATION OF CLEARWIRE 10'-7X3'-0" EQUIPMENT LEASE AREA (84.2 SQ. FT. TOTAL)
- 2 PROPOSED 10'-0" WIDE CLEARWIRE ACCESS ROUTE
- 3 PROPOSED CLEARWIRE ELECTRICAL CONDUIT ROUTING ALONG EXISTING MECHANICAL SCREENWALL
- 4 EXISTING ELECTRICAL SWITCHGEAR CABINET (PROPOSED CLEARWIRE POWER P.O.C.)
- 5 PROPOSED CLEARWIRE PANEL ANTENNAS (1 PER SECTOR, 3 SECTORS TOTAL) STEALTHED BEHIND NEW RF TRANSPARENT SCREEN
- 6 PROPOSED CLEARWIRE MICROWAVE DISH (2'-0"x4') (1 PER SECTOR, 6 SECTORS TOTAL) STEALTHED BEHIND NEW RF TRANSPARENT SCREEN
- 7 EXISTING T-MOBILE COAX CABLE TRAY
- 8 EXISTING MECHANICAL SCREENWALL
- 9 EXISTING T-MOBILE PANEL ANTENNAS
- 10 EXISTING ROOFTOP HVAC EQUIPMENT
- 11 EXISTING ROOFTOP ACCESS HATCH
- 12 EXISTING TREES/LANDSCAPING
- 13 PROPOSED CLEARWIRE ELECTRICAL CONDUIT AND MICROWAVE COAX ROUTING ALONG ROOFTOP, TO RUN ON C-PORT C-STRUT CHANNEL SUPPORTS
- 14 PROPOSED CLEARWIRE COAX/FIBER CABLE ROUTING WITHIN 6" WIDE CABLE TRAY
- 15 PROPOSED CLEARWIRE MICROWAVE DISH (2'-6"x4') (1 PER SECTOR, 6 SECTORS TOTAL) STEALTHED BEHIND NEW RF TRANSPARENT SCREEN
- 16 PROPOSED CLEARWIRE MICROWAVE DISH (1'-0"x4') (1 PER SECTOR, 6 SECTORS TOTAL) STEALTHED BEHIND NEW RF TRANSPARENT SCREEN

**NOTES:**  
 1. DO NOT SCALE DRAWINGS. ALL DIMENSIONS OF AND BETWEEN EXISTING BUILDINGS/STRUCTURES, OR RELATIVE DISTANCES AS SHOWN BETWEEN EXISTING BUILDINGS/STRUCTURES, PROPERTY LINES, EASEMENTS AND THE TRUE NORTH ARE TO BE CONFIRMED BY A SURVEYOR.  
 2. POWER ROUTING DESIGN IS PRELIMINARY AND MUST BE VERIFIED WITH LOCAL UTILITY COMPANIES.



**OVERALL SITE PLAN**

SCALE: 1 inch = 40 ft

40' 0' 30' 1

**clearw're**  
 4400 CARILLON POINT  
 KIRKLAND, WA 98033

PROJECT INFORMATION:  
**SUNNYVALE TOWN CENTER**  
 CA-SJC0127B  
 100 MATHILDA PLACE  
 SUNNYVALE, CA 94086  
 SANTA CLARA COUNTY

CURRENT ISSUE DATE:  
 1/26/10

ISSUED FOR:  
 ZD (100%)

REV. DATE: DESCRIPTION: BY:

1/26/10	ZD (100%)	JS
1/21/10	ZD (100%)	JS

PLANS PREPARED BY:

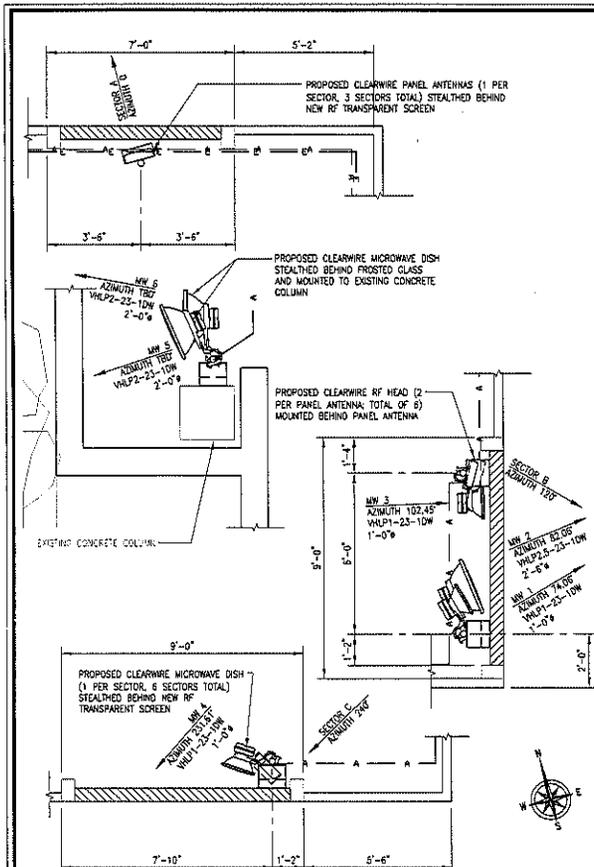
**DELTA GROUPS ENGINEERING, INC.**  
 CONSULTING ENGINEERS  
 8630 WEST LAG POINTE, SUITE 403  
 PLEASANTON, CA 94588  
 TEL: (925) 468-0115 FAX: (925) 468-0355

