For: Monday, **June 22, 2015**, City Council Meeting

Advance Packet Information

Dated: June 12, 2015

Included in this packet is documentation to support the following Agenda items:

PUBLIC HEARINGS

1. Legislative public hearing in the matter of LDC-2-15, approval to add provisions for amateur communication facilities Brookings Municipal Code Title 17, Land Development Code. [Planning, pg. 2]
    a. Draft language [pg. 6]
    b. May 5, 2015 Planning Commission Staff Report [pg. 12]
    c. May 5, 2015 Supplemental Packet [pg. 63]
    d. May 21, 2015 Memo to the Planning Commission [pg. 158]

*Obtain Public Comment Forms and view the agenda and packet information on-line at www.brookings.or.us, or at City Hall. Return completed Public Comment Forms to the City Recorder before the start of meeting or during regular business hours.

All public meetings are held in accessible locations. Auxiliary aids will be provided upon request with at least ten days advance notification. Please contact 541-469-1102 if you have any questions regarding this notice.

CITY OF BROOKINGS

COUNCIL AGENDA REPORT

Meeting Date: June 22, 2015

Originating Dept: PWDS-Planning

Donna Colby-Hanks
Signature (submitted by)

City Manager Approval

Subject: A hearing on File LDC-2-15 for consideration of the addition of BMC Section 17.124.230 Specific Standards Applying to Conditional Uses, Amateur communication facilities and the addition of Amateur communication facilities as a permitted use in Chapter 17.16 Suburban Residential (SR) and Chapter 17.20 Single-Family Residential (R-1-12) and as a conditional use in Chapter 17.20 Single-Family Residential (R-1-6, R-1-8, R-1-10), Chapter 17.24 Two-Family Residential (R-2), Chapter 17.32 Manufactured Home Residential (R-MH), Chapter 17.28 Multiple-Family Residential (R-3), Chapter 17.36 Professional Office (PO-1), Chapter 17.40 Public Open Space (P/OS), Chapter 17.44 Neighborhood Commercial (C-1), Chapter 17.48 Shopping Center Commercial (C-2), Chapter 17.52 General Commercial (C-3), Chapter 17.56 Tourist Commercial (C-4), Chapter 17.64 Industrial Park (I-P), and Chapter 17.68 General Industrial (M-2). City initiated. The criteria used to decide this matter are found in Chapter 17.140 Amendments, of the Brookings Municipal Code (BMC) to provide additional opportunities for amateur radio facilities.

Recommended Motion: A motion to approve revisions proposed by LDC-2-15 to add provisions for additional opportunities for amateur radio facilities as an accessory use to dwellings and direct staff to prepare an ordinance for adoption.

Financial Impact: The financial impact will be minimal as very few applications for Conditional Use Permits are anticipated.

Background/Discussion: Federal and State laws require that amateur radio facilities be reasonably accommodated and the regulations imposed be the minimum necessary to accomplish the goals of the city. State law goes on to state that a city may not restrict the facilities to heights of 70 feet or lower unless the restriction is necessary to achieve a clearly defined health, safety, or aesthetic objective. BMC Chapter 17.128.040(B) provides for antennas of one and one-half the height limitation of the underlying zone. The height limitation in all residential zones with the exception of Multiply-Family (R-3) is 30 feet. This provides for facilities not exceeding 45 feet. The City Attorney recommended provisions be added to allow for facilities of 70 feet or lower to be processed.

Amateur radio facilities are private, non-commercial wireless communication facilities consisting of antennas, towers, and/or supporting structures. Amateur radio operators are recognized for their service to a community especially in the event of emergencies.

The Planning Commission reviewed draft code revisions at workshops in February and March, 2015 and public hearings in May and June, 2015 prior to unanimously recommending approval

to City Council. The public provided testimony at all the meetings. Public comments were divided with some folks concerned that the provisions were too burdensome and others that they were too lenient.

The proposed revisions would allow amateur radio facilities, accessory to any dwelling, with approval of a conditional use permit (CUP) in all zones with the exception of Suburban Residential (SR) and Single-Family Residential (R-1-12, 12,000 sq ft minimum lot size) where it would be an outright use. Both CUP and outright use approval would require the facilities to meet the proposed criteria in Chapter 17.124.230. The SR and R-1-12 zones require larger minimum lots and are adjacent to property within Curry County's jurisdiction. With the exception of Deschutes County, no other jurisdictions within Oregon were identified that have requirements beyond a building permit. In Deschutes County, the use is outright but must meet specific criteria.

The proposed criteria in Chapter 17.124.230 includes requirements for setbacks, building permits, finishes that reduces visibility, fencing and security, no lighting, complying with Airport Overlay Zone, safety and warning signs, Federal Communications Commission (FCC) license, abandonment and maintenance. Public notice for the CUP would be provided to all property owners within 1000 feet of the subject property. The Land Development Code requires notification to all properties within 250 feet for all other land use actions.

Several additional criteria were considered by the Planning Commission. Interference was removed when it was determined that Federal law provides exclusive jurisdiction of transmission interference to the FCC. Retractable facilities within a certain distance of each other and of Chetco Avenue was removed when information was received that neither of the two largest manufacturers make facilities that can meet the windload requirements.

Policy Considerations: Current policy limits amateur radio facilities to 45 feet. This change would allow facilities to 70 feet in compliance with Federal and State law.

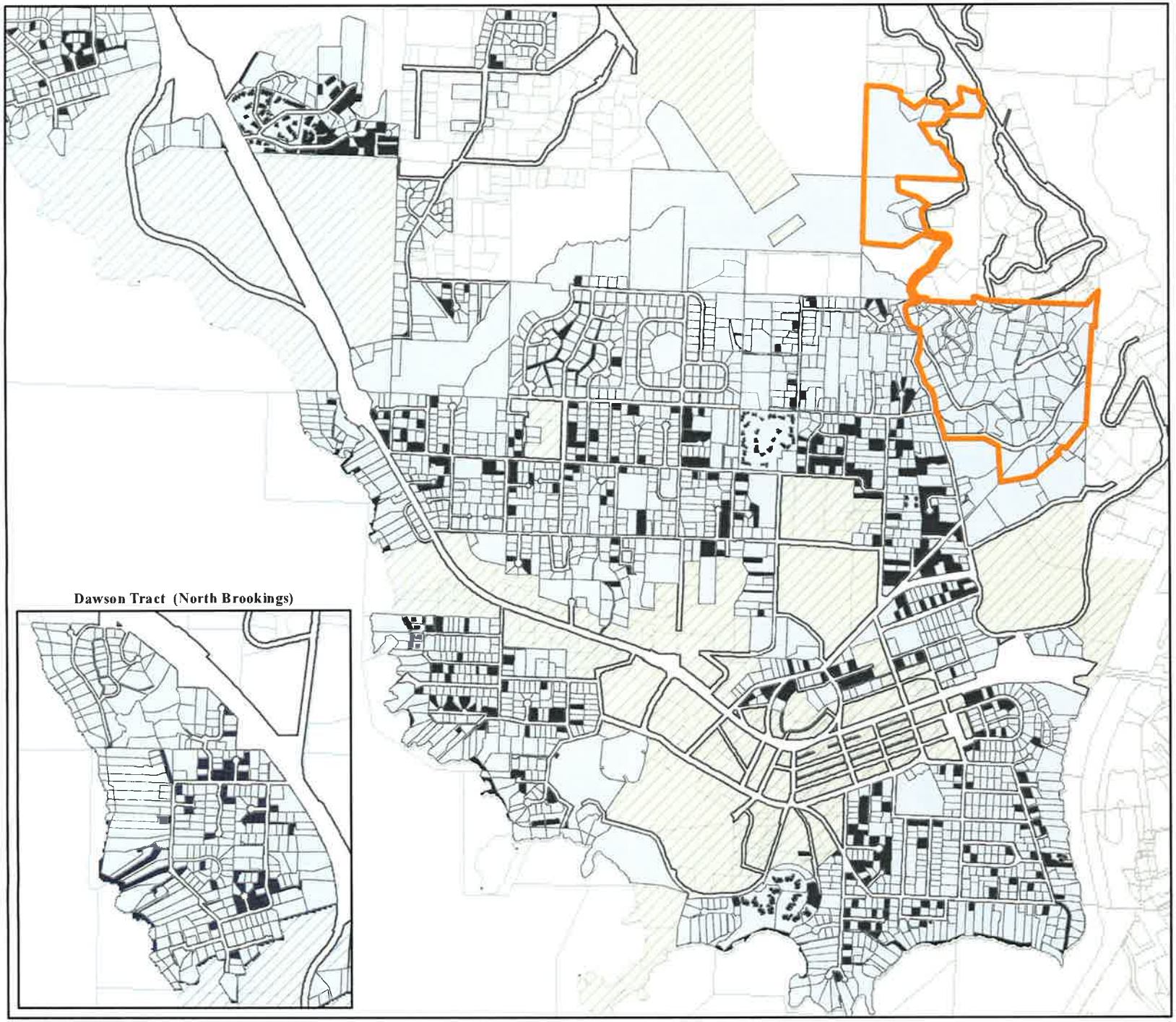
Attachment(s):

A. Draft provisions

B. Staff report and attachments for May 5, 2015 Planning Commission meeting

C. Supplemental packet for May 5, 2015 Planning Commission meeting

D. Memo and attachments for June 2, 2015 Planning Commission meeting



Dawson Tract (North Brookings)

Area of Interest - City of Brookings, OR

Legend

- 70' tower with a 23' Setback (3:1)
- Zoning w/Larger Min. Lot Size
- Setback will not allow for 70' Tower
- Non-Residential Zoning

Notes:

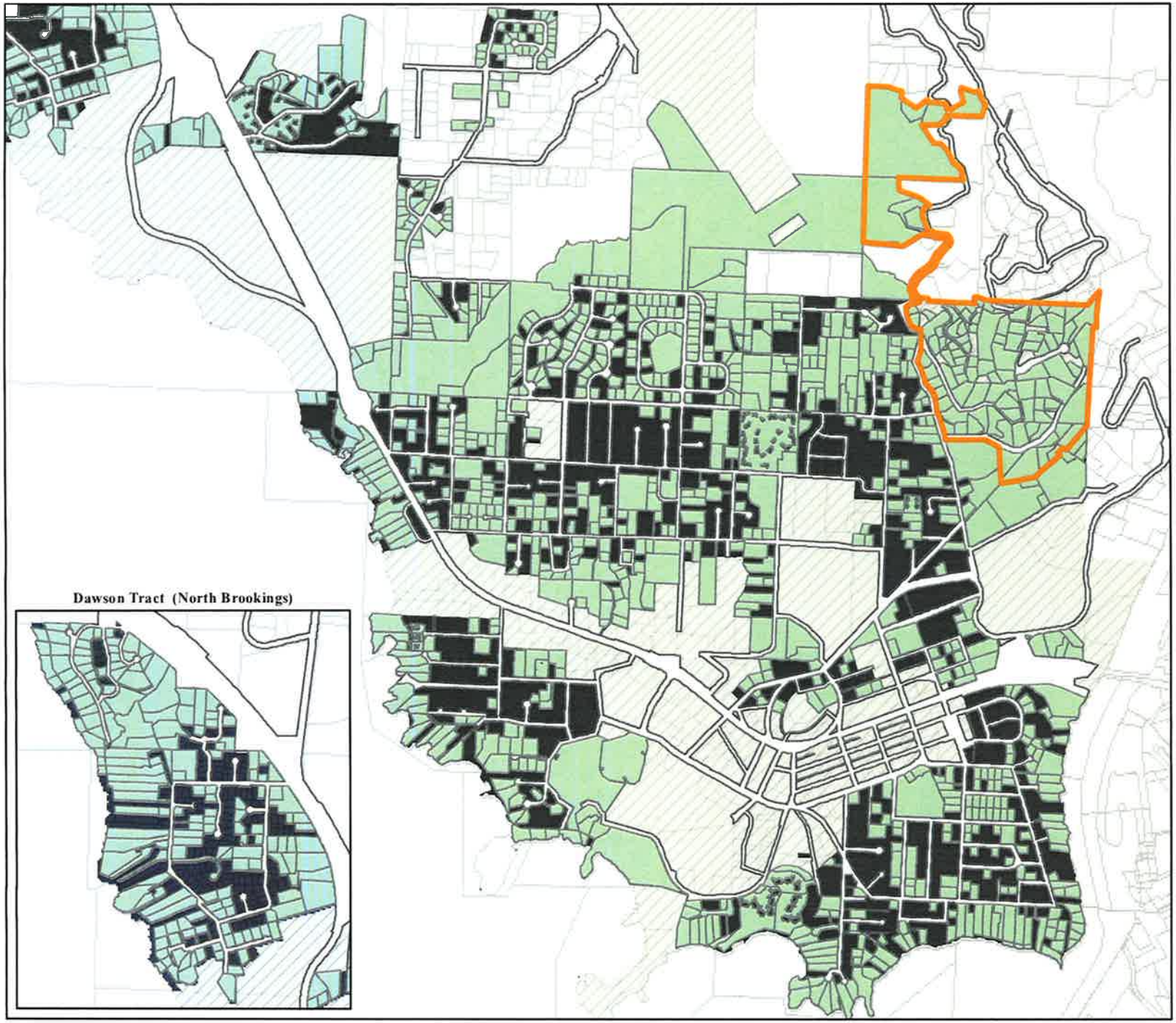
Draft Analysis. This map is for general reference purposes only. Limited variables considered for calculation. Each lot must be addressed on an individual basis after considering all factors. For more information contact the City of Brookings Planning Department.

3:1 Setback - Site Suitabiltiy Analysis

Amateur Radio (Calculated w/tower height @ 70')

Projections: NAD83 ORSouth; Brookings GIS jf; 2/19/2015

N 0 1,000 2,000 Feet



Area of Interest - City of Brookings, OR

Legend

- 70' tower with a 35' Setback (2:1)
- Zoning w/Larger Min. Lot Size
- Setback will not allow for 70' Tower
- Non-Residential Zoning

Notes:

Draft Analysis. This map is for general reference purposes only. Limited variables considered for calculation. Each lot must be addressed on an individual basis after considering all factors. For more information contact the City of Brookings Planning Department.

2:1 Setback - Site Suitabiltiy Analysis

Amateur Radio (Calculated w/tower height @ 70')

Projections: NAD83 ORSouth; Brookings GIS jf: 2/19/2015

N 0 1,000 2,000 Feet

Proposed new text is **bold.**

Chapter 17.16 Suburban Residential (SR) District

17.16.030 Accessory uses
The following accessory uses are permitted:

E. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.20 Single-Family Residential (R-1) District

17.20.030 Accessory uses.
The following uses are permitted:

E. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230 in the R-1-12 zone.

17.20.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

U. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230 in the R-1-6, R-1-8, and R-1-10 zones.

Chapter 17.24 Two-Family Residential (R-2) District

17.24.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

V. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.28 Multiple-Family Residential (R-3) District

17.28.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

T. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.32 Manufactured Home Residential (R-MH) District

17.32.040 Conditional uses.
The following conditional uses may be permitted:

V. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.36 Professional Office (PO-1) District

17.36.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

L. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.40 Public Open Space (P/OS) District

17.40.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

D. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.44 Neighborhood Commercial (C-1) District

17.44.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

D. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.48 Shopping Center Commercial (C-2) District

17.48.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

J. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.52 General Commercial (C-3) District

17.52.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

O. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.56 Tourist Commercial (C-4) District

17.56.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

J. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.64 Industrial Park (I-P) District

17.64.040 Conditional uses.
The following uses may be permitted subject to a conditional use permit:

I. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.68 General Industrial (M-2) District

17.68.040 Conditional uses.
The following uses may be permitted subject to a conditional use permit:

G. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.124 Specific Standards Applying to Conditional Uses

17.124.230 Amateur radio facilities.

Amateur radio facilities are private, non-commercial wireless communication facilities consisting of antennas, towers, and/or support structures. The City recognizes the importance of amateur radio operators and their service to the community especially in the event of emergencies.

Amateur radio facilities are considered an accessory use to a residential dwelling. Chapter 17.128.020(B) provides for exceptions to height limitations for antenna. Antenna may be one and one-half times the height limitation of the applicable zoning district. However, towers and support structures shall comply with height limitations and setbacks.

The following siting criteria shall apply to amateur radio facilities that do not meet the provisions of Chapter 17.128.020(B) and/or the applicable zoning district. The criteria are intended to maximize public safety and minimize visual impacts to promote and protect the residential characteristics of the residential zoning districts consistent with federal and state law. Public notice shall be provided to all property owners within 1000 feet of a proposed amateur radio facility requesting approval with a conditional use permit (CUP).

A. Height. The maximum tower/antenna height shall not exceed 70 feet from the finished grade at the base of the tower.

B. Front, Side and Rear Yard Setbacks. The minimum setback from all property lines to the finished grade at the base of the tower shall be One (1) foot for every two (2) feet of height. With the exception of guy wires, antennas, and footings that do not project above grade level, no component of the facility may encroach into the required setback.

C. Construction. A building permit shall be obtained for the construction or erection of the amateur radio facility. Plans and calculations shall be provided and shall comply with the provisions of Section 3108 of the Oregon Structural Specialty Code.

D. Finish (paint/surface). The facility shall have a finish, tone or color that reduces its visibility. In most circumstances this condition may be satisfied by painting the facility with a flat light haze gray paint. The owner shall maintain the finish, painted or unpainted. Red and white or orange and white finish is not allowed. If these colors are required by the FAA (Federal Aviation Administration) or ODA (Oregon Department of Aviation), the height shall be reduced to a level that it is not required.

E. Fencing and Security. For security purposes, towers and accessory facilities shall be enclosed by a minimum six-foot fence or be equipped with anti-climb devices. If this conflicts with TIA-222 or other agencies, the most restrictive requirements shall prevail.

F. Lighting. No lighting shall be permitted on the facility. If required by the FAA or ODA, the facility shall be reduced to a level that does not require lighting.

G. Airport Overlay Zone. The facility shall comply with the requirements in BMC Chapter 17.76, Airport Overlay Zone.

H. Advertising/Signs. No advertising or signs of any type are to be placed on the tower at any time except those required or necessary for safety and warnings. Safety and warning signs shall be less than two square feet and be placed on the facility at a height of less than six feet.

I. License. The owner of the facility shall possess and provide a copy of a current FCC license to the Planning Department. After six (6) months with no valid license, the facility shall be considered abandoned and shall be removed by the property owner within 60 days thereafter.

J. Abandonment. The property owner shall provide annual written documentation that the facilities are functioning. Amateur radio facilities that do not have functioning antennas for a period of six month shall be considered abandoned and shall be removed by the owner of the facility within 60 days thereafter. Upon written application, prior to the expiration of the six-month period, the planning commission if approved with a CUP or staff if permitted outright may, in writing, grant a six-month time extension for reuse of the facility. Additional extensions beyond the first six-month extension may be granted by the planning commission subject to any conditions required to bring the project or facility into compliance with current regulation(s).

K. Maintenance. Amateur radio facilities shall be maintained in good order and repair at all time so to not constitute any danger or hazard to adjacent properties.

L. Unrelated equipment. Equipment and antenna for other than amateur radio facilities shall comply with height and setback requirements of Chapter 17.128.020(B) and the underlying zone.

M. Hazardous Building Sites. Construction or erection of amateur radio facilities shall comply with Chapter 17.100 Hazardous Building Site Protection.

CITY OF BROOKINGS PLANNING COMMISSION
STAFF REPORT

SUBJECT: Land Development Code Amendment
FILE NO: LDC-2-15
HEARING DATE: May 5, 2015

REPORT DATE: April 22, 2015
ITEM NO: 5.2

GENERAL INFORMATION

APPLICANT:	City Initiated.
REPRESENTATIVE:	City Staff.
REQUEST:	Addition of **Section 17.124.230** Specific Standards Applying to Conditional Uses, Amateur radio facilities and the addition of Amateur radio facilities as a permitted use in **Chapter 17.16 Suburban Residential (SR)** and **Chapter 17.20 Single-Family Residential (R-1-12)** and as a conditional use in **Chapter 17.20 Single-Family Residential (R-1-6, R-1-8, R-1-10), Chapter 17.24 Two-Family Residential (R-2), Chapter 17.32 Manufactured Home Residential (R-MH), Chapter 17.28 Multiple-Family Residential (R-3), Chapter 17.36 Professional Office (PO-1), Chapter 17.40 Public Open Space (P/OS), Chapter 17.44 Neighborhood Commercial (C-1), Chapter 17.48 Shopping Center Commercial (C-2), Chapter 17.52 General Commercial (C-3), Chapter 17.56 Tourist Commercial (C-4), Chapter 17.64 Industrial Park (I-P),** and **Chapter 17.68 General Industrial (M-2), Brookings Municipal Code (BMC).**
PUBLIC NOTICE:	Published in local newspaper and mailed to workshop participants.

BACKGROUND INFORMATION

Federal and State laws require that amateur radio facilities be reasonably accommodated and the regulations imposed be the minimum necessary to accomplish the goals of the City. State law goes on to state that a city may not restrict the facilities to heights of 70 feet or lower unless the restriction is necessary to achieve a clearly defined health, safety, or aesthetic objective. The Brookings Municipal Code (BMC) does not provide for facilities exceeding 45 feet. BMC Chapter 17.128.040(B) provides for antennas of one and one-half the height limitation of the underlying zone. The City Attorney recommended provisions to allow for facilities of 70 feet or less to be processed.

The Planning Commission reviewed draft code revisions to add opportunities for amateur radio facilities of 70 feet or less at workshops in February and March, 2015. Memos from these workshops are included as **Attachment B**. Several interested citizens attended and provided input for consideration.

At the February workshop, the Planning Commission reviewed draft provisions to accommodate amateur radio facilities 70 feet or less. Site Plan Committee reviewed the regulations and their suggestions were incorporated. The matter was continued to allow staff to conduct additional research.

At the March workshop, the Planning Commission discussed the 2:1 and 3:1 setbacks, regulation of interference, and separation of amateur radio facilities. The Planning Commission directed staff to confer with the City Attorney to ascertain if the proposed separation of facilities and the 1000-foot buffering of Checto Avenue could be considered as reasonably accommodating the facilities. The City Attorney advises that any outright prohibition of amateur radio facilities in any residential zone or area would not be providing reasonable accommodations. She suggested an alternative might be to require facilities in these areas to be lowered to the height limitation of the underlying zone when not in use. An alternate standard has been included for retractable facilities in the draft text, BMC 17.124.230(L) included as **Attachment G.**

Concern has been expressed regarding the availability of retractable facilities designed to meet the engineering requirements for the City of Brookings. Contact has been made to several of the larger manufacturers of the towers. One company has provided a response **(Attachment D)** and stated they do not manufacture retractable towers. It would not be reasonable to require retractable facilities if they are not available.

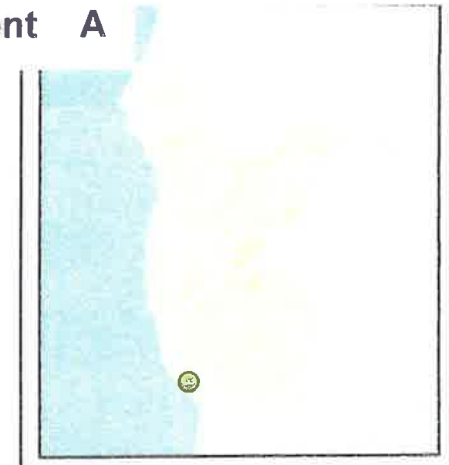
ATTACHMENTS:

A - Maps showing 2:1 and 3:1 setbacks
B - Memos from the January 22 and February 20, 2015 Workshops
C - ORS 221.295 Ordinances regulating radio antennas
D - Professional comments
E - *Antenna Height and Communications Effectiveness* by R. Dean Straw and Gerald L. Hall
F - *Effective Amateur Radio Communications in Brookings* by Charles Ristorcelli
G - Draft text

RECOMMENDATION

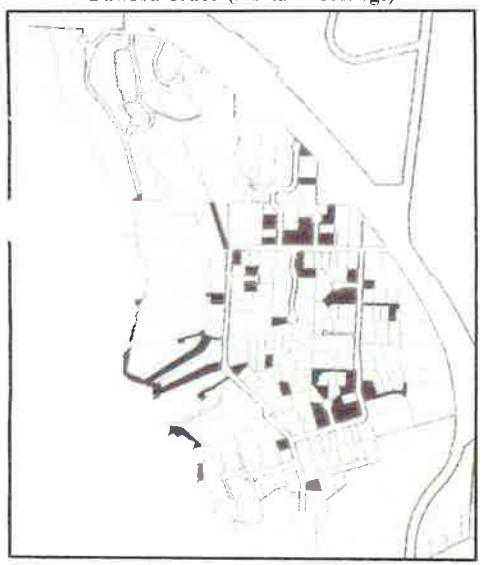
After careful consideration, and any input the public may provide, Staff recommends the hearing for File No. LDC-2-15, Amateur Radio Facilities, be continued to the June 2, 2015 meeting at 7:00 PM to allow additional information regarding the availability of retractable towers to be provided by manufacturers.

Attachment A



Area of Interest - City of Brookings, OR

Dawson Tract (North Brookings)



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Zoning w/Larger Min. Lot Size

Setback will not allow for 70' Tower

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Projections: NAD83 ORSouth, Brookings GIS pl, 2/19/2015

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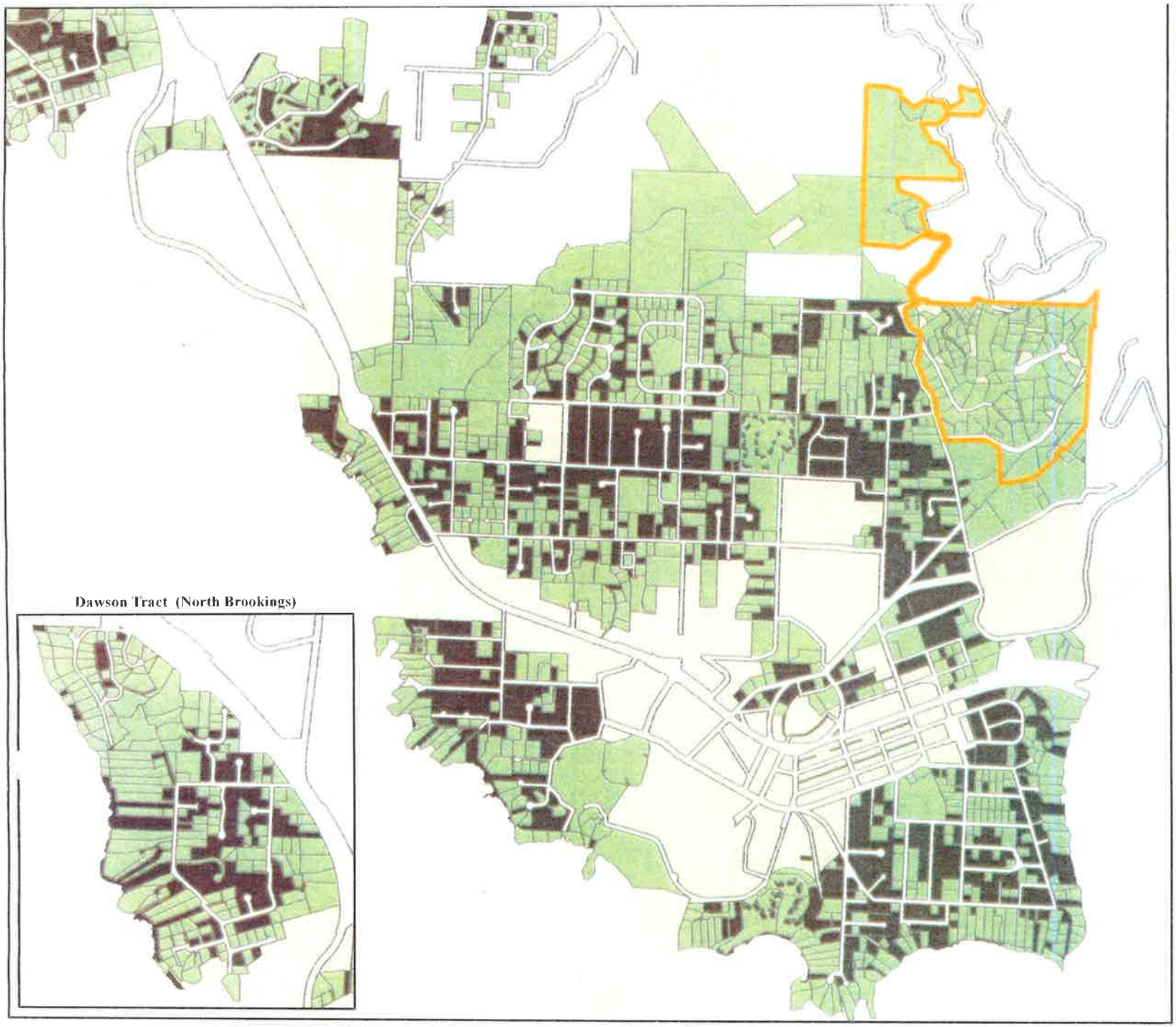
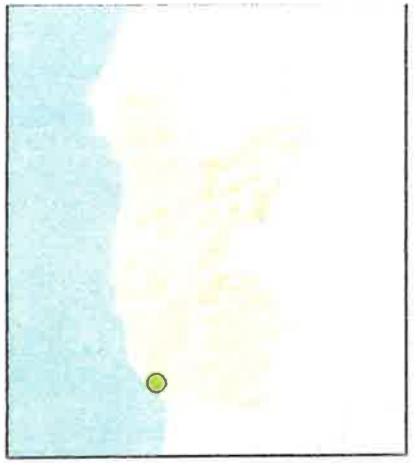


Dawson Tract (North Brookings)



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Amateur Radio (Calculated w/tower height @ 70')

Projections: NAD83 ORSouth, Brookings GIS pl, 2/19/2015

N 0 1,000 2,000 Feet

MEMO

TO: **Planning Commission**

FROM: **Donna Colby-Hanks, Planning Manager**

DATE: **January 22, 2015**

SUBJECT: **February 3, 2015 Planning Commission Workshop to review code revisions to add conditional use permit provisions for amateur radio facilities that do not meet the height limitations of Chapter 17.128.020(B) and/or the applicable zoning district.**

Staff received a request for a amateur radio facility that exceeded what is allowed in Chapter 17.128.020(B) **(Attachment A)** and the underlying residential zone. After conferring with the City Attorney, provisions to provide additional opportunities for facilities of a greater height were drafted. The draft has been reviewed by Site Plan Committee and their suggestions incorporated into the text provided in **Attachment B.**

Amateur radio facilities are private, non-commercial wireless communication facilities consisting of antennas, towers, and/or support structures. The use is a hobby and considered an accessory use in residential zones. However, the facilities must comply with height limitations and setbacks.

The City recognizes the importance of the operators and their service to the community especially in the event of emergencies but also the need to protect the residential characteristics of neighborhoods. There are approximately 30 licensed operators within the city limits.

A hearing on these draft revisions will be scheduled for a future Planning Commission meeting.

The Planning Commission will be acting in their role of *Committee for Citizen Involvement (CCI)* in conducting this workshop.

MEMO

TO: **Planning Commission**

FROM: **Donna Colby-Hanks, Planning Manager**

DATE: **February 20, 2015**

SUBJECT: March 3, 2015 Planning Commission Workshop to review code revisions to add provisions for amateur radio facilities that do not meet the height limitations of Chapter 17.128.020(B) and/or the applicable zoning district.

The Planning Commission conducted a workshop on February 3, 2015 to review draft code revisions to add opportunities for amateur radio facilities of less than 70 feet in height. The Commission directed Staff to conduct research and schedule another workshop for further discussion.

Federal and State laws require that amateur radio facilities be reasonably accommodated and that the regulations imposed on them be the minimum necessary to accomplish the goals of the city. State law goes on to state that a city may not restrict the facilities to heights of 70 feet or lower unless the restriction is necessary to achieve a clearly defined health, safety or aesthetic objective. Several of the draft criteria proposed by Staff and discussed at the previous workshop do not address this.

The requirement that facilities have a separation of 1000 feet may not be perceived as reasonable or necessary as it could prohibit the use by a property owner without considering a specific proposal. The same would be true to prohibit the facilities by a particular residential zone. The Planning Commission may want to consider allowing the use outright in the SR-20 and R-1-12 zones. These zones require larger minimum lot sizes and are located adjacent to properties under Curry County jurisdiction where the radio facilities are allowed outright without any criteria for approval. The use could be subject to a Conditional Use Permit (CUP) in all other single family residential zones. Whether outright or a CUP, the facility should be required to meet all the criteria. As stated previously, Staff has not been able to locate any jurisdictions within Oregon that require a CUP or have criteria for the siting of these facilities.

Another proposed criteria that could be problematic regards interference. Federal law provides exclusive jurisdiction over transmission interference to the Federal

Communication Commission (FCC). The City has no authority to regulate interference and consideration should be given to removing that criteria.

Maps **(Attachment A)** are included that show properties that are of a size to accommodate a 70 foot tower with a setback of one foot for every two feet in height and a setback of one foot for every three feet in height. The maps provide a visual of the properties within the city limits that are of a size that could comply with the different setback options.

The revised criteria **(Attachment B)** are attached for your review and discussion.

A hearing on these draft revisions will be scheduled for a future Planning Commission meeting.

The Planning Commission will be acting in their role of *Committee for Citizen Involvement (CCI)* in conducting this workshop.

2013 ORS 221.295

221.295 Ordinances regulating placement or height of radio antennas. Notwithstanding ORS chapters 215 and 227, a city or county ordinance based on health, safety or aesthetic considerations that regulates the placement, screening or height of the antennas or antenna support structures of amateur radio operators must reasonably accommodate amateur radio communications and must represent the minimum practicable regulation necessary to accomplish the purpose of the city or county. However, a city or county may not restrict antennas or antenna support structures of amateur radio operators to heights of 70 feet or lower unless the restriction is necessary to achieve a clearly defined health, safety or aesthetic objective of the city or county. [1999 c.507 §1]

Brookings Email

Attachment D

Re: Data posted to form 1 of http://www.criticaltowers.com/Contact Us/Contact Us.htm

Keith Clark <wa1hzk@usa.net> Tue, Apr 21, 2015 at 8:59 AM
Reply-To: wa1hzk@usa.net
To: Donna Colby-Hanks <dcolbyhanks@brookings.or.us>

OK
That spec will not allow towers. You will only be allowing the people that can spend a fortune to be able to erect towers. I have personally had experience with crank up towers and would not take one as a gift. When it failed it would have killed me if I was standing 10 feet closer to it and if I happened to be working on it when the cable snapped, I would have lost both hands and both feet. ROHN has decided to never venture into manufacturing these and they are the largest manufacturer in the world. This is a very bad idea and if I lived there I would be contacting the legal departments of the ARRL to challenge such a bad ordinance.
Sorry for the rant but these kinds of rules make me crazy and get people hurt after they pay four times what they should for a Federally protected hobby.
Keith Clark
WA1HZK, (Ham Operator since 1967)

Check these links out. This battle was settled in Federal Courts all over the Country already.

http://wireless.fcc.gov/services/index.htm?job=prb-1&id=amateur&page=1

http://www.arrl.org/restrictive-antenna-ordinances

http://www.arrl.org/local

http://www.wileyrein.com/publications.cfm?sp=articles&id=4290

http://napavalleyregister.com/news/local/city-puts-curbs-on-towering-backyard-antenna/article_5334bf10-d5df-5133-b27b-616e8e065651.html

http://articles.chicagotribune.com/2004-09-23/news/0409230264_1_radio-tower-ham-radio-height-limit
[Quoted text hidden]
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ARRL The national association for AMATEUR RADIO

QST OFFICIAL JOURNAL

Section Manager

November 11, 2014

Planning Commission
City of Brookings
898 Elk Drive
Brookings OR 97415-9648

RE: Amateur Radio Antenna Proposal

Planning Commissioners:

I am writing in support of the antenna proposal before you for consideration. I serve as the American Radio Relay League (ARRL) Section Manager for the State of Oregon. The ARRL is the National Association for Amateur Radio and sponsor of the Amateur Radio Emergency Services (ARES) program in the United States. Many of the nearly 18,000 amateur radio licensees in Oregon are associated with ARES. They volunteer their time and personal stations for local and regional emergency communication. Often they are the first to provide links outside the emergency area. When all else fails, they are there to provide life-saving communication.

The proposed height for Amateur Radio antenna system towers will significantly enhance effective communication reliability. The benefit of an adequate antenna system, is critical in a disaster situation. In my personal service, I have served during fire, flood, and earthquake emergencies. The adequacy of the antenna system was a key to effective amateur radio emergency service.

I am an FCC licensed Amateur Radio Operator hold call sign W6ABM. First licensed in 1956, I am a Life Member of the ARRL and have been a resident of Coos and Washington Counties for more than thirty-six years. I have been actively involved in emergency communication drills in order to be a competent communicator. The dedication of amateur radio operators in Curry County is a model for all citizen volunteers. I support this reasonable request and am available to you if you wish further information on the ARRL and ARES.

Yours,

Everett Curry W6ABM
Oregon Section Manager
1546 NE Greensword Dr
Hillsboro OR 97124-6139
Phone: (503) 522-7142
Email: w6abm@arrl.org

Attachment E

Antenna Height and Communications Effectiveness

Second Edition

A Guide for City Planners and Amateur Radio Operators

By R. Dean Straw, N6BV, and Gerald L. Hall, K1TD
Senior Assistant Technical Editor and Retired Associate Technical Editor

The American Radio Relay League, Inc.
225 Main Street
Newington, CT 06111

Executive Summary

Amateur radio operators, or "hams" as they are called, communicate with stations located all over the world. Some contacts may be local in nature, while others may be literally halfway around the world. Hams use a variety of internationally allocated frequencies to accomplish their communications.

Except for local contacts, which are primarily made on Very High and Ultra High Frequencies (VHF and UHF), communicating between any two points on the earth rely primarily on high-frequency (HF) signals propagating through the ionosphere. The earth's ionosphere acts much like a mirror at heights of about 150 miles. The vertical angle of radiation of a signal launched from an antenna is one of the key factors determining effective communication distances. The ability to communicate over long distances generally requires a low radiation angle, meaning that an antenna must be placed high above the ground in terms of the wavelength of the radio wave being transmitted.

A beam type of antenna at a height of 70 feet or more will provide greatly superior performance over the same antenna at 35 feet, all other factors being equal. A height of 120 feet or even higher will provide even more advantages for long-distance communications. To a distant receiving station, a transmitting antenna at 120 feet will provide the effect of approximately 8 to 10 times more transmitting power than the same antenna at 35 feet. Depending on the level of noise and interference, this performance disparity is often enough to mean the difference between making distant radio contact with fairly reliable signals, and being unable to make distant contact at all.

Radio Amateurs have a well-deserved reputation for providing vital communications in emergency situations, such as in the aftermath of a severe icestorm, a hurricane or an earthquake. Short-range communications at VHF or UHF frequencies also require sufficient antenna heights above the local terrain to ensure that the antenna has a clear horizon.

In terms of safety and aesthetic considerations, it might seem intuitively reasonable for a planning board to want to restrict antenna installations to low heights. However, such height restrictions often prove very counterproductive and frustrating to all parties involved. If an amateur is restricted to low antenna heights, say 35 feet, he will suffer from poor transmission of his own signals as well as poor reception of distant signals. In an attempt to compensate on the transmitting side (he can't do anything about the poor reception problem), he might boost his transmitted power, say from 150 watts to 1,500 watts, the maximum legal limit. This ten-fold increase in power will very significantly increase the *potential* for interference to telephones, televisions, VCRs and audio equipment in his neighborhood.

Instead, if the antenna can be moved farther away from neighboring electronic devices—putting it higher, in other words—this will greatly reduce the likelihood of interference, which decreases at the inverse square of the distance. For example, doubling the distance reduces the potential for interference by 75%. As a further benefit, a large antenna doesn't look anywhere near as large at 120 feet as it does close-up at 35 feet.

As a not-so-inconsequential side benefit, moving an antenna higher will also greatly reduce the potential of exposure to electromagnetic fields for neighboring human and animals. Interference and RF exposure standards have been thoroughly covered in recently enacted Federal Regulations.

Antenna Height and Communications Effectiveness

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The purpose of this paper is to provide general information about communications effectiveness as related to the physical height of antennas. The intended audience is amateur radio operators and the city and town Planning Boards before which a radio amateur must sometimes appear to obtain building permits for radio towers and antennas.

The performance of horizontally polarized antennas at heights of 35, 70 and 120 feet is examined in detail. Vertically polarized arrays are not considered here because at short-wave frequencies, over average terrain and at low radiation angles, they are usually less effective than horizontal antennas.

Ionospheric Propagation

Frequencies between 3 and 30 megahertz (abbreviated MHz) are often called the "short-wave" bands. In engineering terms this range of frequencies is defined as the *high-frequency* or *HF* portion of the radio spectrum. HF radio communications between two points that are separated by more than about 15 to 25 miles depend almost solely on propagation of radio signals through the *ionosphere*. The ionosphere is a region of the Earth's upper atmosphere that is ionized primarily by ultraviolet rays from the Sun.

The Earth's ionosphere has the property that it will refract or bend radio waves passing through it. The ionosphere is not a single "blanket" of ionization. Instead, for a number of complex reasons, a few discrete layers are formed at different heights above the earth. From the standpoint of radio propagation, each ionized layer has distinctive characteristics, related primarily to different amounts of ionization in the various layers. The ionized layer that is most useful for HF radio communication is called the *F layer*.

The F layer exists at heights varying from approximately 130 to 260 miles above the earth's surface. Both the layer height and the amount of ionization depend on the latitude from the equator, the time of day, the season of the year, and on the level of sunspot activity. Sunspot activity varies generally in cycles that are approximately 11 years in duration, although short-term bursts of activity may create changes in propagation conditions that last anywhere from a few minutes to several days. The ionosphere is not homogeneous, and is undergoing continual change. In fact, the exact state of the ionosphere at any one time is so variable that is best described in statistical terms.

The F layer disappears at night in periods of low and medium solar activity, as the ultraviolet energy required to sustain ionization is no longer received from the Sun. The amount that a passing radio wave will bend in an ionospheric layer is directly related to the intensity of ionization in that layer, and to the frequency of the radio wave.

A triangle may be used to portray the cross-sectional path of ionospheric radio-wave travel, as shown in **Fig 1**, a highly simplified picture of what happens in propagation of radio waves. The base of the triangle is the surface of the Earth between two distant points, and the apex of the triangle is the point representing refraction in the ionosphere. If all the necessary conditions are

met, the radio wave will travel from the first point on the Earth's surface to the ionosphere, where it will be bent (*refracted*) sufficiently to travel to the second point on the earth, many hundreds of miles away.

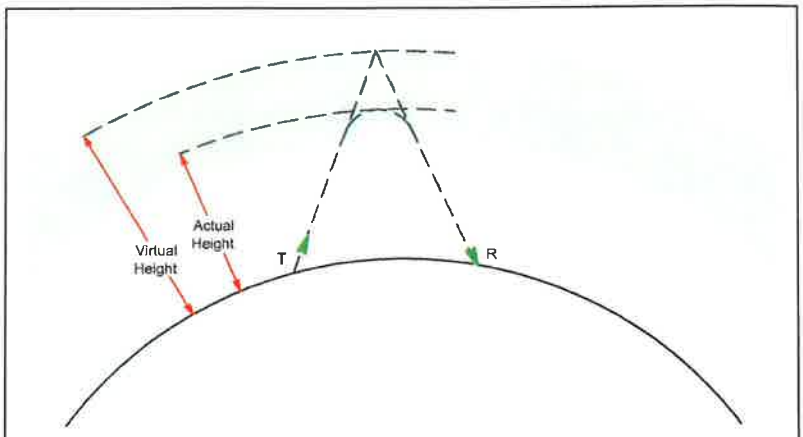


Fig 1—A simplified cross-sectional representation of ionospheric propagation. The simple triangle goes from the Transmitter T up to the virtual height and then back down to the Receiver R. Typically the F layer exists at a height of 150 miles above the Earth at mid-latitudes. The distance between T and R may range from a few miles to 2500 miles under normal propagation conditions.

Of course the Earth's surface is not a flat plane, but instead is curved. High-frequency radio waves behave in essentially the same manner as light waves—they tend to travel in straight lines, but with a slight amount of downward bending caused by refraction in the air. For this reason it is not possible to communicate by a direct path over distances greater than about 15 to 25 miles in this frequency range, slightly farther than the optical horizon. The curvature of the earth causes the surface to "fall away" from the path of the radio wave with greater distances. Therefore, it is the ionosphere that permits HF radio communications to be made between points separated by hundreds or even thousands of miles. The range of frequencies from 3 to 30 MHz is unique in this respect, as ionospheric propagation is not consistently supported for any frequencies outside this range.

One of the necessary conditions for ionospheric communications is that the radio wave must encounter the ionosphere at the correct angle. This is illustrated in **Fig 2**, another very simplified drawing of the geometry involved. Radio waves leaving the earth at high elevation angles above the horizon may receive only very slight bending due to refraction, and are then lost to outer space. For the same fixed frequency of operation, as the elevation angle is lowered toward the horizon, a point is reached where the bending of the wave is sufficient to return the wave to the Earth. At successively lower angles, the wave returns to the Earth at increasing distances.

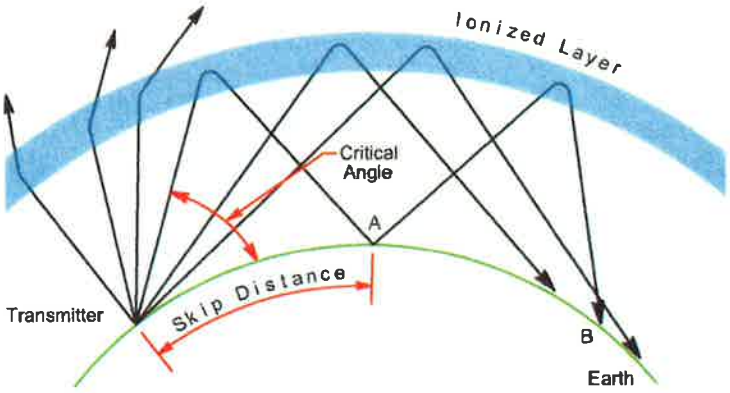


Fig 2—Behavior of radio waves encountering the ionosphere. Rays entering the ionized region at angles above the critical angle are not bent enough to return to Earth and are lost to space. Waves entering at angles below the critical angle reach the Earth at increasingly greater distances as the angle approaches the horizontal. The maximum distance that may normally be covered in a single hop is 2500 miles. Greater distances may be covered with multiple hops.

If the radio wave leaves the earth at an *elevation angle* of zero degrees, just toward the horizon (or just tangent to the earth's surface), the maximum distance that may be reached under usual ionospheric conditions is approximately 2,500 miles (4,000 kilometers). However, the Earth itself also acts as a reflector of radio waves coming down from the ionosphere. Quite often a radio signal will be reflected from the reception point on the Earth back into the ionosphere again, reaching the Earth a second time at a still more distant point.

As in the case of light waves, the angle of reflection is the same as the angle of incidence, so a wave striking the surface of the Earth at an angle of, say, 15° is reflected upward from the surface at the same angle. Thus, the distance to the second point of reception will be approximately twice the distance of the first. This effect is also illustrated in Fig 2, where the signal travels from the transmitter at the left of the drawing via the ionosphere to Point A, in the center of the drawing. From Point A the signal travels via the ionosphere again to Point B, at the right. A signal traveling from the Earth through the ionosphere and back to the Earth is called a *hop*. Under some conditions it is possible for as many as four or five signal hops to occur over a radio path, but no more than two or three hops is the norm. In this way, HF communications can be conducted over thousands of miles.

With regard to signal hopping, two important points should be recognized. First, a significant loss of signal occurs with each hop. Lower layers of the ionosphere absorb energy from the signals as they pass through, and the ionosphere tends to scatter the radio energy in various directions, rather than confining it to a tight bundle. The earth also scatters the energy at a reflection point. Thus, only a small fraction of the transmitted energy actually reaches a distant receiving point.

Again refer to Fig 2. Two radio paths are shown from the transmitter to Point B, a one-hop path and a two-hop path. Measurements indicate that although there can be great variation in the ratio of the two signal strengths in a situation such as this, the signal power received at Point B will generally be from five to ten times greater for the one-hop wave than for the two-hop wave. (The terrain at the mid-path reflection point for the two-hop wave, the angle at which the wave is reflected from the earth, and the condition of the ionosphere in the vicinity of all the refraction points are the primary factors in determining the signal-strength ratio.) Signal levels are generally compared in decibels, abbreviated dB. The decibel is a logarithmic unit. Three decibels difference in signal strengths is equivalent to a power ratio of 2:1; a difference of 10 dB equates to a power ratio of 10:1. Thus the signal loss for an additional hop is about 7 to 10 dB.

The additional loss per hop becomes significant at greater distances. For a simplified example, a distance of 4,000 miles can be covered in two hops of 2,000 miles each or in four hops of 1,000 miles each. For illustration, assume the loss for additional hops is 10 dB, or a 1/10 power ratio. Under such conditions, the four-hop signal will be received with only 1/100 the power or 20 dB below that received in two hops. The reason for this is that only 1/10 of the two-hop signal is received for the first additional (3^{rd}) hop, and only 1/10 of that 1/10 for the second additional (4^{th}) hop. It is for this reason that no more than four or five propagation hops are useful; the received signal eventually becomes too weak to be heard.

The second important point to be recognized in multihop propagation is that the geometry of the first hop establishes the geometry for all succeeding hops. And it is the elevation angle at the transmitter that sets up the geometry for the first hop.

It should be obvious from the preceding discussion that one needs a detailed knowledge of the range of elevation angles for effective communication in order to do a scientific evaluation of a possible communications circuit. The range of angles should be statistically valid over the full 11-year solar sunspot cycle, since the behavior of the Sun determines the changes in the nature of the Earth's ionosphere. ARRL did a very detailed computer study in the early 1990s to determine the angles needed for propagation throughout the world. The results of this study will be examined later, after we introduce the relationship between antenna height and the elevation pattern for an antenna.

Horizontal Antennas Over Flat Ground

A simple antenna that is commonly used for HF communications is the horizontal half-wave *dipole*. The dipole is a straight length of wire (or tubing) into which radio-frequency energy is fed at the center. Because of its simplicity, the dipole may be easily subjected to theoretical performance analyses. Further, the results of proper analyses are well borne out in practice. For these reasons, the half-wave dipole is a convenient performance standard against which other antenna systems can be compared.

Because the earth acts as a reflector for HF radio waves, the directive properties of any antenna are modified considerably by the ground underneath it. If a dipole antenna is placed horizontally above the ground, most of the energy radiated downward from the dipole is

reflected upward. The reflected waves combine with the direct waves (those radiated at angles above the horizontal) in various ways, depending on the height of the antenna, the frequency, and the electrical characteristics of the ground under and around the antenna.

At some vertical angles above the horizon, the direct and reflected waves may be exactly in phase—that is, the maximum signal or field strengths of both waves are reached at the same instant at some distant point. In this case the resultant field strength is equal to the sum of the two components. At other vertical angles the two waves may be completely out of phase at some distant point—that is, the fields are maximum at the same instant but the phase directions are opposite. The resultant field strength in this case is the difference between the two. At still other angles the resultant field will have intermediate values. Thus, the effect of the ground is to increase the intensity of radiation at some vertical angles and to decrease it at others. The elevation angles at which the maxima and minima occur depend primarily on the antenna height above ground. (The electrical characteristics of the ground have some slight effect too.)

For simplicity here, we consider the ground to be a perfectly conducting, perfectly flat reflector, so that straightforward trigonometric calculations can be made to determine the relative amount of radiation intensity at any vertical angle for any dipole height. Graphs from such calculations are often plotted on rectangular axes to show best resolution over particularly useful ranges of elevation angles, although they are also shown on polar plots so that both the front and back of the response can be examined easily. **Fig 3** shows an overlay of the polar elevation-pattern responses of two dipoles at different heights over perfectly conducting flat ground. The lower dipole is located a half wavelength above ground, while the higher dipole is located one wavelength above ground. The pattern of the lower antenna peaks at an elevation angle of about 30°, while the higher antenna has two main lobes, one peaking at 15° and the other at about 50° elevation angle.

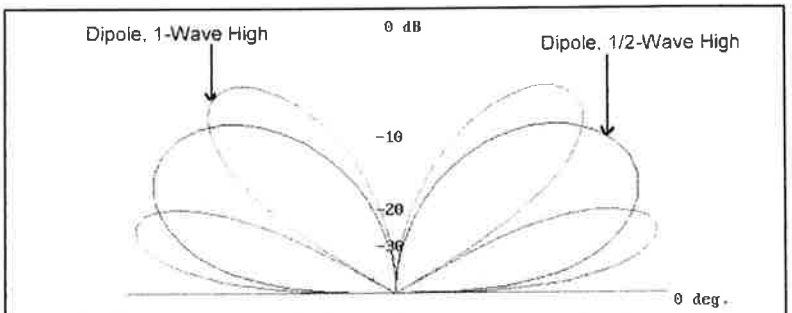


Fig 3–Comparison of elevation responses for two dipoles: one ½-wavelength high, and the other 1-wavelength high.

In the plots shown in Fig 3, the elevation angle above the horizon is represented in the same fashion that angles are measured on a protractor. The concentric circles are calibrated to represent ratios of field strengths, referenced to the strength represented by the outer circle. The circles are calibrated in decibels. Diminishing strengths are plotted toward the center.

You may have noted that antenna heights are often discussed in terms of *wavelengths*. The reason for this is that the length of a radio wave is inversely proportional to its frequency. Therefore a fixed physical height will represent different electrical heights at different radio frequencies. For example, a height of 70 feet represents one wavelength at a frequency of 14 MHz. But the same 70-foot height represents a half wavelength for a frequency of 7 MHz and only a quarter wavelength at 3.5 MHz. On the other hand, 70 feet is 2 wavelengths high at 28 MHz.

The lobes and nulls of the patterns shown in Fig 3 illustrate what was described earlier, that the effect of the ground beneath an antenna is to increase the intensity of radiation at some vertical elevation angles and to decrease it at others. At a height of a half wavelength, the radiated energy is strongest at a rather high elevation angle of 30°. This would represent the situation for a 14-MHz dipole 35 feet off the ground.

As the horizontal antenna is raised to greater heights, additional lobes are formed, and the lower ones move closer to the horizon. The maximum amplitude of each of the lobes is roughly equal. As may be seen in Fig 3, for an antenna height of one wavelength, the energy in the lowest lobe is strongest at 15°. This would represent the situation for a 14-MHz dipole 70 feet high.

The elevation angle of the lowest lobe for a horizontal antenna above perfectly conducting ground may be determined mathematically:

$$\theta = \sin^{-1}\left(\frac{0.25}{h}\right)$$

Where

θ = the wave or elevation angle
h = the antenna height above ground in wavelengths

In short, the higher the horizontal antenna, the lower is the lowest lobe of the pattern. As a very general rule of thumb, the higher an HF antenna can be placed above ground, the farther it will provide effective communications because of the resulting lower radiation angle. This is true for any horizontal antenna over real as well as theoretically perfect ground.

You should note that the *nulls* in the elevation pattern can play an important role in communications—or lack of communication. If a signal arrives at an angle where the antenna system exhibits a deep null, communication effectiveness will be greatly reduced. It is thus quite possible that an antenna can be *too high* for good communications efficiency on a particular frequency. Although this rarely arises as a significant problem on the amateur bands below 14 MHz, we'll discuss the subject of optimal height in more detail later.

Actual earth does not reflect all the radio-frequency energy striking it; some absorption takes place. Over real earth, therefore, the patterns will be slightly different than those shown in Fig 3, however the differences between theoretical and perfect earth ground are not significant for the range of elevation angles necessary for good HF communication. Modern computer programs can do accurate evaluations, taking all the significant ground-related factors into account.

Beam Antennas

For point-to-point communications, it is beneficial to concentrate the radiated energy into a beam that can be aimed toward a distant point. An analogy can be made by comparing the light

from a bare electric bulb to that from an automobile headlight, which incorporates a built-in focusing lens. For illuminating a distant point, the headlight is far more effective.

Antennas designed to concentrate the radiated energy into a beam are called, naturally enough, *beam antennas*. For a fixed amount of transmitter power fed to the transmitting antenna, beam antennas provide increased signal strength at a distant receiver. In radio communications, the use of a beam antenna is also beneficial during reception, because the antenna pattern for transmission is the same for reception. A beam antenna helps to reject signals from unwanted directions, and in effect boosts the strength of signals received from the desired direction.

The increase in signal or field strength a beam antenna offers is frequently referenced to a dipole antenna in free space (or to another theoretical antenna in free space called an *isotropic antenna*) by a term called *gain*. Gain is commonly expressed in decibels. The isotropic antenna is defined as being one that radiates equally well in all directions, much like the way a bare lightbulb radiates essentially equally in all directions.

One particularly well known type of beam antenna is called a *Yagi*, named after one of its Japanese inventors. Different varieties of Yagi antennas exist, each having somewhat different characteristics. Many television antennas are forms of multi-element Yagi beam antennas. In the next section of this paper, we will refer to a four-element Yagi, with a gain of 8.5 dBi in free space, exclusive of any influence due to ground.

This antenna has 8.5 dB more gain than an isotropic antenna in free space and it achieves that gain by squeezing the pattern in certain desired directions. Think of a normally round balloon and imagine squeezing that balloon to elongate it in one direction. The increased length in one direction comes at the expense of length in other directions. This is analogous to how an antenna achieves more signal strength in one direction, at the expense of signal strength in other directions.

The elevation pattern for a Yagi over flat ground will vary with the electrical height over ground in exactly the same manner as for a simpler dipole antenna. The Yagi is one of the most common antennas employed by radio amateurs, second in popularity only to the dipole.

Putting the Pieces Together

In **Fig 4**, the elevation angles necessary for communication from a particular transmitting site, in Boston, Massachusetts, to the continent of Europe using the 14-MHz amateur band are shown in the form of a bargraph. For each elevation angle from 1° to 30°, Fig 4 shows the percentage of time when the 14-MHz band is open at each elevation angle. For example, 5° is the elevation angle that occurs just over 12% of the time when the band is available for communication, while 11° occurs about 10% of the time when the band is open. The useful range of elevation angles that must accommodated by an amateur station wishing to talk to Europe from Boston is from 1° to 28°.

In addition to the bar-graph elevation-angle statistics shown in Fig 4, the elevation pattern responses for three Yagi antennas, located at three different heights above flat ground, are overlaid on the same graph. You can easily see that the 120-foot antenna is the best antenna to cover the most likely angles for this particular frequency, although it suffers at the higher elevation angles on this particular propagation path, beyond about 12°. If, however, you can accept somewhat lower gain at the lowest angles, the 70-foot antenna would arguably be the best overall choice to cover all the elevation angles.

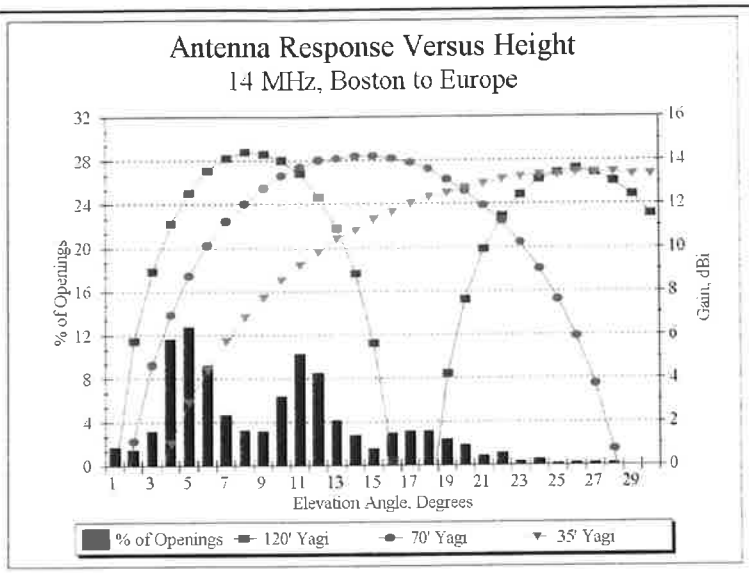


Fig 4—Elevation response patterns of three Yagis at 120, 70 and 35 feet, at 14 MHz over flat ground. The patterns are overlaid with the statistical elevation-angles for the path from Boston to continental Europe over the entire 11-year solar sunspot cycle. Clearly, the 120-foot antenna is the best choice to cover the low angles needed, but it suffers some at higher angles.

Other graphs are needed to show other target receiving areas around the world. For comparison, **Fig 5** is also for the 14-MHz band, but this time from Boston to Sydney, Australia. The peak angle for this very long path is about 2°, occurring 19% of the time when the band is actually open for communication. Here, even the 120-foot high antenna is not ideal. Nonetheless, at a moderate 5° elevation angle, the 120-foot antenna is still 10 dB better than the one at 35 feet.

Fig 4 and Fig 5 have portrayed the situation for the 14-MHz amateur band, the most popular and heavily utilized HF band used by radio amateurs. During medium to high levels of solar sunspot activity, the 21 and 28-MHz amateur bands are open during the daytime for long-distance communication. **Fig 6** illustrates the 28-MHz elevation-angle statistics, compared to the elevation patterns for the same three antenna heights shown in Fig 5. Clearly, the elevation response for the 120-foot antenna has a severe (and undesirable) null at 8°. The 120-foot antenna is almost 3.4 wavelengths high on 28 MHz (whereas it is 1.7 wavelengths high on 14 MHz.) For many launch angles, the 120-foot high Yagi on 28 MHz would simply be too high.

The radio amateur who must operate on a variety of frequencies might require two or more towers at different heights to maintain essential elevation coverage on all the authorized bands. Antennas can sometimes be mounted at different heights on a single supporting tower, although it is more difficult to rotate antennas that are "vertically stacked" around the tower to point in all the needed directions. Further, closely spaced antennas tuned to different frequencies usually interact electrically with each other, often causing severe performance degradation.

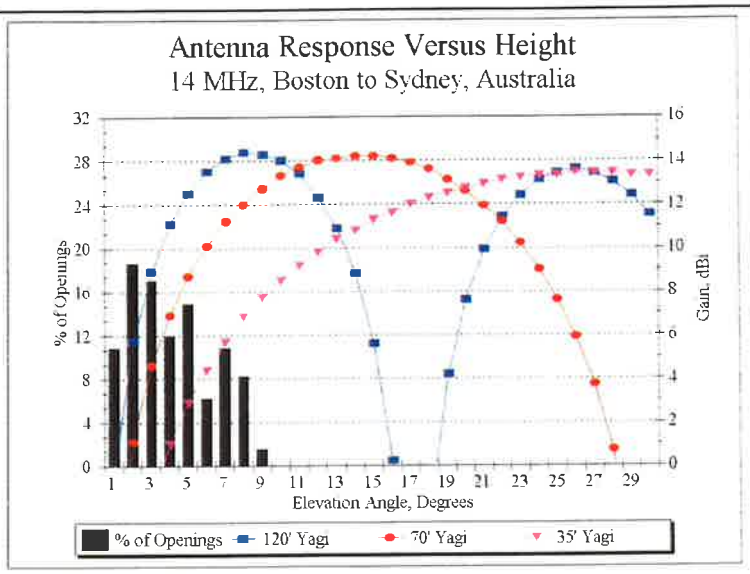


Fig 5—Elevation responses for same antennas as Fig 4, but for a longer-range path from Boston to Sydney, Australia. Note that the prevailing elevation angles are very low.

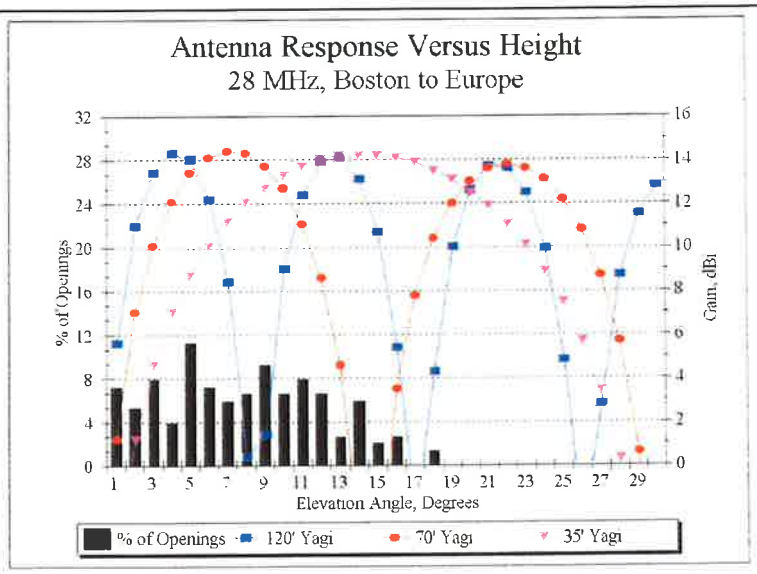


Fig 6—Elevation angles compared to antenna responses for 28-MHz path from Boston to Europe. The 70-foot antenna is probably the best overall choice on this path.

During periods of low to moderate sunspot activity (about 50% of the 11-year solar cycle), the 14-MHz band closes down for propagation in the early evening. A radio amateur wishing to continue communication must shift to a lower frequency band. The next most highly used band below the 14-MHz band is the 7-MHz amateur band. **Fig 7** portrays a 7-MHz case for another transmitting site, this time from San Francisco, California, to the European continent. Now, the range of necessary elevation angles is from about 1° to 16°, with a peak statistical likelihood of about 16% occurring at an elevation of 3°. At this low elevation angle, a 7-MHz antenna must be *very* high in the air to be effective. Even the 120-foot antenna is hardly optimal for the peak angle of 3°. The 200-foot antenna shown would be far better than a 120-foot antenna. Further, the 35-foot high antenna is *greatly* inferior to the other antennas on this path and would provide far less capabilities, on both receiving and transmitting.

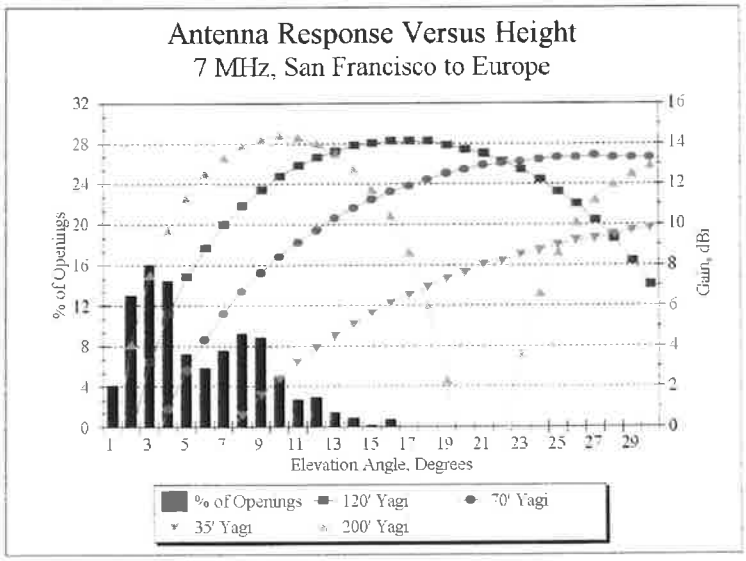


Fig 7—Comparison of antenna responses for another propagation path: from San Francisco to Europe on 7 MHz. Here, even a 120-foot high antenna is hardly optimal for the very low elevation angles required on this very long path. In fact, the 200-foot high antenna is far better suited for this path.

What If the Ground Isn't Flat?

In the preceding discussion, antenna radiation patterns were computed for antennas located over *flat ground*. Things get much more complicated when the exact local terrain surrounding a tower and antenna are taken into account. In the last few years, sophisticated ray-tracing computer models have become available that can calculate the effect that local terrain has on the elevation patterns for real-world HF installations—and *each* real-world situation is indeed different.

For simplicity, first consider an antenna on the top of a hill with a constant slope downward. The general effect is to lower the effective elevation angle by an amount equal to the downslope of the hill. For example, if the downslope is –3° for a long distance away from the tower and the flat-ground peak elevation angle is 10° (due to the height of the antenna), then the net result will be 10° – 3° = 7° peak angle. However, if the local terrain is rough, with many bumps and valleys in the desired direction, the response can be modified considerably. **Fig 8** shows the fairly complicated terrain profile for Jan Carman, K5MA, in the direction of Japan. Jan is located on one of the tallest hills in West Falmouth, Massachusetts. Within 500 feet of his tower is a small hill with a water tower on the top, and then the ground quickly falls away, so that at a distance of about 3000 feet from the tower base, the elevation has fallen to sea level, at 0 feet.

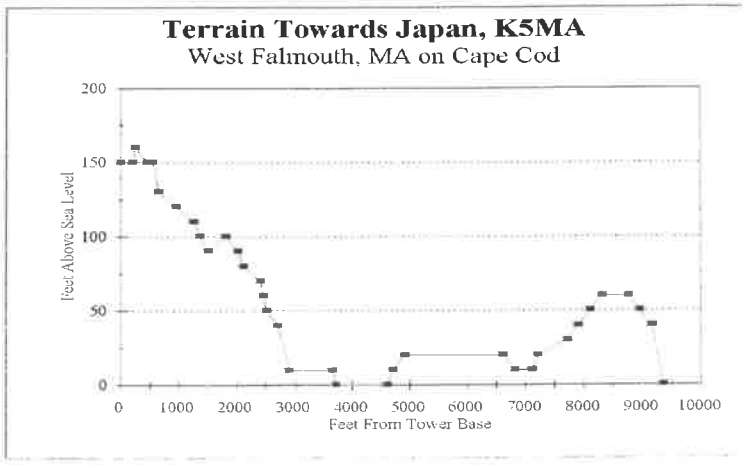


Fig 8—Terrain profile from location of K5MA, Jan Carman, in West Falmouth, MA, towards Japan. This is a moderately complicated real-world terrain on one of the highest hills on Cape Cod.

The computed responses toward Japan from this location, using a 120- and a 70-foot high Yagi, are shown in **Fig 9**, overlaid for comparison with the response for a 120-foot Yagi over flat ground. Over this particular terrain, the elevation pattern for the 70-foot antenna is actually better than that of the 120-foot antenna for angles below about 3°, but not for medium angles! The responses for each height oscillate around the pattern for flat ground — all due to the complex reflections and diffractions occurring off the terrain.

At an elevation angle of 5°, the situation reverses itself and the gain is now higher for the 120-foot-high antenna than for the 70-foot antenna. A pair of antennas on one tower would be required to cover all the angles properly. To avoid any electrical interactions between similar antennas on one tower, two towers would be much better. Compared to the flat-ground situation, the responses of real-world antenna can be very complicated due to the interactions with the local terrain.

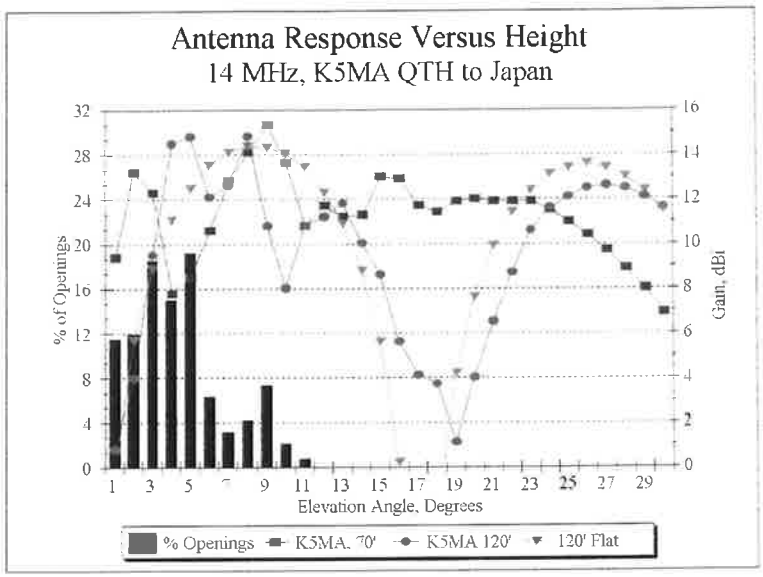


Fig 9—Computed elevation responses of 120- and 70-foot high Yagis, at the K5MA location on Cape Cod, in the direction of Japan and over flat ground, for comparison. The elevation response of the real-world antenna has been significantly modified by the local terrain.

Fig 10 shows the situation for the same Cape Cod location, but now for 7 MHz. Again, it is clear that the 120-foot high Yagi is superior by at least 3 dB (equivalent to twice the power) to the 70-foot high antenna at the statistical elevation angle of 6°. However, the response of the real-world 120-foot high antenna is still up some 2 dB from the response for an identical antenna over flat ground at this angle. On this frequency, the local terrain has helped boost the gain at the medium angles more than a similar antenna 120 feet over flat ground. The gain is even greater at lower angles, say at 1° elevation, where most signals take off, statistically speaking. Putting the antenna up higher, say 150 feet, will help the situation at this location, as would adding an additional Yagi at the 70-foot level and feeding both antennas in phase as a vertical stack.

Although the preceding discussion has been in terms of the transmitting antenna, the same principles apply when the antenna is used for reception. A high antenna will receive low-angle signals more effectively than will a low antenna. Indeed, amateur operators know very well that "If you can't hear them, you can't talk to them." Stations with tall towers can usually hear far better than their counterparts with low installations.

The situation becomes even more difficult for the next lowest amateur band at 3.5 MHz, where optimal antenna heights for effective long-range communication become truly heroic! Towers that exceed 120 feet are commonplace among amateurs wishing to do serious 3.5-MHz long-distance work.

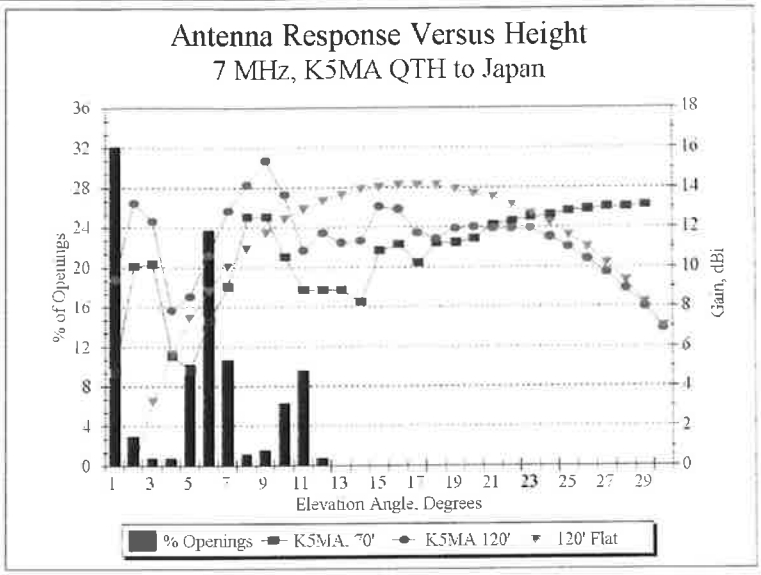


Fig 10—Elevation response on 7 MHz from K5MA location towards Japan on 7 MHz. The 120-foot high Yagi is definitely superior to the one only 70-feet high.

The 3.5 and 7-MHz amateur bands are, however, not always used strictly for long-range work. Both bands are crucial for providing communications throughout a local area, such as might be necessary in times of a local emergency. For example, earthquakes, tornadoes and hurricanes have often disrupted local communications—because telephone and power lines are down and because local police and fire-department VHF/UHF repeaters are thus knocked out of action. Radio amateurs often will use the 3.5 and 7-MHz bands to provide communications out beyond the local area affected by the disaster, perhaps into the next county or the next metropolitan area. For example, an earthquake in San Francisco might see amateurs using emergency power providing communications through amateurs in Oakland across the San Francisco Bay, or even as far away as Los Angeles or Sacramento. These places are where commercial power and telephone lines are still intact, while most power and telephones might be down in San Francisco itself. Similarly, a hurricane that selectively destroys certain towns on Cape Cod might find amateurs in these towns using 3.5 or 7.0 MHz to contact their counterparts in Boston or New York.

However, in order to get the emergency messages through, amateurs must have effective antennas. Most such relatively local emergency situations require towers of moderate height, less than about 100 feet tall typically.

Antenna Height and Interference

Extensive Federal Regulations cover the subject of interference to home electronic devices. It is an unfortunate fact of life, however, that many home electronic devices (such as stereos, TVs, telephones and VCRs) do not meet the Federal standards. They are simply inadequately designed to be resistant to RF energy in their vicinity. Thus, a perfectly legal amateur-radio transmitter may cause interference to a neighbor's VCR or TV because cost-saving shortcuts were taken in

the design and manufacture of these home entertainment devices. Unfortunately, it is difficult to explain to an irate neighbor why his brand-new $1000 stereo is receiving the perfectly legitimate transmissions by a nearby radio operator.

The potential for interference to any receiving device is a function of the transmitter power, transmitter frequency, receiver frequency, and most important of all, the proximity of the transmitter to the potential receiver. The transmitted field intensity decreases as the inverse square of the distance. This means that doubling the height of an antenna from 35 to 70 feet will reduce the potential for interference by 75%. Doubling the height again to 140 feet high would reduce the potential another 75%. Higher is better to prevent interference in the first place!

Recently enacted Federal Regulations address the potential for harm to humans because of exposure to electromagnetic fields. Amateur-radio stations rarely have problems in this area, because they use relatively low transmitting power levels and intermittent duty cycles compared to commercial operations, such as TV or FM broadcast stations. Nevertheless, the potential for RF exposure is again directly related to the distance separating the transmitting antenna and the human beings around it. Again, doubling the height will reduce potential exposure by 75%. The higher the antenna, the less there will any potential for significant RF exposure.

THE WORLD IS A VERY COMPLICATED PLACE

It should be pretty clear by now that designing scientifically valid communication systems is an enormously complex subject. The main complications come from the vagaries of the medium itself, the Earth's ionosphere. However, local terrain can considerably complicate the analysis also.

The main points of this paper may be summarized briefly:

The radiation elevation angle is the key factor determining effective communication distances beyond line-of-sight. Antenna height is the primary variable under control of the station builder, since antenna height affects the angle of radiation.

In general, placing an amateur antenna system higher in the air enhances communication capabilities and also reduces chances for electromagnetic interference with neighbors.

EFFECTIVE AMATEUR RADIO COMMUNICATIONS IN BROOKINGS

By Charles Ristorcelli, NN3V

Executive Summary:

This technical analysis identifies the *minimum antenna height needed for effective amateur radio communications* in Brookings, by analyzing the principal factors impacting long range radio communications.

Effective communications are a 90% probability of achieving the desired communication.

The analysis describes the components needed for a typical amateur radio station, identifies how environmental factors influence radio propagation, and then studies the technical decisions and component selection for the radio station that lead to a compromise antenna height for a licensed amateur radio operator (Ham) to effectively communicate.

The analysis assumes a Brookings Ham living on a standard lot size property, erecting at least a single permitted antenna, and desiring to operate the amateur radio station as a hobby, for experimentation, and as an emergency communication service for Brookings and Curry County residents in the event of a natural or man-made disaster.

The uncontrollable laws of physics impacting the probability of achieving effective communications are examined and are considered that they *"are what they are."*

A radio station's elevation above sea level impacts long distance effective communication. To study all possible radio location elevations in Brookings, the analysis would have to address innumerable locations. Such an effort would be nearly impossible to complete without expending tremendous resources. Therefore, this analysis uses *"smooth earth assumption."* The impact of the assumption in effect *lowers the antenna height needed.* This is considered a reasonable compromise.

Antenna height is the core issue of concern surrounding the City of Brookings' proposed amateur radio antenna ordinance. This study proves antenna height is the single most important controllable variable influencing effective communications at long distance, and technically specifies the needed compromise height.

The analysis proves that the compromise antenna height needed for effective communication in Brookings is 75 feet.

Discussion

"Effective radio communication" is achieved when there is a 90% probability of completing the communication.

In the aggregate of all possible factors influencing this situation, this is ultimately driven by five factors: the radiated power of the transmitting station antenna in the direction of the intended receiving antenna, the ionosphere, the receiver sensitivity, the receiver selectivity, and the antenna height.

The *Electromagnetic Reciprocity Theorem* states that the transmitted characteristics of an electromagnetic wave mirror those influencing its reception (Reference 1). This analysis concentrates on the transmitted signal and relies on reciprocity to apply the analysis to the received signal.

The ionosphere is a region of the upper atmosphere lying between 55 miles and 370 miles above sea level. The ionosphere contains atoms and molecules that are highly charged by solar incidence and activity.

The dominant influence on radio wave propagation is the ionosphere's condition. The ionosphere is not controllable; therefore the radio operator must be aware of its condition and choose a radio frequency suitable for the conditions and the target communication.

The ionosphere reflects and refracts HF/VHF radio waves, permitting long range communication as illustrated in Figure 1.

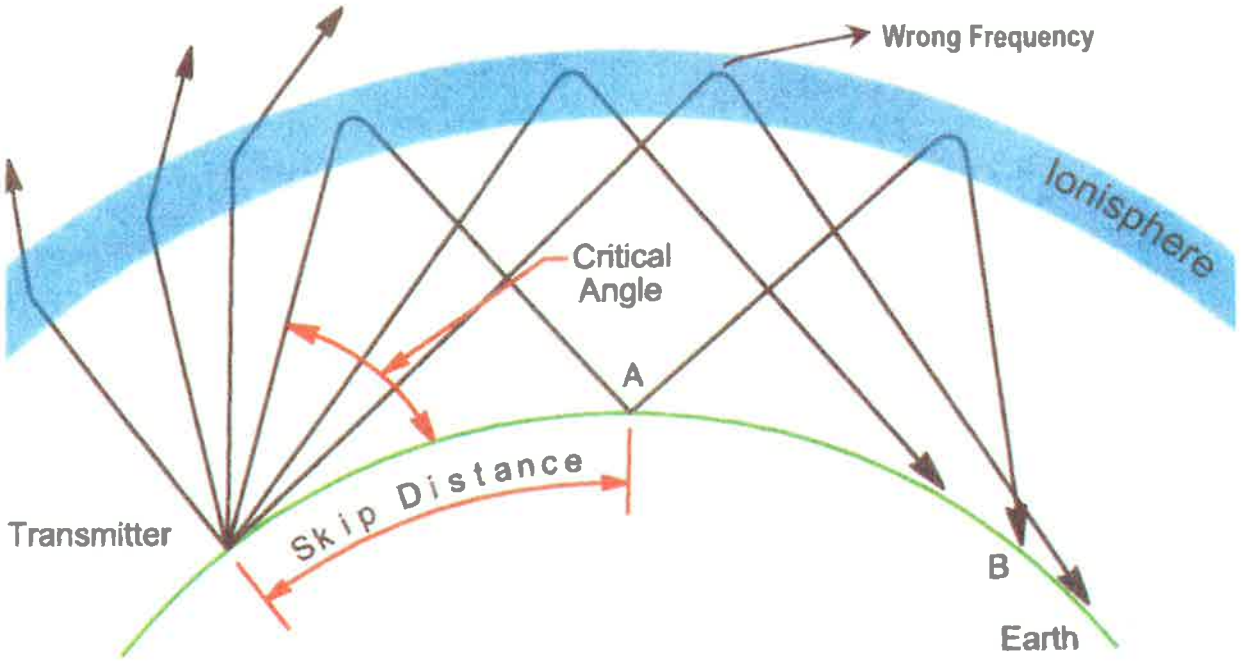


Figure 1. - Radio signal propagation paths.

As shown above, the ionosphere ***bends*** the transmitted wave directing it back to earth. Choosing the wrong frequency for a specific time of day and condition of the ionosphere does not bend the transmitted wave enough, so the signal escapes, as shown in Fig 1. With proper choices, the signal bends back down, creating one or possibly many ***hops***. Each hop covers a *"skip distance"* of about 2,500 miles. Multiple hops result in even greater communication range. The angle at which a transmitted wave leaves the antenna in order to reach a specific skip distance is called the *"critical angle."*

HF/VHF radio waves departing the antenna at or near tangent to the earth are more likely to provide the longest communication range. In the illustration in Figure 1, the signal that departs the transmitter tangent to the earth's surface is said to depart at "*zero critical elevation angle.*" It travels the farthest to reach the ionosphere.

Many other factors influence transmitted radio signals. Soil conductivity, moisture in the atmosphere, objects in the near and far fields of the propagation envelope, passing automobiles, lightning, etc. are not practically controllable by the operator. They too "***are what they are***" and must be tolerated.

Topography influences propagation. While Brookings presents innumerable hills and valleys, analyzing every possible location for a transmitter in Brookings represents an insurmountable task. This analysis assumes a smooth earth surface. This is a routine assumption for propagation studies. The result is a general lowering of antenna heights required for effective communications. For the objective of this study, this results in an acceptable compromise.