CONSULTANT:

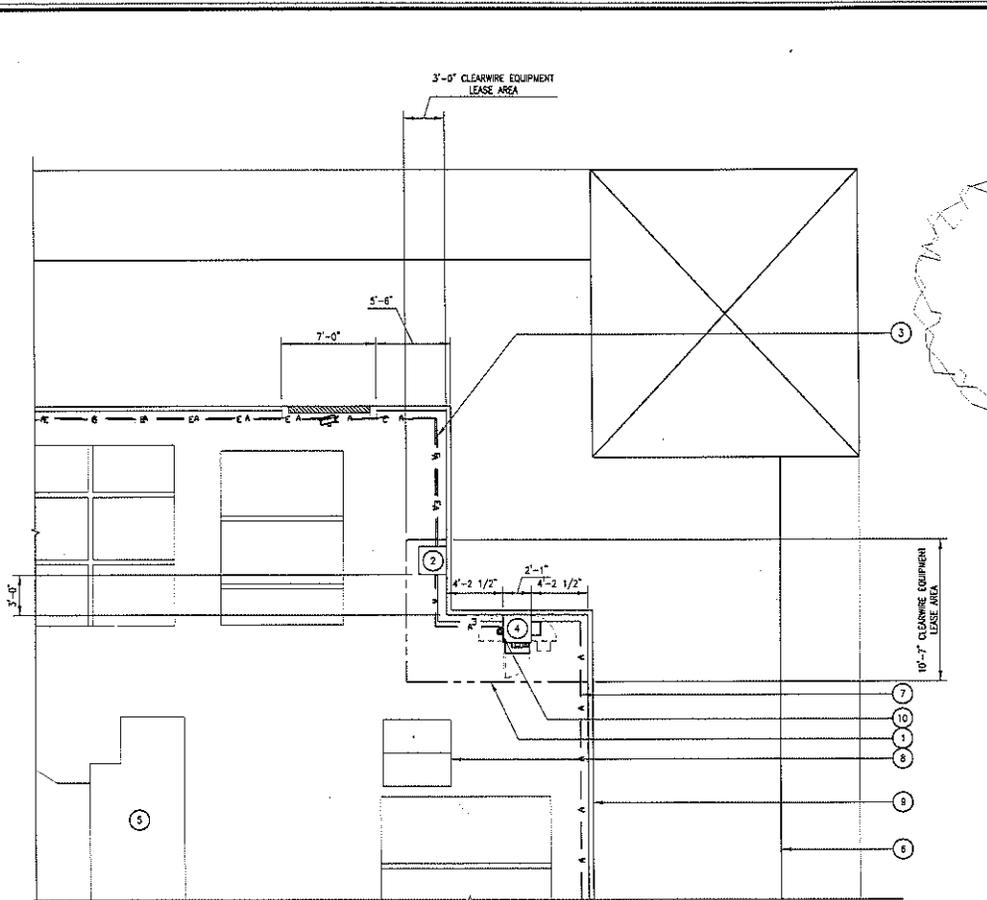
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**ATTACHMENT B**  
 Page 2 of 5



ANTENNA LAYOUT



**NOTES:**  
 1. DO NOT SCALE DRAWINGS. ALL DIMENSIONS OF AND BETWEEN EXISTING BUILDINGS/STRUCTURES, OR RELATIVE DISTANCES AS SHOWN BETWEEN EXISTING BUILDINGS/STRUCTURES, PROPERTY LINES, EASEMENTS AND THE TRUE NORTH ARE TO BE CONFIRMED BY A SURVEYOR.  
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**KEY NOTES:**

- ① PROPOSED LOCATION OF CLEARWIRE 10'-7"x3'-0" EQUIPMENT LEASE AREA (84.2 SQ. FT. TOTAL)
- ② PROPOSED CLEARWIRE STEPDOWN TRANSFORMER, MOUNTED TO EXISTING MECHANICAL SCREENWALL ON SHELF
- ③ PROPOSED CLEARWIRE ELECTRICAL CONDUIT ROUTING ALONG EXISTING MECHANICAL SCREENWALL
- ④ PROPOSED CLEARWIRE EQUIPMENT CABINET, MOUNTED TO EXISTING MECHANICAL SCREENWALL ON STEEL SHELF
- ⑤ EXISTING PROPERTY PLUMBING SHELF
- ⑥ EXISTING BUILDING PARAPET WALL
- ⑦ PROPOSED CLEARWIRE COAX/FIBER CABLE ROUTING ALONG EXISTING MECHANICAL SCREENWALL
- ⑧ EXISTING POSITIVE ACCESS HATCH
- ⑨ EXISTING MECHANICAL SCREENWALL
- ⑩ PROPOSED CLEARWIRE GPS