Conditions at the radio station intended as the receiver "*are what they are.*" It is presumed the receiver operator has carried out a careful selection of components, and consequently maximized the receiver station sensitivity and selectivity.

Operationally, the Brookings Ham operator will use amateur radio for long range, ground based, terrestrial, point-to-point communication. The communication will be performed without assistance from other communications technologies i.e. internet, telephony and relay points. The transmitter will be operated within its modulation and power limits. Living in the city, this operator will be situated permanently on a regular size city lot, and will design a modest cost amateur radio station.

The steps in this analysis consider the controllable environmental and operational factors influencing radio wave transmission. The Brookings Ham must deal with these influences to achieve effective communications.

Five fundamental factors must be considered to maximize any effective radio communications capability

- Antenna Type
- Antenna installation height
- Operating Radio Frequency
- Maximum Effective Transmitted Power
- Time of Day

As a hobby or experimenter, the Brookings Ham can choose any time to operate. However, we said there is interest in assuring the radio station is able to assist Brookings residents with communications in the event of an emergency or disaster (major earthquake, fire, terrorist act, etc.). So the communication may have to be at any time (365 x 24 x 7), on the amateur radio bands most commonly used for communications within the United States, or to other countries.

With limited residential property size, and considering practical and affordable amateur radio installations, this means operation on the 40 through 6 Meter amateur radio bands (HF/VHF) using at least one permitted antenna.

This is the most common amateur radio station configuration in the-world.

Long range HF/VHF communication is analogous to trying to illuminate an outdoor scene at night. You need the brightest possible light beam pointed only toward the scene, without illuminating objects outside the scene, or between the light and the scene.

There are three things the Brookings Ham can do to achieve effective communications:

1. Avoid terrain interference of the signal transmitted toward the receiver. This means avoiding hills, trees in the face of the antenna, large metal barns in front of the property, etc.

2. Maximize the station's effective transmitted signal power in the direction of the intended receiver. This is achieved by delivering the maximum possible transmitter power to the antenna, and ensuring the antenna can focus the transmitted power towards the intended receiver.

3. Minimize the departure angle of the transmitted signal radio wave toward the horizon. This is accomplished by ensuring the antenna is at the proper height above ground for the chosen operating frequency.

The technical design, and operational decisions needed to-achieve the above are analyzed in detail in what follows.

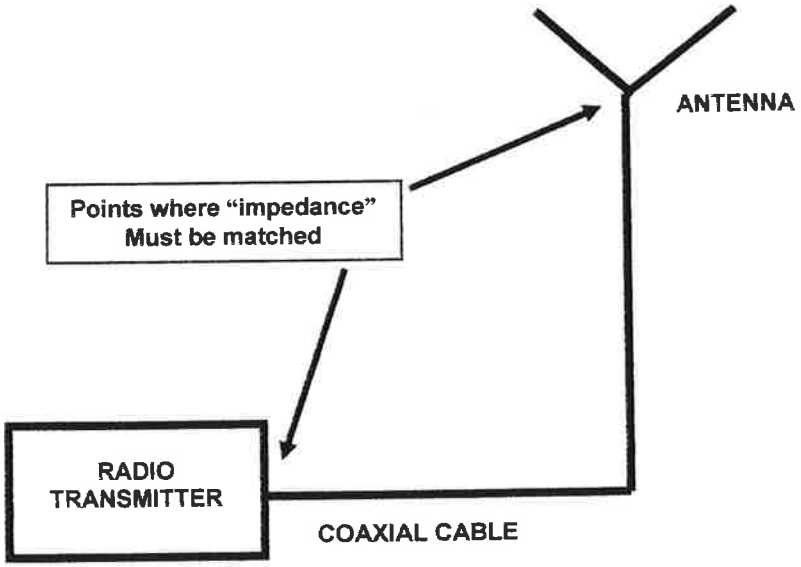


Figure 1 An amateur radio station

Figure 1 is representative of a simple amateur radio station.

To avoid propagation interference, the station should be at the highest point possible, devoid of hills, trees, and obstacles in the desired direction of propagation. For this analysis those factors are considered to be whatever they are, and we presume a *smooth earth*. The effect on the analysis at best is no impact, and at worst is to require a higher antenna installation. This is a reasonable compromise.

Maximum radio signal power in the direction of an intended receiver is achieved by three conditions: ensuring that maximum power generated by the transmitter is transferred to the transmission line (wire) to the antenna; minimizing the loss of that power along the transmission line; and selecting an appropriate antenna for maximum directive gain towards the receiver.

Power loss between the radio transmitter and antenna is minimized through proper transmitter design; transmission line choice; and minimum *Standing Wave Ratio (SWR)* on the transmission line.

A standard, commercially available amateur radio transmitter manufactured to current technology standards is the basis of the analysis. The transmitter must transfer all of its power to the antenna.

The key to this power transfer is the *transmitter output impedance.* All commonly available amateur radio transmitters and transceivers are manufactured with an output impedance of 50 ohms.

The *electromagnetic maximum power transfer theorem* shows that maximum power is transferred between a generator (transmitter) and a load (transmission line plus antenna) *when the transmitter output impedance is equal to the load impedance* (Reference 2).

In this case, the load impedance is the impedance seen by the transmitter at the transmission line input. This is a combination of the transmission line characteristic impedance plus the antenna impedance. Given the transmitter construction stated earlier, to transfer maximum power, the load impedance must be 50 ohms.

There are many available choices for connecting a transmitter to an antenna. The conditions specified for this case narrow the selection. A low visibility, easily installed, multi band capable transmission line is needed. A coaxial transmission cable fills this need. Given that the transmitter output impedance is 50 ohms, the installation requires a 50 ohm coaxial cable. Two of the most common 50 ohm coax types are RG-58 and RG-8.

Electromagnetic wave propagation along a coaxial cable will create what is known as a *"standing wave"* (Reference 3). The measure of the amount of standing wave present on a transmission line is known as the *Standing Wave Ratio (SWR)*. SWR is a measure of the efficiency of power transfer, and is determined with a commercially and readily available instrument.

While the effects of a standing wave on the operation of a transceiver and antenna are very complex, they can be best summarized by recognizing that *the lower the SWR, the higher the transmitted power and the more effective communication.*

Maximum power transfer to the antenna is achieved as shown in Reference 3 when the SWR on the line is 1 to 1 (a minimum). This takes place as predicted by the maximum

power transfer theorem, when the coaxial cable characteristic impedance matches the load (in this case the antenna) impedance. The antenna needed must present 50 ohm input impedance.

The antenna is the amateur radio station component with the greatest impact on effective communications, and antenna choices are truly innumerable. (Reference 4)

For this case, the choices are conveniently limited by the operating constraints. The antenna must be multi-band capable, in the HF/VHF range. Its characteristic impedance must match the transmission line impedance (50 ohms), and it must direct the transmitted signal toward the intended receiver.

The most common and popular antenna in amateur radio is the ½ wave center-fed dipole (Reference 4). It consists of a wire parallel to the ground, split in the center where the feed line from the transmitter is attached. The length of the wire is ½ the wavelength at the specifically transmitted frequency. An example is seen in Figure 2

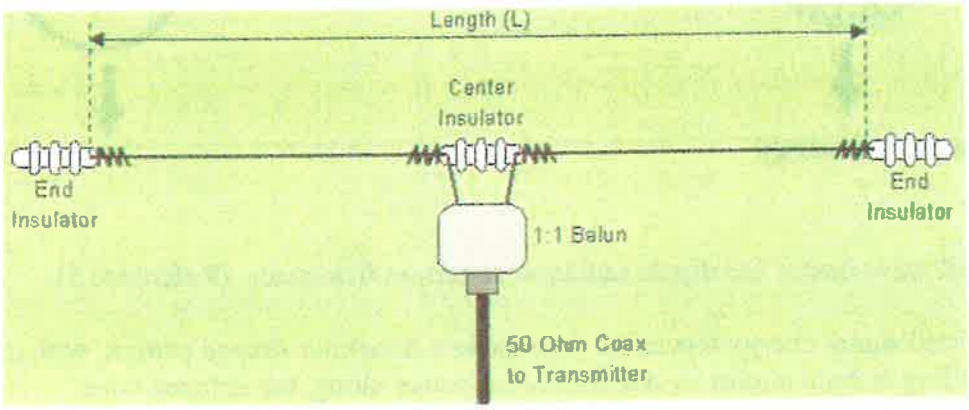


Figure 2 Illustration of a ½ wave center fed dipole antenna

While not capable of satisfying the operational need for multiband operation for the Brookings Ham, it serves to illustrate important antenna properties. At resonance, as shown in the figure, the impedance presented by the antenna at the coax to the transmitter is 50 ohms. Again, by matching impedance, the antenna will accept all the power delivered by the transmitter to the coaxial feed line.

Measurement in feet for 1 Wavelength and ½ Wavelength versus Operating Frequency (MHz)

BAND	FREQ	FW	1/2W
40M	7.1 MHz	142'	71'
30M	10.1 MHz	100'	50'
20M	14.1 MHz	71'	36'
17M	18.1 MHz	56'	28'
15M	21.2 MHz	47'	24'
12M	24.9 MHz	40'	20'
10M	28.3 MHz	36'	18'

The radiation pattern of a ½ wave center fed dipole antenna, that is, a representation of the energy dispersed from the antenna suspended in free space, is shown in Figure 3.

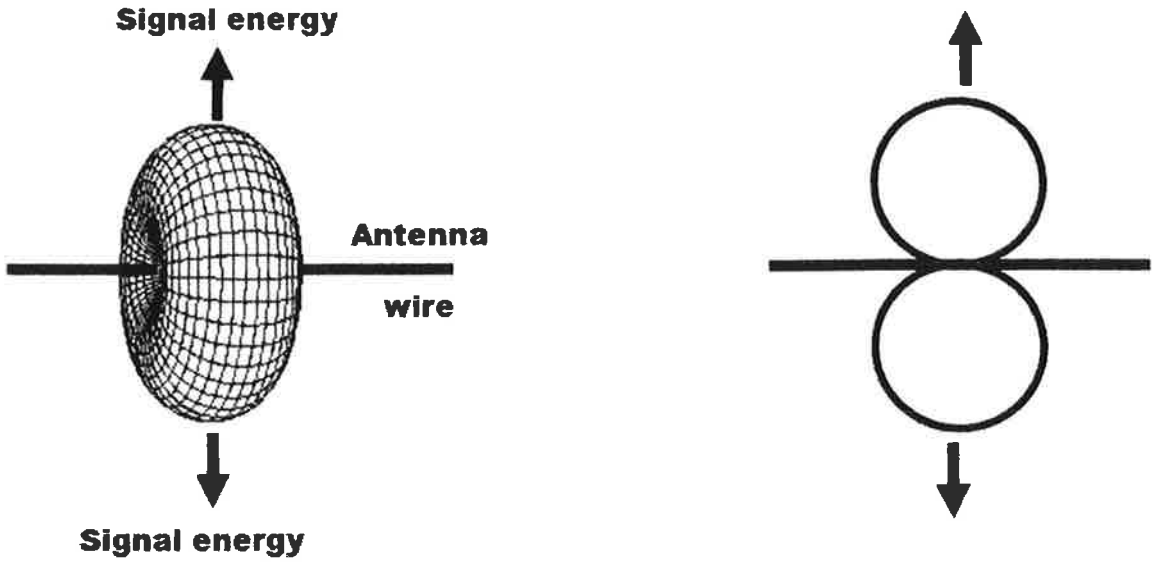


Figure 3 Half wave center fed dipole radiation pattern in free space. (Reference 5)

The transmitted signal energy leaves the antenna in a doughnut shaped pattern, with maximum power travelling at right angles to, and minimum power along, the antenna wire.

Concentrating the signal power in a specific direction is what is known as "*antenna directive gain*".

Antenna directive gain is a measure of the power effectively transmitted by the antenna in the intended direction of transmission (Po), relative to the power delivered by the transmission line (Pi). It is measured in *"decibels"* abbreviated *"dB"*. It is a logarithmic ratio of the output to the input power given by the formula:

Gain = 10 log Po / Pi (Reference 4)

If the directive gain of an antenna as given by the formula is 3 dB, the radiated power from the antenna in the intended direction is *twice the input power*.

Antenna gain is calculated in many ways. One way is to apply electromagnetic propagation theorems to antenna numerical models on the assumption they are in free space. This leads to the isotropic measure of gain, and is abbreviated dBi.

The gain of a center fed ½ wave dipole antenna is 2.15 dBi (Reference 4). Therefore the transmitted power in the maximum gain direction is 1.64 times greater than the power produced by the transmitter and delivered to the antenna.

Without the ground's influence, the ½ wave dipole's radiation pattern is shaped like a pair of balloons (Figure 3, right). Proximity to the ground "*squeezes the balloon*". As the balloon is squeezed, it collapses in some areas, and expands in others. *The extent of the squeeze will vary with the height of the antenna over the ground* (Reference 6). A half wave center fed dipole at ½ wavelength above ground has one lobe at 30 degrees. A half wave center fed dipole at one wavelength above ground shows two lobes of radiation, one at 50 degrees elevation and the other at about 15 degrees.

The ground effect is such that the higher the antenna is placed above ground, the closer the lowest lobe of radiation will be to the ideal departure angle. The effect is shown in Figure 4.

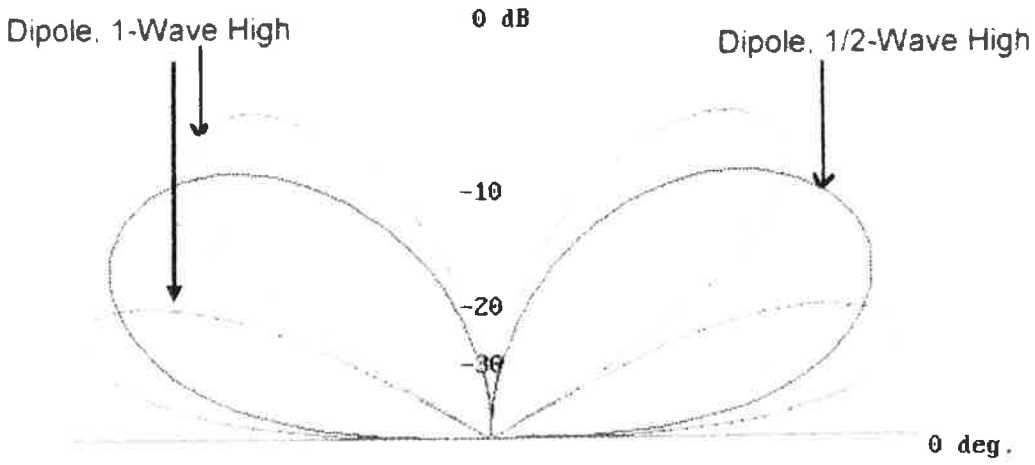


Figure 4 Pattern of radio signal energy transmitted into the ionosphere from two ½ wave center fed dipole antennas, each at a different suspension height above ground. (Reference 6)

Analysis of all antennas reveals two important facts (Reference 6):

1. The *departure angle* at which a wave leaves the antenna is the key factor determining effective communication distances beyond line-of-sight. *It is directly related to antenna height*. The higher the antenna, the lower the departure angle, and the longer the resulting skip distance. For maximum long distance, the departure angle or critical angles must be as low as possible..

2. In general, placing an amateur antenna system higher in the air enhances communication capabilities and also reduces electromagnetic interference with neighbors.

Figure 1 illustrated the effect of the ionosphere on radio wave propagation. It showed that a radio wave leaving the antenna at the lowest departure angle is the one that propagates farthest. This is the effect the Brookings Ham needs to achieve. Figure 4 shows *how a higher antenna produces a lower lobe with the lowest departure angle.* Consequently the higher an antenna is placed above ground, the farther it will communicate because of the resulting lower radiation angle.

Theoretical analysis, and millions of hours of communication operations show that a center fed ½ wave dipole antenna is not the most effective antenna for reliable 24 x 7 x 365 day multi-band communications. It is only resonant on one frequency band, creating high SWR values if operated at non-resonant frequencies, and only provides modest gain in many directions, where a high gain in a single direction is needed.

To transmit a strong signal toward a chosen direction requires rotating the antenna. In the case of the center-fed ½ wave dipole, this would require antenna disassembly and repositioning, with all the attendant installation complications and loss of operating time.

Engineering research and design considerations have proven that multiple ½ wave dipoles can be combined in various configurations to increase gain and directivity. The analogy of the balloon applies. The more dipoles, the greater the number of radiation pattern balloons, and the greater the squeezing effect of the ground.

Obviously assembling multiple ½ wave center fed wire dipoles, of long lengths of wire, is very impractical.

This led to the design of what are called "*directive beam antennas.*" There are many commercially available for reasonable prices. They all offer increased gain, enhanced directivity, ease of erection and installation, and 50 ohm input impedance.

One particularly well known type of beam antenna is called a *Yagi*, named after one of its Japanese inventors. The common television antenna is an example. Second to the ½ wave center fed dipole, the Yagi is the most popular amateur radio antenna (Reference 4). A 3 element yagi is illustrated in Figure 5.

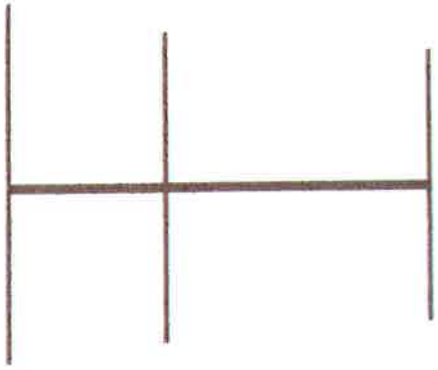


Figure 5 Three element Yagi antenna consisting of the reflector element (far left), the feed element (middle), and the director element (far right)

Depending on design, the Yagi combines a number of elements of varying lengths, separated by varying distances along a support boom. Electromagnetic design principles, too complex to describe here, allow multi-band operation (HF/VHF) capability with an input impedance of 50 ohms.

The antenna radiation patterns, vertical and horizontal, of a 4 element Yagi antenna above ground are shown in Figure 6. The figure illustrates the directional gain achieved by a typical Yagi antenna, in both the vertical and horizontal planes of radiation.

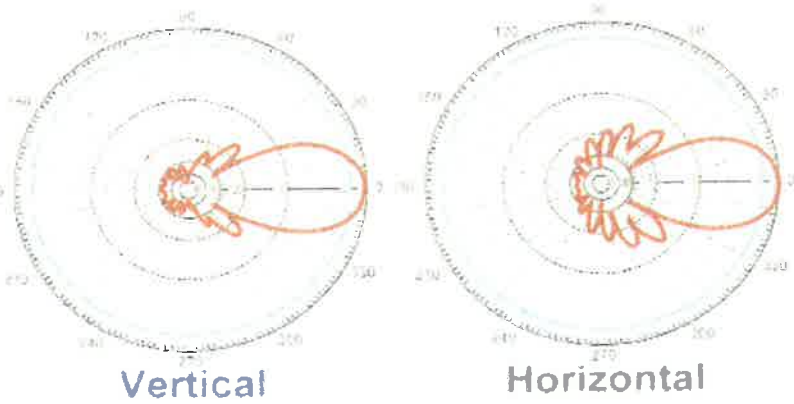


Figure 6. Yagi antenna radiation patterns.

The construction of a Yagi eliminates the disadvantages associated with ½ wave center fed dipoles. Common commercially available Yagi antennas are rugged, lightweight, and low profile. They can easily be rotated to aim their primary transmitted lobe in any direction. Their input impedance of 50 ohms meets our criteria for matched impedance

and minimum SWR. In the HF/VHF frequency range they produce horizontal polarization.

Figure 7 shows a commercially available 4 element Yagi antenna.

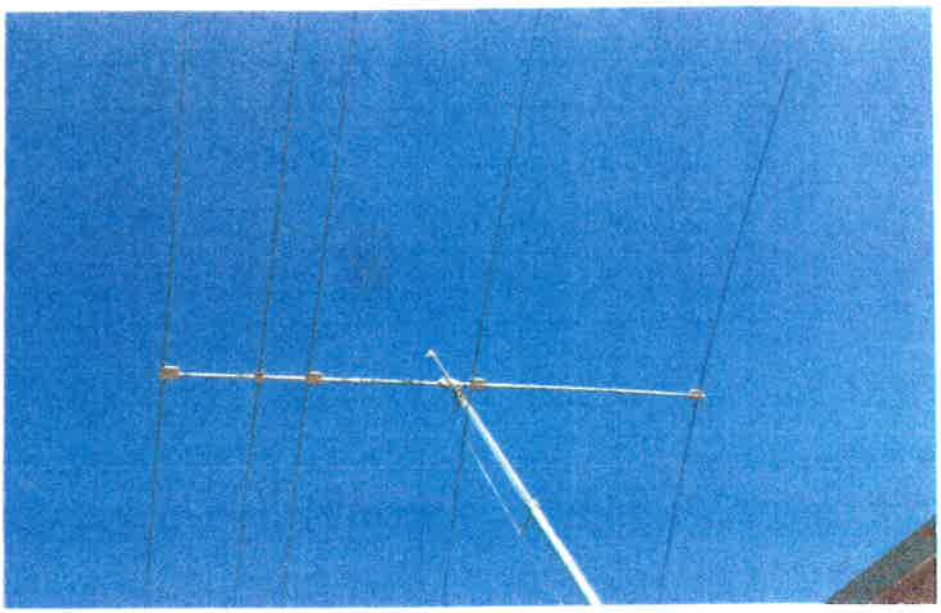


Figure 7- Four element Yagi multi-band antenna designed to operate on the 40 – 6 meter amateur radio band. The second and third elements from the left are one continuous loop, and are the feed point for the antenna.

Table 1 presents the performance specifications for the Yagi shown in Figure 7.

Performance for Licensed amateur radio operator Bands	4E Gain dBi	4E Front to Rear, dB	30/40 Option gain, dBi	30/40 option Front to Rear, dB
40M	n/a	n/a	1.8	n/a
30M	n/a	n/a	2.1	n/a
20M	9.5	21		
17M	10	20		
15M	10.2	27		
12M	10.4	21		
10M	10.6	11		
6M – 4 elements	7.8	4		

Table 1. - Performance specifications of the Yagi antenna shown in Figure 7.
http://www.steppir.com/4-element-yagi

The table shows that depending on the operating frequency, the antenna produces modest to substantial directive gain. In the case here illustrated for example, we find that:

1. In the 40 meter band, the antenna produces a gain of 1.8 dBi (1.5 times power gain)
2. In the 20 meter band, the antenna produces a gain of 9.5 dBi (8.9 times power gain)
3. In the 6 meter band, the antenna produces a gain of 7.8 dBi (6.0 times power gain)

There are many other commercially available directional beam HF/VHF multi band antennas besides the Yagi. Their application to an amateur radio station and the analysis of how their operation will satisfy the conditions we imposed for this analysis is the same as carried out above. *The resulting height for antenna installation is independent of antenna type*, however different antennas will show variations in gain on some bands (depending on nature of the feed element or reflecting elements), the size of the boom on which the elements are attached, etc.

Up to this point, the analysis has shown all the important technical decisions the Brookings Ham must make in assembling an amateur radio station that delivers the requisite signal to a directive multi band antenna.

The final decision needed is a choice of an antenna support structure.

The question is:

Given the equipment selected, ***what is the minimum acceptable antenna height for effective worldwide communications from Brookings****?*

As stated earlier, the best height must result in the lowest critical radiation angle, and that is frequency dependent. This poses a challenge. For the multi-band capability needed, different antenna heights would be needed for the various frequencies of operation.

One might envision a structure that would raise and lower the antenna as a function of operating frequency. Such a structure would seem to be the commercially available *"crank-up tower."* Unfortunately *they are not built for that purpose.* Instead they are intended to occasionally raise and lower the antenna for maintenance or experimentation

Furthermore, any antenna selected for use as described would not survive the vibration stresses induced by the continued raising and lowering of the structure, and the apparatus used to raise and lower the antenna would have to be of special design to assure reliability. Neither is commercially available.

So how can the necessary antenna height for 90% communications effectiveness on the HF/VHF bands be decided?

A ***compromise solution*** is to choose an antenna height optimized for the lowest critical angle at the highest HF frequency of operation.

In this case that is the 10m meter band.

The rationale for doing so will be explained in what follows.

At the transmitting antenna, a detailed study of *critical departure angle* requires dealing with the effects of the *"near field radiation pattern."* That is much too complex for this analysis. Fortunately, the near field effects disappear in the far field, where the receiving station is located.

The earlier cited *electromagnetic reciprocity theorem* shows that the effects at the receiving antenna are identical to the effects at the transmitting antenna.

Consider the electromagnetic field effects at the receive antenna, *"the far field,"* as shown in Figure 8.

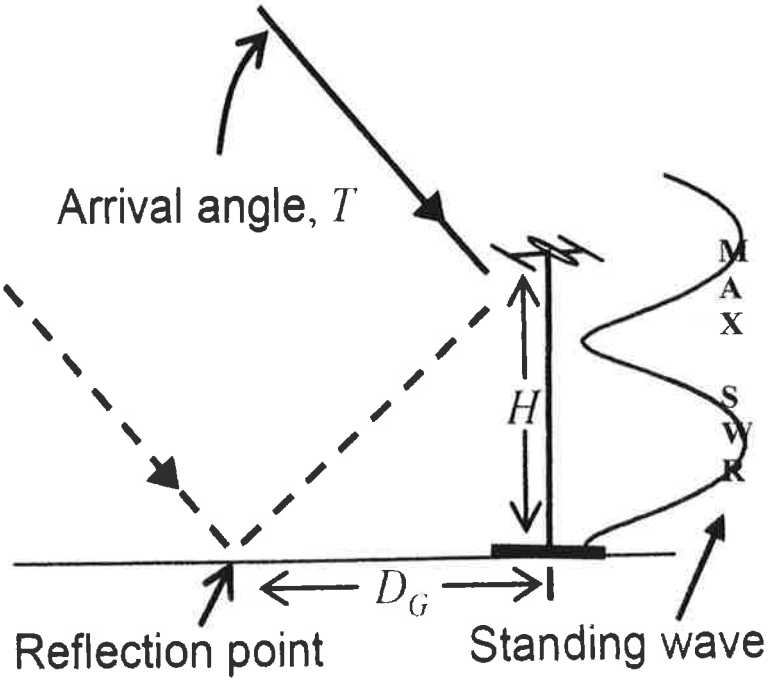


Figure 8 Waves arrive directly and via an earth reflection forming a local vertical wave pattern.

By analyzing the effect of the propagation path on the signal arriving at the receiving antenna, we get an understanding of the antenna height needed at the origin and reception antennas in order to achieve 90% communication effectiveness.

The analysis must consider two electromagnetic waves. The wave arriving directly from reflecting off the ionosphere, and the wave bouncing from the earth's surface.

Depending on the antenna height, the waves will arrive in or out of phase at various heights above ground, reinforcing or cancelling the resulting received signal. The effect creates a *standing wave* surrounding the antenna as illustrated by the sinusoidal pattern shown at the right of figure 8. Highest SWR (the *humps* to the right in the sinusoid) will vary in height depending on the frequency of operation. The antenna must not be placed at a height of maximum SWR, as that will minimize the received signal.

The antenna installation height must also consider the critical arrival angles. The lower the critical angle of arrival, the longer the propagation from where the wave originated. The critical angles will also vary by operating frequency.

Expected arrival angles for waves direct from the ionosphere for HF propagation are listed in Reference 8. They show that half the arrival angles are less than 6°, and that *90% of the arrival angles are smaller than 16°.*

So for multi-band HF signals, to achieve 90% probability of communication, the transmission and reception antennas must be at heights that concentrate on critical angles up to 16°

The Brookings Ham must optimize the antenna height accordingly.

The optimum heights to achieve minimum critical elevation angles for various frequency bands between 7 and 54 MHz are shown in Figure 9. The curves show four different minimum angles. The green curve shows optima for a 1° arrival angle, the red curve for 2°, the blue curve for 3° , and the black curve for 4° . Increasing angles very nearly scale with frequency.

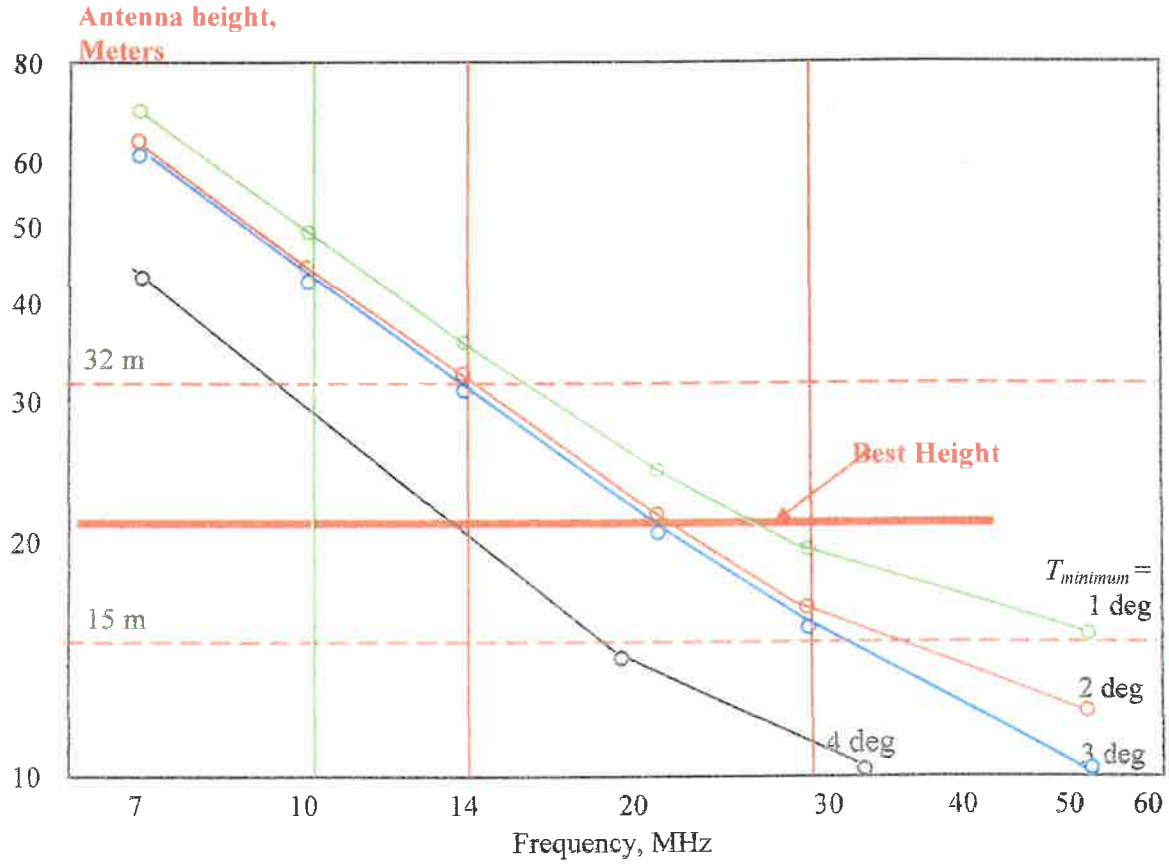


Figure 9 Optimum antenna heights over even terrain for various frequencies.

As shown above (Reference 7), to achieve the lowest critical angle for operation on all amateur radio bands, the required antenna height is 80 meters (262 feet). To operate with the lowest possible critical angle on the 10 meter band, while preserving satisfactory effective communications on the remainder of the frequencies permitted for amateur radio, ***the antenna height should be 23 Meters (75 feet).***

10 Meters is the amateur radio band that, under satisfactory ionosphere conditions allows the longest range communications with the lowest necessary effective transmitted power (Reference 5).

Studying Figure 9 shows that as the operating band is lowered, the antenna height to achieve the lower critical angle rises. Should the ham operator hope to achieve the lowest angle of arrival on the 40 meter band, the satisfactory antenna height is seen as 70 meters (230 feet). However, the 40 meter band is more readily used for local (nearby) communications during an emergency. For daytime use, the band is adequate for communicating between Brookings and Medford, Salem, etc. which may have greater need for communicating with Brookings. However, even when operating on the 20 meter band, a critical angle of 4 degrees is achieved. That is an acceptable compromise, as other ionosphere factors compensate with multi-hop paths at the lower frequencies (longer wavelengths).

The analysis does not ignore the lower 40 – 30 meter bands. While an antenna height of 75 feet leads to higher direct critical arrival angles (implying shorter propagation path), the utility of the bands for emergency communications are enhanced for medium range distances, and their utility during daylight for hobby operation is limited by the high ambient noise created by the ionosphere condition.

Thus, with 75 ft. antenna height, the Brookings Ham achieves a station design that accomplishes, ***with a compromise to lower antenna height***, a 90% probability of success for long range communications any time of day or night, regardless of the ionosphere condition.

As a compromise for effective communication, the Brookings amateur should install the multi-band HF/VHF antenna at a height of 75 feet.

Reference 1 Wikipedia
http://en.wikipedia.org/wiki/Reciprocity_%28electromagnetism%29

Reference 2 Wikipedia
http://en.wikipedia.org/wiki/Maximum_power_transfer_theorem

Reference 3 ARRL Handbook for Radio Communications, Chapter 20, Section 20.1

Reference 4 ARRL Handbook for Radio Communications, Chapter 21, Section 21.1

Reference 5 ARRL Handbook for Radio Communications, Chapter 21, Section 21.2.1

Reference 6 "*Antenna Height and Communications Effectiveness*", Second Edition, by R. Dean Straw, N6BV, and Gerald A. Hall, K1TV,

Reference 7 *"An Optimum Height for an Elevated HF Antenna", QEX May 2011,* by Kazimierz "Kai" Siwiak, KE4PT

Reference 8.- The ARRL Antenna Book, 18th. Edition, April 1997, Chapter 20.

About the author: Mr. Ristorcelli has been a licensed amateur radio operator radio operator (NN3V) since 1976. A graduate engineer, he holds a B.S.E.E, M.S.E.E. and M.S.C.S, and the Degree Electrical Engineer (PhD, ABD) specializing in electromagnetic propagation and communication systems. During 35 years as a U.S. Navy officer he commanded ships, and was the Commanding Officer of Naval Electronics Systems Engineering Center, Portsmouth Virginia, responsible for the procurement, installation, and maintenance of the Navy's worldwide communication system. During the last 8 years of Navy service as the Director of Navy Electronic Combat Surveillance Systems, he was responsible for the design, procurement, installation, and maintenance of the Navy's afloat and ashore HF/VHF/UHF surveillance network.

Proposed new text is **bold.**
Text added from PC workshop is **bold underlined**.
Text deleted from PC workshop is ~~**bold double stricken**~~.

Chapter 17.16 Suburban Residential (SR) District

17.16.030 Accessory uses
The following accessory uses are permitted:

E. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.20 Single-Family Residential (R-1) District

17.20.030 Accessory uses.
The following uses are permitted:

E. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230 in the R-1-12 zone.

17.20.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

U. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230 in the R-1-6, R-1-8, and R-1-10 zones.

Chapter 17.24 Two-Family Residential (R-2) District

17.24.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

V. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.28 Multiple-Family Residential (R-3) District

17.28.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

T. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.32 Manufactured Home Residential (R-MH) District

17.32.040 Conditional uses.
The following conditional uses may be permitted:

V. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.36 Professional Office (PO-1) District

17.36.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

L. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.40 Public Open Space (P/OS) District

17.40.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

D. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.44 Neighborhood Commercial (C-1) District

17.44.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

D. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.48 Shopping Center Commercial (C-2) District

17.48.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

J. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.52 General Commercial (C-3) District

17.52.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

O. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.56 Tourist Commercial (C-4) District

17.56.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

J. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.64 Industrial Park (I-P) District

17.64.040 Conditional uses.
The following uses may be permitted subject to a conditional use permit:

I. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.68 General Industrial (M-2) District

17.68.040 Conditional uses.
The following uses may be permitted subject to a conditional use permit:

G. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.124 Specific Standards Applying to Conditional Uses

17.124.230 Amateur radio facilities.

Amateur radio facilities are private, non-commercial wireless communication facilities consisting of antennas, towers, and/or support structures. The City recognizes the importance of amateur radio operators and their service to the community especially in the event of emergencies.

Amateur radio facilities are considered an accessory use to a residential dwelling. Chapter 17.128.020(B) provides for exceptions to height limitations for antenna. Antenna may be one and one-half times the height limitation of the applicable zoning district. However, towers and support structures shall comply with height limitations and setbacks.

The following siting criteria shall apply to amateur radio facilities that do not meet the provisions of Chapter 17.128.020(B) and/or the applicable zoning district. The criteria are intended to maximize public safety and minimize visual impacts to promote and protect the residential characteristics of the residential zoning districts consistent with federal and state law. Public notice shall be provided to all property owners within 1000 feet of a proposed amateur radio facility requesting approval with a conditional use permit (CUP).

A. Height. The maximum tower/antenna height shall not exceed 70 feet from the finished grade at the base of the tower.

B. Front, Side and Rear Yard Setbacks. The minimum setback from all property lines to the finished grade at the base of the tower shall be 1 foot for every ~~3~~ 2 feet of height. With the exception of guy wires, ~~that connect directly to the ground~~ antennas, and footings that do not project above grade level, no component of the facility may encroach into the required setback.

C. Construction. A building permit shall be obtained for the construction or erection of the amateur radio facility. Plans and calculations shall be provided and shall comply with the provisions of Section 3108 of the Oregon Structural Specialty Code. Towers/antennas shall be designed and constructed in accordance with the current provisions of TIA-222.

D. Finish (paint/surface). The facility shall have a finish, tone or color that reduces its visibility. In most circumstances this condition may be satisfied by painting the facility with a flat light haze gray paint. The owner shall maintain the finish, painted or unpainted. Red and white or orange and white finish is not allowed. If these colors are required by the FAA (Federal Aviation Administration) or ODA (Oregon Department of Aviation), the height shall be reduced to a level that it is not required.

E. Fencing and Security. For security purposes, towers and accessory facilities shall be enclosed by a minimum six-foot fence or be equipped with anti climb devices. If this conflicts with TIA-222 or other agencies, the most restrictive requirements shall prevail.

F. Lighting. No lighting shall be permitted on the facility. If required by the FAA or ODA, the facility shall be reduced to a level that does not require lighting.

G. Airport Overlay Zone. The facility shall comply with the requirements in BMC Chapter 17.76, Airport Overlay Zone.

H. Advertising/Signs. No advertising or signs of any type are to be placed on the tower at any time except those required or necessary for safety and warnings.

Safety and warning signs shall be less than two square feet and be placed on the facility at a height of less than six feet.

~~I. Interference. The facility shall not cause any interference with normal radio and television reception in the surrounding area nor with any public safety agency or organization (including but not limited to police, fire, ambulance, and Coast Guard) radio transmissions. The owner shall bear the costs of immediately eliminating any such interference should any occur, or shall immediately shut down the antennas or other equipment causing the interference.~~

J. License. The owner of the facility shall possess and provide a copy to the Planning Department of a current FCC license. After six months with no valid license, the facility shall be considered abandoned and shall be removed by the ~~operator~~ property owner ~~of the facility~~ within 60 days thereafter.

K. Abandonment. The property owner shall provide annual written documentation that the facilities are functioning. Amateur radio facilities that do not have functioning antennas for a period of six month shall be considered abandoned and shall be removed by the owner of the facility within 60 days thereafter. Upon written application, prior to the expiration of the six-month period, the planning commission if approved with a CUP or staff if permitted outright may, in writing, grant a six-month time extension for reuse of the facility. Additional extensions beyond the first six-month extension may be granted by the planning commission subject to any conditions required to bring the project or facility into compliance with current regulation(s).

L. Separation distance and Chetco Avenue buffer. Amateur radio facilities shall be separated by a distance of ~~500~~ 1000 feet. The measurement is the shortest distance between towers taken at grade level. No facilities shall be located within 1000 feet of Chetco Avenue. The measurement is the shortest distance between the right-of-way boundary and the base of the tower.

Alternate provision accounting for City Attorney input: L. Separation distance and Chetco Avenue buffer. Amateur radio facilities shall be separated by a distance of 1000 feet. The measurement is the shortest distance between towers taken at grade level. Any tower within the separation distance shall be retractable and be lowered to the maximum height of the underlying zone when not in use. Facilities located within 1000 feet of Chetco Avenue shall be retractable and be lowered to the maximum height of the underlying zone when not in use. The measurement is the shortest distance between the right-of-way boundary and the base of the tower.

M. Maintenance. Amateur radio facilities shall be maintained in good order and repair at all time so to not constitute any danger or hazard to adjacent properties.

N. Unrelated equipment. Equipment and antenna for other than amateur radio facilities shall comply with height and setback requirements of Chapter 17.128.020(B) and the underlying zone.

O. Hazardous Building Sites. Construction or erection of amateur radio facilities shall comply with Chapter 17.100 Hazardous Building Site Protection.

Supplemental Packet For Planning Commission

Hearing Date: May 5, 2015 7:00 pm - Council Chambers

Exhibit B

Doc. #	Received:	From	page #	Description
LDC-2-15				
B-1	4/24/2015	E. Curry, ARRL	1	email
B-2	4/28/2015	B. Warren	91	documents
B-3	4/29/2015	J. & L. Brock	2	email with letter

Exhibit B-1
LDC - 2-15

Brookings Email

Donna Colby-Hanks <dcolbyhanks@brookings.or.us>

retractable HAM towers

arsw6abm <arsw6abm@gmail.com> Fri, Apr 24, 2015 at 10:31 AM
To: Donna Colby-Hanks <dcolbyhanks@brookings.or.us>

Donna

This is what I have learned as I've looked at available push-up, crank-up, and tilt-over towers.

TIA-222 specification:
The specification is for steel towers. Many push-up, crank-up, and tilt-over towers are aluminum. None of these will meet the TIA-222 spec on the face of it. The TIA-222 is a steel industry standard. It should not be the sole specification for a tower design code.

Many of the steel crank-up types do not meet the TIA-222 specification.

Mechanical engineers take into account the soil, wind, ice, and other requirements of the site when executing the
specific application.