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 4400 CARLETON POINT  
 KIRKLAND, WA 98033

PROJECT INFORMATION:  
**SUNNYVALE TOWN CENTER**  
 CA-SJC0127B  
 100 MATHILDA PLACE  
 SUNNYVALE, CA 94086  
 SANTA CLARA COUNTY

CURRENT ISSUE DATE:  
 1/26/10

ISSUED FOR:  
 ZD (100%)

REV. DATE: DESCRIPTION: BY:

1/26/10	ZD (100%)	J/S
1/21/10	ZD (100%)	J/S

PLANS PREPARED BY:

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CONSULTANT:

SEAL OF APPROVAL:

SHEET TITLE:  
 EQUIPMENT AREA ANTENNA LA  
 EQUIPMENT

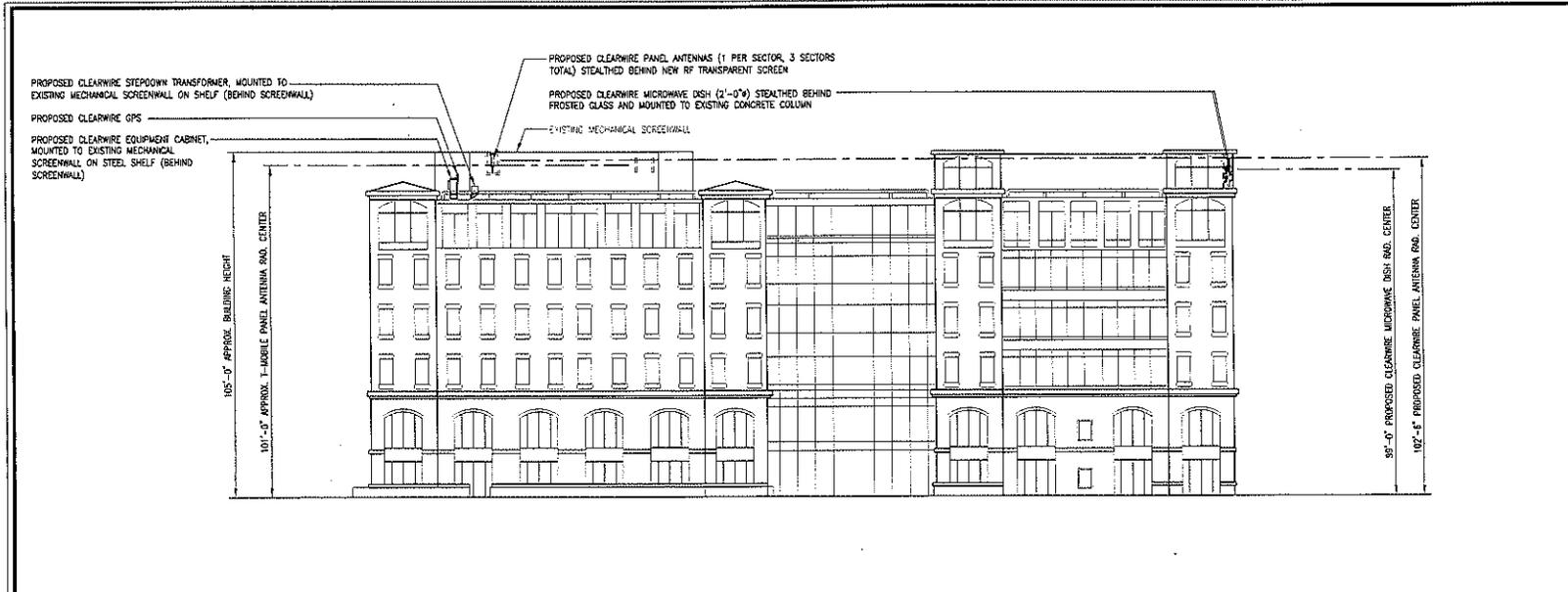
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UNUSED