Everett W6ABM
[Quoted text hidden]
--
Everett Curry, W6ABM
Oregon Section Manager

Phone: (503) 522-7142
Email: w6abm@arrl.org

ARRL, the national association for Amateur Radio™

Think about this:

"...a truism that is too often forgotten: Ham radio is a hobby. That means it is supposed to be fun, or at least rewarding in ways we consider worthwhile. When what you are doing in ham radio no longer meets that test, you should be trying to figure out why, and then make changes until it is fun again."
– Bob Locher W9KNI

Exhibit B-2
LDC-2-15

CONTENTS

UNITED STATES OF AMERICA
FEDERAL COMMUNICATIONS COMMISSION

AMATEUR RADIO LICENSE

N1EQG

WARREN, BRUCE
PO BOX 1384
BROOKINGS, OR 97415

FCC Registration Number (FRN): 0001977545

Special Conditions / Endorsements
NONE

Grant Date	Effective Date	Print Date	Expiration Date
05-30-2007	06-08-2011	06-08-2011	06-26-2017

File Number	Operator Privileges	Station Privileges
0004756011	Amateur Extra	PRIMARY

THIS LICENSE IS NOT TRANSFERABLE

(Licensee's Signature)

FCC 660 - May 2007

PREAMBLE

We, the people of Brookings, Oregon, in order to avail ourselves of self-determination in municipal affairs to the fullest extent now or hereafter possible under the constitutions and laws of the United States and the State of Oregon, through this charter confer upon the city the following powers, subject it to the following restrictions, prescribe for it the following procedures and governmental structure, and repeal all previous charter provisions of the city, except as provided in Chapter X, Section 37.

CHAPTER I

NAMES AND BOUNDARIES

Section 1. Title of Charter. This charter may be referred to as the 1993 Brookings Charter.

Section 2. Name of City. The city of Brookings, Oregon, continues under this charter to be a municipal corporation with the name city of Brookings.

Section 3. Boundaries. The city includes all territory within its boundaries as they now exist or hereafter are modified pursuant to state law. The custodian of the city's records shall keep an accurate, current description of the boundaries and make a copy of it available for public inspection in the city during regular city office hours.

CHAPTER II

POWERS

Section 4. Powers of the City. The city has all powers that the constitutions, statutes, and common law of the United States and of this state now or hereafter expressly or impliedly grant or allow the city, as fully as though this charter specifically enumerated each of those powers.

Section 5. Construction of Powers. In this charter, no specification of a power is exclusive or restricts authority that the city would have if the power were not specified. The charter shall be liberally construed, so that the city may exercise fully all its powers possible under this charter and under United States and Oregon law. All powers are continuing unless a specific grant of power clearly indicates the contrary.

Section 6. Distribution of Powers. Except as this charter prescribes otherwise and as the Oregon Constitution reserves municipal legislative power to the voters of the city, all powers of the city are vested in the council.

CHAPTER III

FORM OF GOVERNMENT

Section 7. Council. The council consists of a mayor and four councilors nominated and elected from the city at large or, in case of one or more vacancies in the council, the council members whose offices are not vacant.

Section 8. Councilors. The term of office of a councilor in office when this charter is adopted is the term of office for which the councilor has been elected before adoption of the charter (or is elected at the time of the adoption). At each general election after the adoption, two councilors shall be elected, each for a four-year term.

Section 9. Mayor. The term of office of the most recently elected mayor at the time this charter takes effect begins at the first council meeting of the year 1993. At the general election of the year 1994 and at each subsequent general election, a mayor shall be elected for a two-year term, whose term of office shall commence at the first council meeting in January immediately following such general election.

Section 10. Terms of Office. The term of office of an elective officer who is elected at a general election begins at the first council meeting of the calendar year immediately after the election and continues until the successor to the office assumes the office.

Section 11. Appointive Offices. A majority of the council shall appoint and may remove a city man-

103D CONGRESS
1ST SESSION

S. J. RES. 90

To recognize the achievements of radio amateurs, and to establish support for such amateurs as national policy.

IN THE SENATE OF THE UNITED STATES

MAY 7 (legislative day, APRIL 19), 1993

Mr. ROBB (for himself, Mr. AKAKA, Mr. DECONCINI, Mr. PRESSLER, and Mr. SHELBY) introduced the following joint resolution; which was read twice and referred to the Committee on Commerce, Science, and Transportation

---

JOINT RESOLUTION

To recognize the achievements of radio amateurs, and to establish support for such amateurs as national policy.

Whereas Congress has expressed its determination in section 1 of the Communications Act of 1934 (47 U.S.C. 151) to promote safety of life and property through the use of radio communication;

Whereas Congress, in section 7 of the Communications Act of 1934 (47 U.S.C. 157), established a policy to encourage the provision of new technologies and services;

Whereas Congress, in section 3 of the Communications Act of 1934, defined radio stations to include amateur stations operated by persons interested in radio technique without pecuniary interest;

Whereas the Federal Communications Commission has created an effective regulatory framework through which the amateur radio service has been able to achieve the goals of the service;

Whereas these regulations, set forth in part 97 of title 47 of the Code of Federal Regulations clarify and extend the purposes of the amateur radio service as a—

(1) voluntary noncommercial communication service, particularly with respect to providing emergency communications;

(2) contributing service to the advancement of the telecommunications infrastructure;

(3) service which encourages improvement of an individual's technical and operating skills;

(4) service providing a national reservoir of trained operators, technicians and electronics experts; and

(5) service enhancing international good will;

Whereas Congress finds that members of the amateur radio service community has provided invaluable emergency communications services following such disasters as Hurricanes Hugo, Andrew, and Iniki, the Mt. St. Helens eruption, the Loma Prieta earthquake, tornadoes, floods, wild fires, and industrial accidents in great number and variety across the Nation; and

Whereas Congress finds that the amateur radio service has made a contribution to our Nation's communications by its crafting, in 1961, of the first Earth satellite licensed by the Federal Communications Commission, by its proof-of-concept for search and rescue satellites, by its continued exploration of the low Earth orbit in particular pointing the way to commercial use thereof in the 1990s, by its pioneering of communications using reflections

from meteor trails, a technique now used for certain government and commercial communications, and by its leading role in development of low-cost, practical data transmission by radio which increasingly is being put to extensive use in, for instance, the land mobile service: Now, therefore, be it

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. FINDINGS AND DECLARATIONS OF CONGRESS.

Congress finds and declares that—

(1) radio amateurs are hereby commended for their contributions to technical progress in electronics, and for their emergency radio communications in times of disaster;

(2) the Federal Communications Commission is urged to continue and enhance the development of the amateur radio service as a public benefit by adopting rules and regulations which encourage the use of new technologies within the amateur radio service; and

(3) reasonable accommodation should be made for the effective operation of amateur radio from residences, private vehicles and public areas, and that regulation at all levels of government should facilitate and encourage amateur radio operation as a public benefit.

○

Code of Federal Regulations

(b) Except as provided in paragraph (c) of this section, non-reserve DSRCS channels are available on a shared basis only for use in accordance with the Commission's rules. All licensees shall cooperate in the selection and use of channels in order to reduce interference. This includes monitoring for communications in progress and any other measures as may be necessary to minimize interference. Licensees suffering or causing harmful interference within a communications zone are expected to cooperate and resolve this problem by mutually satisfactory arrangements. If the licensees are unable to do so, the Commission may impose restrictions, including specifying the transmitter power, antenna height and direction, additional filtering, or area or hours of operation of the stations concerned. Further, the use of any channel at a given geographical location may be denied when, in the judgment of the Commission, its use at that location is not in the public interest; the use of any channel may be restricted as to specified geographical areas, maximum power, or such other operating conditions, contained in this part or in the station authorization.

(c) *Safety/public safety priority.* The following access priority governs all DSRCS operations:

(1) Communications involving the safety of life have access priority over all other DSRCS communications;

(2) Subject to a control channel priority system management strategy (see ASTM E2213–03 DSRC Standard at §4.1.1.2(4)), DSRCS communications involving public safety have access priority over all other DSRC communications not listed in paragraph (c)(1) of this section. On-Board Units (OBUs) operated by state or local governmental entities are presumptively engaged in public safety priority communications.

(d) *Non-priority communications.* DSRCS communications not listed in paragraph (c) of this section, are non-priority communications. If a dispute arises concerning non-priority DSRCS–OBU communications with Roadside Units (RSUs), the provisions of §90.377(e) and (f) of this chapter will apply. Disputes concerning non-priority DSRCS–OBU communications not associated with RSUs are governed by paragraph (b) of this section.

[71 FR 52750, Sept. 7, 2006]

PART 97—AMATEUR RADIO SERVICE

Subpart A—General Provisions

Subpart B—Station Operation Standards

Subpart C—Special Operations

Subpart D—Technical Standards

Wavelength band	Evaluation required if power[1] (watts) exceeds
EHF (all bands)	250
Repeater stations (all bands)	*non-building-mounted antennas:* height above ground level to lowest point of antenna <10 m *and* power >500 W ERP *building-mounted antennas:* power >500 W ERP

[1] Power = PEP input to antenna except, for repeater stations only, power exclusion is based on ERP (effective radiated power).

(2) If the routine environmental evaluation indicates that the RF electromagnetic fields could exceed the limits contained in §1.1310 of this chapter in accessible areas, the licensee must take action to prevent human exposure to such RF electromagnetic fields. Further information on evaluating compliance with these limits can be found in the FCC's OET Bulletin Number 65, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields."

[54 FR 25857, June 20, 1989, as amended at 55 FR 20698, May 18, 1990; 61 FR 41019, Aug. 7, 1996; 62 FR 47963, Sept. 12, 1997; 62 FR 49557, Sept. 22, 1997; 62 FR 61448, Nov. 18, 1997; 63 FR 68979, Dec. 14, 1998; 65 FR 6549, Feb. 10, 2000]

§97.15 Station antenna structures.

(a) Owners of certain antenna structures more than 60.96 meters (200 feet) above ground level at the site or located near or at a public use airport must notify the Federal Aviation Administration and register with the Commission as required by part 17 of this chapter.

(b) Except as otherwise provided herein, a station antenna structure may be erected at heights and dimensions sufficient to accommodate amateur service communications. (State and local regulation of a station antenna structure must not preclude amateur service communications. Rather, it must reasonably accommodate such communications and must constitute the minimum practicable regulation to accomplish the state or local authority's legitimate purpose. *See* PRB–1, 101 FCC 2d 952 (1985) for details.)

[64 FR 53242, Oct. 1, 1999]

§97.17 Application for new license grant.

(a) Any qualified person is eligible to apply for a new operator/primary station, club station or military recreation station license grant. No new license grant will be issued for a Novice, Technician Plus, or Advanced Class operator/primary station or a RACES station.

(b) Each application for a new amateur service license grant must be filed with the FCC as follows:

(1) Each candidate for an amateur radio operator license which requires the applicant to pass one or more examination elements must present the administering VEs with all information required by the rules prior to the examination. The VEs may collect all necessary information in any manner of their choosing, including creating their own forms.

(2) For a new club or military recreation station license grant, each applicant must present all information required by the rules to an amateur radio organization having tax-exempt status under section 501(c)(3) of the Internal Revenue Code of 1986 that provides voluntary, uncompensated and unreimbursed services in providing club and military recreation station call signs ("*Club Station Call Sign Administrator*") who must submit the information to the FCC in an electronic batch file. The Club Station Call Sign Administrator may collect the information required by these rules in any manner of their choosing, including creating their own forms. The Club Station Call Sign Administrator must retain the applicants information for at least 15 months and make it available to the FCC upon request. The FCC will issue public announcements listing the qualified organizations that have completed a pilot autogrant batch filing project and are authorized to serve as a Club Station Call Sign Administrator.

(c) No person shall obtain or attempt to obtain, or assist another person to obtain or attempt to obtain, an amateur service license grant by fraudulent means.

Amateur Radio Service

PRB-1 (1985)

PRB-1 (1985)
PRB-1 (1999)
PRB-1 (2000 - Reconsideration)
PRB-1 (2001)

Adopted 9/16/1985
Released 9/19/1985

MEMORANDUM OPINION AND ORDER (FCC 85-506)

Federal preemption of state and Local Regulations Pertaining to Amateur Radio Facilities

Before the Federal Communications Commission Washington, D.C. 20554 36149

By the Commission: Commissioner Rivera not participating.

Return To Top

Background

1. On July 16, 1984, the American Radio Relay League, Inc. (ARRL) filed a Request for Issuance of a Declaratory Ruling asking us to delineate the limitations of local zoning and other local and state regulatory authority over Federally-licensed radio facilities. Specifically, the ARRL wanted an explicit statement that would preempt all local ordinances which provably preclude or significantly inhibit effective, reliable amateur radio communications. The ARRL acknowledges that local authorities can regulate amateur installations to insure the safety and health of persons in the community, but believes that those regulations cannot be so restrictive that they preclude effective amateur communications.

2. Interested parties were advised that they could file comments in the matter. [1] With extension, comments were due on or before December 26, 1984[2], with reply comments due on or before January 25, 1985[3]. Over sixteen hundred comments were filed.

Return To Top

Wireless Rules & Regulations (Title 47)
ULS Universal Licensing System
WTB Wireless Telecommunications Bureau

Local Ordinances

3. Conflicts between amateur operators regarding radio antennas and local authorities regarding restrictive ordinances are common. The amateur operator is governed by the regulations contained in Part 97 of our rules. Those rules do not limit the height of an amateur antenna but they require, for aviation safety reasons, that certain FAA notification and FCC approval procedures must be followed for antennas which exceed 200 feet in height above ground level or antennas which are to be erected near airports. Thus, under FCC rules some amateur antenna support structures require obstruction marking and lighting. On the other hand, local municipalities or governing bodies frequently enact regulations limiting antennas and their support structures in height and locations, e.g. to side or rear yards, for health, safety or aesthetic considerations. These limiting regulations can result in conflict because the effectiveness of the communications that emanate from an amateur radio station are directly dependent upon the location and the height of the antenna. Amateur operators maintain that they are precluded from operating in certain bands allocated for their use if the height of their antennas is limited by a local ordinance.

4. Examples of restrictive local ordinances were submitted by several amateur operators in this proceeding. Stanley J. Cichy, San Diego, California, noted that in San Diego amateur radio antennas come under a structures ruling which limits building heights to 30 feet. Thus, antennas there are also limited to 30 feet. Alexander Vrenios, Mundelein, Illinois wrote that an ordinance of the Village of Mundelein provides that an antenna must be a distance from the property line that is equal to one and one-half times its height. In his case, he is limited to an antenna tower for his amateur station just over 53 feet in height.

5. John C. Chapman, an amateur living in Bloomington, Minnesota, commented that he was not able to obtain a building permit to install an amateur radio antenna exceeding 35 feet in height because the Bloomington city ordinance restricted "structures" heights to 35 feet. Mr. Chapman said that the ordinance, when written, undoubtedly applied to buildings but was now being applied to antennas in the absence of a specific ordinance regulating them. There were two options open to him if he wanted to engage in amateur communications. He could request a variance to the ordinance by way of a hearing before the City Council, or he could obtain affidavits from his neighbors swearing that they had no objection to the proposed antenna installation. He got the building permit after obtaining the cooperation of his neighbors. His concern, however, is that he had to get permission from several people before he could effectively engage in radio communications for which he had a valid FCC amateur license.

6. In addition to height restrictions, other limits are enacted by local jurisdictions -- anti-climb devices on towers or fences around them; minimum distances from high voltage power lines; minimum distances of towers from property lines; and regulations pertaining to the structural soundness of the antenna installation. By and large, amateurs do not find these safety precautions objectionable. What they do object to are the sometime prohibitive, non-refundable application filing fees to obtain a permit to erect an antenna installation and those provisions in ordinances which regulate antennas for purely aesthetic reasons. The amateurs contend, almost universally, that "beauty is in the eye of the beholder." They assert that an antenna installation is not more aesthetically displeasing than other objects that people keep on their

property, e.g. motor homes, trailers, pick-up trucks, solar collectors and gardening equipment.

Return To Top

Restrictive Comments

7. Amateur operators also oppose restrictions on their amateur operations which are contained in the deeds for their homes or in their apartment leases. Since these restrictive covenants are contractual agreements between private parties, they are not generally a matter of concern to the Commission. However, since some amateurs who commented in this proceeding provided us with examples of restrictive covenants, they are included for information. Mr. Eugene O. Thomas of Hollister, California included in his comments an extract of the Declaration of Covenants and Restrictions for Ridgemark Estates, County of San Benito, State of California. It provides:

> **"No antenna for transmission or reception of radio signals shall be erected outdoors for use by any dwelling unit except upon approval of the Directors. No radio or television signals or any other form of electomagnetic radiation shall be permitted to originate from any lot which may unreasonably interfere with the reception of television or radio signals upon any other lot."**

Marshall Wilson, Jr. provided a copy of the restrictive covenant contained in deeds for the Bell Martin Addition #2, Irving, Texas. It is binding upon all of the owners or purchasers of the lots in the said addition, his or their heirs, executors, administrators or assigns. It reads:

> **"No antenna or tower shall be erected upon any lot for the purpose of radio operations. William J. Hamilton resides in an apartment building in Gladstone, Missouri. He cites a clause in his lease prohibiting the erection of an antenna. He states that he has been forced to give up operating amateur radio equipment except a hand-held 2 meter (144-148 MHz) radio transceiver. He maintains that he should not be penalized just because he lives in an apartment."**

Other restrictive covenants are less global in scope than those cited above. For example, Robert Webb purchased a home in Houston, Texas. His deed restriction prohibited "transmitting or receiving antennas extending above the roof line."

8. Amateur operators generally oppose restrictive covenants for several reasons. They maintain that such restrictions limit the places that they can reside if they want to pursue their hobby of amateur radio. Some state that they impinge on First Amendment rights of free speech. Others believe that a constitutional right is being abridged because, in their view, everyone has a right to access the airwaves regardless of where they live.

9. The contrary belief held by housing subdivision communities and condominium or homeowner's associations is that amateur radio installations constitute safety hazards,

cause interference to other electronic equipment which may be operated in the home (televisions, radio, stereos) or are eyesores that detract from the aesthetic and tasteful appearance of the housing development or apartment complex. To counteract these negative consequences, the subdivisions and associations include in their deeds, leases or by-laws restrictions and limitations on the location and height of antennas or, in some cases, prohibit them altogether. The restrictive covenants are contained in the contractual agreement entered into at the time of the sale or lease of the property. Purchasers or lessees are free to choose whether they wish to reside where such restrictions on amateur antennas are in effect or settle elsewhere.

Return To Top

Supporting Comments

10. The Department of Defense (DOD) supported the ARRL and emphasized in its comments that continuesd success of existing national security and emergency preparedness telecommunications plans involving amateur stations would be severely diminished if state and local ordinances were allowed to prohibit the construction and usage of effective amateur transmission facilities. DOD utilizes volunteers in the Military Affiliate Radio Service (MARS)[4], Civil Air Patrol (CAP) and the Radio Amateur Civil Emergency Service (RACES). It points out that these volunteer communicators are operating radio equipment installed in their homes and that undue restrictions on antennas by local authorities adversely affected their efforts. DOD states that the responsiveness of these volunteer systems would be impaired if local ordinances interfere with the effectiveness of these important national telecommunication resources. DOD favors the issuance of a ruling that would set limits for local and state regulatory bodies when they are dealing with amateur stations.

11. Various chapters of the American Red Cross also came forward to support the ARRL's request for a preemptive ruling. The Red Cross works closely with amateur radio volunteers. It believes that without amateurs' dedicated support, disaster relief operations would significantly suffer and that its ability to serve disaster victims would be hampered. It feels that antenna height limitations that might be imposed by local bodies will negatively affect the service now rendered by the volunteers.

12. Cities and counties from various parts of the United States filed comments in support of the ARRL's request for a Federal preemption ruling. The comments from the Director of Civil Defense, Port Arthur, Texas are representative:

The Amateur Radio Service plays a vital role with our Civil Defense program here in Port Arthur and the design of these antennas and towers lends greatly to our ability to communicate during times of disaster.

We do not believe that there should be any restrictions on the antennas and towers except for reasonable safety precautions. Tropical storms, hurricanes and tornadoes are a way of life here on the Texas Gulf Coast and good communications are absolutely essential when preparing for a hurricane and even more so during recovery operations after the hurricane has past.

13. The Quarter Century Wireless Association took a strong stand in favor of the issuance of a declaratory ruling. It believes that Federal preemption is necessary so that there

will be uniformity for all Amateur radio installations on private property throughout the United States.

14. In its comments, the ARRL argued that the Commission has the jurisdiction to preempt certain local land use regulations which frustrate or prohibit amateur communications. It said that the appropriate standard in preemption cases is not the extent of state and local interest in a given regulation, but rather the impact of that regulation on Federal goals. Its position is that Federal preemption is warranted whenever local governmental regulations relate adversely to the operational aspects of amateur communication. The ARRL maintains that localities routinely employ a variety of land use devices to preclude the installation of effective amateur antennas, including height restrictions, conditional use permits, building setbacks and dimensional limitations on antennas. It sees a declaratory ruling of Federal preemption as necessary to cause municipalities to accommodate amateur operator needs in land use planning efforts.

15. James C. O'Connell, an attorney who has represented several amateurs before local zoning authorities, said that requiring amateurs to seek variances or special use approval to erect reasonable antennas unduly restricts the operation of amateur stations. He suggested that the Commission preempt zoning ordinances which impose antenna height limits of less than 65 feet. He said that this height would represent a reasonable accommodation of the communication needs of most amateurs and the legitimate concerns of local zoning authorities.

Return To Top

Opposing Comments

16. The City of La Mesa, California has a zoning regulation which controls amateur antennas. Its comments reflected an attempt to reach a balanced view.

This regulation has neither the intent, nor the effect, of precluding or inhibiting effective and reliable communications. Such antennas may be built as long as their construction does not unreasonably block views or constitute eyesores. The reasonable assumption is that there are always alternatives at a given site for different placement, and/or methods for aesthetic treatment. Thus, both public objectives of controlling land use for the public health, safety, and convenience, and providing an effective communications network, can be satisfied.

A blanket ruling to completely set aside local control, or a ruling which recognizes control only for the purpose of safety of antenna construction, would be contrary to . . . legitimate local control.

17. Comments from the County of San Diego state:

While we are aware of the benefits provided by amateur operators, we oppose the issuance of a preemption ruling which would elevate 'antenna effectiveness' to a position above all other considerations. We must, however, argue that the local government must have the ability to place reasonable limitations upon the placement and configuration of amateur radio transmitting and receiving antennas. Such ability is necessary to assure that the local decision-makers have the authority to protect the public health, safety and welfare of all citizens. In conclusion, I would like to emphasize an important difference between your regulatory powers and

that of local governments. Your Commission's approval of the preemptive requests would establish a 'national policy'. However, any regulation adopted by a local jurisdiction could be overturned by your Commission or a court if such regulation was determined to be unreasonable.

18. The City of Anderson, Indiana, summarized some of the problems that face local communities:

I am sympathetic to the concerns of these antenna owners and I understand that to gain the maximum reception from their devices, optimal location is necessary. However, the preservation of residential zoning districts as 'liveable neighborhoods' is jeopardized by placing these antennas in front yards of homes. Major problems of public safety have been encountered, particularly vision blockage for auto and pedestrian access. In addition, all communities are faced with various building lot sizes. Many building lots are so small that established setback requirements (in order to preserve adequate air and light) are vulnerable to the unregulated placement of these antennas. . . . the exercise of preemptive authority by the FCC in granting this request would not be in the best interest of the general public.

19. The National Association of Counties (NACO), the American Planning Association (APA) and the National League of Cities (NLC) all opposed the issuance of an antenna preemption ruling. NACO emphasized that federal and state power must be viewed in harmony and warns that Federal intrusion into local concerns of health, safety and welfare could weaken the traditional police power exercised by the state and unduly interfere with the legitimate activities of the states. NLC believed that both Federal and local interests can be accommodated without preempting local authority to regulate the installation of amateur radio antennas. The APA said that the FCC should continue to leave the issue of regulating amateur antennas with the local government and with the state and Federal courts.

Return To Top

Discussion

20. When considering preemption, we must begin with two constitutional provisions. The tenth amendment provides that any powers which the constitution does not delegate to the United States or does not prohibit the states from exercising are reserved to the states. These are the police powers of the states. The Supremacy Clause, however, provides that the constitution and the laws of the United States shall supersede any state law to the contrary. Article III, Section 2. Given these basic premises, state laws may be preempted in three ways: First, Congress may expressly preempt the state law. See Jones v. Rath Packing Co., 430 U.S. 519, 525 (1977). Or, Congress may indicate its intent to completely occupy a given field so that any state law encompassed within that field would implicitly be preempted. Such intent to preempt could be found in a congressional regulatory scheme that was so pervasive that it would be reasonable to assume that Congress did not intend to permit the states to supplement it. See Fidelity Federal Savings & Loan Ass'n v. de la Cuesta, 458 U.S. 141, 153 (1982). Finally, preemption may be warranted when state law conflicts with federal law. Such conflicts may occur when "compliance with both Federal and state regulations is a physical impossibility," Florida Lime and Avocado Growers, Inc. v. Paul, 373 U.S. 132, 142, 143 (1963), or when state law "stands as an obstacle to the accomplishment and execution of the full purposes and objectives of Congress," Hines v. Davidowitz, 312 U.S. 52, 67

(1941). Furthermore, federal regulations have the same preemptive effect as federal statutes. Fidelity Federal Savings & Loan Association v. de la Cuesta, supra.

21. The situation before us requires us to determine the extent to which state and local zoning regulations may conflict with federal policies concerning amateur radio operators.

22. Few matters coming before us present such a clear dichotomy of viewpoint as does the instant issue. The cities, counties, and local communities and housing associations see an obligation to all of their citizens and try to address their concerns. This is accomplished through regulations, ordinances or covenants oriented toward the health, safety and general welfare of those they regulate. At the opposite pole are the individual amateur operators and their support groups who are troubled by local regulations which may inhibit the use of amateur stations or, in some instances, totally preclude amateur communications. Aligned with the operators are such entities as the Department of Defense, the American Red Cross and local civil defense and emergency organizations who have found in Amateur Radio a pool of skilled radio operators and a readily available backup network. In this situation, we believe it is appropriate to strike a balance between the federal interest in promoting amateur operations and the legitimate interests of local governments in regulating local zoning matters. The cornerstone on which we will predicate our decision is that a reasonable accommodation may be made between the two sides.

23. Preemption is primarily a function of the extent of the conflict between federal and state and local regulation. Thus, in considering whether our regulations or policies can tolerate a state regulation, we may consider such factors as the severity of the conflict and the reasons underlying the state's regulations. In this regard, we have previously recognized the legitimate and important state interests reflected in local zoning regulations. For example, in Earth Satellite Communications, Inc., 95 FCC 2d 1223 (1983), we recognized that . . . countervailing state interests inhere in the present situation . . . For example, we do not wish to preclude a state or locality from exercising jurisdiction over certain elements of an SMATV operation that properly may fall within its authority, such as zoning or public safety and health, provided the regulation in question is not undertaken as a pretext for the actual purpose of frustrating achievement of the preeminent federal objective and so long as the non-federal regulation is applied in a nondiscriminatory manner.

24. Similarly, we recognize here that there are certain general state and local interests which may, in their even-handed application, legitimately affect amateur radio facilities. Nonetheless, there is also a strong federal interest in promoting amateur communications. Evidence of this interest may be found in the comprehensive set of rules that the Commission has adopted to regulate the amateur service [5]. Those rules set forth procedures for the licensing of stations and operators, frequency allocations, technical standards which amateur radio equipment must meet and operating practices which amateur operators must follow. We recognize the Amateur radio service as a voluntary, noncommercial communication service, particularly with respect to providing emergency communications. Moreover, the amateur radio service provides a reservoir of trained operators, technicians and electronic experts who can be called on in times of national or local emergencies. By its nature, the Amateur Radio Service also provides the opportunity for individual operators to further international goodwill. Upon weighing these interests, we believe a limited preemption policy is

warranted. State and local regulations that operate to preclude amateur communications in their communities are in direct conflict with federal objectives and must be preempted.

25. Because amateur station communications are only as effective as the antennas employed, antenna height restrictions directly affect the effectiveness of amateur communications. Some amateur antenna configurations require more substantial installations than others if they are to provide the amateur operator with the communications that he/she desires to engage in. For example, an antenna array for International amateur communications will differ from an antenna used to contact other amateur operators at shorter distances. We will not, however, specify any particular height limitation below which a local government may not regulate, nor will we suggest the precise language that must be contained in local ordinances, such as mechanisms for special exceptions, variances, or conditional use permits. Nevertheless, local regulations which involve placement, screening, or height of anatennas based on health, safety, or aesthetic considerations must be crafted to accommodate reasonably amateur communications, and to represent the minimum practicable regulation to accomplish the local authority's legitimate purpose.[6]

26. Obviously, we do not have the staff or financial resources to review all state and local laws that affect amateur operations. We are confident, however, that state and local governments will endeavor to legislate in a manner that affords appropriate recognition to the important federal interest at stake here and thereby avoid unnecessary conflict with federal policy, as well as time-consuming and expensive litigation in this area. Amateur operators who believe that local or state governments have been overreaching and thereby have precluded accomplishment of their legitimate communications goals, may, in addition, use this document to bring our policies to the attention of local tribunals and forums.

27. Accordingly, the Request for Declaratory Ruling filed July 16, 1984, by the American Radio Relay League, Inc., IS GRANTED to the extent indicated herein and, in all other respects, IS DENIED.

FEDERAL COMMUNICATIONS COMMISSION

William J. Tricarico
Secretary

Return To Top

Footnotes

1. Public Notice, August 30, 1984, Mimeo. No. 6299, 49 F.R. 36113, September 14, 1984.

2. Public Notice, December 19, 1984, Mimeo No. 1498.

3. Order, November 8, 1984, Mimeo. No. 770.

4. MARS is solely under the auspices of the military which recruits volunteer amateur operators to render assistance to it. The Commission is not involved in the MARS program.

5. 47 CFR Part 97.

6. We reiterate that our ruling herein does not reach restrictive covenants in private contractual agreements. Such agreements are voluntarily entered into by the buyer or

tenant when the agreement is executed and do not usually concern this Commission.

Return To Top

Last reviewed/updated on 2/19/2002

2013 ORS § 221.295[1]

Ordinances regulating placement or height of radio antennas

Notwithstanding ORS chapters 215 and 227, a city or county ordinance based on health, safety or aesthetic considerations that regulates the placement, screening or height of the antennas or antenna support structures of amateur radio operators must reasonably accommodate amateur radio communications and must represent the minimum practicable regulation necessary to accomplish the purpose of the city or county. However, a city or county may not restrict antennas or antenna support structures of amateur radio operators to heights of 70 feet or lower unless the restriction is necessary to achieve a clearly defined health, safety or aesthetic objective of the city or county. [1999 c.507 §1]

Note: 221.295 (Ordinances regulating placement or height of radio antennas) was enacted into law by the Legislative Assembly but was not added to or made a part of ORS chapter 221 or any series therein by legislative action. See Preface to Oregon Revised Statutes for further explanation.

* * *

(No annotations for this section.)

[1] Legislative Counsel Committee, *CHAPTER 221—Organization and Government of Cities*, https://www.oregonlegislature.gov/bills_laws/lawsstatutes/2013ors221.html (2013) (last accessed Apr. 27, 2014).

[2] OregonLaws.org contains the contents of Volume 21 of the ORS, inserted alongside the pertinent statutes. See the preface to the ORS Annotations for more information.

[3] OregonLaws.org assembles these lists by analyzing references between Sections. Each listed item refers back to the current Section in its own text. The result reveals relationships in the code that may not have otherwise been apparent.

Currency Information

(d) Existing ORS sections are assigned new ORS numbers if reorganization of the material is warranted. For example, ORS 418.035 was renumbered to ORS 412.001 in 2007.

(e) Actual effective dates are inserted in place of "the effective date of this Act." For example, "the effective date of this 2003 Act" was replaced by "August 29, 2003" in section 4, chapter 733, Oregon Laws 2003, compiled as ORS 238A.070.

(f) References in session laws to "this (year) Act" or to a section of the session laws are replaced by specific ORS references. For example, in section 23, chapter 179, Oregon Laws 2009, amending ORS 125.015, the words "sections 1 to 22 of this 2009 Act" are replaced by "ORS 125.800 to 125.852" and the words "section 2 of this 2009 Act" are replaced by "ORS 125.802."

(g) Alterations are made in unamended ORS sections containing references to a specific series of ORS sections when new session law sections were "added to and made a part of" that ORS series. For example, "ORS ***475.846*** to 475.894" (emphasis added) cited in ORS 133.619 (6) in the 2009 edition was expanded to "ORS ***475.806*** to 475.894" (emphasis added) in the 2011 edition to accommodate sections 6 to 20, chapter 524, Oregon Laws 2011, which were added to and made a part of ORS 475.846 to 475.894 by section 5, chapter 524, Oregon Laws 2011, but which could not be accommodated numerically within the existing series. The new sections became ORS 475.806 to 475.834 and expanded the series to become ORS 475.806 to 475.894.

(h) Alterations are made in unamended ORS sections when new session law sections are enacted "in lieu of" repealed ORS sections or when ORS sections were renumbered, and such unamended ORS sections contain references to the repealed or renumbered ORS sections. For example, "414.844" was substituted for "735.724" in ORS 735.714 when ORS 735.724 was renumbered ORS 414.844 in 2009.

(2) Changes made pursuant to specific statutes. Alterations are made in unamended ORS sections pursuant to specific statutes directing the substitution of new words or phrases for existing words or phrases. For example, section 2, chapter 762, Oregon Laws 2009, authorized the substitution of "Oregon University System" for "Department of Higher Education" in *Oregon Revised Statutes*. A complete list of statutes authorizing substitutions of this nature appears as a note at the end of this Preface.

"Not added to and made a part of." Notes may indicate that a particular ORS section was not added to and made a part of the ORS chapter or series in which the section appears. These notes mean that the placement of the section was editorial and not by legislative action. Notes also are used when the series references are either too numerous or too complex to bear further adjustment. However, the note does ***not*** mean that the section not added to a series or a chapter is any less the law. The note is intended ***only*** to remind the user that definitions, penalties and other references to the series should be examined carefully to determine whether they apply to the noted section.

For example, *Oregon Revised Statutes* contains chapter 137 relating to judgment, execution, parole and probation. A law relating to any of those subjects may be enacted but not legislatively added to ORS chapter 137, even though the section clearly belongs with the related materials found in that chapter. The Legislative Counsel compiles the section where it logically belongs and provides the "not added to" note.

ac·com·mo·date verb

: to provide room for (someone) : to provide a place to stay and sleep for (someone)

: to have room for (someone or something)

: to do something helpful for (someone) : to provide what is needed or wanted for (someone or something)

ac·com·mo·dat·ed **ac·com·mo·dat·ing**

Full Definition of ACCOMMODATE

transitive verb

1 : to make fit, suitable, or congruous

2 : to bring into agreement or concord : RECONCILE

3 : to provide with something desired, needed, or suited

4 **a** : to make room for

b : to hold without crowding or inconvenience

5 : to give consideration to : allow for <*accommodate* the special interests of various groups>

intransitive verb

: to adapt oneself; *also* : to undergo visual accommodation

— ac·com·mo·da·tive *adjective*
— ac·com·mo·da·tive·ness *noun*
— ac·com·mo·da·tor *noun*

See accommodate defined for English-language learners »
See accommodate defined for kids »

Examples of ACCOMMODATE

Over 600 people can be *accommodated* on the cruise ship.

The ceilings were too low to *accommodate* his terrific height.

They were kind enough to *accommodate* me with a ride to the train station.

I asked them for additional money, and they *accommodated* me with a loan.

He would often change his schedule to *accommodate* his clients.

New facilities are being added to *accommodate* the special needs of elderly residents.

minimal

Save Popularity

5 ENTRIES FOUND

minimal
minimal art
minimal brain dysfunction

min·i·mal *adjective* \ˈmi-nə-məl\

: very small or slight in size or amount

Full Definition of MINIMAL

1 : relating to or being a minimum: as

a : the least possible <a victory won with *minimal* loss of life>

b : barely adequate <a *minimal* standard of living>

c : very small or slight <a *minimal* interest in art>

2 *often capitalized* **:** of, relating to, or being minimal art or minimalism

— min·i·mal·ly *adverb*

See minimal defined for English-language learners »
See minimal defined for kids »

Examples of MINIMAL

The storm caused *minimal* damage.

areas at *minimal* risk for flooding

First Known Use of MINIMAL

1666

Related to MINIMAL

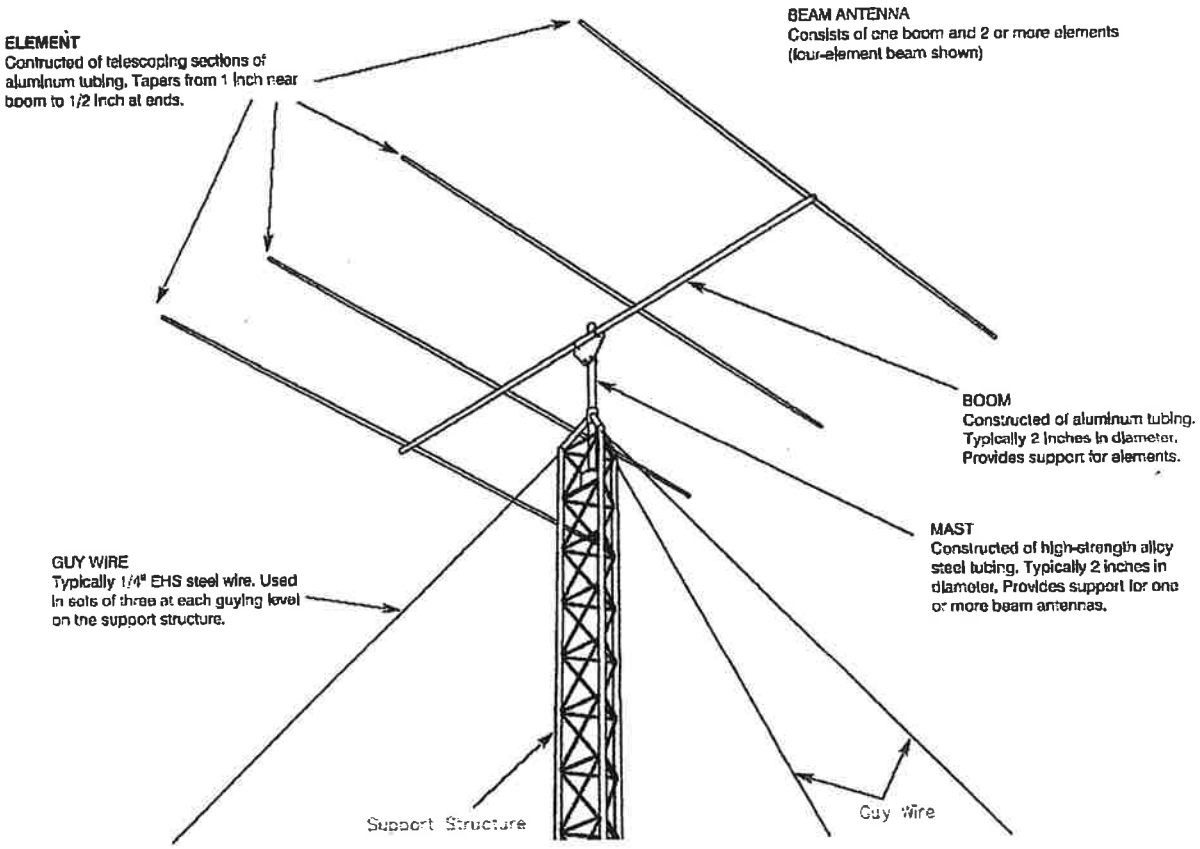
Synonyms
fewest, littlest, lowest, minimum, minutest, slightest, smallest, tiniest

Antonyms
biggest, full, greatest, hugest, largest, maximum, most, top, topmost, utmost

- more

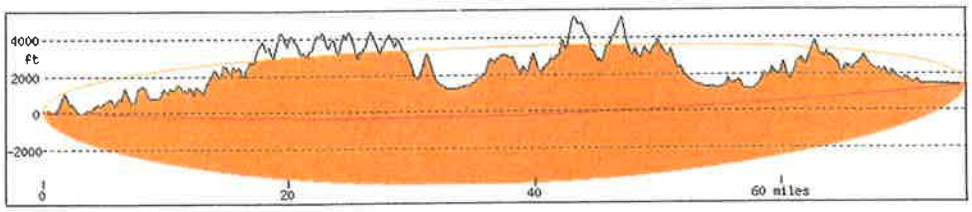
min·i·mal *adjective* \ˈmi-nə-məl\ (Medical Dictionary)

Medical Definition of MINIMAL


ELEMENT
Contructed of telescoping sections of aluminum tubing. Tapers from 1 inch near boom to 1/2 inch at ends.
BEAM ANTENNA
Consists of one boom and 2 or more elements (four-element beam shown)
BOOM
Constructed of aluminum tubing. Typically 2 inches in diameter. Provides support for elements.
MAST
Constructed of high-strength alloy steel tubing. Typically 2 inches in diameter. Provides support for one or more beam antennas.
GUY WIRE
Typically 1/4" EHS steel wire. Used in sets of three at each guying level on the support structure.
Support Structure
Guy Wire

HeyWhatsThat Path Profiler

Hide



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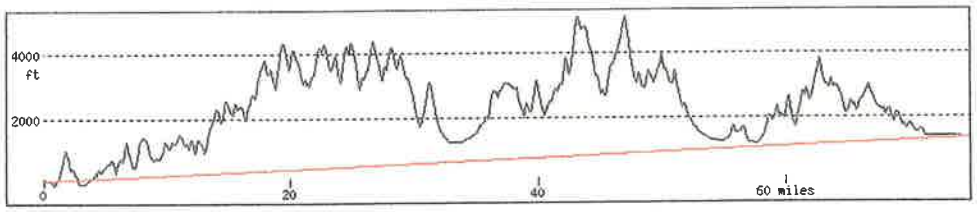

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75° 74.6 miles
Medfo
42.326515° N 122.875595° W

Needs Analysis
for Height of
Amateur Radio Antenna Support Structures

Submitted on Behalf of
Charles T. Ristorcelli, NN3V
13307 Avenida La Valencia
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Prepared by
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May 3, 2014

TABLE OF CONTENTS

Executive Summary

The purpose of this report is to show the need for an antenna system of sufficient height and dimensions to provide reliable High Frequency (HF), or "shortwave," communications, under the changing variables that impact amateur radio communications. It was prepared for Charles Ristorcelli, Amateur Radio Operator NN3V, for his home in Poway, California. Mr. Ristorcelli's location is typical of locations in Poway with "rolling terrain."

This report is written to address inadequacies in a report entitled "Review of Amateur Radio Antenna Height Requirements" by Lawrence Behr Associates, Inc. of Greenville, NC for the Green Valley Civic Association of the City of Poway, CA. The report is dated 2 April 2014.

The studies presented here consider antenna heights to compute standard reliability criteria for communications on the 20, 15 40-meter Amateur Radio bands for:

1. A height of 65 feet for the 20, 15 and 40-meter bands (14.0, 21.0 and 7.0 MHz) to Asia and Europe, using horizontally polarized beam antennas.
2. A height of 35 feet for the 20, 15 and 40-meter bands (14.0, 21.0 and 7.0 MHz) to Asia and Europe, using horizontally polarized beam antennas. Note that 35 feet is the present height limit in Poway, CA.
3. Comparisons with simple vertically polarized antennas, as suggested by consultant Lawrence Behr Associates, Inc.

Mr. Ristorcelli has specified that the purpose the High Frequency (1.8 to 30 MHz) antenna systems is intended to serve to provide effective communications with Europe, Asia and North America. These three geographic areas are the most highly populated areas for Amateur Radio operators. North America, basically Canada, the USA and Mexico, is located relatively close to California, while Asia and Europe are far more distant, requiring higher antennas for reliable communications.

It is the conclusion of this report that the specified antenna systems at the proposed 65-foot height for the antennas are barely adequate for the modest needs of this Amateur Radio operator, when measured against commonly used engineering metrics. Mr. Ristorcelli has indicated that the structure is an acceptable compromise, as he has always wished to avoid litigation.

A proposed height limit of 35 feet for HF antenna systems results in clearly unacceptable performance, which cannot meet the needs of the Amateur Radio operator when measured against commonly used engineering metrics.

Outline

This report is organized as follows:

1. Background of the author.
2. A brief discussion of communications reliability as pertaining to amateur radio.
3. An HF communications reliability study of the installation, using industry standard tools.
4. A reprint of a publication from the American Radio Relay League, "Antenna Height and Communications Effectiveness," that provides the basic technical background as to why higher antennas perform more reliably.

Resume of the Author, R. Dean Straw

R. Dean Straw received the degree of Bachelor of Engineering and Applied Science from Yale University in New Haven, CT, in 1967.

After a 25-year career in the Marine Electronics field, doing engineering and technical marketing for major manufacturers (ITT/Mackay, Furuno, Datamarine, and Raytheon Marine), in 1993 Mr. Straw started work at the ARRL (American Radio Relay League) as a Senior Assistant Technical Editor. ARRL is the National Organization for Amateur Radio.

Straw's primary function was to be the Editor for five different editions (17th through the 21st Editions) of *The ARRL Antenna Book*, the premier publication dealing with antennas, transmission lines and propagation in the Amateur Radio field. Straw wrote not only text for this book, but also created innovative software programs for analysis of propagation, antennas and transmission-lines. This includes the industry-standard *HFTA* (High Frequency Terrain Assessment) program. He has lectured on these subjects at dozens of national and regional conventions and more than 50 seminars.

Straw also edited a number of books in his 15-year tenure at ARRL, including:

1. Three editions of *The ARRL Handbook*
2. Four volumes of *The ARRL Antenna Compendium* series
3. *ON4UN's Low-Band DXing* (two editions)
4. *Low-Profile Amateur Radio*
5. *The ARRL DXCC Handbook*
6. *Antenna Zoning*
7. *DXing on the Edge—the Thrill of 160 Meters*
8. *Basic Radio*
9. *Basic Antennas*
10. He was co-author of *Simple and Fun Antennas for Hams*.
11. He has authored dozens of technical articles for the ARRL monthly magazine, *QST*.

Straw retired in March 2008, and has been devoting his time primarily to the technical analysis of propagation and antenna phenomena, while indulging also in his passion for traveling and operating ham-radio contests around the world. He has been licensed as a Radio Amateur for 54 years, holding an Amateur Extra, the highest class, license since 1969.

HF Communications Reliability

For the reader to meaningfully interpret the reliability and signal-strength study presented herein, a brief discussion of the major concepts and terms involved is relevant. The reader is also urged to review the document prepared by technical staff at the American Radio Relay League, "Antenna Height and Communications Effectiveness," which provides the physical explanation as to why radio communications reliability and effectiveness is strongly affected by antenna height.

Reliability (REL) in a radio communications context, answers the question "How often, on average, can this communication take place at a specified 'minimum acceptable level'?" Reliability is normally expressed as a percentage, and arriving at a specific value depends on the definition of "Minimum Acceptable Level" (or MAL) in use. Several different MALs are commonly accepted in the engineering community.

Measures of Reliability

Imagine watching a distant VHF or UHF analog TV station (not digital), which occasionally fades in and out. If we define the MAL as "a completely clear picture without snow or fuzziness," then the measured Reliability might be as low as 20 to 30%. On the other hand, if we are willing to accept an MAL of "we can just make out the picture," then the measured Reliability might jump to 80 to 90%... for the same picture.

Or consider this real-world example. Many areas of the communications industry (broadcasting and networking, to pick two) routinely use a Reliability figure of 99.99% (commonly referred to as the 'four nines'). In this case, the MAL is usually "the transmission (or network) is functioning, and of first quality" — nothing less. Being "up" 99.99% of the time, conversely, means you are "down" no more than 0.01% or, equivalently, no more than 52 minutes per year. Radio amateurs do not, generally speaking, require such a high level of Reliability.

Application to HF analysis

If we turn closer to our radio domain, High Frequency (HF) shortwave broadcasters, like the Voice of America or the BBC World Service, look for Reliability numbers in the 80 to 90% range when planning their time and frequency schedules, to achieve an area-coverage goal. In their cases, the MAL parameter (yardstick) is the Signal-to-Noise ratio, or SNR. This is basically the ratio of how loud the broadcast is in relation to background radio "hiss" and static levels (such as noise caused by nearby thunderstorms). Commonly required SNR numbers range anywhere from 40-70 dB (a higher number means better quality reception).

In the analysis presented below, the Reliability (REL) threshold is set at 57%, using an SNR of 43 dB for Single Sideband (SSB) voice communications. This is a *very* conservative (low) value for measuring acceptable communications quality.

Long-distance HF radio communication is made possible by reflecting signals off an ionized portion of the Earth's atmosphere known as the *ionosphere*. The very nature of this communication is variable (ie, not constant) and depends on many factors, including the time of year, time of day, solar (sunspot) activity, local noise sources and other geomagnetic and atmospheric conditions. In our test cases we have consistently used very conservative models and accepted a low Reliability (REL) factor (57%).

1. A Reliability threshold of 57% is equivalent to four days a week. Imagine if your cell phone or cable TV service worked only four days out of seven during the week — that would be a Reliability of 57%. If your cell phone or cable TV service worked only five days out of seven, that would be a Reliability of 71%. In the area-coverage maps that follow, the Reliability contours are 14, 29, 43, 57, 71 and 86%, to correspond to easily understood levels of one to six days per week.
2. The MAL (Minimum Acceptable Level) is expressed as a percentage of time that communications are available at a specified Signal-to-Noise Ratio (SNR). The SNR value of 43 dB is commonly used in Amateur Radio for trained operators accustomed to fading, noise and interference. It is the *minimum required SNR* for a Single Sideband (voice) transmission. Single sideband transmissions sometimes require an SNR of up to 50 dB or more, which would further lower the results presented here (ie, this would require a larger/taller antenna system). In other words, in presenting the results here, the assumptions about required Reliability are very modest indeed.

In contrast to our scientific approach in this report, we must point out the statement by Lawrence Behr Associates, Inc. on page 2 of their report, under *"ASSUMPTION: This study does not perform analytical or computational electromagnetic calculations to predict radio propagation."* It would seem that Lawrence Behr Associates is making open-ended recommendations without documentation, a troubling methodology.

High Frequency (HF) Analysis

PROCEDURE

For the High Frequency (HF or shortwave) radio spectrum, the reliability (REL) of a given path (say, Poway to Europe or to Asia) is commonly defined as the percentage of days that the signal at the receiver's end meets or exceeds a defined Signal-to-Noise ratio (SNR). The REL value depends on many parameters. Several directly or indirectly affect the "take-off" angle as described in the well-documented American Radio Relay League (ARRL) publication that accompanies this report. Other parameters include transmitter power, local terrain, and the hourly and daily absorptive and reflective properties of the ionosphere.

In this section, we use two industry standard software tools: the High Frequency Terrain Analysis (*HFTA*) program, which computes the effect of local terrain on the launch of HF signals into the ionosphere, and the Voice of America Coverage Analysis Program (*VOACAP*), which predicts the reliability (REL) and signal strength (SDBW) values to Asia and to Europe, using two different antenna heights for operation, 65 and 35 feet, in the amateur bands from 7.1, 14.2 and 21.2 MHz (40, 20 and 15 meters).

Throughout this study, the home location of Mr. Charles Ristorcelli, amateur radio call NN3V, was used as an example of the typical kind of location found in Poway, CA. The process starts by using the USGS National Elevation Dataset terrain data for the exact latitude and longitude of the antenna-support location at Mr. Ristorcelli's home in Poway. His location is typical of the rolling terrain found throughout Poway. This USGS terrain data is used as input for the *HFTA* (High Frequency Terrain Assessment) program. *HFTA* uses the Ristorcelli actual (not theoretical) terrain profiles from each support structure location and the actual antenna parameters (free-space antenna gain and

height) as inputs. It thus provides the actual antenna gain and take-off (elevation) angle data as output.

The output from *HFTA* is then used as the antenna input to the *VOAAREA* program (a subset of *VOACAP*) to produce Area Coverage maps. *VOACAP* is an HF Propagation Analysis software tool developed by the US Department of Commerce / Institute for Telecommunication Sciences over the last four decades. This software suite is in the public domain, and was made possible by funding from the Voice of America (VOA), the US Army and the US Air Force. Area Coverage is one of many calculations that *VOACAP* can perform. It displays a number of calculated quantities (including REL and signal strength SDBW) for a specified transmitter to a desired reception area, for a specified date, time of day, frequency and sunspot level. The results appear as contours plotted on a world-map background.

On the resulting map, reliability contours that meet our criteria are shown dark green (86%, occurring 6 out of 7 days per week), light green (71%, occurring 5 out of 7 days a week) and then yellow (57%, occurring 4 out of 7 days a week). Those areas that fail to meet the standard 57% reliability criteria are shown in blue, dark gray, light gray or white. **Table 1** shows the relationships.

Table 1, VOAAREA REL Color Coding

Color	% Availability	Days per Week
Dark Green	86%	>6 out of 7
Light Green	71%	5 out of 7
Yellow	57%	4 out of 7
Light Blue	43%	3 out of 7
Dark Gray	29%	2 out of 7
Light Gray	14%	1 out of 7
White	<14%	< 1 out of 7

DETAILED DESCRIPTION OF *VOAAREA* INPUT PARAMETERS

Some parameters are held constant for all the cases analyzed in *VOAAREA*. They are:

1. Transmitter location: the Ristorcelli location in Poway, California.
2. Transmitter power: 1.5 kW (kilowatts). This is the maximum legal power limit for Amateur-Radio stations.
3. Transmitter frequency: 7.1, 14.2 and 21.2 MHz (40, 20 and 15 meters).
4. Receiving antenna type: a 75-foot high dipole over flat ground.
5. The Smoothed Sunspot Number (SSN): 100. This is an acceptable average value over the entire 11-year solar sunspot cycle.
6. Month: November.
7. SNR required: 43 dB for SSB (voice) communications. This is the minimum acceptable signal-to-noise value needed for voice transmissions. A minimum SNR of 24 dB could be used for narrow-band CW (Morse code) transmissions if satisfactory voice communication isn't possible.
8. Level of local noise: Quiet rural man-made noise.
9. Absorption model: IONCAP.

The transmitting antennas created in *HFTA* and used in *VOAAREA* were:

1. 40 m Dipole at 35, 65 and 120 feet to Europe and Asia for 7.1 MHz
2. 3-element Yagis at 35 and 65 feet to Europe and Asia for 14.2 MHz
3. 3-element Yagis at 35 and 65 feet to Europe and Asia for 21.2 MHz
4. Quarter-wave vertical Ground Plane antennas for 40, 20 and 15 meters

The geographic targets of Europe and Japan (Asia) were specified for the most popular bands (40, 20 and 15 meters), since these locations represent the largest concentrations of ham-radio operators outside of the USA. Europe is a challenging target area from California, mainly because of the long distances involved, which results in weak signals. But there is another problem over this path. The signal to Europe from California must transit the northern *auroral zone* HF signals and it can be severely absorbed during periods of high auroral activity.

In the detailed discussion that follows, 57% is used as the minimum acceptable reliability (REL) value. That is, successful communications is defined as a path reliability of 57% or greater — four or more days a week out of seven — of available time when signals achieve the desired 43 dB SNR level.

Note that blackout periods due to solar flares and other solar disturbances, when communications are not realistically possible, are not included. If blackout times were included, the reliability would be even lower, dramatically lower, in fact. The 57% REL requirement is a very conservative service goal, as *Snook v. Missouri City* (Texas)[1], an Amateur-Radio case tried in the U.S. District Court, Southern District of Texas (2003), accepted a service reliability standard of 75 to 90%. This higher level of service reliability would in general require even larger and higher antennas at the Ristorcelli location.

Fig 1 shows the Terrain Profile from the base of the Ristorcelli antenna support for two azimuths of special interest: 30° to Europe and 305° to Japan. The terrain towards Europe is somewhat challenging, since it slopes upwards from the tower base at 650 feet ASL in the shape of a "saddle back." This tends to block signals at low elevation takeoff angles. The terrain towards Japan, on the other hand, is more beneficial in that the average height drops quickly until about 2 miles away. The diamond represent the height of a Yagi transmitting antenna at 65 feet.

[1] *Snook v. City of Missouri City*, No. 03-cv-243, 2003 U.S. Dist. LEXIS 27256, 2003 WL 25258302 (S.D. Tex. Aug. 26, 2003, Hittner, J.) (the Order, Slip Opinion, 63 pp.), see also the Final Judgment, Slip Opinion, 2 pp. PACER citation: https://ecf.txsd.uscourts.gov/cgi-bin/login.pl?387442335892775-L_238_0-14:03-cv-00243_Snook v._City_of_Missouri, (S.D. Tex. 2003). http://www.arrl.org/FandES/field/regulations/PRB-1_Pkg/Snook%20KB5F%20Decision%20&%20Order%2034.pdf

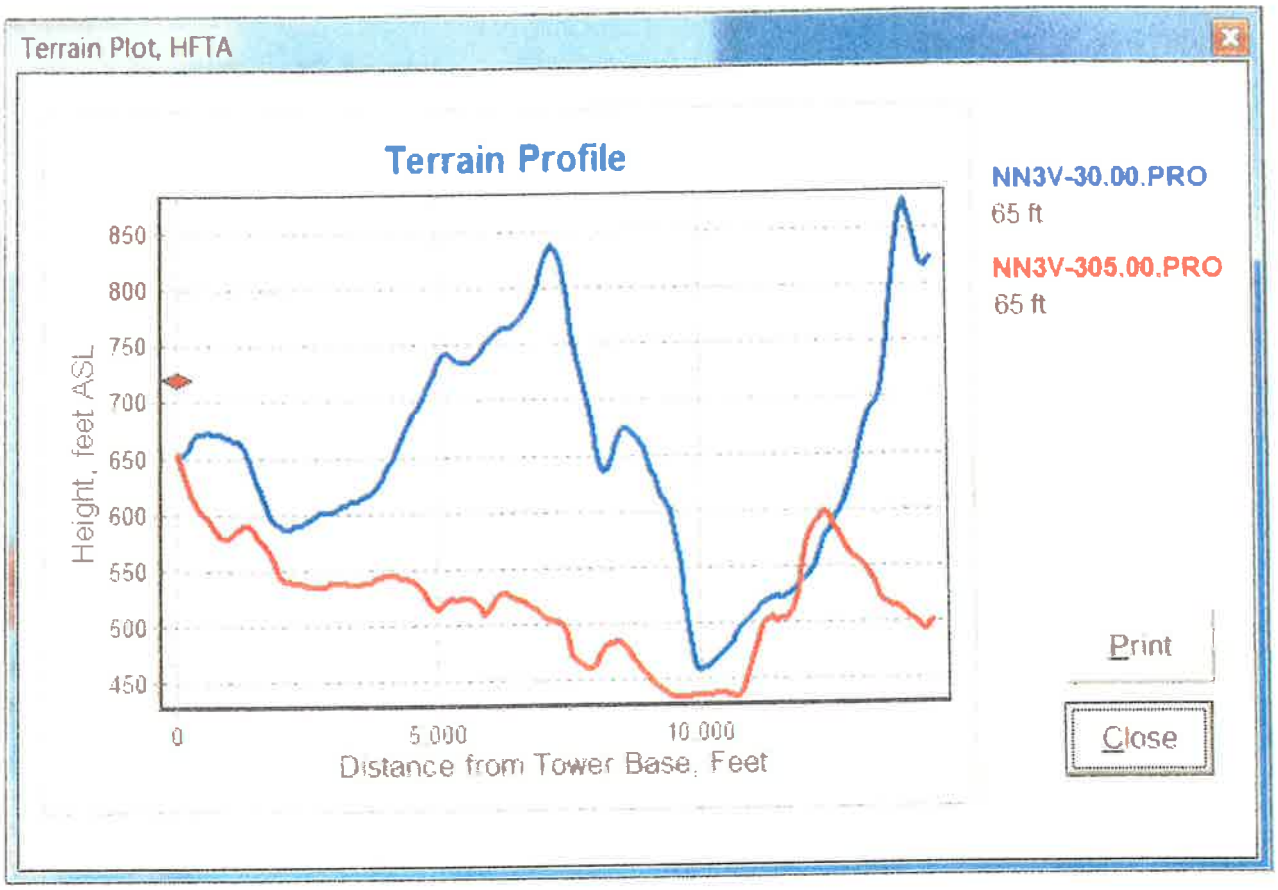


Fig 1 — Terrain profile from the base of the antenna towards Europe (blue, at azimuth of 30°) and towards Asia (red, at 305°). The average slope is downwards to Japan, aiding the takeoff of signals along this terrain, but the terrain towards Europe is somewhat more challenging.

40 METERS (7.1 MHZ)

The 40-meter band is important for communications with Europe from southern California. However, it is also a challenging band because of the physical size of antennas designed for 40 meters. Not only must the width of a 40-meter antenna be close to 67 feet, but a 40-meter antenna must be mounted high in the air in order to achieve the low elevation angles needed for long-distance communications.

Fig 2 shows the elevation responses computed by *HFTA* on 40 meters (7.1 MHz) for three different antennas on the azimuth (30°) towards Europe: 120 feet (blue), 65 feet (red) and 35 feet (green).

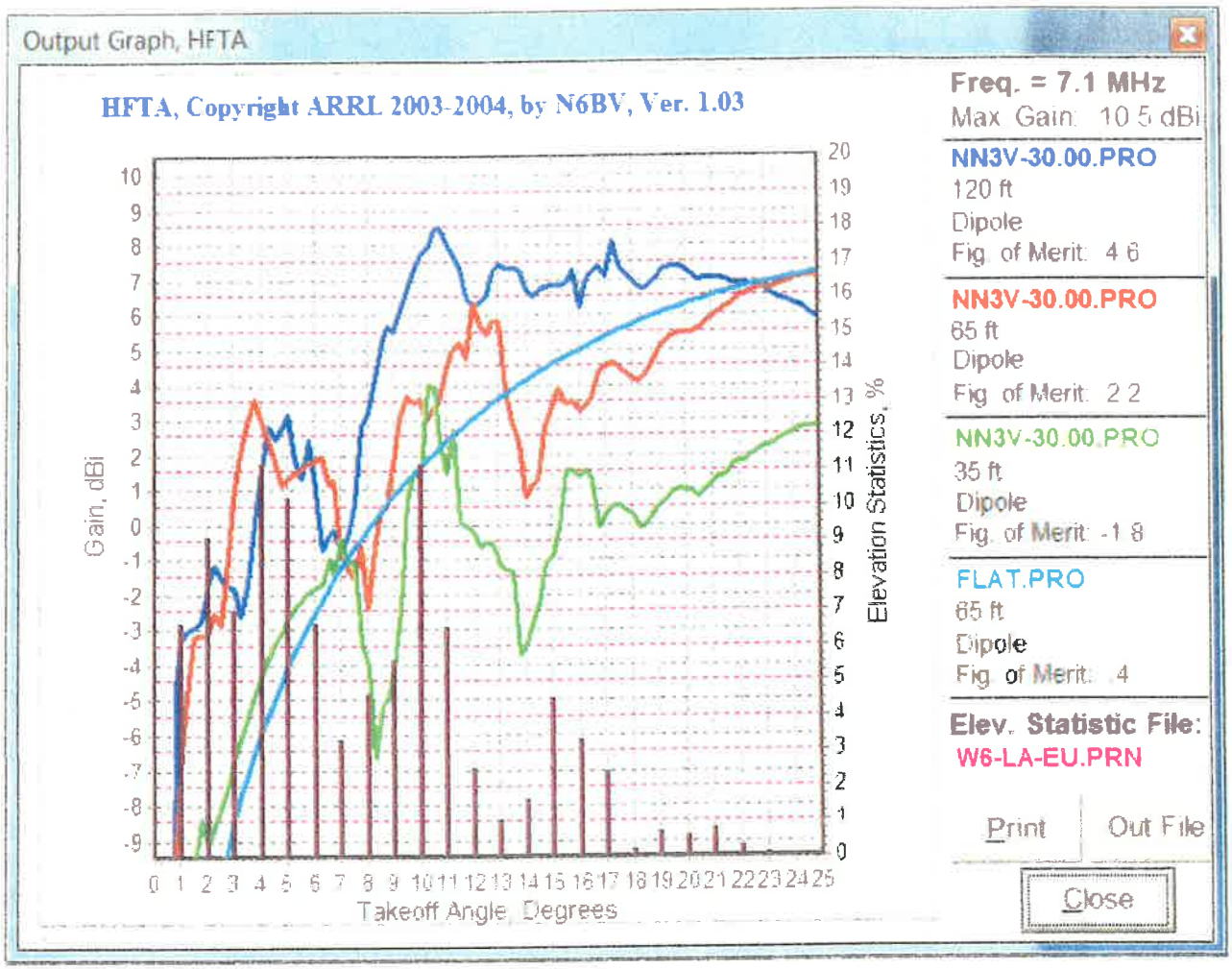


Fig 3 — *HFTA* 40-meter (7.1 MHz) gain over NN3V's terrain in Poway for three different antenna heights: 120, 65 and 35 feet. For reference, the cyan line is for a 65-foot dipole over flat ground, rather than the undulating terrain of NN3V.

What then are the actual effects of using these antennas, in terms of the reliability of signal coverage into Europe? **Fig 4** shows the REL (reliability) contours generated by *VOAAREA* for a 40-meter dipole at a height of 65 feet, at 0600 UTC in November for a high level of solar activity (SSN = 100).

The 71% (yellow) reliability contour covers most of Europe, with the exception of portions of Eastern Europe, including Moscow, which falls in the 42% coverage area (dark grey: three days in a week). Even a 65-foot-high 40-meter antenna is too low to achieve the 57% reliability mark.

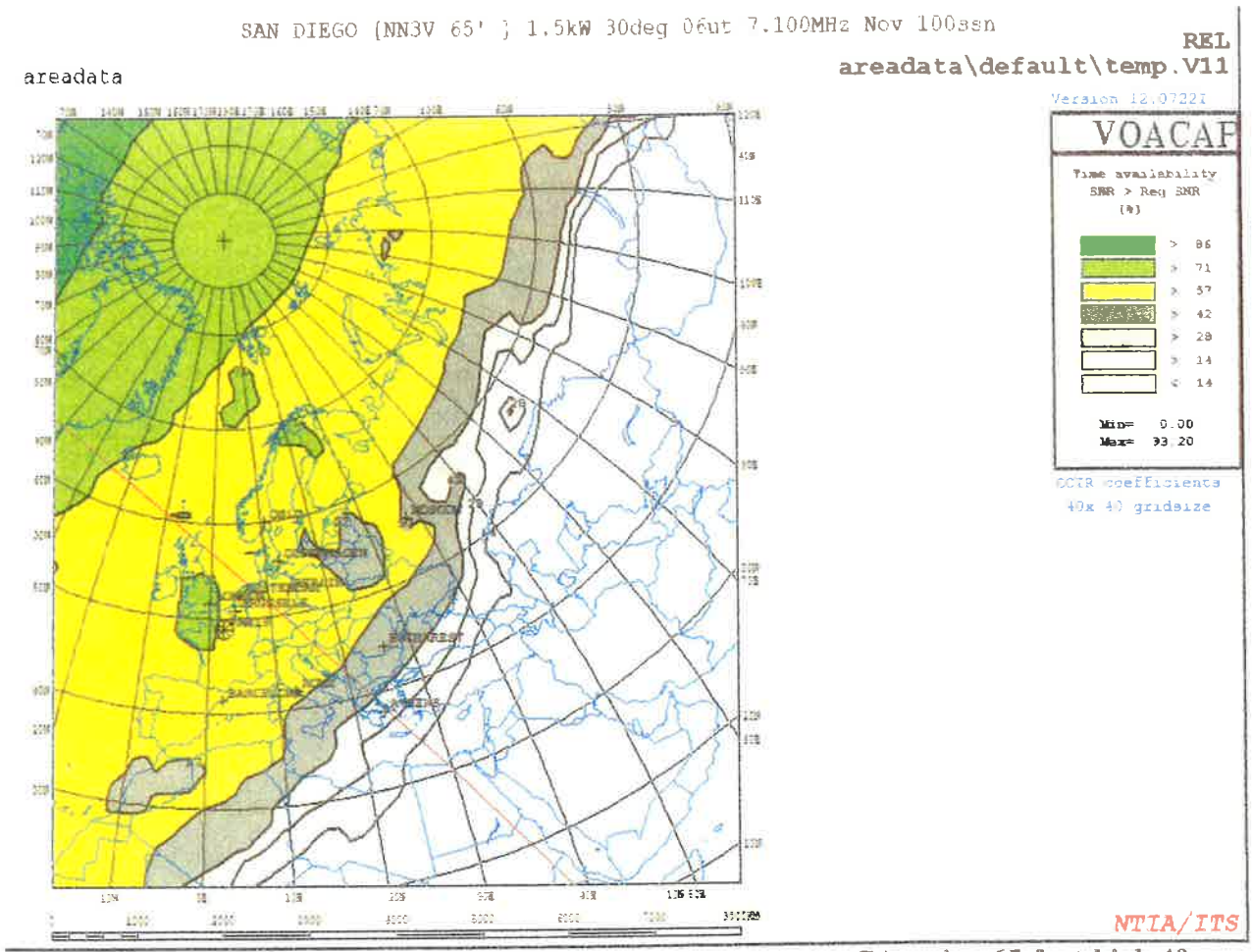


Fig 4 — Reliability of 40-meter coverage in Europe from Poway, CA, using 65-foot-high 40-meter dipole antenna. This coverage map was generated by the *VOAAREA* program. The 57% reliability contour (yellow = 4 days out of 7) covers all of Western Europe and parts of Eastern Europe. At 65 feet, coverage misses Moscow, Bucharest and the southernmost portion of Italy (dark grey = 3 days out of 7).

Fig 5 — shows the area coverage for a 35-foot dipole over NN3V's terrain toward Europe.

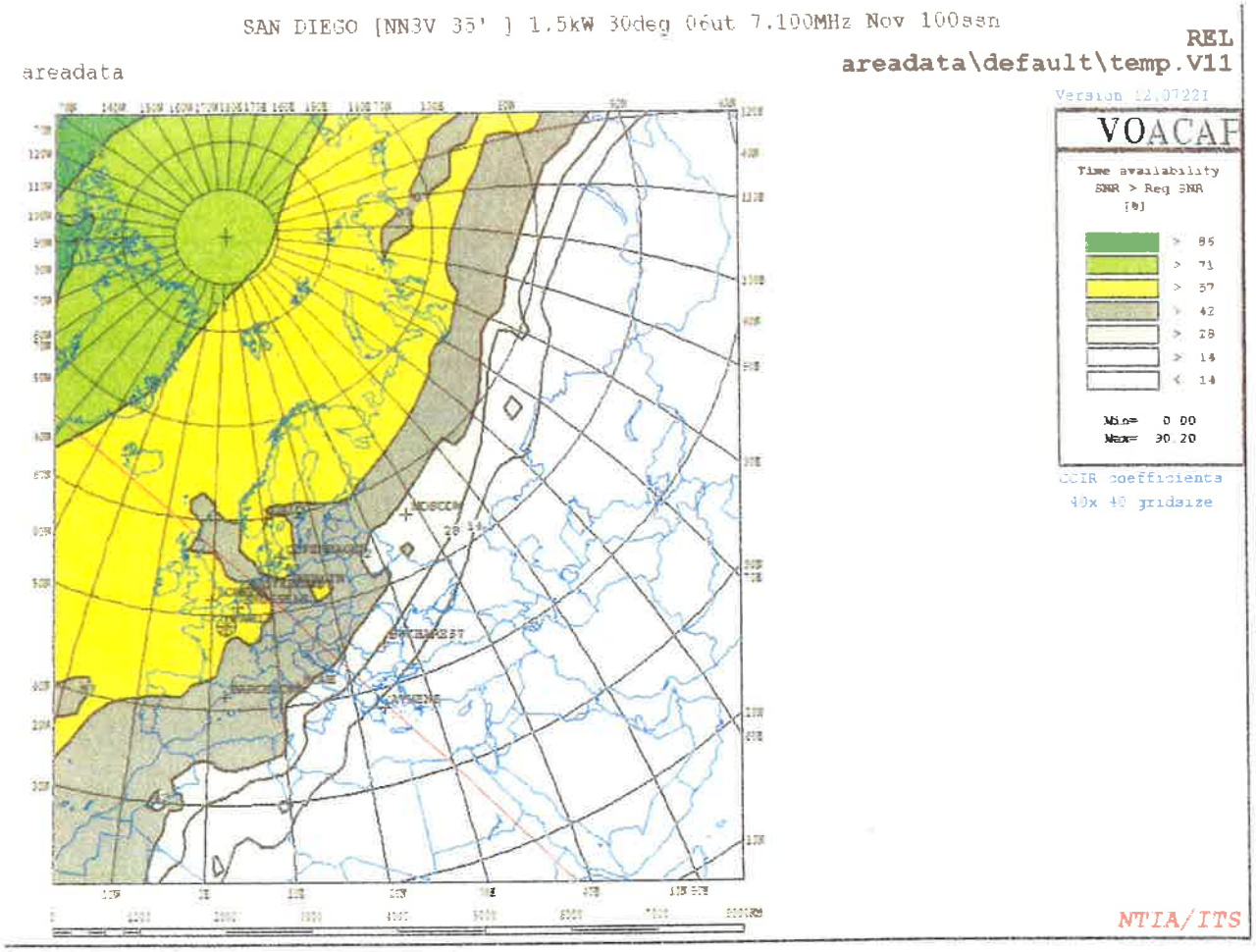


Fig 5 — Area coverage map generated using 35-foot-high Yagi in Poway, CA. Now reliable coverage covers only portions of Western Europe, missing Eastern and Southern Europe. Clearly a 35-foot high antenna won't yield reliable coverage in Europe.

When a single 35-foot high Yagi antenna is substituted for the 65-foot Yagi, the result is shown in **Fig 5**. Again, most of Western Europe is covered by the 57% reliability contour, but coverage is missing in Eastern and Southern Europe, falling into the range of 42% reliability, good for three days out of seven.

Use a Vertical?

While citing only vague generalities about the effects of height on the launch of HF signals into the ionosphere, Lawrence Behr Associates, Ltd suggests what could be an "effective" antenna on pages 3 and 4 of their report, where they state, "Typical band conditions for amateur radio are shown in Appendix 1 which implies that a multiband antenna (vertical with an antenna matching network/tuner) is recommended although not mandatory for successful operation."

Fig 6 shows the area coverage on 40 meters, where the transmitting antenna in Poway has been changed from a horizontally polarized 40-meter dipole to a simple quarter-wave Ground Plane vertical. Now the area covered in Europe has been reduced to the U.K. plus a few islands in the

Arctic north of Scandinavia and northwestern Russia. The entire continent of Europe is very poorly served by the antenna that Lawrence Behr Associates suggests, with no numerical analysis given to back up their assertions.

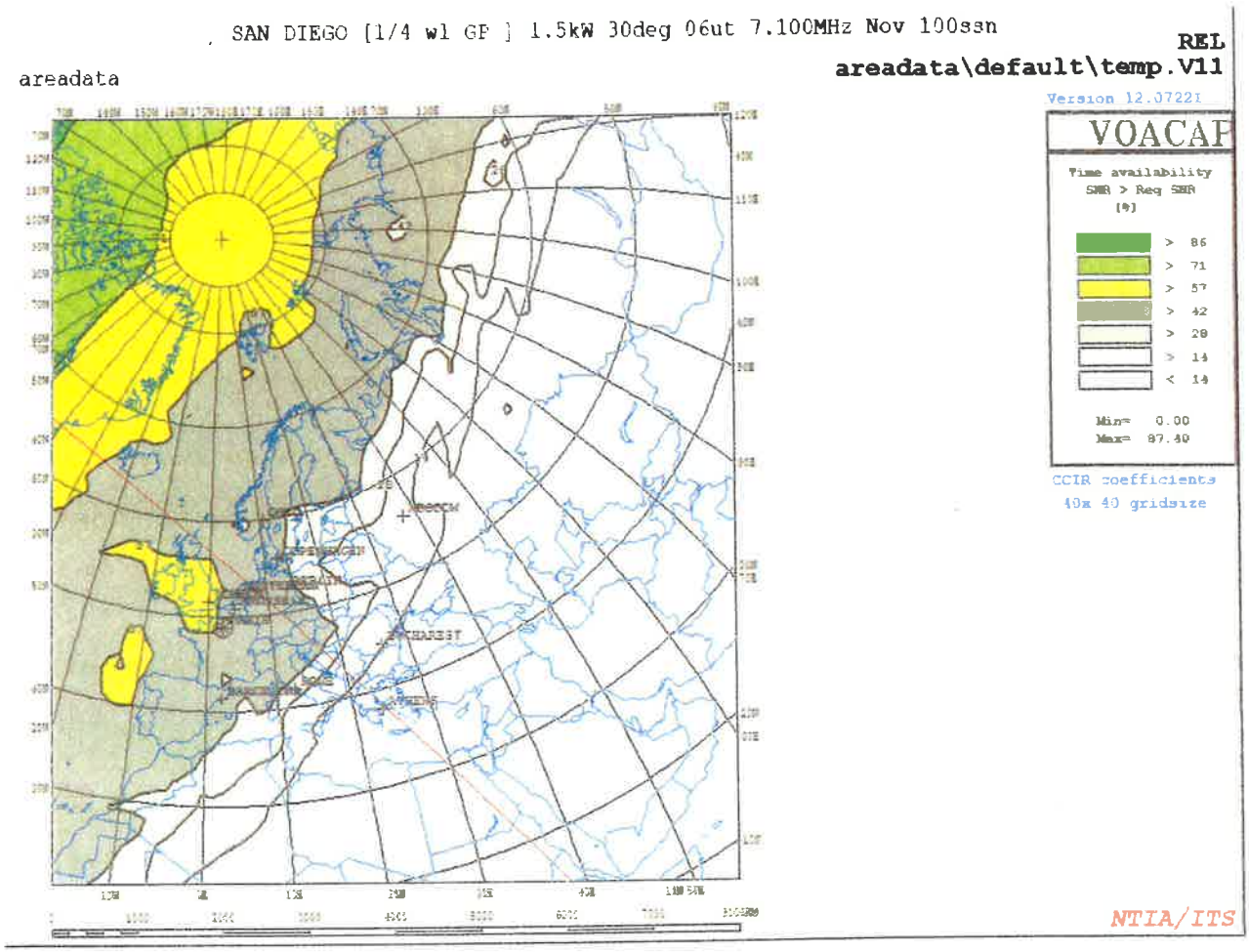


Fig 6 — In this 40-meter area-coverage plot, the transmitting antenna is a simple quarter-wave Ground Plane vertical mounted over soil with average conductivity and dielectric constant. The coverage of most of Europe, except for the British Isles, is greatly impacted. This is not an "effective" antenna, despite claims to the contrary.

What about a 120-foot high dipole? What areas in Europe would have a 57% reliability? **Fig 7** shows the results from *VOAAREA*. Clearly, the 120-foot antenna provides better coverage than a 65-foot high antenna, and far superior coverage compared to a 35-foot antenna. Higher is definitely better on 7.1 MHz (40 meters).

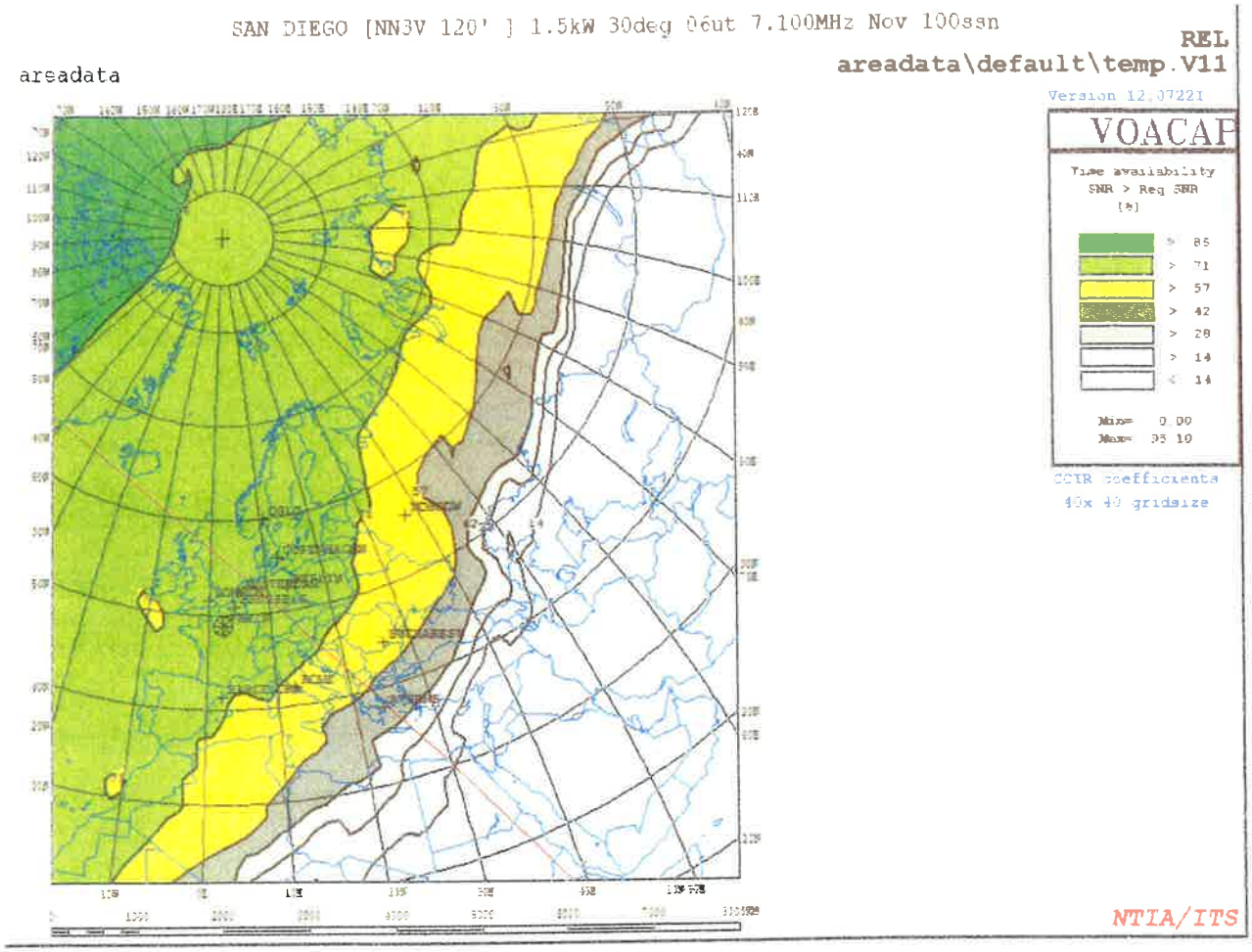


Fig 7 — Reliability coverage in Europe for 120-foot high 40-meter dipole. Almost all of Europe is covered with a 57% or better reliability. Only the area near Athens in far southwestern Europe barely misses the cut.

Fig 8 shows the coverage areas in Asia on the 40-meter band from Poway, CA.

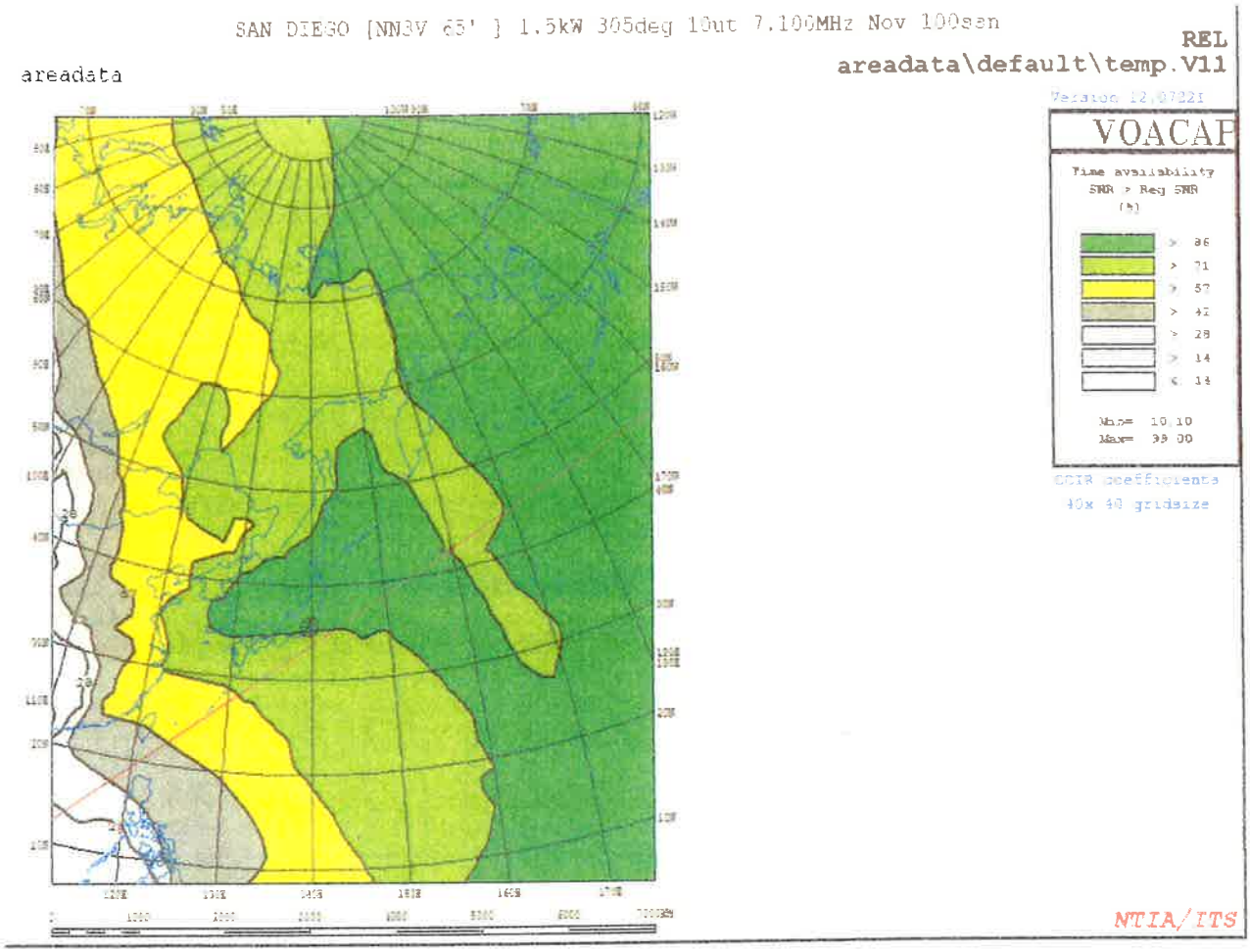


Fig 8—Reliability contours for NN3V into Asia using a 65-foot-high antenna for the month of November at 10 UTC. The 57% contour covers Taiwan all the way up through part of Mongolia.