EQUIPMENT AREA PLAN

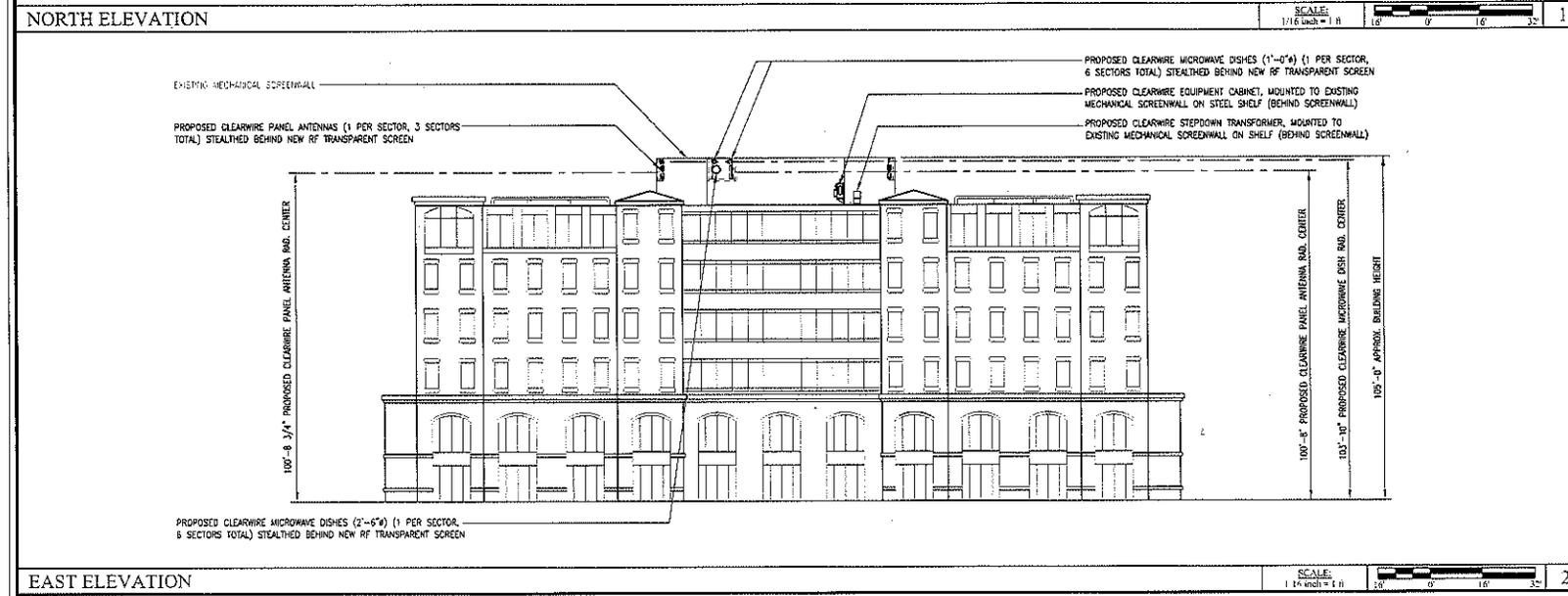
SCALE: 1/2 inch = 1 ft

ATTACHMENT       
 Page 3 of 5



NORTH ELEVATION

SCALE: 1/16" inch = 1 ft  
 1



EAST ELEVATION

SCALE: 1/16" inch = 1 ft  
 2

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 KIRKLAND, WA 98033

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**CA-SJC01273**  
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REV.	DATE	DESCRIPTION	BY
1	1/26/10	ZD (100%)	JS
2	1/21/10	ZD (100%)	JS

PLANS PREPARED BY:

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 CONSULTING ENGINEERS

2633 WEST LAS POSITAS, SUITE 403  
 PLEASANTON, CA 94588  
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CONSULTANT:

SEAL OF APPROVAL:

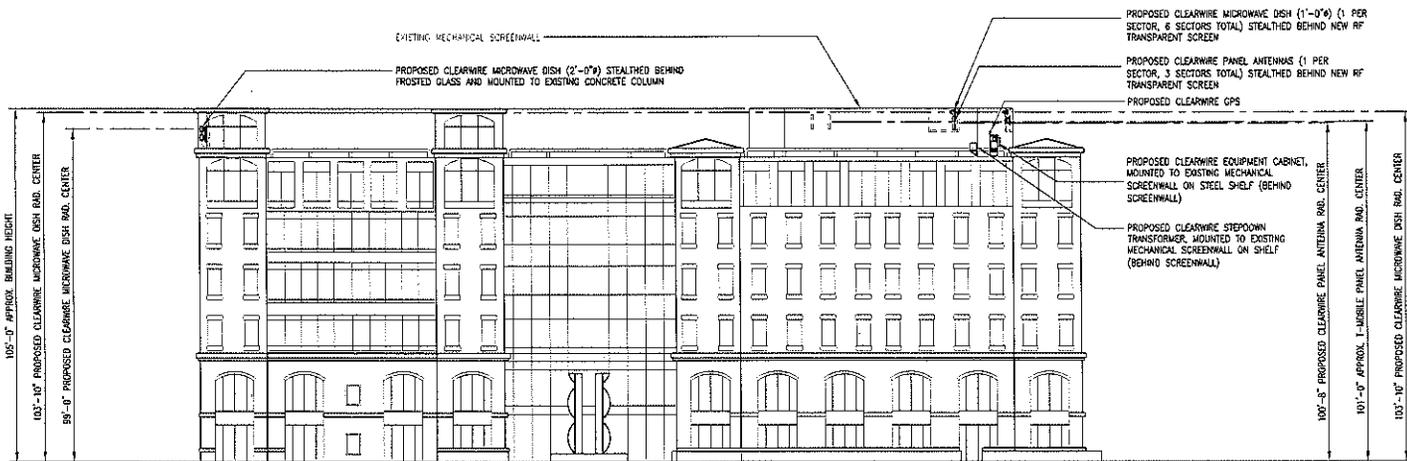
SHEET TITLE:

NORTH & ELEVATI

SHEET NUMBER:

**A3**

ATTACHMENT 8  
 Page 4 of 5



SOUTH ELEVATION

SCALE: 1/16" = 1'-0"



WEST ELEVATION

SCALE: 1/16" = 1'-0"