20 METERS (14.2 MHZ)

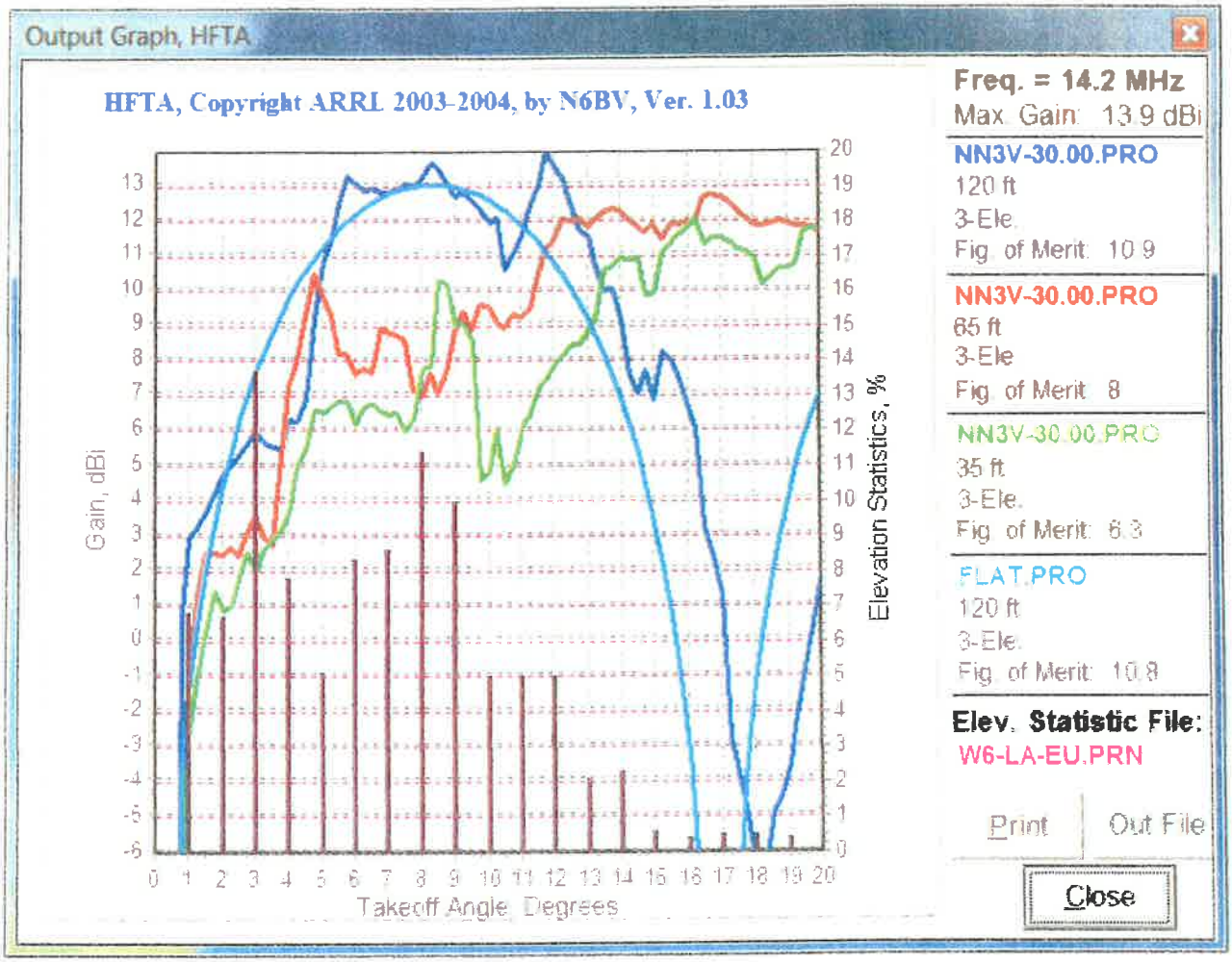


Fig 9 — *HFTA* analysis of the terrain for several 20-meter antennas towards Europe. The blue line is for a 120-foot high antenna array; the red line for an antenna at 65 feet, while the green line is for a single Low (35') antenna. The cyan line is the 120-foot high array over flat ground, shown for reference. The higher antennas are generally superior.

The single 35-foot high antenna is dramatically less effective than the higher two antennas. You can see that the difference between the blue and red lines is a measure of the effect of the local terrain on the launch of 20-meter signals into the ionosphere. The bar-graph vertical violet lines show the statistical percentages versus takeoff angle. For example, 13.7% of all the times the 20-meter band is open from southern California to Europe, communications occur at a takeoff angle of 3° degrees, a very low angle that requires high antennas.

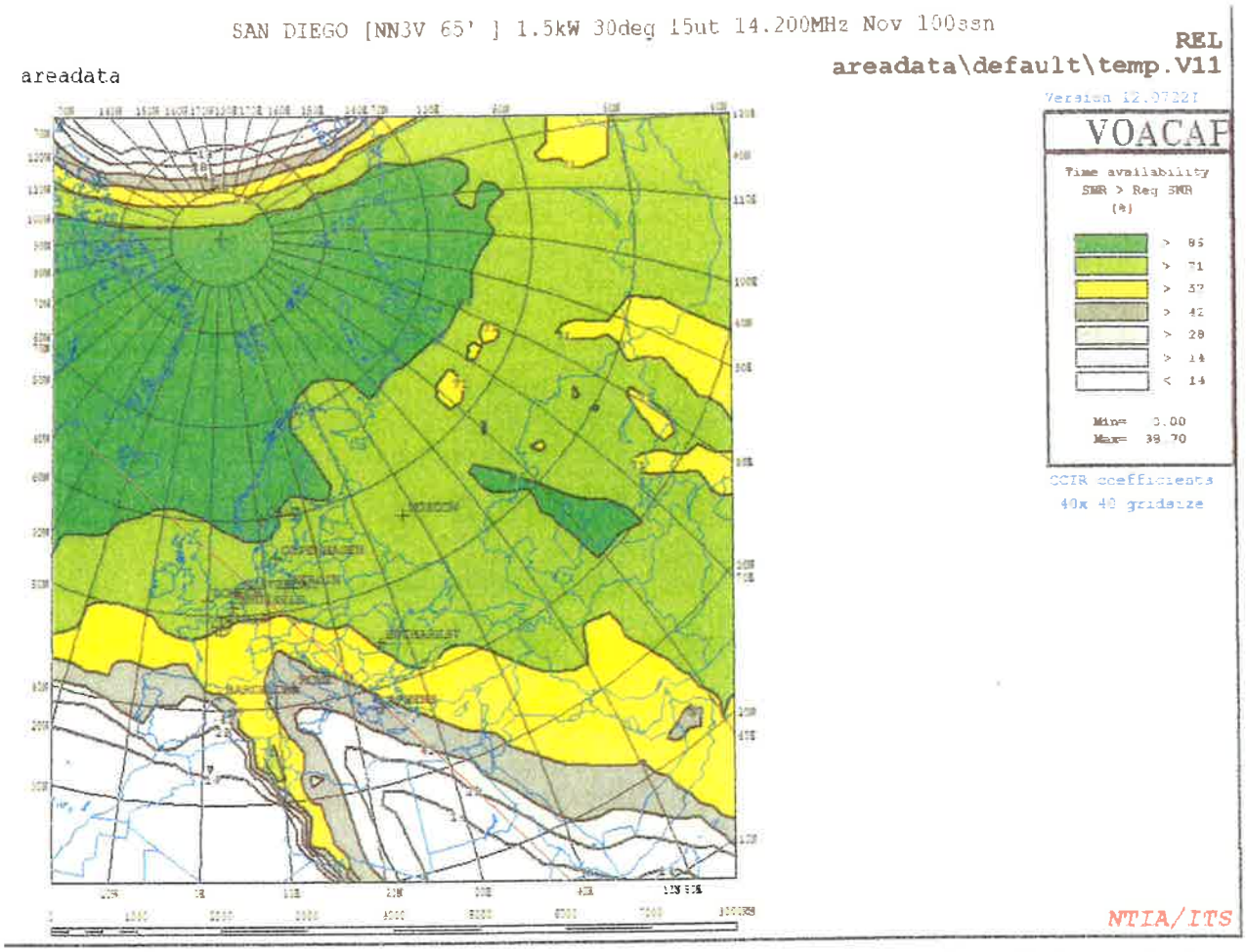


Fig 10 — Reliability coverage from Poway, CA, to Europe on 20 meters for a 65-foot-high 3-element Yagi. Almost all of Europe is covered by the 57% contour, except for Rome and Athens. Much of Europe is covered by the 86% contour, meaning communication is possible for 6 out of 7 days in a week.

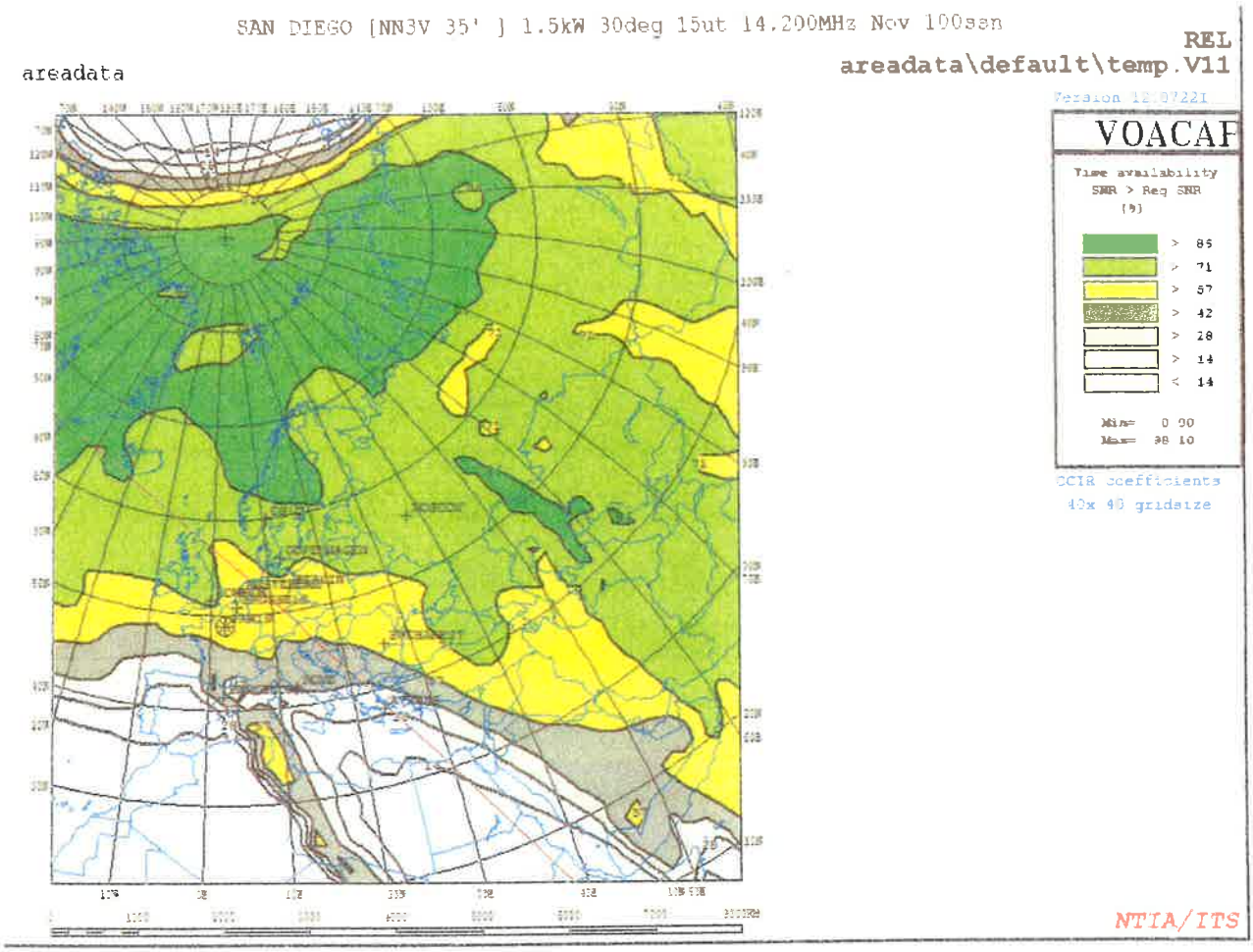


Fig 11 — 20-meter area coverage for 35-foot-high 3-element Yagi for coverage of Europe from Poway, CA. Some of Europe is covered by 57% contour, but a large swath of southern and southeastern Europe is not covered. The 35-foot antenna is clearly not high enough.

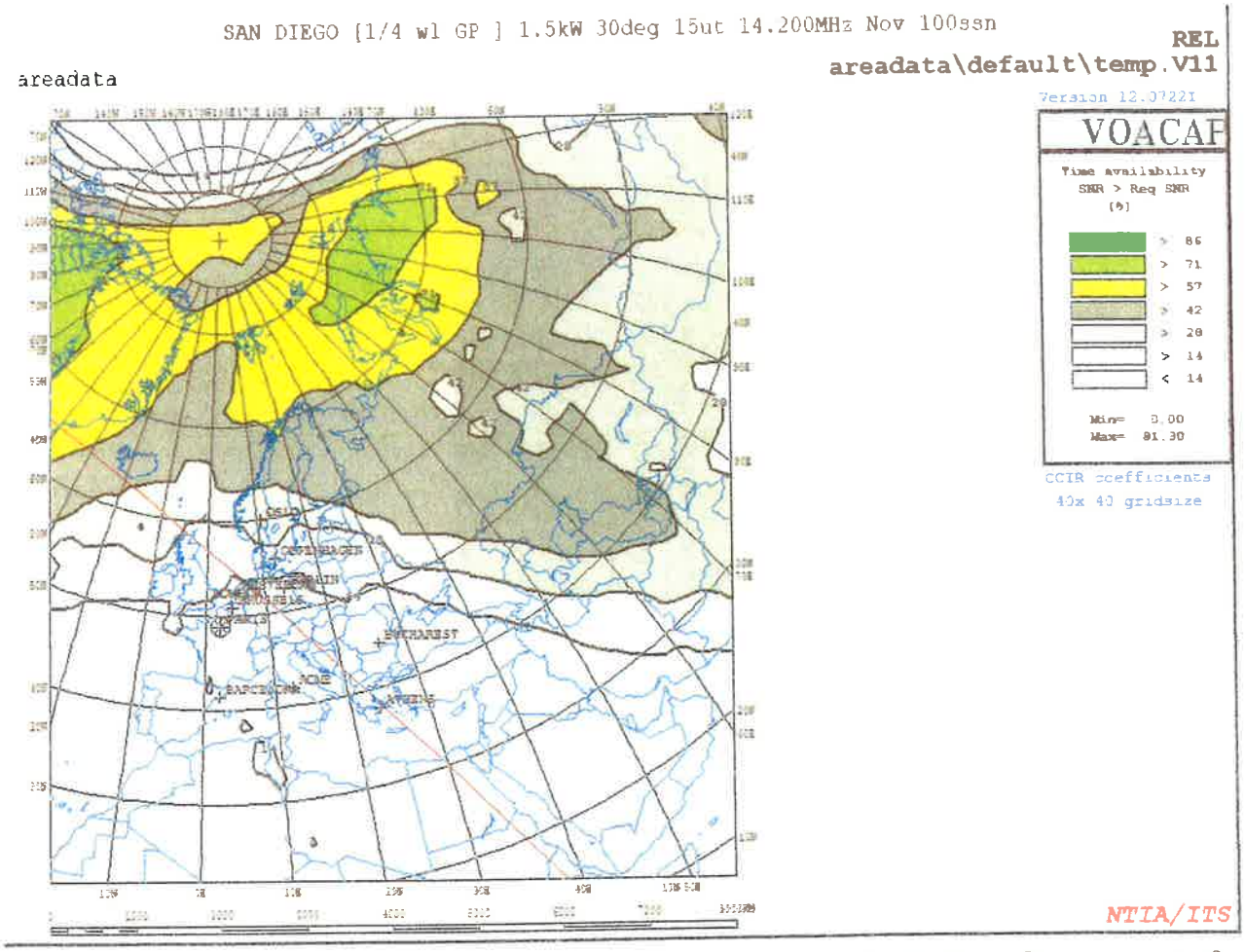


Fig 12 — Changing to a simple vertical Ground Plane antenna seriously degrades coverage of Europe from Poway, CA on 20 meters. Only Iceland and some of the polar islands off the northwest coast of Russia are covered with a 57% reliability. A simple vertical antenna is not sufficient.

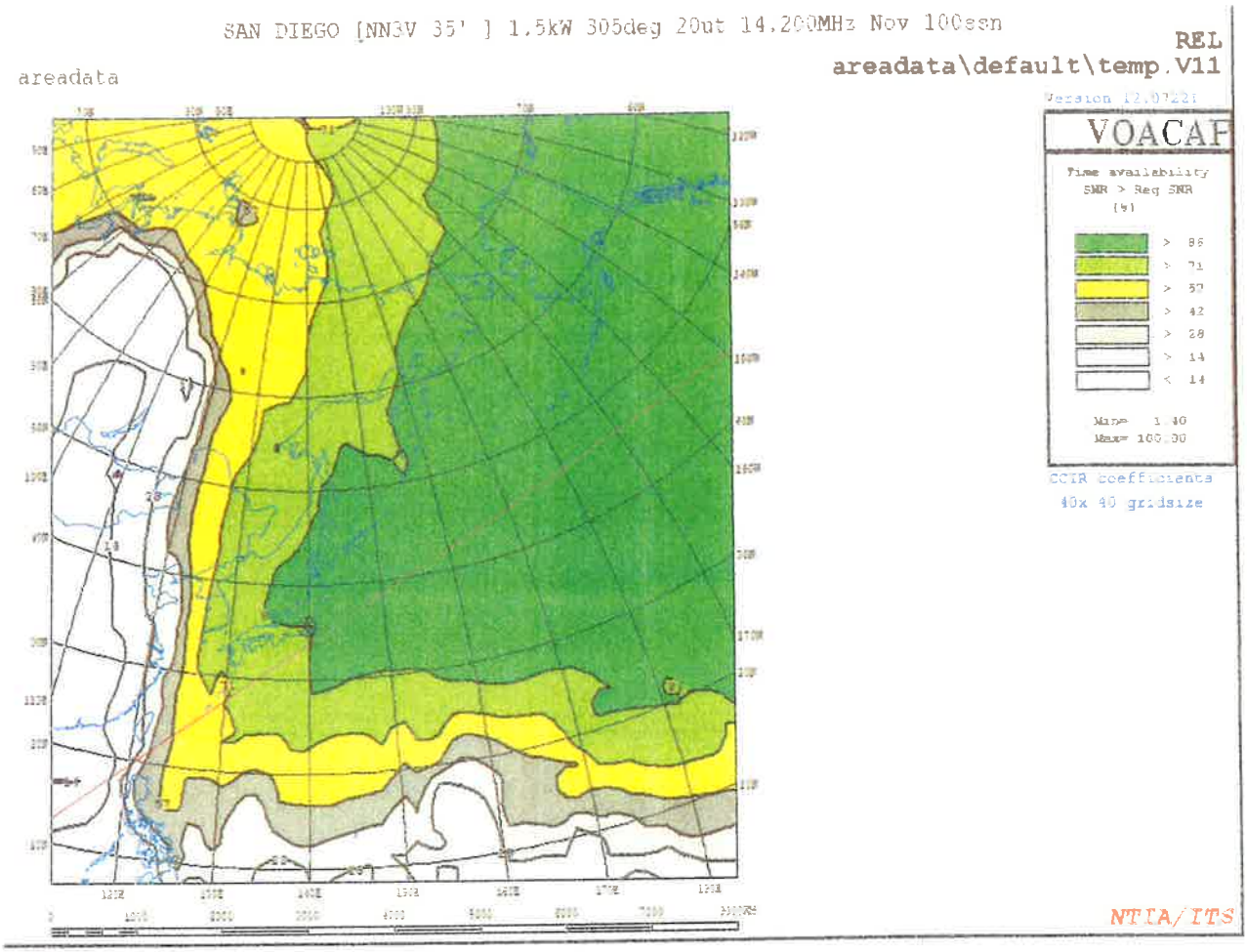


Fig 13 — Reliability contours to Asia for 20-meter 3-element Yagi at 35 feet. The coverage of the Far East is good even for this low antenna height because of the sloping terrain in the direction of Asia at NN3V. This makes the effective height of the tower higher than that for flat land.

15 METERS (21.2 MHZ)

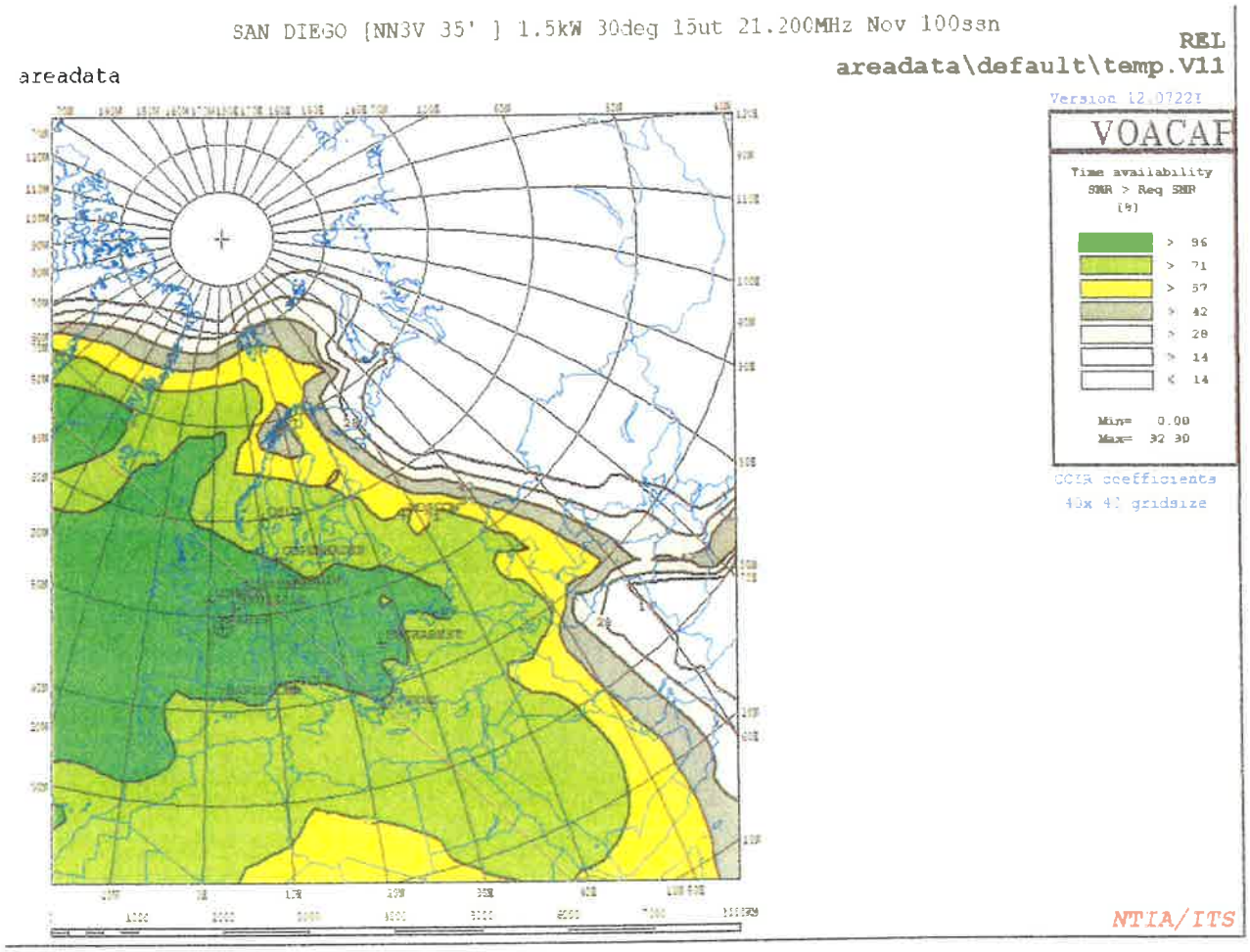


Fig 14 — Reliability contours for 15-meters with 35-foot-high 3-element Yagi antenna. All of Europe is covered by the yellow 57% contour. In fact, the dark green 86% contour covers most of Europe. As the frequency increases the wavelength decreases in direct proportion. This means that a fixed height antenna will be up higher in terms wavelength and the elevation angle will consequently be lower.

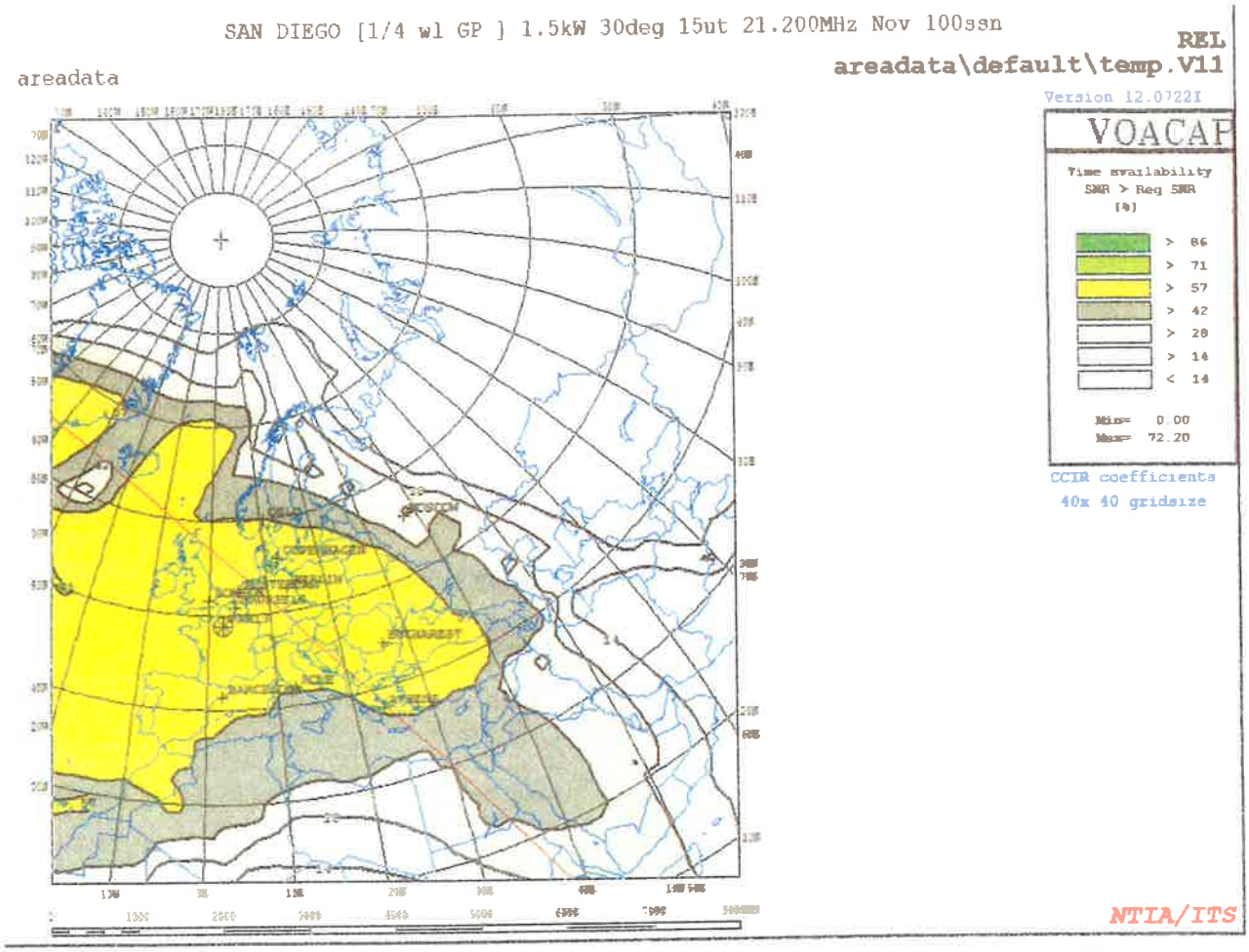


Fig 15 — Reliability coverage with simple vertical Ground Plane antenna. Much of Europe can be covered with this simple antenna on 15 meters, with the exception of northern Europe and parts of Eastern Europe. This would be a compromise antenna that has the virtue of being deployed fairly easily.

Noise

The term "Signal-to-Noise Ratio" suggests that there are two quantities compared to each other — a (desired) voice signal and some sort of (undesired) noise. *VOAAREA* calculates the average noise mainly due to seasonal thunderstorms (whether the lightning crashes are coming from nearby or distant storms, propagating through the ionosphere). *VOAAREA* adds to that the average level of noise coming from the local environment — perhaps noise pulses coming from arcing high-voltage insulators, electric fences or an electric trolley running in the street near your receiving antenna.

What *VOAAREA* doesn't compute explicitly is the "noise" from legitimate transmissions from other stations — most hams would call this "interference," but it too is a form of undesired noise.

Communications Analysis, Conclusions

This document was prepared in response to a study done by Lawrence Behr Associates, Inc. of Greenville, NC, in which claims were made that an antenna height of 35 feet would be adequate to satisfy a Radio Amateur seeking to exercise his rights as a federally licensed operator to communicate on the amateur HF bands.

Our study analyzed the height of antennas for the purpose of determining whether they would meet the legitimate needs of a typical Radio Amateur. The location of Mr. Charles Ristorcelli in Poway, CA, in San Diego County was used as an example throughout our study. Commonly used engineering metrics were employed to determine the effectiveness of communications.

We showed through a variety of engineering analyses that a height limitation of 35 feet only marginally meets the need for reliable HF communications to limited portions of Europe and Asia on the higher frequencies 20 and 15 meters (14.1 and 21.2 MHz). On the lower 40-meter band (7.1 MHz), the ability to communicate with Europe was grossly inadequate with a 35-foot-high dipole antenna.

Respectfully submitted,

R. Dean Straw
San Francisco
May 3, 2014

26

City Hall

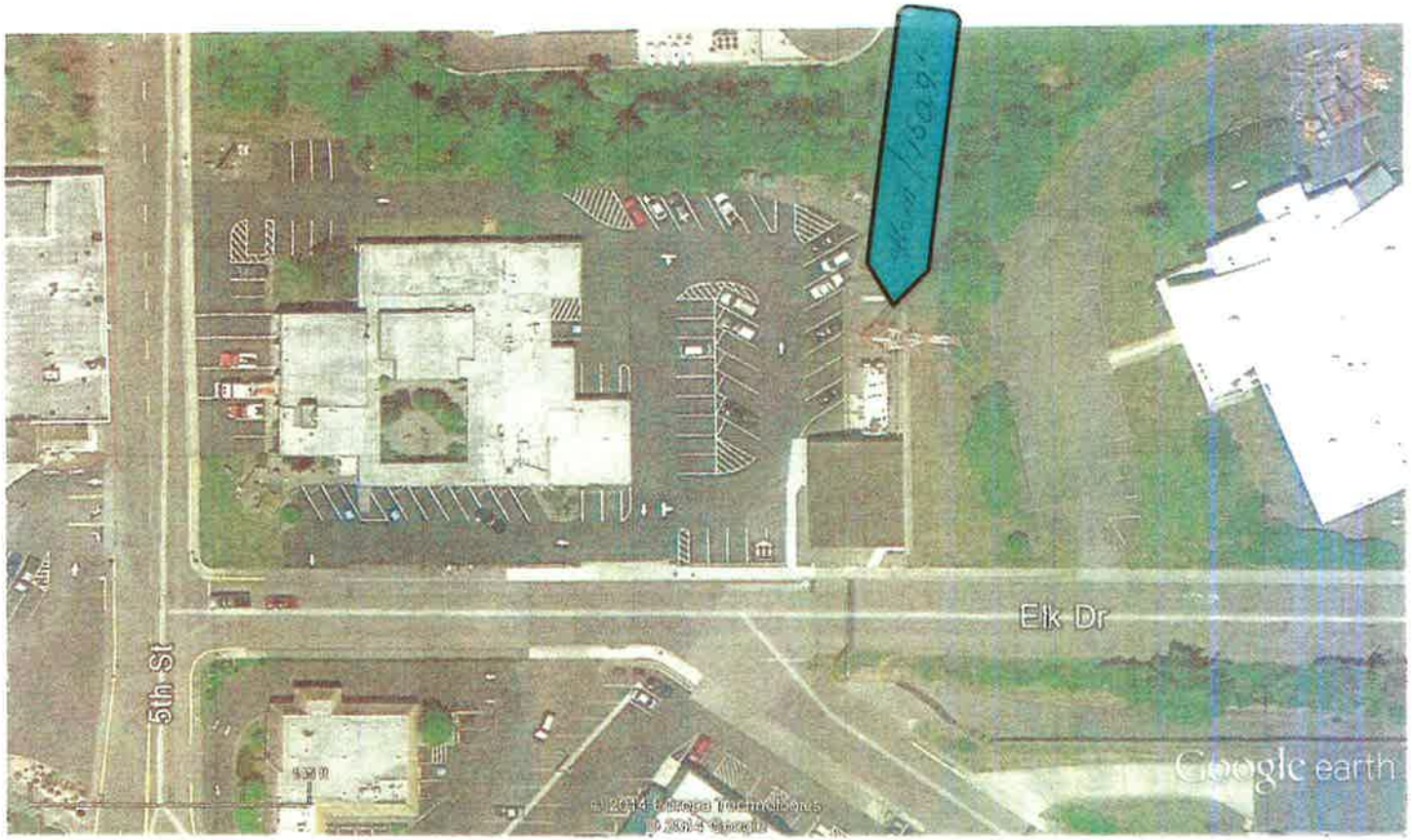
Legend

- TOWNSHIPS
- SITUS
- ASSESSMENT
- ROADS
- PARCELS
- CITY LIMITS
- URBAN GROWTH BOUNDARY

0 150 300 450 ft.

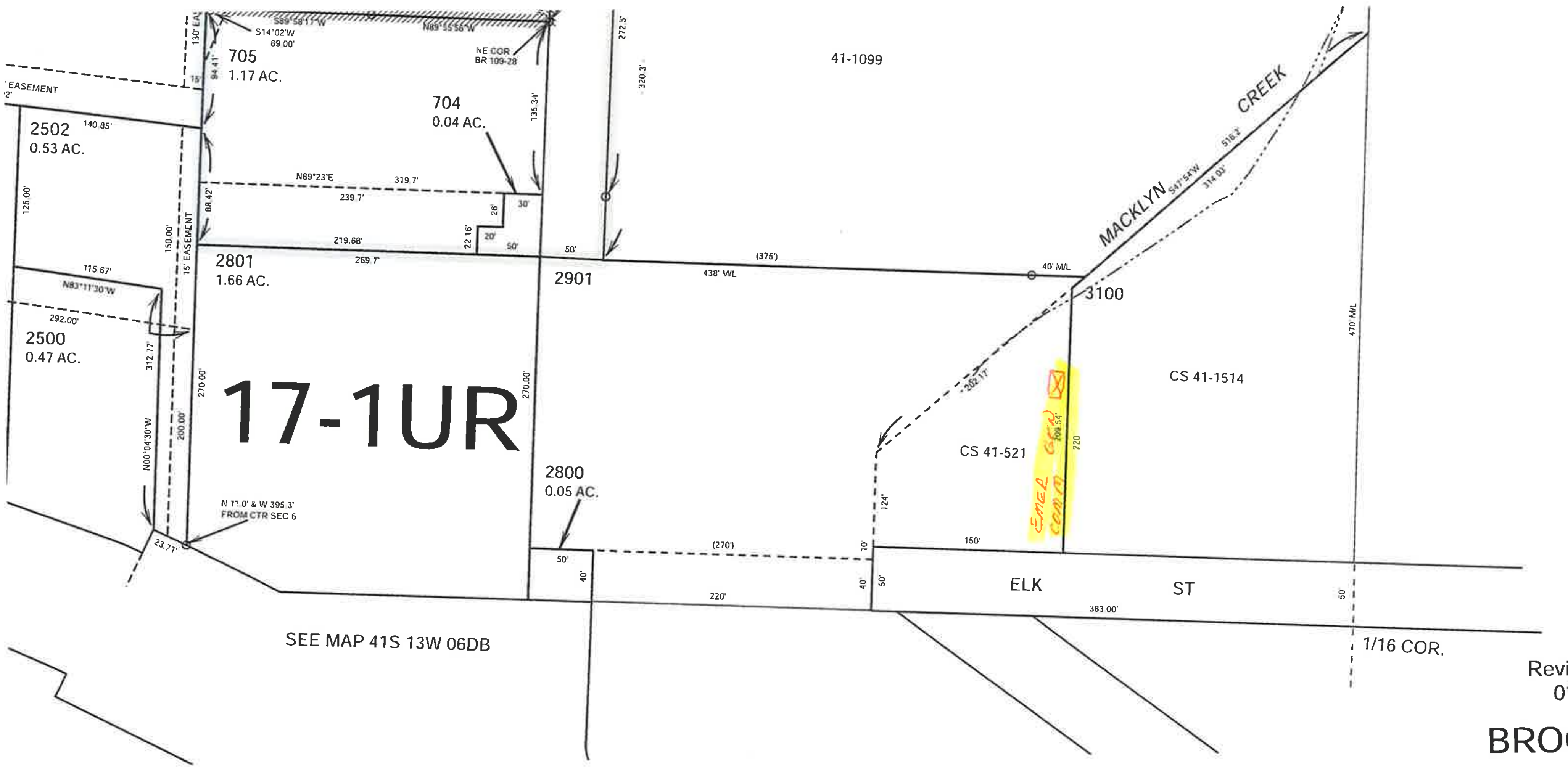
Map center: 42° 3' 19.1" N, 124° 17' 12.2" W

Scale: 1:1,561



Google earth

feet 300
meters 100


17-1UR
705
1.17 AC.
704
0.04 AC.
2502
0.53 AC.
2500
0.47 AC.
2801
1.66 AC.
2901
2800
0.05 AC.
3100
41-1099
CS 41-1514
CS 41-521
MACKLYN
CREEK
ELK
ST
S89°58'17"W
N89°55'56"W
S14°02'W
69.00'
NE COR
BR 109-28
N89°23'E
319.7'
239.7'
219.68'
269.7'
135.34'
272.5'
320.3'
(375')
438' M/L
40' M/L
S47°54'W
516.2'
314.03'
202.17'
470' M/L
209.54'
220
124'
150'
(270')
220'
383.00'
270.00'
200.00'
150.00'
15' EASEMENT
N00°04'30"W
312.77'
N83°11'30"W
115.67'
292.00'
140.85'
125.00'
23.71'
N 11.0' & W 395.3'
FROM CTR SEC 6
SEE MAP 41S 13W 06DB
1/16 COR.

252 King Street, OR, Registration #1207910

Structure Details

Status Code: Constructed
Construction Date: 10/2/2001
Structure Type: TOWER
Overall Height Above Ground: 35.1 (m)
Elevation of Site Above Mean Sea Level: 70.5 (m)

Owner & Contact Information

United States Cellular Corporation - PETER CONNOLLY
8410 W. BRYN MAWR AVENUE, SUITE 700
CHICAGO, IL, 60631

Fcc Towers
»Oregon
»Curry County
»Brookings
»898 Elk Drive

898 Elk Drive, OR, Registration #1267557

Structure Details

Status Code: Constructed
Construction Date: 3/11/2009
Structure Type: TOWER
Overall Height Above Ground: 46 (m) 150.9 ft
Elevation of Site Above Mean Sea Level: 83 (m)

Owner & Contact Information

Brookings, City of - Donny Dotson
898 Elk Drive
Brookings, OR, 97415

limited land use decisions in Chapter 17.120.

17.12.090 Lot coverage.

In the R-1 zone, buildings shall not occupy more than fifty (50) percent of the lot area.

17.12.100 Exceptions to height limitations

A. Chimneys, provided that they do not extend more than five feet above the highest point of the proposed structure.

B. Private, non-commercial antennas or HAM radio antennas and towers up to seventy (70) feet in height, provided that no commercial communication equipment is located on or near such antennas. Such antennas exceeding (70) feet may be allowed as a Conditional Use.

60.70. WIRELESS COMMUNICATIONS FACILITIES. [ORD 4248; May 2003]

60.70.05. Purpose.

1. The purpose of these regulations is to ensure that Wireless Communications Facilities (WCF) are regulated in a manner that:

   A. Conforms to the current federal, state, local laws and with FCC Declaratory Rulings to date. [ORD 4596; February 2013]

   B. Promotes universal communication service to all City residents, businesses and visitors.

   C. Establishes clear and objective standards for the placement, design and continuing maintenance of WCF.

   D. Minimizes the adverse visual, aesthetic and structural safety impacts of WCF on residential neighborhoods and on the community as a whole.

   E. Encourages the design of WCF to be as aesthetically and architecturally compatible as possible with the surrounding natural and built environments.