**clearw're**

4400 CARLIGAN POINT  
 KIRKLAND, WA 98033

PROJECT INFORMATION:

**SUNNYVALE TOWN CENTER**  
**CA-SJC0127B**  
 100 MATHILDA PLACE  
 SUNNYVALE, CA 94086  
 SANTA CLARA COUNTY

CURRENT ISSUE DATE:

1/26/10

ISSUED FOR:

ZD (100%)

REV.: DATE: DESCRIPTION: BY:

REV.	DATE	DESCRIPTION	BY
1	1/26/10	ZD (100%)	JS
2	1/21/10	ZD (100%)	JS

PLANS PREPARED BY:

**DELTA GROUPS**  
**ENGINEERING, INC.**  
 CONSULTING ENGINEERS  
 3435 WEST LAKE PARKWAY, SUITE 403  
 PLEASANTON, CA 94566  
 TEL: (925) 468-0119 FAX: (925) 464-0355

CONSULTANT:

SEAL OF APPROVAL:

SHEET TITLE:

SOUTH & WEST ELEVATION

SHEET NUMBER:

**A4**

ATTACHMENT B  
 Page 5 of 5

clearwire®

DELTA GROUP  
2362 MCGA  
989.622.033

P10CL005

EXISTING VIEW LOOKING EAST



**SUNNYVALE TOWN CENTER**

100 MATHILDA PLACE, SUNNYVALE, CA 94086

PROPOSED VIEW LOOKING EAST

Proposed Clearwire Microwave Dishes (2'-0" Dia.)  
Stealthed Behind Existing Frosted Glass and Mounted  
To Existing Concrete Column



clearwire®

DELTA GRO  
2362 M  
989.62

P10CL005

EXISTING VIEW LOOKING WEST



**SUNNYVALE TOWN CENTER**

100 MATHILDA PLACE, SUNNYVALE, CA 94086

PROPOSED VIEW LOOKING WEST

Proposed Clearwire Microwave  
Dishes (1'-0" Dia.) Stealthed Behind  
New RF Transparent Screening (Painted  
To Match Existing Mechanical Screenwall)



Proposed Clearwire Equipment Cabinet,  
Mounted to Existing Mechanical Screenwall  
on Steel Shelf (Behind Screenwall)

Proposed Clearwire Stepdown Transformer,  
Mounted to Existing Mechanical Screenwall  
on Steel Shelf



January 30, 2010

City of Sunnyvale  
Planning Division  
456 W. Olive Avenue  
Sunnyvale, CA 94088

RE: **ClearWire Site CA-SJC0127:** Application for a Minor Use Permit for a Wireless Communications Facility at 101 Mathilda Place, Sunnyvale, CA, 94087; APN 209-07-024 (Revised)

This letter is hereby submitted in conjunction with an application for a minor use permit for an unmanned wireless communications facility located on the rooftop of an existing building located at 101 Mathilda Place in the City of Sunnyvale. The proposed facility is part of a wireless communications network for ClearWire Technologies.

## **I. Applicant Information**

### Lessee/Applicant

ClearWire Technologies  
12657 Alcosta Blvd., Ste. 300  
San Ramon, CA 94583  
Attn: Tom Derkas  
Phone: (925) 202-3333

### Agent for Applicant

Bell + Associates (Attn: Gordon Bell)  
4020 Sierra Springs Drive  
Pollock Pines, CA 95726  
Phone: (530) 647-1932  
Fax: (805) 456-3958  
Email: [gbell61639@aol.com](mailto:gbell61639@aol.com)

### Property Owner

SPF Mathilda LLC/JP Morgan Real Estate  
1999 Avenue of the Stars #2600  
Los Angeles, CA 90067  
Attn: Stacey Kelsie  
Ph: 408.736.7609