   F. Encourages collocation of WCF on existing support structures to minimize the number of new facilities required.

   G. Ensures that regulations do not constitute a barrier to entry and apply to providers on a competitively neutral basis.

60.70.10. Applicability.

1. The regulations contained within this section shall apply to the construction or installation or modification of Wireless Communication Facilities (WCF) within the municipal limits of the City of Beaverton.

60.70.10.

2. Regulations contained in this section shall apply to wireless communication facilities used for essential public communication services conducted by police, fire, and other public safety or emergency networks.

3. Compliance with the regulations contained within this section shall be required in addition to any other applicable standards and regulations contained within the Code.

60.70.15. Federal and State Compliance.

1. In addition to compliance with the regulations in this section, the applicant shall be responsible for the identification of and compliance with all applicable federal and state regulations pertaining to WCF.

2. Permanent alterations to previously City reviewed and approved WCF resulting from the adoption of new or updated federal and/or state regulations shall be reviewed through the City's development review process prior to the making of such alterations, unless local review and approval is exempted by federal or state statute.

60.70.20. Exemptions.

1. All of the following are exempt from the regulations contained in this section of the Code:

   A. Emergency or routine repairs, or maintenance of existing facilities and of transmitters, antennas or other components of existing facilities that do not increase the size, footprint, or bulk of such facilities, and which otherwise comply with City, state and federal regulations.

   B. Federally-authorized industrial, scientific and medical equipment operating at frequencies designated for that purpose by the Federal Communications Commission (FCC) in Part 18 of Title 47 of the Code of Federal Regulations (CFR).

60.70.20.1.

C. Amateur radio facility antennas, or a combination of antennas and support structures seventy (70) feet or less in height as measured from the base of the support structure consistent with ORS 221.295. This includes antennas attached to towers capable of telescoping or otherwise being extended by mechanical device to a height greater than 70 feet so long as the amateur radio facility is capable of being lowered to 70 feet or less. This exemption applies only to the Beaverton Development Code and does not apply to other applicable city, state, and federal regulations. Amateur radio facilities not meeting the requirements of this exemption are considered non-exempt, and must comply with Section 60.70.45.

D. Military and civilian radar equipment, operating within the regulated frequency ranges, for the purpose of national, state or local defense or aircraft safety.

E. Antennas and associated equipment completely located within the interior of an existing or proposed structure with no associated exterior equipment, the purpose of which is to enhance or facilitate communication functions within the structure or other structures on the site.

F. Satellite antennas up to and including two (2) meters in diameter in Commercial, Industrial, and Multiple Use zoning districts. [ORD 4584; June 2012]

G. Direct-to-home satellite service and satellite antennas up to and including one (1) meter in diameter located in Residential zoning districts. [ORD 4584; June 2012]

H. AM or FM radio broadcast towers and equipment, or television broadcast towers and equipment, as regulated by the Federal Communications Commission (FCC).

I. Antennas installed by a public agency for the purpose of emergency communications that are less the 30-inches in diameter affixed to existing structures with associated equipment completely located within the interior of an existing or proposed structure. [ORD 4397; August 2006]

18.72.030 Applicability

Site design standards shall apply to all zones of the city as outlined below.

A. Applicability. The following development is subject to Site Design Review:

1. Commercial, Industrial, Non-Residential and Mixed uses:

a. All new structures, additions or expansions in C-1, E-1, HC, CM and M-1 zones.

b. All new non-residential structures or additions (e.g. public buildings, schools, churches, etc.).

c. Mixed-use structures or developments containing commercial and residential uses in residential zoning districts within the Pedestrian Places Overlay.

d. Expansion of impervious surface area in excess of 10% of the area of the site or 1,000 square feet, whichever is less.

e. Expansion of parking lots, relocation of parking spaces on a site, or other changes which alters or affects circulation on adjacent property or a public right-of-way.

f. Any change of occupancy from a less intensive to a more intensive occupancy, as defined in the City building code, or any change in use which requires a greater number of parking spaces.

g. Any change in use of a lot from one general use category to another general use category, e.g., from residential to commercial, as defined b the zoning regulations of this Code.

h. Any exterior change to a structure which is listed on the National Register of Historic Places or to a contributing property within an Historic District on the National Register of Historic Places that requires a building permit, or includes the installation of Public Art.

i. Mechanical equipment not otherwise exempt from site design review per Section 18.72.030(B).

j. Installation of wireless communication facilities in accordance with Section 18.72.180.

2. Residential uses:

a. Two or more residential units on a single lot.

b. Construction of attached single-family housing (e.g. town homes, condominiums, row houses, etc.) in all zoning districts.

c. Residential development when off-street parking or landscaping, in conjunction with an approved Performance Standards Subdivision required by ordinance and not located within the boundaries of the individual unit parcel (e.g. shared parking).

d. Any exterior change to a structure individually listed on the National Register of Historic Places that requires a building permit, or includes the installation of Public Art.

e. Mechanical equipment not otherwise exempt from site design review per Section 18.72.030(B). (Ord 2984, amended, 05/19/2009; Ord 2951, amended, 07/01/2008; Ord 3036, amended, 08/17/2010)

f. Installation of wireless communication facilities in accordance with Section 18.72.180.

B. Exemptions. The following development is exempt from Site Design Review application and procedure requirements provided that the development complies with applicable standards as set forth by this Chapter.

1. Detached single family dwellings and associated accessory structures and uses.

2. Land divisions regulated by the following chapters: Partitioning (18.76), Subdivisions (18.80), Manufactured Housing (18.84) and Performance Standards (18.88).

3. The following mechanical equipment:

a. Private, non-commercial radio and television antennas not exceeding a height of seventy (70) feet above grade or thirty (30) feet above an existing structure, whichever height is greater and provided no part of such antenna shall be within the yards required by this Title. A building permit shall be required for any antenna mast, or tower over fifty (50) feet above grade or thirty (30) feet above an existing structure when the same is constructed on the roof of the structure.

b. Not more than three (3) parabolic disc antennas, each under one (1) meter in diameter, on any one lot or dwelling unit.

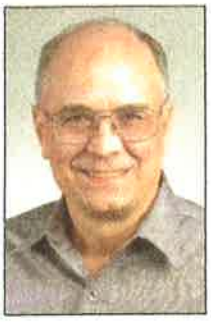
c. Roof-mounted solar collection devices in all zoning districts, with the exception of Employment and Commercial zoned properties located within designated historic districts. The devices shall comply with solar setback standards described in 18.70 and height requirements of the respective zoning district.

d. Roof-mounted solar collection devices on Employment and Commercial zoned properties located within designated historic districts if the footprint of the structure is not increased, the place of the system is parallel to the slope of the roof and does not extend above the peak height of the roof or existing parapets, or is otherwise not visible from a public right of way. The devices shall comply with solar setback standards described in 18.70 and height requirements of the respective zoning district.

e. Installation of mechanical equipment not exempted by (a, b, c) above or (e) below, and which is not visible from a public right-of-way or adjacent residentially zoned property and consistent with other provisions of this Title, including solar access, noise, and setback requirements of Section 18.68.140(c).

f. Routine maintenance and replacement of existing mechanical equipment in all zones. (Ord 2951, amended, 07/01/2008)

(Ord 3054, 2011; ORD 3058, 2012)



Midwest Division Director-Elect Rod Blocksome, K0DAS. Because no candidates stepped forward to run for the Vice Director's slot that he is vacating, ARRL President Kay Craigie, N3KN, will appoint someone to the post once it is officially declared open.

Director's position. Running are Scott Bauer, W2LC, who served previously as Western New York Section Manager; Bob Famiglio, K3RF, the current Eastern Pennsylvania Section Manager, and John Mueller, K2BT, the outgoing Western New York SM.

In the only other contest, members in the Great Lakes Division will choose between incumbent Vice Director Tom Delaney, W8WTD, and Steve Putman, N8ZR, to fill the Vice Director's chair. Delaney was appointed as Vice Director earlier this year after the former Vice Director, Dale Williams, WA8EFK, became Director when Jim Weaver, K8JE, stepped down from the Board. Williams is the only candidate for Great Lakes Division Director and has been declared elected.

Incumbents in the Dakota and Delta divisions also ran unopposed and have been declared elected. They are Dakota Division Director Greg Widin, K0GW, and Vice Director Kent Olson, KA0LDG, and Delta Division Director David Norris, K5UZ, and Vice Director Ed Hudgens, WB4RHQ.

Amateur Radio Operators Delighted with California City Council's Antenna Decision

The nearly 300 radio amateurs who live in Poway, California, may erect antenna support structures of up to 65 feet with only a building permit and a courtesy notice to their neighbors. The Poway City Council unanimously approved the new ordinance on August 5.

ARRL General Counsel Chris Imlay, W3KD, said the League had worked with Poway's Amateur Radio community for "a very long time" on the matter. ARRL's Amateur Radio Legal Defense and Assistance Committee contributed funding for the effort."It represented a big change in well-entrenched attitudes in Poway spanning decades, so this is a big win for us," Imlay said.

A technical report prepared by members of the Poway Amateur Radio Society and submitted to City Council concluded that antenna support structures of up to 65 feet would represent "reasonable accommodation" for Amateur Radio communication under PRB-1, due to the area's varied topography. The subject of Poway's Amateur Radio antenna ordinance arose in the case of Howard Groveman, W6HDG, who sought to install a 59-foot crank-up tower. Poway's previous ordinance had set a maximum height of 35 feet and required a variance for anything taller.

Under the new regime, installing an antenna support structure taller than 65 feet would require a new antenna permit and City Council approval.

Silent Keys

NASA Astronaut Steven R. Nagel, N5RAW

Steven Nagel, N5RAW, at the 2013 Midwest Division Convention. [Midwest Division Newsletter photo]

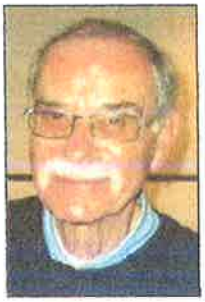
Astronaut and Space Shuttle veteran Steven Nagel, N5RAW, of Houston, Texas, died August 21. He was 67. In April 1991, Nagel was the commander of the first all-ham Space Shuttle crew aboard *Atlantis* with Kenneth Cameron, KB5AWP; Jay Apt, N5QWL; Linda Godwin, N5RAX — whom he later married — and Jerry Ross, N5SCW, during the SAREX (Shuttle Amateur Radio EXperiment) program, the forerunner to ARISS — the Amateur Radio on the International Space Station program.

Nagel joined the Astronaut Corps in 1979 and was the pilot on the last successful mission of *Challenger* in the 1980s, the only time eight people were launched into space aboard the same spacecraft. Following the *Challenger* disaster in January 1986 that killed seven astronauts, Nagel was part of the effort to develop a crew escape mechanism.

Nagel retired from the Air Force and the Astronaut Office in 1995 and went to work for Johnson Space Center in Houston. A year later, he transferred to NASA's Aircraft Operations Division as a research pilot. He retired from NASA in 2011 and joined the faculty of the University of Missouri at Columbia. One of his last public appearances was at the 2013 ARRL Midwest Division Convention in Lebanon, Missouri.

Survivors include Godwin and the couple's two daughters. — *Thanks to NASA, NPR, ARRL Midwest Division Newsletter*

"Archie's Ham Radio Adventure" Comic Artist Stan Goldberg



Cartoonist Stan Goldberg.

Stan Goldberg, the artist who, with Mike Esposito, drew the "Archie's Ham Radio Adventure" comic for ARRL in the 1990s, died August 31. He was 82. A New York City native, Goldberg was Marvel Comics' chief colorist during the 1960s, when most of the characters now associated with Marvel were created.

"He's the reason Spider Man's costume is red and dark blue, the reason the Incredible Hulk's skin is green," said Jim Massara, N2EST, who penned *QST* cartoons in the 1980s and also once worked for Marvel. "Goldberg was a giant in our industry."

Goldberg started as a staff colorist at Marvel Comics in 1949, when he was just 16. He went on to work for DC Comics and, finally, for Archie Comics starting in the early 1970s. "He was Archie Comics' prolific lead artist for a number of years, and along with Dan DeCarlo was one of two artists who defined the look of Archie and the gang for several decades," Massara told ARRL.

In 1994, Goldberg was honored with an Inkpot Award at Comic-Con International in San Diego, and in 2012 he was inducted into the National Cartoonist Society's Hall of Fame.

ORDINANCE NO. 5841

AN ORDINANCE AMENDING SECTION 10 OF ORDINANCE NO. 4647; PROVIDING A PENALTY CLAUSE, A SAVINGS CLAUSE AND A SEVERABILITY CLAUSE; AND PROVIDING AN EFFECTIVE DATE.

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF GARLAND, TEXAS:

Section 1

That Section 10 of Ordinance No. 4647, the comprehensive zoning ordinance of the City of Garland, Texas is hereby amended by adding a new subsection 10-313 to read as follows:

"10-313 Licensed Amateur Communications

The provisions of this section apply only to antennas and antenna support structures used in licensed amateur communications. The provisions of this section shall control in the event of a conflict with Section 10-306. If the communication facilities do not comply with the applicable district development standards and the following regulations, then a Specific Use Permit shall be required.

10-313.1 Definitions

For the purposes of this section and notwithstanding any conflicting definition contained in Section 38:

"Antenna" means "private antenna" for purposes of determining allowed uses under the Schedule of Uses in Section 10-200.

"Antenna support structure" means a structure, such as a mast, tower or pole, that is placed, erected or constructed to support one or more antennas for the purpose of engaging in licensed amateur communications. Buildings and associated roof mounted equipment shall not be considered as antenna support structures.

"Licensed amateur communications" means amateur radio operations, also known as the amateur radio service, as regulated and licensed by the Federal Communications Commission pursuant to 47 C.F.R. Part 97, and

"Compelling communications need" means a need for relief based upon the inability of the applicant to obtain reasonable communications goals due to engineering or technical limitations or physical characteristics, such as trees, buildings, or structures located on the subject and adjacent

properties that obstruct or significantly impede communications to and from the subject property.

10-313.2 Maximum Number of Antennas and Antenna Support Structures in Residential Districts

No more than two (2) antenna support structures for licensed amateur communications shall be allowed per lot of record in a residential district. Upon a showing of a compelling communications need, the Director of Planning may administratively approve additional antenna support structures.

10 313.3 Height

The maximum height for an antenna support structure in any district shall be eighty (80) feet. Upon a showing of a compelling communications need, the Director of Planning may administratively approve a maximum height of one hundred (100) feet. An antenna support structure that exceeds 100 feet in height shall be allowed only with the approval of a Specific Use Permit.

10-313.4 Antenna and Antenna Support Structure Standards

10-313.4.1 Number and Size

The number and size of antennas placed upon an antenna support structure used for licensed amateur communications shall be limited by the wind load requirements contained in the current version of the City's building codes or by the manufacturer's specifications for wind loading, whichever is more restrictive.

10-313.4.2 Setbacks

Front Yards. Antenna support structures (including guy wires, foundations, anchors, and other components of the structure) shall not be permitted in required front yards. The Director of Planning may administratively approve the location of guy wires in a required front yard if it is demonstrated that there is compelling communications need for such location or if there are limiting physical characteristics of the subject property that necessitate the location of guy wires in the front yard.

Side and Rear Yards. Guy wires shall be permitted in required side and rear yards. Minimum setbacks for antenna support structures shall be the same as those required for accessory buildings in the applicable residential district and as for all buildings in nonresidential districts, except that side yard encroachments equal to that allowed for fireplaces under single-family district regulations shall be permitted.

Separation: There shall be no minimum or maximum separation requirements for antenna support structures from other structures on the same lot of record.

10-313.4.3 Lights

Lights mounted on antenna support structures shall comply with all requirements of the Glare and Lighting Standards.

10-313.4.4 Construction Standards

Antenna support structures shall be installed and may be modified in accordance with the manufacturer's specifications or under the seal of a registered professional engineer of the State of Texas.

10-313.4.5 Maintenance

Antennas and antenna support structures that have, due to damage, lack of repair, or other circumstances, become unstable, lean significantly out-of-plumb, or pose a danger of collapse shall be removed or brought into repair within 90 days following notice given by the Building Official; provided that the Building Official may order immediate action to prevent an imminent threat to public safety or property.

10-313.4.6 License Requirements

Only licensed amateur radio operators shall be permitted to install, or have installed, and operate licensed amateur communication facilities under the provisions of this section. Proof of license shall be required at the time application is made for a building permit to install and operate licensed amateur communication facilities under the provisions of this section.

10-313.4.7 Discontinuance

Within 180 days of the date of discontinuance, the owner of property on which an antenna structure is located shall remove the structure from the property in the event licensed amateur communications will be discontinued at the property due to change in ownership from a licensed amateur radio operator to a person not licensed to engage in licensed amateur communications, the death of the licensee, or the loss or surrender of the FCC license authorizing those communications.

Section 2

That a violation of any provision of this Ordinance shall be a misdemeanor punishable in accordance with Sec. 10.05 of the Code of Ordinances of the City of Garland, Texas.

Section 3

That Ordinance No. 4647, as amended, shall be and remain in full force and effect save and except as amended by this Ordinance.

Section 4

That the terms and provisions of this Ordinance are severable and are governed by Sec. 10.06 of the Code of Ordinances of the City of Garland, Texas.

Section 5

That this Ordinance shall be and become effective immediately upon and after its passage and approval.

PASSED AND APPROVED this the 17th day of August 2004.

CITY OF GARLAND, TEXAS

Mayor

ATTEST:

City Secretary

(2) Upon removal, the land shall be restored to its previous condition, including but not limited to the removal of paved areas and the seeding of exposed soils.

(3) As security for the performance of the requirements set forth above, the applicant shall, upon the issuance of a certificate of occupancy, execute and file with the Village of Scotia Clerk a bond or other undertaking which shall he approved as to form, manner of execution and sufficiency for surety by the Village Board of Trustees and shall be with a solvent surety corporation. The bond undertaking shall remain in full force and effect until the removal of the communications system, facilities and site restoration. The value of the bond shall be equal to the cost of the demolition and restoration of the site as determined by the applicant and approved by the Planning Board.

J. Fees. Costs or fees incurred for necessary consultant services or other extraordinary expense in connection with the review of a proposed site plan shall be paid by the applicant, provided that the necessity of such services has been determined by the Planning Board. Such costs shall be in addition to any application fee schedule and shall be paid prior to the issuance of a building permit.

§ 250-58.4 Amateur radio communications towers.

[Added 3-10-2004 by L.L. No. 4-2004]

A. Review authority. In accordance with §7-725-a of New York Village Law, the Planning Board is hereby authorized to review applications for site plan review pertaining to the construction of amateur radio communications towers. The Planning Board shall also have the authority to suggest reasonable conditions and restrictions as are directly related to and incidental to the proposed application.

B. Purpose and intent. The purpose of this section is to establish regulations for the siting of amateur radio communications towers in order to accommodate such equipment as required by Federal Communications Commission Order dated September 16, 1985, known as PRB-1, while protecting the public against any adverse impacts on aesthetic resources, assure public safety and welfare, minimize visual impacts through proper design, sitting and screening, and avoid potential physical damage to adjacent properties.

C. Preexisting amateur radio communications towers are exempt from the provisions of this section.

D. Definition. As used in this subsection, the following terms shall have the meanings indicated:

AMATEUR RADIO COMMUNICATIONS TOWER
A structure or series of structures, attached to or nonattached to a building, which are used in the transmission of amateur radio communications.

E. Application requirements. The applicant for site plan review under this section shall he required to provide the following information in addition to the information required in §250-59.5 of this chapter:

(1) A scaled plan or drawing of the proposed tower, with design data, certified by a professional engineer or the manufacturer that the tower meets or exceeds the current specifications of the Electronics Industry Association guidelines or the Telecommunications Industry Association guidelines.

(2) Satisfactory evidence that such tower will be constructed to meet all regulations established in the New York State Fire Prevention and Building Code.

(3) A plot plan showing the lot or parcel and its dimensions, and all structural improvements thereon, on which the tower is to be located and showing the location of all structures on the lot or parcel, any and all easements and the location of the proposed tower.

(4) Proof that the applicant and property owner is an amateur radio operator licensed by the Federal Communications Commission.

(5) Proof of insurance specifically covering the proposed tower.

(6) If the FCC license holder and operator is not the property owner, the property owner must also sign the application, be present at all Planning Board meetings unless excused by the Planning Board, and will he bound by laws of this section.

F. Planning Board review criteria. The Planning Board, in reviewing the application for amateur radio communications towers, shall be guided by the following standards instead of those contained in § 250-59.2 of this chapter:

(1) The proposed tower meets accepted engineering standards for such towers, including wind-load requirements for such structures.

(2) Whenever possible, the proposed tower shall be to the rear of the lot or parcel.

(3) The proposed tower, including all masts and antennas, shall not exceed a height of 95 feet above the ground.

(4) No part of the proposed tower, including stays and guy or supporting wires, shall be in violation of the relevant district setbacks.

(5) If the base of a ground-based tower is visible from any public right-of-way or from adjacent property, then reasonable screening of the base may be required.

(6) Towers may not be located on conservation easements, drainage easements, public utility easements or on any reserved open space.

(7) The licensed amateur radio operator is required to provide a valid copy of his FCC license to the Building Inspector, and of any renewals thereafter.

(8) Any approval shall contain the condition that the Building Inspector may enter the premises at any reasonable time to inspect the tower installation for its construction, stability and maintenance.

G. Approvals. The federal government has determined that amateur radio communications towers and the activities of a licensed operator are beneficial to the public health, safety and general welfare of the community. If the proposed tower meets the requirements of Subsections D and E of this section, then the site plan review application shall be approved, with such reasonable conditions as the Planning Board may impose in accordance with the provisions of Subsection E herein.

H. Abandonment and removal. The applicant agrees to remove the tower and to restore the property to its original state upon selling the property or when the applicant no longer holds a valid FCC license to operate as an amateur radio operator.

§ 250-58.5 Wind energy facilities.

[Added 1-8-2009 by L.L. No. 2-2009]

A. Review authority. Notwithstanding Article XIV, § 250-60 of this chapter, and pursuant to § 7-725-b of the New York State Village Law, the Planning Board is hereby authorized to review and approve, approve with modifications, or disapprove special use permits for wind energy facilities. The Planning Board shall also have the authority to impose such reasonable conditions and restrictions as are directly related to and incidental to the proposed wind energy facility.

B. Purpose and intent. The purpose of this section is to establish predictable and balanced regulations for the siting of wind energy facilities in order to accommodate such equipment while protecting the public against any adverse impacts on aesthetic resources and assuring public health, safety and welfare.

C. Definitions. As used in this section, the following terms shall have the meanings indicated:

OPERATOR

The entity responsible for the day-to-day operation and maintenance of a wind energy facility, including any third-party subcontractor.

OWNER

The person, entity or entities with equity interest in a wind energy project, including respective successors or designees.

SMALL WIND ENERGY CONVERSION SYSTEM (SMALL WECS)

ORDINANCE NO. 2001-22

TOWNSHIP OF MEDFORD, NJ

AN ORDINANCE OF THE TOWNSHIP OF MEDFORD IN THE COUNTY OF BURLINGTON AMENDING THE MEDFORD TOWNSHIP LAND DEVELOPMENT ORDINANCE BY AMENDING CHAPTER 203 "DEFINITIONS", CHAPTER 531 "AMATEUR RADIO ANTENNAS", AND CHAPTER 604.A "HEIGHT LIMITATIONS" TO GOVERN AMATEUR RADIO ANTENNAS AND ANTENNA SUPPORT STRUCTURES WHOSE HEIGHTS EXCEED PREVAILING ZONING ORDINANCE LIMITS.

WHEREAS, the Federal Communications Commission of the United States of America ("FCC") has issued and Order declaring a limited preemption over local regulation of amateur radio antenna facilities (known as "FCC Order PRB-1") appearing at 101 FCC 2d 952; 50 Fed. Reg. At 38813-38816 (1985)), the policy of which limited preemption is to require that amateur radio communications be reasonably accommodated by local regulation and to preempt local land use regulations which unduly restrict effective amateur radio communications beyond the minimal practical regulation appropriate to accomplish the local authority's legitimate purpose and

WHEREAS, in compliance with FCC Order PRB-1 the Township Council intends for the provisions of this Ordinance to accommodate reasonably such amateur radio communication as may be within the jurisdiction of the Township, and that to that end, to authorize the Planning Board of the Township to conduct reviews and impose such specific conditions on construction as the Planning Board in its discretion deems proper under the terms of this Ordinance and the then existing preemption policy of the FCC; and

WHEREAS, the Planning Board shall be both bound and instructed by the promulgated limited preemption policy of the FCC, including FCC Order PRB-1, and other and future such FCC orders, ruling and applicable pronouncements of policy; now, therefore:

BE IT ORDAINED, by the Township Council of the Township of Medford in the County of Burlington, that:

SECTION ONE. The Medford Township Land Development Ordinance, together with all amendments and supplements thereto, shall be and hereby is amended as follows:

A. The following definitions are added to Section 203, where appropriate:

Amateur Radio Antenna are the arrangement of wires or metal rods used in the sending and receiving of electro-magnetic waves.

Amateur Radio Station is a radio station operated in the Amateur Radio Service under license by the Federal Communications Commission.

Amateur Radio Antenna Support Structure is any structure, mast, pole, tripod or tower utilized for the purpose of supporting an antenna or antennas for the purpose of transmission or reception of electro-magnetic waves (by Federally licensed amateur radio operators).

B. The following section shall be created and added to the Land Development Ordinance, at Section 531:

Section 531. Amateur Radio Antennas and Antenna Support Structures.

Antenna support structures of amateur radio operators licensed by the Federal Communications Commission may, as a right, have a height not exceeding one hundred (100) feet above grade, subject to the provisions of this Section. The height shall be measured vertically and shall include the height to any building upon which the antenna support structure is mounted. Every antenna and antenna support structure shall be located in conformity with this Section, as same may be amended and

supplemented, and, in any case, to the rear of the front line (or extended front line) of the main building on the same lot. In addition, no antenna support structure or antenna shall be located between any principal building and the street line. Every antenna and antenna support structure shall be set back at least twenty feet (20') from side and read property lines. In order to obtain a building permit for the structure, the applicant shall provide a copy of his or her valid Federal Amateur Radio Operating License.

2. Antenna may be located above the antenna support structure as reasonably necessary for effective radio communications.

3. Where the height of the antenna support structure is to exceed the height otherwise permitted in a district, the Planning Board shall review the site plan, including detail of proposed structures and such other information as may be submitted by the applicant to the Building Inspector, and may impose reasonable conditions on the proposed construction necessary to protect public health and safety and to serve the purposes of the Municipal Land Use Law (N.J.S.A. 40:550-1, et seq., as amended and supplemented) and other applicable law including, to the extent permitted by law, the protection and promotion of aesthetic interests. The Planning Board shall afford the public an opportunity to be heard as part of the review process, upon such notice to be given as the Planning Board deems appropriate.

4. Any existing antenna support structures accommodating only amateur radio communication that were previously approved by permit or variance approval is hereby permitted under this ordinance as a grandfathered use.

5. Upon the FCC-licensed operator's cessation of ownership or leasehold rights in the subject antenna support structures, or upon the loss of his or her Federal amateur radio operator's license (whichever shall occur earlier), the operator shall forthwith (but in no case later than 30 days after written notice to the operator and to the owner of record of the subject lot if known, or if not known, then to the assessed owner, sent by certified mail, return receipt requested) safely remove all antenna support structures at no expense to the Township.

6. In the event said operator shall fail during said 30-day period to remove the antenna support structures pursuant to subsection 4 above, it shall be the duty, responsibility and obligation of the owner of the subject lot upon which any or all of such antenna support structures are located, to remove such structures forthwith at no expense to the Township.

7. Nothing set forth herein shall exempt or excuse anyone from compliance with requirements of applicable provisions of the Uniform Construction Code, other codes, all general law, and other Township ordinances.

C. The following revisions are made to the end of Section 604.A:

...tower or structure, except in the case of amateur radio antenna support structures which may be located on a lot in accordance with Section 531 of this Ordinance.

SECTION TWO. In all other respects said Medford Township Land Development Ordinance, as amended and supplemented, shall remain in full force and effect.

SECTION THREE. All other ordinances and parts of ordinances, and resolutions, insofar as they are inconsistent with any of the terms and provisions of this Ordinance, are hereby repealed to the extent of such inconsistency only.

SECTION FOUR. If any section, paragraph, sentence, clause, phrase, term, provision or port of this Ordinance shall be adjudged by any court of competent jurisdiction to be invalid or inoperative, such judgment shall not affect, impair, or invalidate the remainder thereof, but shall be confined in its operation to the section, paragraph, sentence, clause, phrase, term, provision of part thereof directly involved in the controversy in which such judgment shall have been rendered.

SECTION FIVE. This Ordinance shall take effect on the earliest date allowed by law following final passage, adoption and publication, in accordance with the law.

DOCUMENT NO. 6(A)

MODEL ANTENNA ORDINANCE: BURBANK, ILLINOIS

BURBANK

A. Section _____ Amateur Radio/Citizens Radio Antennas-definitions.

The following definitions shall apply in the interpretation and enforcement of this division of Chapter 4, Buildings and Structures:

(1) "Antenna" shall mean the arrangement of wires or metal rods used in the sending and receiving of electromagnetic waves.

(2) "Antenna Support Structure" shall mean any structure, mast, pole, tripod, or tower utilized for the purpose of supporting an antenna or antennas for the purpose of transmission or reception of electromagnetic waves by federally licensed amateur radio or citizens band radio operators.

(3) "Antenna Height" shall mean the overall vertical length of the antenna support structure above grade, or if such system is located on a building, then the overall vertical length includes the height of the building upon which the structure is mounted.

B. Section _____. Permit required.

It shall be unlawful for any person to install, construct or increase the height of any antenna support structure without first obtaining a building permit, except that no permit shall be required if the height of the antenna support structure (excluding the height of any building to which the antenna support structure is attached) is less than 12 feet.

C. Section _____. Application.

Applications for a building permit required in Section _____ [Permit required] shall be made upon such forms requested by the city and shall have attached thereto the following items:

1. A location plan for the antenna support structure.
2. Manufacturer's specifications for the antenna support structure and details of footings, guys and braces.
3. A copy of the applicant's homeowner or renters insurance policy.
4. A permit fee not to exceed $15.00 for ground mounted or $10.00 for roof mounted antenna support structures.

D. Section _____. Height limitation.

No antenna support structure shall be installed, constructed, or increased to exceed 65 feet above grade in single-family residential zoning districts or 30 feet above the height limitation allowed if located in a multi-family residential or commercial zoning district.

E. Section _____. Construction requirements.

(a) Materials. Antenna support structures must be constructed from one of the following materials: Aluminum, galvanized steel, or equally weather resistant steel. All ground mounted antenna support structures exceeding 35 feet in height shall be mounted in concrete, and erected in such a manner so as to be able to withstand a minimum wind velocity of 80 M.P.H. (impact pressure of 25 pounds per square foot).

(b) The thickness of steel used in antenna support structures shall be not less than one-eighth inch when galvanized. If not galvanized, steel shall be not less than one-fourth inch in thickness when used structurally. Where antenna support structures are constructed of aluminum tubing, the minimum wall thickness of the tubing shall be not less than one-sixteenth inch and such tubing, if steel, shall be galvanized on the exterior.

(c) Electrical Requirements. All antenna support structures, whether ground or roof mounted, shall be grounded. Grounding shall be in accordance with the provisions of the Chicago Electrical Code, and for ground mounted towers, shall consist of a minimum of one ground rod a minimum of five-eighths inch in diameter and eight feet in length. The ground conductor shall be a minimum of #10 GA copper; however, in all instances, construction shall follow the manufacturer's requirements for grounding.

F. Section _____. Restrictions.

(a) No antenna shall protrude in any manner upon the adjoining property without the written permission of the adjoining property owner; and no antenna shall protrude upon the public way.

(b) Ground mounted antenna support structures may be erected only in a rear or side yard.

G. Section _____. **Exemptions.**

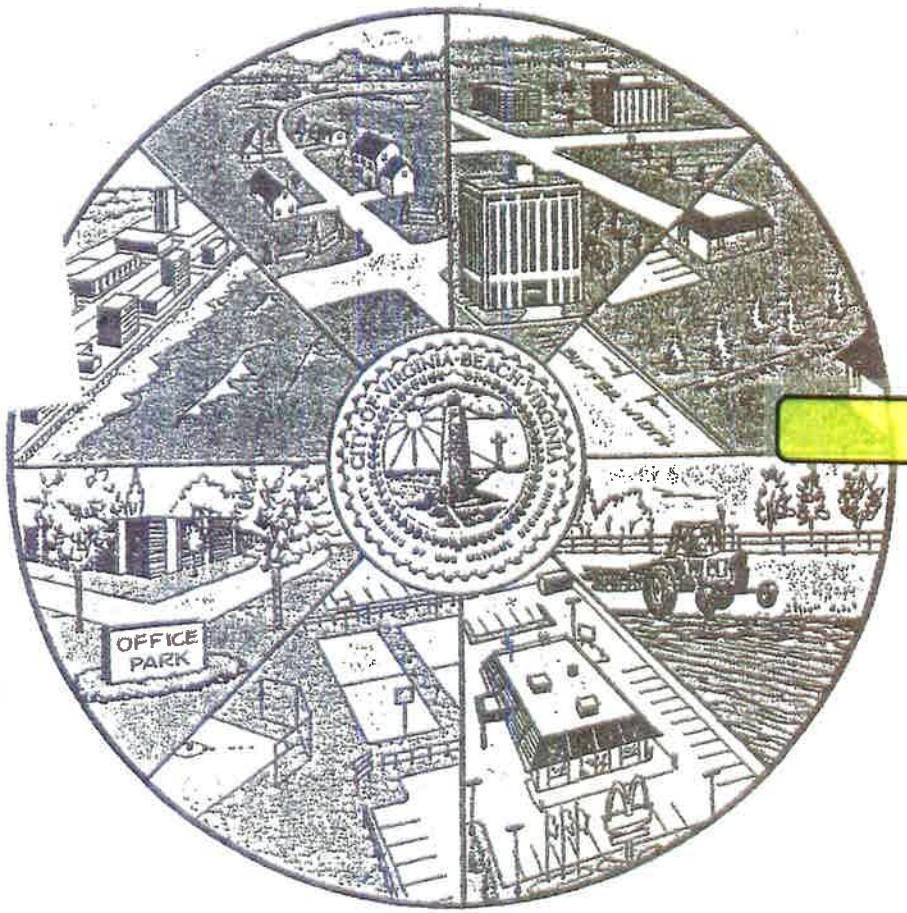
This ordinance shall not affect any existing antenna support structure, utilized by federally licensed amateur radio or federally authorized citizens radio service stations, which has been constructed and which is in place prior to the date of the passage of this ordinance; provided however, that such antenna support structures must comply with the grounding requirements of Section _____ [Construction requirements]; and further provided that owners of existing antenna support structures submit to the Building Department, within 90 days of the date of this Ordinance, the documentation required by Section _____ [Application], less the required fee.

DOCUMENT NO. 6(B)

MODEL ANTENNA ORDINANCE: VIRGINIA BEACH, VIRGINIA

CITY ZONING ORDINANCE

Virginia Beach, Virginia



Adopted by City Council April 18, 1988

rights-of-way (projected if rounded) and a line connecting the ends of such twenty-foot lines. Where sidewalks have been provided within the right-of-way line, vision clearance measurements shall be taken from the curb line, rather than the right-of-way line.

(2) Intersections of driveways with streets. No wall, fence or other structure shall exceed a height of thirty (30) inches above the finished elevation of a driveway within a visibility triangle created by measuring ten (10) feet in from the intersection of a driveway boundary and property lines away from the driveway with the ends of the two (2) ten-foot lines connected in a straight line to form the visibility triangle. The thirty-inch height for any portion within the triangle shall be computed from the elevation of the driveway which is perpendicular to that portion of wall or structure within the triangle.

Sec. 202. Height regulations.

(a) Whenever height limits for buildings and other structures are established, no portion of any building or other structure shall extend above such height limits, except residential chimneys, line-of-sight relaying devices, broadcasting towers, radio or television antennas, spires, flagpoles, water tanks, or monuments otherwise approved for erection; provided, however, that smokestacks may also extend beyond such limits, if they do not exceed in height the distance to the nearest lot line; and further provided that one tower for purposes of an amateur radio station operation, which may contain multiple antennae, may extend beyond said height limits but shall not exceed ninety (90) feet in height above ground elevation.

(b) No structure which on the basis of its height would constitute an obstruction to air navigation pursuant to the standards of the Federal Aviation Administration shall be allowed in any district unless it is subsequently determined by the Federal Aviation Administration that the structure does not constitute a hazard to air navigation.

Sec. 203. Off-street parking requirements.

(a) The following specified uses shall comply with the off-street parking requirements designated therefore:

(1) Animal hospitals, business studios, eleemosynary and philanthropic institutions, veterinary establishments, commercial kennels, animal pounds and shelters, wholesaling and distribution operations, financial institutions other than banks, laboratories other than medical, passenger transportation terminals and broadcasting studios: At least one space per four hundred (400) square feet of floor area;

DOCUMENT NO. 6(C)

MODEL ANTENNA ORDINANCE: CITY OF HINESVILLE, GEORGIA

City of Hinesville
DEPARTMENT OF INSPECTIONS
115 EAST SOUTH STREET
Hinesville, Georgia 31313
912-876-4147

BILL DOWNS
DIRECTOR OF INSPECTIONS

CHERYL A. BLOCKER
SECRETARY

City of Hinesville
DEPARTMENT OF INSPECTIONS
115 EAST SOUTH STREET
Hinesville, Georgia 31313
912-876-4147

BILL DOWNS
DIRECTOR OF INSPECTIONS

CHERYL A. BLOCKER
SECRETARY

ARTICLE SIX: ADDITIONAL REGULATIONS

ADD:
Section 619 ANTENNAS AND ANTENNA SUPPORT STRUCTURE INSTALLATION REQUIREMENTS.

A. DEFINITIONS: The following definitions shall apply in the interpretation and enforcement of this section of Article Six, Additional Regulations, City of Hinesville Zoning Ordinance.

(1) ANTENNA: Shall mean the arrangement of wires or metal rods used in the sending and receiving of electromagnetic waves (radio waves).

(2) ANTENNA SUPPORT STRUCTURE OR TRANSMISSION TOWER: Shall mean any structure, mast, pole, tripod or tower utilized for the purpose of supporting an antenna or antennas for the purpose of transmission or reception of electromagnetic waves.

(3) ANTENNA SUPPORT STRUCTURE HEIGHT: Shall mean the overall ver[illegible] length of the antenna support structure or tower, above grad[illegible] ground (measured between the highest point of the antenna su[illegible] structure and the natural grade directly below this point), or if such system is mounted on a building, then the overall vertical length includes the height of the building upon which the antenna support structure is mounted.

B. PERMIT REQUIRED: It shall be unlawful for any person, firm or corporation to erect, install, construct, alter, move, relocate, enlarge or increase the height of any antenna support structure, or cause the same to be done, without first obtaining a building permit from the Director of Inspections.

C. APPLICATION FOR PERMIT: Application for a building permit, signed by the owner or his authorized agent, shall be filed with the Director of Inspections, on a form furnished for that purpose, and shall have attached thereto the following.

(1) A site plan, drawn to scale, identifying the site boundary, location of existing buildings or structures and the proposed location of the antenna support structure including guy wire anchors.

(2) Two copies of construction and installation drawings and specifications, preferably manufacturer's drawings and specifications of available, for the antenna support structure including details of footing, foundation, guys, braces, anchors and antenna installation. Such drawings and specifications shall be drawn to scale with sufficient clarity and detail to indicate nature and character of the work and shall contain information, in the form of notes or otherwise, as to quality of materials. All drawings and specifications and accompanying data shall bear the name and address of the designer.

(3) Written manufacturer's and/or professional structural engineer certification that the antenna support structure has been designed in compliance with the minimum design loads prescribed in chapter XII, Section 1205 (Table 1205.1) of the Standard Building Code, 1985 Edition.

(4) All antenna support structures are to be completely enclosed by a fence at least 4 ft in height or shall have an approved anti-climb device attached. If fenced, the openings in the fence shall not permit the passage of a 6 inch diameter sphere.

(5) Permit fee.

D. HEIGHT LIMITATION: No antenna support structure shall be installed, erected or constructed, or increased in height to exceed 65 feet above grade or ground in a single-family residential area.

E. ELECTRICAL REQUIREMENTS: All antenna support structures, whether ground or roof mounted, shall be electrically grounded. Grounding shall be in accordance with the provisions of the National Electrical Code, 1987 Edition, and the support structure's manufacturer's specifications.

F. RESTRICTIONS:
(1) Ground mounted antenna support structures, including guy wire anchors may be erected, constructed or installed only in rear or side yards and must be located within the allowable building area. Exception: Guy wire anchors may be installed within 1 foot of the rear or side property lines providing the yard area in which the antenna support structure is fenced in accordance with 619 C (4). No antenna or antenna support structure will be permitted in the front setback area.

(2) No more than one primary antenna support structure and appurtenances shall be permitted on any one lot or principal building unless otherwise approved by the Hinesville City Council.

City of Kingsville
DEPARTMENT OF INSPECTIONS
115 EAST SOUTH STREET
Kingsville, Georgia 31313
912-876-4147

BILL DOWNS
DIRECTOR OF INSPECTIONS

CHERYL A. BLOCKER
SECRETARY

G. EXEMPTIONS: This ordinance shall not affect any existing antenna support structure, utilized by federally licensed amateur radio operator, which has been constructed and which was in place prior to the date of the passage of this ordinance; provided however, that such antenna support structures must comply with the grounding requirements of Section E; and provided that owners of existing antenna support structures submit to the Building Inspections Department, within 90 days of the date of this ordinance, the documentation required by Section C, less the required fee.

DOCUMENT NO. 6(D)

MODEL ANTENNA ORDINANCE: MOORESTOWN, NEW JERSEY

ORDINANCE NO. 1388

AN ORDINANCE OF THE TOWNSHIP OF MOORESTOWN IN THE COUNTY OF BURLINGTON AMENDING THE MOORESTOWN TOWNSHIP ZONING ORDINANCE, AS AMENDED AND SUPPLEMENTED, WITH RESPECT TO AMATEUR RADIO ANTENNAS AND ANTENNA SUPPORT STRUCTURES WHOSE HEIGHTS EXCEED PREVAILING ZONING ORDINANCE LIMITS.