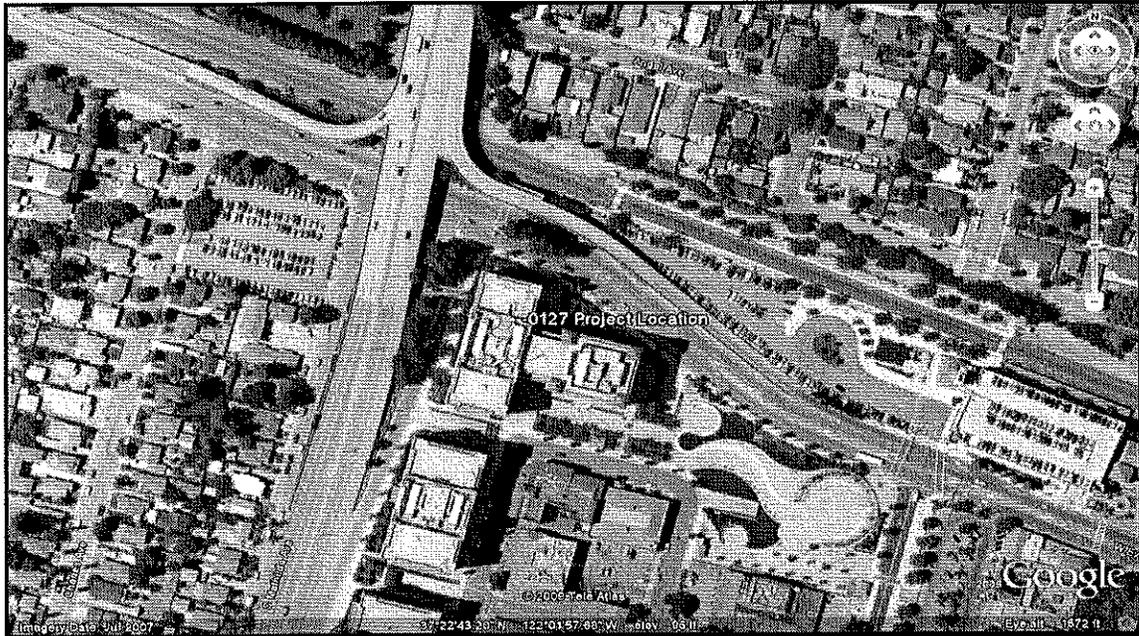
## **II. Project Description**

### Project Location

The proposed project is located at 101 Mathilda Place in the City of Sunnyvale. The proposed communications facility will be located on the rooftop of the existing building behind existing mechanical screen walls and existing RF transparent windows. The project site is located on Assessor's Parcel 209-07-024. Geographic coordinates (NAD 83) for the proposed facility are Latitude: 37°22' 42.77"; Longitude: -122° 01' 59.14", at an elevation of approximately

96' AMSL (above mean sea level). The aerial photo below shows project location and surrounding land uses.

**Fig. 1. Aerial Photo Showing Project Location and Surrounding Land Uses**



### Project Components

The proposed project would consist of the installation of antennas and radio equipment on the rooftop of an existing 105'-tall building as shown on the attached plans. The proposed project components would consist of the following elements to be contained within an approximate 86.0 (10'7" x 8') square foot lease area:

- Radio equipment cabinet (approx. 30" x 30" x 50"(H)) to be installed wall-mounted on the existing mechanical screen wall (behind it) on the eastern portion of the building as shown on the attached plans. A stepdown transformer is also included within the lease area.
- Three (3) panel antennas and six (6) RF heads and to be installed at an antenna centerline of approximately 102'6" AMSL. All panel antennas would be mounted behind RF-transparent cutouts (painted and textured to match existing wall) in the existing mechanical screen as shown on the attached plans.
- Six (6) microwave dishes, 3 two-foot diameter dishes and 3 one-foot diameter dishes to be mounted behind RF-transparent cutouts (painted and textured to match existing wall) or behind the existing RF-transparent window panes at a centerline elevation ranging from 99'-103'10" as shown on the attached plans.
- One (1) GPS antenna to be mounted on the radio cabinet within the lease area.
- Associated fiber/coax cable to be run from the radio cabinets on the rooftop along the rooftop behind the screen walls or parapets. Power would be pulled from existing electrical service within the building.
- No generators are proposed as part of this project.

Access would be provided by existing driveways from Evelyn Avenue or Mathilda Place.

### Collocation/Alternatives Analysis

The existing rooftop already supports one existing communications facility (T-Mobile) and may be capable of handling additional antennas should other wireless communications companies be interested in collocation on the rooftop with appropriate architectural designs.

In terms of looking for alternatives, the first alternative which was pursued was Washington Park which is owned by the City of Sunnyvale. Because of the lack of suitable structures upon which to collocate, and the lengthy leasing process, it was decided that we would look outside the center of the search ring and move to other structures upon which carriers have pursued. This led us to the building at Mathilda Place, where T-Mobile has pursued a permit. The landlord was willing to lease to us, and thus we undertook at project at this location that would meet our coverage objectives and avoid interference with T-Mobile. In order to avoid such interference it was necessary to construct a facility above the plane of T-Mobile's antennas which are located in existing building parapets. The proposed design is reflective of those needs.

### Network Technology

Clearwire offers a robust suite of advanced voice, high-speed Internet services to consumers and businesses. The company is building the first Mobile WiMax 4G network in the San Francisco Bay area bringing together an unprecedented combination of speed and mobility. Clearwire is licensed by the FCC to operate the Mobile WiMax Network in the 2.5-2.7GHz frequency range in San Francisco market. Clearwire will be using microwave backhaul for the Mobile WiMax network.

The Clearwire network is designed upon utilization of microwave backhaul throughout the network of hundreds of sites in the Bay area. This is a 100 percent backhaul solution, with no hardline connections within the system. What this means is that the majority of the sites transport a signal to at least three other sites with "hubs" located at the center of some of the rings to transport an initial signal. Because sites are inextricably linked by these microwave connections, it is imperative that the MW dishes obtain maximum height over the surrounding clutter and topography to ensure a point-to-point connection with other sites in the system.