WHEREAS, the Federal Communications Commission of the United States of America ("FCC") has issued an Order declaring a limited preemption over local regulation of amateur radio antenna facilities (known as "FCC Order PRB-1" appearing at 101 FCC 2d 952; 50 Fed. Reg. at 38813-38816 (1985)), the policy of which limited preemption is to require that amateur radio communications be reasonably accommodated by local regulation and to preempt local land use regulations which unduly restrict effective amateur radio communications beyond the minimum practical regulation appropriate to accomplish the local authority's legitimate purpose; and

WHEREAS, in compliance with FCC Order PRB-1 the Township Council in the provisions of this ordinance to accommodate reasonably such amateur communications as may be within the jurisdiction of the Township, and to that end, to authorize the Planning Board of the Township to conduct reviews and impose such specific conditions on construction as the Planning Board in its discretion deems proper under the terms of this ordinance and the then existing preemption policy of the FCC; and

WHEREAS, the Planning Board shall be both bound and instructed by the promulgated limited preemption policy of the FCC, including FCC Order PRB-1, and other and future such FCC orders, rulings and applicable pronouncements of policy; now, therefore,

BE IT ORDAINED, by the Township Council of the Township of Moorestown in the County of Burlington, that:

SECTION 1. The Moorestown Township Zoning Ordinance, together with all amendments and supplements thereto, shall be and hereby is amended as follows:

A. The following definitions are added to Article I, Section 102, where appropriate:

Amateur Radio Antenna and Antenna are the arrangement of wires or metal rods used in the sending and receiving of electro-magnetic waves.

Amateur Radio Station is a radio station operated in the Amateur Radio Service under license by the Federal Communication Commission.

Antenna Support Structure is any structure, mast, pole, tripod or tower utilized for the purpose of supporting an antenna or antennas for the purpose of transmission or reception of electro-magnetic waves (by federally licensed amateur radio operators).

B. The following section shall be added to Article XI immediately following Section 1118 thereof:

Section 1119. Amateur Radio Antennas and Antenna Support Structures.

1. Antenna support structures of amateur radio operators licensed by the Federal Communications Commission may, as of right, have a height not exceeding 65 feet above grade, subject to the provisions of this Section 1119. The height shall be measured vertically and shall include the height of any building upon which the antenna support structure is mounted. Every antenna and antenna support structure shall be located in conformity with Section 1103, as same may be amended and supplemented, and, in any case, to the rear of the front line (or extended front line) of the main building on the same lot.

2. Antennas may be located above the antenna support structure as reasonably necessary for effective radio communications.

3. Where the height of an antenna support structure is to exceed the height otherwise permitted in a district, the Planning Board shall review the site plan, including detail of proposed structures and such other information as may be submitted by the applicant to the Building Inspector, and may impose reasonable conditions on the proposed construction necessary to protect public health and safety and to serve the purposes of the Municipal Land Use Law (N.J.S.A. 40:55D-1, et seq., as amended and supplemented) and other applicable law including, to the extent permitted by law, the protection and promotion of aesthetic interests. The Planning Board shall afford the public an opportunity to be heard as part of the review process, upon such notice to be given as the Planning Board deems appropriate.

Prep.WMB
11/3/87

4. Upon the FCC-licensed operator's cessation of ownership or leasehold rights in the subject antenna support structures, or upon the loss of his or her federal amateur radio operator's license (whichever shall occur earlier), the operator shall forthwith (but in no case later than 30 days after written notice to the operator and to the owner of record of the subject lot if known, or if not known, then to the assessed owner, sent by certified mail, return receipt requested) safely remove all antenna support structures at no expense to the Township.

5. In the event said operator shall fail during said 30-day period to remove the antenna support structures pursuant to subsection 4 above, it shall be the duty, responsibility and obligation of the owner of the subject lot upon which any or all of such antenna support structures are located, to remove such structures forthwith at no expense to the Township.

6. Nothing set forth herein shall exempt or excuse anyone from compliance with requirements of applicable provisions of the Uniform Construction Code, other codes, all general law, and other Township ordinances.

SECTION 2. In all other respects said Moorestown Township Zoning Ordinance, as amended and supplemented, shall remain in full force and effect.

SECTION 3. All other ordinances and parts of ordinances, and resolutions, insofar as they are inconsistent with any of the terms and provisions of this Ordinance, are hereby repealed to the extent of such inconsistency only.

SECTION 4. If any section, paragraph, sentence, clause, phrase, term, provision or part of this Ordinance shall be adjudged by any court of competent jurisdiction to be invalid or inoperative, such judgment shall not affect, impair or invalidate the remainder thereof, but shall be confined in its operation to the section, paragraph, sentence, clause, phrase, term, provision or part thereof directly involved in the controversy in which such judgment shall have been rendered.

SECTION 5. This Ordinance shall take effect on the earliest date allowed by law following final passage, adoption and publication, and may be cited as Ordinance No. 1388.

Certified to be a true and correct copy of an ordinance adopted by Moorestown Township Council at their regular meeting on 23 November 1987.

Dolores H. Wilkinson
Deputy Township Clerk

DOCUMENT NO. 6(E)

MODEL ANTENNA ORDINANCE: NEWPORT BEACH, CALIFORNIA

ORDINANCE NO. 88-6

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF NEWPORT BEACH ADDING CHAPTER 20.77 REGARDING AMATEUR RADIO ANTENNAS

The City Council of the City of Newport Beach does hereby ordain as follows:

Section 1:

Chapter 20.77 is hereby added to the Newport Beach Municipal Code to read as follows:

Sections:

Section 20.77.005. Findings.

The City Council of the City of Newport Beach, in adopting this Ordinance, finds and declares as follows:

A. The Federal Communications Commission has established a rule preempting state and local regulations that operate to preclude amateur radio communications. However, the FCC has not preempted local regulations involving placement, screening or height of amateur radio antennas so long as the regulations are based on health, safety or aesthetic considerations, represent a reasonable accommodation of amateur radio communications, and constitute the minimum practicable regulation necessary to accomplish the local agency's legitimate purposes.

B. Amateur radio antennas differ from other antenna, such as roof-mounted television antenna, in terms of their size,

shape, weight and foundation requirements, and these factors raise aesthetic, safety and welfare concerns that warrant special regulation.

C. The regulation of amateur radio antenna, as provided in this ordinance, is necessary to the health, safety and welfare of persons living, working and owning property in the City of Newport Beach in that:

1. The unique charm and beauty of the residential, waterfront commercial, and recreational areas of the City of Newport Beach contribute to high property values and constitute the basis for a large percentage of the City's economy. The failure to maintain, and enhance, the charm and beauty of Newport Beach could result in reduced property values and reduced revenue for those businesses that serve the many visitors to Newport Beach.

2. The Land Use Policies in the General Plan and Zoning Ordinances of the City of Newport Beach seek to maintain and enhance those qualities that make Newport Beach one of the most desirable places to live, work or visit. According to the General Plan policies of the City of Newport Beach, a primary objective is to preserve and protect those areas, buildings, structures or natural resources which are of historic, cultural, or aesthetic value to the community. The General Plan requires the adoption of zoning ordinances and other controls to preserve visual access to major natural features, such as the ocean and bay, and insure that all public and private development is compatible with the unique natural and manmade resources that give Newport Beach its charm and character.

3. The unique charm and character of Newport Beach is preserved, in large measure, by ordinances, policies and regulations which, among other things, restrict and regulate the height and location of structures, related facilities or equipment and landscaping.

4. Amateur radio antennas, due to their height, size, and overall appearance, have the potential to block or impair views of natural and manmade features of importance to the public and owners of property if left unregulated. The antennas, because of their height and unique appearance, tend to dominate the landscape and reduce visual open space. The overall

appearance of amateur radio antennas is inconsistent with the character and aesthetics of many of the existing residential, commercial and recreational areas within Newport Beach and the proliferation of such antennas could significantly reduce the charm and beauty of those areas, reduce property values, reduce income derived from tourism, and reduce the number of job opportunities available in the City.

D. The provisions of this Ordinance also protect the safety of persons living, and working, in Newport Beach in that free-standing amateur radio antennas do pose a threat to the safety of persons or property in the vicinity in the event of collapse. The provisions of this Ordinance, will help insure that amateur radio antennas are installed in a manner that insures the safety and security of persons and property living or working nearby.

E. The provisions of this Ordinance represent the minimum practical regulation necessary to satisfy the aesthetic, health, safety and welfare concerns that have prompted these minimal restrictions on amateur radio antennas.

F. It is the intent of the City Council that this ordinance be administered and interpreted to reasonably accommodate amateur radio communications, to constitute the minimum regulation necessary to accomplish the purposes of this Ordinance, and to impose no unreasonable cost on the amateur radio operators.

Section 20.77.010. Definitions.

A. Amateur Radio Antenna. The term "amateur radio antenna" shall mean any antenna which is used for the purpose of transmitting and receiving radio signals in conjunction with an amateur radio station licensed by the Federal Communications Commission.

B. Antenna Structure. The term "antenna structure" refers collectively to an antenna and its supporting mast or tower, if any.

C. Mast. The term "mast" shall mean a pole of wood or metal, or a tower fabricated of metal, used to support an amateur radio antenna and maintain it at the proper elevation.

D. Whip Antenna. The term "whip antenna" shall mean an antenna consisting of a single, slender, rod-like element, less than one wave length long, which is supported only at or near its base.

Section 20.77.020. Permitted Use.

Amateur radio antennas, structures and masts that comply with the development standards specified in Section 20.77.030 are permitted as an accessory use in all zoning districts subject to issuance of any other appropriate permit. Amateur radio antennas, structures and masts which do not conform to Section 20.77.030 shall be permitted subject to first securing an amateur radio antenna permit, and any other appropriate permits.

Section 20.77.030. Development Standards.

A. Lowering device.

All amateur radio antennas, capable of a maximum extended height in excess of 40 feet, with the exception of whip antennas, shall be equipped with a motorized device which permits easy raising and lowering of the antenna. Or hand cranked

B. Permitted height.

(1) The height of an antenna shall be measured from natural grade at the point the mast touches, or if extended would touch, the ground.

(2) When in operation, no part of any amateur radio antenna shall extend to a height of more than 75 feet above natural grade of the site on which the antenna is installed.

(3) When not in operation, no part of any amateur radio antenna, excepting whip antennas, shall extend to a height of more than 28 feet measured above natural grade of the site on which the antenna is installed.

C. Number permitted.

One amateur radio antenna structure and one whip antenna shall be permitted on each building site.

D. Siting/Setbacks.

The antenna structure shall be located on site in a manner which will minimize the extent to which the structure is visible to nearby residents and members of the general public. Antenna structures shall be considered to satisfy this criteria if:

1. No portion of the antenna structure or mast is located within any required setback area; and

2. No portion of the antenna structure or mast is within the front 40% of that portion of the building site that abuts a street; and

3. In the event a building site abuts two or more streets, the mast is not located within the front 40% of that portion of the building site where primary access is provided to the property.

Section 20.77.035. Application for Permit.

The development standards in Section 20.77.030 may be waived or modified by the Planning Director upon application for an amateur radio antenna permit. The application shall be on a form supplied by the Planning Department and shall be accompanied by the following information, maps and plans:

(1) Site plans drawn to scale and dimensioned, showing the proposed location of the antenna.

(2) Manufacturer's specifications of the antenna structure.

(3) Details of footings, guys, and braces.

(4) Details of attaching or fixing the antenna to the roof (if applicable).

(5) Elevations drawn to scale and dimensioned so as to fully describe the proposed structure.

(6) Statement of the reasons why strict conformance with the development standards specified in Section 20.77.030 will unreasonably interfere with the operator's ability

to receive or transmit signals or impose unreasonable costs on the amateur radio operator when viewed in light of the cost of the equipment.

Section 20.77.040. Issuance of Permit.

The Planning Director shall issue an amateur radio antenna permit if the applicant demonstrates that strict compliance with the development standards specified in Section 20.77.030 would unreasonably interfere with the applicant's ability to receive or transmit signals, would impose unreasonable costs on the operation when viewed in light of the cost of the equipment, or that strict compliance with the development standards is not, under the circumstances of the particular case, necessary to achieve goals and objectives of this Ordinance. In granting the permit, the Planning Director may impose conditions reasonably necessary to accomplish the purposes of this Ordinance, provided those conditions do not unreasonably interfere with the ability of the applicant to receive or transmit signals or result in extensive cost or expense.

Section 20.77.050. Appeal.

An applicant for an amateur radio antenna permit may appeal a decision of the Planning Director to the Planning Commission. The appeal must be filed within thirty (30) days after written notice of the decision of the Planning Director. The Planning Commission may preside over the appeal, or may appoint a hearing officer to take evidence and submit proposed findings and recommendations to the Planning Commission. The Planning Commission shall render a decision within thirty (30) days after the hearing or receipt of findings and recommendations from the hearing officer. In the event the applicant is not satisfied with the decision of the Planning Commission, the applicant may appeal to the City Council by filing written notice of appeal with the City Clerk within twenty-one (21) days following notice of the action of the Planning Commission. The hearing before the City Council shall be set within thirty (30) days from the date of the appeal. The City Council may appoint a hearing officer to take evidence and make findings and recommendations if the Planning Commission presided over the hearing. The City Council shall render its decision within thirty (30) days after the hearing on the appeal. The decision of the City Council shall be final.

Section 20.77.060. Fees.

[redacted] person shall be charged a fee for applying for a [redacted] radio antenna permit. Reasonable fees for an appeal to the Planning Commission or City Council shall be established by resolution of the City Council.

Section 20.77.070. Notice.

Whenever notice is required pursuant to the provisions of this Chapter, notice of a decision shall be deemed given when the decision is announced by the Planning Commission or City Council at the hearing on the appeal, or written notice of the appeal is deposited in the United States mail, first class, postage prepaid, and addressed as specified on the application for an amateur radio antenna permit.

Section 20.77.075 Nonconforming Antennas.

Amateur radio antennas, antenna structures, and masts in existence as of the effective date of this ordinance may continue to be used without complying with the provisions of this ordinance except as herein provided and shall be considered a legal nonconforming use. Amateur radio antennas, antenna structures, and masts that are a legal nonconforming use shall comply with the provisions of Section 20.77.030B (Permitted Height) to the extent that they are capable of doing so without modification. Amateur radio antennas, antenna structures and masts may be enlarged, expanded or relocated only if brought into compliance with the provisions of this ordinance, unless the expansion, enlargement or relocation is necessary to permit reasonable use of the amateur radio equipment served by the antenna and, in such event, an amateur radio antenna permit shall be obtained before any expansion, enlargement or relocation.

Section 20.77.080. Separability.

If any section, subsection, sentence, clause or phrase of this ordinance is for any reason held to be invalid or unconstitutional by a decision of any court of competent jurisdiction, such decision shall not affect the validity of the remainder of the Ordinance.

Section 3: The City Clerk shall cause the same to be published once in the official newspaper within fifteen (15) days

after its adoption. The Ordinance shall become effective on _____, 1988.

Section 3: This Ordinance was introduced at a regular meeting of the City Council of the City of Newport Beach held on the 22nd day of February, 1988, and adopted on the _____ day of _____, 1988, by the following vote, to-wit:

AYES, COUNCILMEMBERS _____

_____

NOES, COUNCILMEMBERS _____

_____

ABSENT COUNCILMEMBERS _____

_____

_____
Mayor

ATTEST:

_____
City Clerk

DOCUMENT NO. 6

MODEL ANTENNA ORDINANCE: DADE COUNTY, FLORIDA

Antennas for amateur radio stations.

Poles, masts and towers for supporting antenna used in the operation of amateur radio stations licensed by the Federal Communications Commission shall be excepted from the above regulations and shall be governed by the following requirements:

(a) Location on property. All such poles, masts and towers shall be placed no closer than five feet to an official right-of-way line or to property under different ownership, or closer than one foot to an easement. If beam (array) type of antenna installed, no element or part of such beam type array antenna shall extend closer than five feet to an official right-of-way line and/or the property under different ownership or closer than one foot to an easement.

(b) Compliance with electrical codes and federal regulations. All such installations shall conform to the requirements of the National Electrical Code and the F.C.C. regulations governing Amateur Radio Services. National Electrical Code installation must maintain a minimum of eight feet clearance from power lines over two hundred and fifty volts and all high voltage primary lines, and this includes the beam elements or any part thereof.

(c) Permits. Permits shall be required for installation of any poles, masts or towers over twenty feet above the roof of any structure to which they may be attached, and for any installation over thirty-five feet in height when erected on natural ground. Where permits are required, they shall be obtained from the building and zoning department; and applications for permits shall be accompanied by plans and specifications, three copies, showing all dimensions, size and kind of members, footings and guy wires, if any; location, depth and type of guy anchors and footings, if any, and showing the type and weight of antenna, apparatus or structure to be attached to or supported by the structure.

(d) Poles, type. Poles shall be of the approved creosoted type or treated or painted with a chemical preservative and an outer coat of oil base paint before installation (Color to match surrounding development).

(e) Holes. Recommended sizes and depths of holes for various type poles subject to good engineering standards:

Pole Height Above Ground	Hole Depth in Firm Ground	Hole Depth in Rock Ground
16 ft.	3-1/2 ft.	3 ft.
20 ft.	4 ft.	3 ft.
25 ft.	5 ft.	3 ft.
35 ft.	6 ft.	4 ft.
50 ft.	7 ft.	4-1/2 ft.

If the earth is damp or soggy, the depth of hole is to be increased by one foot.

If the pole is guyed in accordance with American Standards Association standards, the depth of hole as listed in code can be decreased by one foot. If carrying a beam, poles must be properly guyed, as is the case where pulling effect of wire antenna or weight of other installations will require guying.

(f) Masts. Masts constructed of wood (2" x 2" or 4" x 4" for either the "A" frame type construction or straight masts) shall be properly chemically treated, painted with an outside coat of oil base paint and be properly guyed both at the top and middle in at least three different directions, approximately one hundred and twenty degrees apart, or otherwise suitably guyed. Masts to support a beam, whether of wood or metal pipe, must comply with all the regulations applicable in regard to location, guying, etc., and the maximum allowable weight of antenna, rotator and components shall not exceed one hundred and fifty pounds.

(g) Towers. Towers of steel, iron or aluminum, whether of the rigid nondemountable type or the rigid, demountable type with the crank-up, crank-down and either the hinged base or swivel crank-over features shall carry no more weight on the top than specified by the manufacturer's specifications.

(h) Waiver of objection for certain structures; servicing; removal. All poles, masts or towers, and other structures used for antennas under this section, which exceed thirty-five feet in height above grade elevation, or

which exceed twenty feet in height above the roof of any structure shall be subject to the following requirements:

If the top of such poles, masts or towers are higher above their foundation, or the foundation of the structure on which they are erected, than ninety per cent of the horizontal distance from its base or projected base to the nearest point on adjacent property under different ownership or to the nearest edge of an official right-of-way, then no permit shall be issued for such installation unless a waiver is obtained from each and every owner of adjacent property that the structure could fall upon.

In calculating the height of demountable type towers, the top of the lower rigid section shall be considered the top for the purpose of this subsection.

Beam array antenna shall be so mounted so as to provide easy servicing and easy access for removal at approach of hurricanes, or provide for the lowering of such beam.

Chapter 17.20

SINGLE-FAMILY RESIDENTIAL (R-1) DISTRICT

Sections:

17.20.010 Purpose.

To promote and encourage a suitable environment for family living and to protect and stabilize the residential characteristics of the district, the R-1 district is intended to provide for single-family residential homes at urban standards. [Ord. 08-O-612 § 2; Ord. 89-O-446 § 1.]

17.20.020 Permitted uses.

The following uses are permitted:

A. Single-family dwellings. Dwellings must have a garage or carport constructed of like materials;

B. Subject to the requirements of BMC 17.20.100, a manufactured home as defined by ORS 446.003. [Ord. 08-O-612 § 2; Ord. 94-O-446.T § 3; Ord. 89-O-446 § 1.]

17.20.030 Accessory uses.

The following uses are permitted:

A. Guest houses containing no kitchen or kitchen facilities and limited to no greater than 500 square feet in size. Guest houses may not be rented or otherwise conducted as a business;

B. Home occupations, subject to the provisions of Chapter 17.104 BMC;

C. Other accessory uses and accessory buildings and structures, such as noncommercial greenhouses, customarily appurtenant to a permitted use;

D. Boats, trailers, pick-up campers, motor homes and similar equipment may be stored, but not occupied, except as provided for temporary sleeping purposes in BMC 8.15.087, on a lot in an "R" district; provided, that:

1. Parking and storage shall be at least five feet from the front property line and at least three feet from a street and interior side or rear lot line; except, however, no storage shall be allowed within 20 feet of the corner along both property lines at a street corner;

2. All areas used for storage of such vehicle/equipment shall be paved or a graveled hard surface. [Ord. 08-O-612 § 2; Ord. 89-O-446 § 1.]

17.20.040 Conditional uses.

The following conditional uses may be permitted subject to a conditional use permit:

A. Recreation uses and facilities, including country clubs, golf courses, and swimming clubs, but not including such intensive commercial recreation uses as a golf driving range, race track or amusement park;

B. Churches, subject to BMC 17.124.100;

C. Hospitals, rest, nursing and convalescent homes, subject to BMC 17.124.100;

D. Public or private schools, but not including a business, dancing, trade, technical or similar school, and subject to BMC 17.124.011;

E. Nursery schools and day care facilities, subject to BMC 17.124.010;

F. Governmental structures or uses including parks and recreation facilities, fire stations, libraries, and museums, but not including storage or repair yards, warehouses or similar uses;

G. Riding academies and public stables, subject to BMC 17.124.070;

H. Cemeteries, mortuaries, crematories, mausoleums, and columbariums, subject to BMC 17.124.090;

I. Excavation and removal of sand, gravel, stone, soil or other earth products, subject to BMC 17.124.020 (commercial excavations);

J. Public and quasi-public halls, lodges and clubs, subject to BMC 17.124.120;

K. The keeping of horses, cattle, sheep and other livestock, subject to BMC 17.124.190;

L. Planned unit developments, including duplex or multifamily development, subject to provisions of Chapter 17.116 BMC;

M. Utility substations or pumping stations, subject to BMC 17.124.030;

N. Bed and breakfast facilities, subject to the provisions of BMC 17.124.140;

O. Dwelling groups, subject to BMC 17.124.180;

P. Signs appurtenant to any c[illegible] which do not comply with BMC 17.20.080;

Q. Short-term rentals pursuant to the provisions of BMC 17.124.170;

R. Poultry farms and eggeri[illegible] provisions of BMC 17.124.040;

S. Temporary living quarters for caretakers, subject to the provisions of BMC 17.124.200;

T. Cottage industries, subject to BMC 17.124.220. [Ord. 14-O-722 § 3; Ord. 08-O-612 § 2; Ord. 01-O-446.MM; Ord. 98-O-446.DD § 4; Ord. 95-O-446.Y § 2; Ord. 95-O-446.X § 3; Ord. 93-O-446.L § 2; Ord. 91-O-446.D § 1; Ord. 89-O-446 § 1.]

17.20.050 Minimum lot area and dwelling density.

Minimum lot areas in the R-1 zone may be 6,000, 8,000, 10,000 or 12,000 square feet, depending upon site, public service and neighborhood characteristics. One dwelling unit may be sited on each lot or parcel. [Ord. 08-O-612 § 2; Ord. 89-O-446 § 1.]

17.20.060 Lot width, lot coverage and yard requirements.

Zone	Lot Width	Front Yard	Side Yard	Rear Yard	Maximum Lot Coverage
R-1-6	60'	20'	5'*	15'	40%
R-1-8	70'	20'	5'*	15'	40%
R-1-10	80'	[illegible]	5'*	15'	40%
R-[illegible]	[illegible]	20'	5'*	15'	40%

* Provided, that the nonstreet side yards shall be increased by one-half foot for each foot by which the average building height exceeds 15 feet.

* Provided, that on an existing structure, proposed additional stories must meet the setbacks for the height of the structure.

Provided, however, that side yards abutting a street shall be a minimum of 15 feet in width.

Rear lots (flag lots) created pursuant to BMC 17.172.061 have setback requirements of 10 feet from all property lines. Any irregularly shaped parcel with minimal street frontage is also subject to the 10-foot setback from all property lines. [Ord. 10-O-659 § 2; Ord. 08-O-612 § 2; Ord. 03-O-446.SS; Ord. 90-O-446.B § 1; Ord. 89-O-446 § 1.]

17.20.070 Maximum building structure height.

No structure shall be over 30 feet in height, except as provided in BMC 17.124.030 or 17.128.020. [Ord. 08-O-612 § 2; Ord. 98-O-446.DD § 4; Ord. 89-O-446 § 1.]

17.20.080 Signs.

Signs shall be permitted in accordance with Chapter 17.88 BMC. [Ord. 08-O-612 § 2; Ord. 89-O-446 § 1.]

17.20.090 Parking.

Off-street parking shall be provided in accordance with Chapter 17.92 BMC. [Ord. 08-O-612 § 2; Ord. 89-O-446 § 1.]

17.20.100 Manufactured housing siting requirements.

A. The manufactured home shall be multisectional and enclose a space of not less than 1,000 square feet.

B. The manufactured home shall be placed on a foundation that complies with the State of Oregon Manufactured Dwelling and Parks Specialty Code, Section 3-8.3, and skirted with masonry block or poured concrete.

C. The manufactured home shall have a pitched roof, except that no standard shall require a slope of greater than a nominal three feet in height for each 12 feet in width.

D. The manufactured home shall have exterior siding and roofing which in color, material and appearance is similar to the exterior siding and roofing material commonly used on residential dwellings within the community or which is comparable to the predominant materials used on surrounding dwellings as determined by the local permit approval authority.

E. The manufactured home shall have a garage or carport constructed of like materials. [Ord. 11-O-677 § 2; Ord. 10-O-655 § 2; Ord. 08-O-612 § 2; Ord. 94-O-446.T § 3; Ord. 89-O-446 § 1.]

17.20.110 Other required conditions.

A. Site plan approval required as provided in Chapter 17.80 BMC.

B. No residential structure shall be located within the ocean coastal shorelands boundary nor the Chetco Estuary shorelands boundary as defined in the comprehensive plan.

FCC Federal Communications Commission

Antenna Structure Registration

TOWAIR Determination Results

HELP

New Search Printable Page

A routine check of the coordinates, heights, and structure type you provided indicates that this structure does not require registration.

*** NOTICE ***

TOWAIR's findings are not definitive or binding, and we cannot guarantee that the data in TOWAIR are fully current and accurate. In some instances, TOWAIR may yield results that differ from application of the criteria set out in 47 C.F.R. Section 17.7 and 14 C.F.R. Section 77.13. A positive finding by TOWAIR recommending notification should be given considerable weight. On the other hand, a finding by TOWAIR recommending either for or against notification is not conclusive. It is the responsibility of each ASR participant to exercise due diligence to determine if it must coordinate its structure with the FAA. TOWAIR is only one tool designed to assist ASR participants in exercising this due diligence, and further investigation may be necessary to determine if FAA coordination is appropriate.

DETERMINATION Results

PASS SLOPE(50:1) NO FAA REQ - 1740.0 Meters (5708.59 Feet)away & below slope by 106.0 Meters (347.759 Feet)

Type	C/R	Latitude	Longitude	Name	Address	Lowest Elevation (m)	Runway Length (m)
AIRP	R	42-04-38.00N	124-17-35.00W	BROOKINGS	CURRY BROOKINGS, OR	132.9	883.89999999999998

Your Specifications

NAD83 Coordinates	
Latitude	42-04-23.0 north
Longitude	124-18-48.0 west
Measurements (Meters)	
Overall Structure Height (AGL)	23.2
Support Structure Height (AGL)	21.3
Site Elevation (AMSL)	37.8
Structure Type	
LTOWER - Lattice Tower	

Tower Construction Notifications
Notify Tribes and Historic Preservation Officers of your plans to build a tower.

TOWAIR Determination

HELP
Phone: 1-877-480-3201
TTY: 1-717-338-2824
Submit Help Request

Federal Communications Commission
445 12th Street SW
Washington, DC 20554

The FCC does not require each antenna structure to be registered. This screen enables the user to enter and submit key information about their antenna structure in order to determine whether or not registration with the FCC is necessary. After submitting the form, you receive one of two reply messages:

- The antenna structure requires registration. A list of reasons is provided.
  Or
- The antenna structure does not require registration. A list of reasons is provided.

For more details on the FCC rules on antenna structure registration see the Code of Federal Regulations (CFR) 47 Part 17.7 (Revision 10/01/1996).

Tower Construction Notifications
Notify Tribes and Historic Preservation Officers of your plans to build a tower.

DETERMINE If Registration is Necessary

NAD83 Coordinates (Convert from NAD27)

Latitude	42	°	04	'	23	" N (+)
Longitude	124	°	18	'	48	" W (+)

Measurements

Measurement System	Feet
Overall Structure Height (AGL)	76
Support Structure Height (AGL)	70
Site Elevation (AMSL)	124

Structure Type

LTOWER - Lattice Tower

SUBMIT RESET

Federal Communications Commission
445 12th Street SW
Washington, DC 20554

Phone: 1-877-480-3201
TTY: 1-717-338-2824

Brookings Email

Exhibit B-3
LDC-2-15

Donna Colby-Hanks <dcolbyhanks@brookings.or.us>

File No. LDC 2-15

1 message

Lana Brock <carmelbythesea76@gmail.com> Wed, Apr 29, 2015 at 10:10 AM
To: DCOLBYHANKS@brookings.or.us

Pursuant to our telephone conversation this morning, please include a copy of our letter dated Jan. 13, 2015 with the documents and evidence that will be reviewed and heard by the Brookings Planning Commission next Tuesday, May 5, 2015. Our previously stated position regarding any variance in established antenna height restrictions is relevant in this matter.

Thank you,

James and Lana Brock

--

January 13, 2015

Brookings Planning Commission
909 Elk Drive
Brookings, OR 97415

Attn.: Donna Colby-Hanks

Dear Ms. Colby-Hanks;

We, James and Lana Brock, live at 17275 Garvin Ct., Brookings. It has come to our attention that the adjoining property owner to the rear, 96506 Susan Pl., has petitioned the City for permission to install a radio antenna on their property.

It has also come to our attention that a planning commission hearing is scheduled to hear the matter on Feb. 3, 2015. We will be out of state until the Spring and unable to attend this hearing.

Our position regarding the antenna is that it's height should not exceed limits established by federal, state or local regulations. We therefore object to any variance to established height restriction that may be requested.

Thank you,

James D. Brock

Lana R. Brock

MEMO

TO: **Planning Commission**

FROM: **Donna Colby-Hanks, Planning Manager** DC

DATE: **May 21, 2015**

SUBJECT: Continued Hearing for LDC-1-15 Amateur Radio Facilities and the availability of retractable towers.

The Planning Commission conducted an initial hearing on this matter on May 5, 2015 following two workshops. A continuance was recommended by Staff to allow additional research into whether retractable amateur radio towers are manufactured that comply with the City's windload requirements. Retractable towers were suggested by the City Attorney who advised that requiring a certain distance between the towers or prohibiting the towers within a certain distance of Chetco Avenue would not be reasonably accommodating the facilities. However, Staff has received information from the two largest manufacturers of towers that neither make a retractable tower that would meet the windload requirements. Therefore, it would not be reasonable to require retractable towers be installed in the above mentioned areas.

Proposed Chapter 17.124.230(L), regarding distance of towers from Chetco Avenue and distances from each other, has been stricken.

The draft provisions are attached for review. After considering any additional public testimony and reviewing the provisions, staff recommends a favorable recommendation to City Council.

Attachment A Draft provisions
Attachment B Letter from Georgeann Rudicel

Proposed new text is **bold.**
Text added from PC workshop is **bold underlined**.
Text deleted from PC workshop is ~~**bold double stricken**~~.
Text deleted from May PC hearing is ~~single stricken~~.

Chapter 17.16 Suburban Residential (SR) District

17.16.030 Accessory uses
The following accessory uses are permitted:

E. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.20 Single-Family Residential (R-1) District

17.20.030 Accessory uses.
The following uses are permitted:

E. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230 in the R-1-12 zone.

17.20.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

U. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230 in the R-1-6, R-1-8, and R-1-10 zones.

Chapter 17.24 Two-Family Residential (R-2) District

17.24.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

V. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.28 Multiple-Family Residential (R-3) District

17.28.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

T. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.32 Manufactured Home Residential (R-MH) District

17.32.040 Conditional uses.
The following conditional uses may be permitted:

V. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.36 Professional Office (PO-1) District

17.36.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

L. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.40 Public Open Space (P/OS) District

17.40.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

D. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.44 Neighborhood Commercial (C-1) District

17.44.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

D. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.48 Shopping Center Commercial (C-2) District

17.48.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

J. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.52 General Commercial (C-3) District

17.52.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

O. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.56 Tourist Commercial (C-4) District

17.56.040 Conditional uses.
The following conditional uses may be permitted subject to a conditional use permit:

J. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.64 Industrial Park (I-P) District

17.64.040 Conditional uses.
The following uses may be permitted subject to a conditional use permit:

I. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.68 General Industrial (M-2) District

17.68.040 Conditional uses.
The following uses may be permitted subject to a conditional use permit:

G. Amateur radio facilities, accessory to a dwelling, subject to the provisions of BMC 17.124.230.

Chapter 17.124 Specific Standards Applying to Conditional Uses

17.124.230 Amateur radio facilities.

Amateur radio facilities are private, non-commercial wireless communication facilities consisting of antennas, towers, and/or support structures. The City recognizes the importance of amateur radio operators and their service to the community especially in the event of emergencies.

Amateur radio facilities are considered an accessory use to a residential dwelling. Chapter 17.128.020(B) provides for exceptions to height limitations for antenna. Antenna may be one and one-half times the height limitation of the applicable zoning district. However, towers and support structures shall comply with height limitations and setbacks.

The following siting criteria shall apply to amateur radio facilities that do not meet the provisions of Chapter 17.128.020(B) and/or the applicable zoning district. The criteria are intended to maximize public safety and minimize visual impacts to promote and protect the residential characteristics of the residential zoning districts consistent with federal and state law. Public notice shall be provided to all property owners within 1000 feet of a proposed amateur radio facility requesting approval with a conditional use permit (CUP).

A. Height. The maximum tower/antenna height shall not exceed 70 feet from the finished grade at the base of the tower.

B. Front, Side and Rear Yard Setbacks. The minimum setback from all property lines to the finished grade at the base of the tower shall be 1 foot for every ~~3~~ 2 feet of height. With the exception of guy wires, ~~that connect directly to the ground~~ antennas, and footings that do not project above grade level, no component of the facility may encroach into the required setback.

C. Construction. A building permit shall be obtained for the construction or erection of the amateur radio facility. Plans and calculations shall be provided and shall comply with the provisions of Section 3108 of the Oregon Structural Specialty Code. ~~Towers/antennas shall be designed and constructed in accordance with the current provisions of TIA-222~~.

D. Finish (paint/surface). The facility shall have a finish, tone or color that reduces its visibility. In most circumstances this condition may be satisfied by painting the facility with a flat light haze gray paint. The owner shall maintain the finish, painted or unpainted. Red and white or orange and white finish is not allowed. If these colors are required by the FAA (Federal Aviation Administration) or ODA (Oregon Department of Aviation), the height shall be reduced to a level that it is not required.

E. Fencing and Security. For security purposes, towers and accessory facilities shall be enclosed by a minimum six-foot fence or be equipped with anti-climb devices. If this conflicts with TIA-222 or other agencies, the most restrictive requirements shall prevail.

F. Lighting. No lighting shall be permitted on the facility. If required by the FAA or ODA, the facility shall be reduced to a level that does not require lighting.

G. Airport Overlay Zone. The facility shall comply with the requirements in BMC Chapter 17.76, Airport Overlay Zone.

H. Advertising/Signs. No advertising or signs of any type are to be placed on the tower at any time except those required or necessary for safety and warnings. Safety and warning signs shall be less than two square feet and be placed on the facility at a height of less than six feet.

~~I. Interference. The facility shall not cause any interference with normal radio and television reception in the surrounding area nor with any public safety agency or organization (including but not limited to police, fire, ambulance, and Coast Guard) radio transmissions. The owner shall bear the costs of immediately eliminating any such interference should any occur, or shall immediately shut down the antennas or other equipment causing the interference.~~

J. License. The owner of the facility shall possess and provide a copy of a current FCC license to the Planning Department. After six months with no valid license, the facility shall be considered abandoned and shall be removed by the ~~operator~~ property owner ~~of the facility~~ within 60 days thereafter.

K. Abandonment. The property owner shall provide annual written documentation that the facilities are functioning. Amateur radio facilities that do not have functioning antennas for a period of six month shall be considered abandoned and shall be removed by the owner of the facility within 60 days thereafter. Upon written application, prior to the expiration of the six-month period, the planning commission if approved with a CUP or staff if permitted outright may, in writing, grant a six-month time extension for reuse of the facility. Additional extensions beyond the first six-month extension may be granted by the planning commission subject to any conditions required to bring the project or facility into compliance with current regulation(s).

~~L. Separation distance and Chetco Avenue buffer. Amateur radio facilities shall be separated by a distance of 500 1000 feet. The measurement is the shortest distance between towers taken at grade level. No facilities shall be located within 1000 feet of Chetco Avenue. The measurement is the shortest distance between the right-of-way boundary and the base of the tower.~~

~~Alternate provision accounting for City Attorney input: L. Separation distance and Chetco Avenue buffer. Amateur radio facilities shall be separated by a distance of 1000 feet. The measurement is the shortest distance between towers taken at grade level. Any tower within the separation distance shall be retractable and be lowered to the maximum height of the underlying zone when not in use. Facilities located within 1000 feet of Chetco Avenue shall be retractable and be lowered to the maximum height of the underlying zone when not in use. The measurement is the shortest distance between the right-of-way boundary and the base of the tower.~~

M. Maintenance. Amateur radio facilities shall be maintained in good order and repair at all time so to not constitute any danger or hazard to adjacent properties.

N. Unrelated equipment. Equipment and antenna for other than amateur radio facilities shall comply with height and setback requirements of Chapter 17.128.020(B) and the underlying zone.

O. Hazardous Building Sites. Construction or erection of amateur radio facilities shall comply with Chapter 17.100 Hazardous Building Site Protection.

Attachment B

May 8, 2015

Enclosed please find a copy of the letter Mr Bruce Warren wrote us concerning his "70'!! offense and how he would <u>not</u> pursue this structure.

Most residents threw away the May 5th agenda thinking it only dealt with a vacation rental on Dawson and also having read Mr Warren's

Letter of non intent.

Please study this matter and take a look at his property and how it would affect his immediate neighbors on Passley and Garvin Court.

Thank you for your attention to this matter.

Sincerely.

Georgeann Rudicel

541 469 5809

PS A self-collapsing ~~imploding~~ tower collapsed in Suisun, California damaging a building.

Our area has recorded 100 mph winds.

February 4, 2015

Mr. & Mrs. John Gauger
Mr. & Mrs. Charles Rudicel
Mr. & Mrs. Ron Sionikers

Dear All:

Please allow me to offer my sincere apology for causing you to come to the Planning Commission Workshop yesterday, Feb. 3, 2015. Please believe me, had I envision such negative reception of the idea of my having an antenna at this properties back yard when we spoke last December. A) I would not have gone forward at all. B) would not have bought this property. Please accept my most sincere apology. As I said to each family when we first met. I would not proceed with this endeavor unless it was acceptable to my future neighbors.

Having something in my yard that would offend you as you stated last night is in no way my intention. You may rest assured, in no way, will I move forward with anything that would cause any kind of unrest in this, our, neighborhood. When ever I walked in and saw Georgeann who would not even exchange greetings, I was completely surprised. Considering the complete change of mind from when we spoke in December really set me back. Goodness. Truly. I wish that you might have shared with me you present position regarding this subject. Maybe we could have discussed it.

The negative energy that I felt last night in the Council Chamber is not something I would care to maintain or foster for the future. Where I live is very important to me as is the atmosphere in that area. Please allow me to try and re-establish that very warm feeling that Diana and I experienced and shared at our first meeting.

As I said earlier, the placement of a 70' antenna at this property is not something I will be moving forward with. I will continue to try and have the Brookings Municipal Code reflect a more friendly Amateur Radio provision.

Mr. Gauger many of the points you made in your presentation were very good. But not specific to an Amateur Radio person that cares to practice the hobby for other than Emergency communication. I do thank you for your very well prepared paper.

Thank you for your attention to this matter. I would welcome your thoughts and reply.

Be well,
Bruce Warren, N1EQG

cc:
Mr. & Mrs. Jim Brock
Ms. Donna Colby-Hanks

CITY OF BROOKINGS

Legal Notice CC Meet 06-22-15
Email to Pilot: 06-05-15
Publish Date: 06-10-15

PUBLIC NOTICE
NOTICE OF PUBLIC HEARING BEFORE THE CITY COUNCIL

NOTICE IS HEREBY GIVEN that a public hearing will be held before the Brookings City Council Monday, June 22, 2015 at 7:00 p.m. in the Council Chambers of Brookings City Hall, 898 Elk Drive, Brookings.

In the matter of File No. **LDC-2-15**, the addition of BMC Section 17.124.230 Specific Standards Applying to Conditional Uses, Amateur communication facilities and the addition of Amateur communication facilities as a permitted use in Chapter 17.16 Suburban Residential (SR) and Chapter 17.20 Single-Family Residential (R-1-12) and as a conditional use in Chapter 17.20 Single-Family Residential (R-1-6, R-1-8, R-1-10), Chapter 17.24 Two-Family Residential (R-2), Chapter 17.32 Manufactured Home Residential (R-MH), Chapter 17.28 Multiple-Family Residential (R-3), Chapter 17.36 Professional Office (PO-1), Chapter 17.40 Public Open Space (P/OS), Chapter 17.44 Neighborhood Commercial (C-1), Chapter 17.48 Shopping Center Commercial (C-2), Chapter 17.52 General Commercial (C-3), Chapter 17.56 Tourist Commercial (C-4), Chapter 17.64 Industrial Park (I-P), and Chapter 17.68 General Industrial (M-2). City initiated. The criteria used to decide this matter are found in Chapter 17.140 Amendments, of the Brookings Municipal Code to provide additional opportunities for amateur radio facilities. This is a legislative hearing and City Council will make a decision on the matter.

All persons wishing to address these matters will have an opportunity to do so in person at the hearing or by submitting written evidence to the Brookings City Planning staff at the address above. A copy of the staff report prepared for this case will be available for inspection, at no cost, and provided at reasonable cost, seven days prior to the hearing. All documents may be viewed or obtained at the Planning Department at Brookings City Hall.

All public meetings are held in accessible locations. Auxiliary aids will be provided upon request with advance notification. If special accommodations are needed please call 469-1137.