In terms of Clearwire's relationship to other carriers and their networks, it should be known that Clearwire is a subsidiary of Sprint/Nextel (Sprint owns 51%), but the systems are not integrated. Clearwire's network is an entirely new network. Eventually, Clearwire's subscribers may have roaming agreements with Sprint/Nextel where Clearwire is not present, but the systems are not integrated to support each other. Because of the ownership relationship, Clearwire's footprint is very similar to Sprint's in the Bay area because we know that it is possible to utilize Sprint/Nextel's shelters, mounting brackets, coax cable

trays, etc. with the appropriate collocation agreement with Sprint/Nextel. Where possible it is Clearwire's first option to collocate with Sprint/Nextel.

### Public Services

Public services such as fire and law enforcement are not required given that the facilities are designed to be vandalism resistant (fenced and located on the tower) and are uninhabitable. The project does not require school or transit facilities, as it is an unmanned wireless communications facility.

### Operations

The site is an unmanned facility that will not generate any noise, dust, or odors. It is expected that a service technician may visit the site for routine maintenance once every month to two months if needed. Ample parking is available within the water company service area for this transient visit.

## **III. Land Use**

### Zoning

The project parcel is zoned DSP, Downtown Specific Plan. The building is a commercial office building. The project site is bounded on the south, north, and east by similar uses. There is single-family residential and some commercial to the west of the site.

### Environmental Setting

The project is located on a relatively level, completely disturbed parcel that is used for the office building and its ancillary uses. The site is developed with the building, parking lots, and ornamental landscaping. There are no sensitive environmental resources on the project site. The project is entirely screened and would not be visible from any viewsheds.

## **IV. Conclusion**

In conclusion, the proposed project is a compatible use with the surrounding land uses as proven by the fact that an existing facility is located on the rooftop and would not be visible from any of the surrounding areas. The proposed project will provide valuable communications services to area residents and businesses. Should you have any questions regarding this application, please feel free to call me at (530) 647-1932.

Sincerely,

Bell + Associates  
**Gordon J. Bell**  
Gordon J. Bell  
Principal

**HAMMETT & EDISON, INC.**  
CONSULTING ENGINEERS  
RADIO AND TELEVISION

DANE E. ERICKSEN, P.E.  
STANLEY SALEK, P.E.  
MARK D. NEUMANN, P.E.  
ROBERT P. SMITH, JR.  
RAJAT MATHUR, P.E.  
FERNANDO DIZON

ROBERT L. HAMMETT, P.E.  
1920-2002  
EDWARD EDISON, P.E.

BY E-MAIL GBELL61639@AOL.COM

September 3, 2009

Mr. Gordon Bell  
Zoning Specialist  
Bell & Associates  
4020 Sierra Springs Drive  
Pollock Pines, California 95726

Dear Gordon:

As you requested, we have analyzed the RF exposure conditions near the Clearwire, LLC base stations proposed to be located at 100 Mathilda Place in Sunnyvale, California. An electronic copy of each report is enclosed. Fields in publicly accessible areas at the sites are calculated to be well below the applicable limits.

We appreciate the opportunity to be of service and would welcome any questions on this material. Please let me know if we may be of additional assistance.

Sincerely yours,



William F. Hammett

nrs

Enclosures

cc: Ms. Pam Henderson (w/encl) - BY E-MAIL PHENDERSON@GOODMANNETWORKS.COM  
Ms. Cynthia Villareal (w/encl) - BY E-MAIL CVILLARREAL@GOODMANNETWORKS.COM  
Ms. Noren Caliva (w/encl) - BY E-MAIL NCALIVA@CI.SUNNYVALE.CA.US

**Clearwire, LLC • Proposed Base Station (Site No. CA-SJC0127B)  
 100 Mathilda Place • Sunnyvale, California**

**Statement of Hammett & Edison, Inc., Consulting Engineers**

The firm of Hammett & Edison, Inc., Consulting Engineers, has been retained on behalf of Clearwire, LLC, a personal wireless telecommunications carrier, to evaluate the base station (Site No. CA-SJC0127B) proposed to be located at 100 Mathilda Place in Sunnyvale, 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:

<u>Personal Wireless Service</u>	<u>Approx. Frequency</u>	<u>Occupational Limit</u>	<u>Public Limit</u>
Broadband Radio (“BRS”)	2,600 MHz	5.00 mW/cm <sup>2</sup>	1.00 mW/cm <sup>2</sup>
Advanced Wireless (“AWS”)	2,100	5.00	1.00
Personal Communication (“PCS”)	1,950	5.00	1.00
Cellular Telephone	870	2.90	0.58
Specialized Mobile Radio (“SMR”)	855	2.85	0.57
Long Term Evolution (“LTE”)	700	2.33	0.47
[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

**Clearwire, LLC • Proposed Base Station (Site No. CA-SJC0127B)  
100 Mathilda Place • Sunnyvale, California**

about 1 inch thick. Because of the short wavelength of the frequencies assigned by the FCC for 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 Clearwire, including drawings by Dyna Limited Telecommunications Services, dated August 12, 2009, it is proposed to mount three Argus Model LLPX310R directional panel antennas within an enclosure to be constructed above the elevator penthouse on the roof of the six-story Sunnyvale City Center, located at 100 Mathilda Place in Sunnyvale. The antennas would be mounted with 2° downtilt at an effective height of about 33½ feet above ground, 22 feet above the main roof, and would be oriented at about 120° spacing, to provide service in all directions. The maximum effective radiated power in any direction would be 970 watts. Also proposed to be mounted on the building are three microwave "dish" antennas, for interconnection of this site with others in the Clearwire network.

Also proposed to be installed on the roof of the building are similar antennas for use by T-Mobile, another wireless telecommunications carrier. That carrier has proposed to install RFS Model APX16-DWV-16DWV-S-E-A20 directional panel antennas at an effective height of about 33 feet above ground and to operate at a maximum effective radiated power of 2,200 watts, representing simultaneous operation at 1,100 watts for PCS and 1,000 watts for AWS.

**Clearwire, LLC • Proposed Base Station (Site No. CA-SJC0127B)  
100 Mathilda Place • Sunnyvale, California**

**Study Results**

For a person anywhere at ground, the maximum ambient RF exposure level due to the proposed Clearwire operation by itself is calculated to be 0.00017 mW/cm<sup>2</sup>, which is 0.017% of the applicable public exposure limit. The maximum calculated cumulative level at ground, for the simultaneous operation of both carriers, is 0.043% of the public exposure limit. The maximum calculated cumulative level at the second-floor elevation of any nearby building\* is 3.4% of the public exposure limit. It should be noted that these results include several “worst-case” assumptions and therefore are expected to overstate actual power density levels. The microwave antennas would be in point-to-point service and are so directional that they make no significant contribution to RF exposure conditions at ground level.

**Recommended Mitigation Measures**

Due to their mounting location, the Clearwire antennas would not be accessible to the general public, and so no mitigation measures are necessary to comply with the FCC public exposure guidelines. To prevent occupational exposures in excess of the FCC guidelines, no access within 15 feet directly in front of the antennas themselves, such as might occur during building maintenance activities on the roof, should be allowed while the base station is in operation, unless other measures can be demonstrated to ensure that occupational protection requirements are met. Posting explanatory warning signs† at the roof access door and on the enclosure housing the antennas, such that the signs would be readily visible from any angle of approach to persons who might need to work within that distance, would be sufficient to meet FCC-adopted guidelines. Similar measures should be installed before the other carrier begins operation; applicable keep-back distances have not been determined as part of this study.

**Conclusion**

Based on the information and analysis above, it is the undersigned’s professional opinion that the base station proposed by Clearwire, LLC at 100 Mathilda Place in Sunnyvale, 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

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\* Located about 180 feet away, based on aerial photographs from Google Maps.

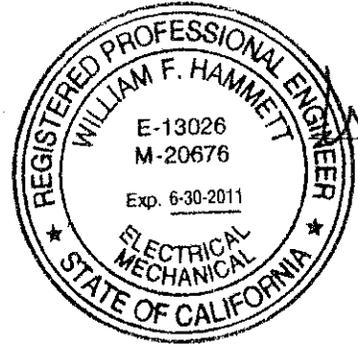
† Warning signs should comply with OET-65 color, symbol, and content recommendations. Contact information should be provided (e.g., a telephone number) to arrange for access to restricted areas. The selection of language(s) is not an engineering matter, and guidance from the landlord, local zoning or health authority, or appropriate professionals may be required.

Clearwire, LLC • Proposed Base Station (Site No. CA-SJC0127B)  
100 Mathilda Place • Sunnyvale, California

base stations. Posting of explanatory signs is recommended to establish compliance with occupational exposure limitations.

**Authorship**

The undersigned author of this statement is a qualified Professional Engineer, holding California Registration Nos. E-13026 and M-20676, which expire on June 30, 2011. This work has been carried out 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.



*William F. Hammett*  
William F. Hammett, P.E.

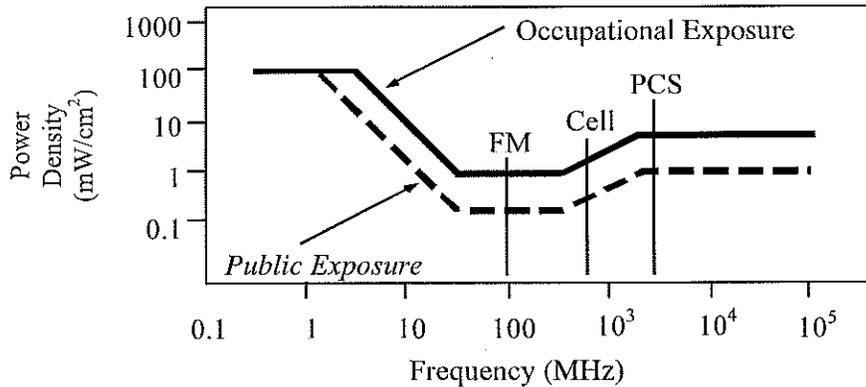
September 3, 2009

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



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.

RFR.CALC™ 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  $S = \frac{180}{\theta_{BW}} \times \frac{0.1 \times P_{net}}{\pi \times D \times h}$ , in mW/cm<sup>2</sup>,

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<sup>2</sup>,

- where  $\theta_{BW}$  = 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
- $\eta$  = 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:

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

- 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.