

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
SYNTHESIS OF HIGHWAY PRACTICE

13

**RADIO SPECTRUM
FREQUENCY MANAGEMENT**

HIGHWAY RESEARCH BOARD
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HIGHWAY RESEARCH BOARD 1972

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13

RADIO SPECTRUM FREQUENCY MANAGEMENT

RESEARCH SPONSORED BY THE AMERICAN ASSOCIATION
OF STATE HIGHWAY OFFICIALS IN COOPERATION
WITH THE FEDERAL HIGHWAY ADMINISTRATION

AREAS OF INTEREST:

TRANSPORTATION ADMINISTRATION
MAINTENANCE, GENERAL
HIGHWAY SAFETY
TRAFFIC CONTROL AND OPERATIONS
URBAN TRANSPORTATION ADMINISTRATION

HIGHWAY RESEARCH BOARD

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NATIONAL ACADEMY OF SCIENCES—NATIONAL ACADEMY OF ENGINEERING

1972

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

In recognition of these needs, the highway administrators of the American Association of State Highway Officials initiated in 1962 an objective national highway research program employing modern scientific techniques. This program is supported on a continuing basis by funds from participating member states of the Association and it receives the full cooperation and support of the Federal Highway Administration, United States Department of Transportation.

The Highway Research Board of the National Academy of Sciences-National Research Council was requested by the Association to administer the research program because of the Board's recognized objectivity and understanding of modern research practices. The Board is uniquely suited for this purpose as: it maintains an extensive committee structure from which authorities on any highway transportation subject may be drawn; it possesses avenues of communications and cooperation with federal, state, and local governmental agencies, universities, and industry; its relationship to its parent organization, the National Academy of Sciences, a private, nonprofit institution, is an insurance of objectivity; it maintains a full-time research correlation staff of specialists in highway transportation matters to bring the findings of research directly to those who are in a position to use them.

The program is developed on the basis of research needs identified by chief administrators of the highway departments and by committees of AASHO. Each year, specific areas of research needs to be included in the program are proposed to the Academy and the Board by the American Association of State Highway Officials. Research projects to fulfill these needs are defined by the Board, and qualified research agencies are selected from those that have submitted proposals. Administration and surveillance of research contracts are responsibilities of the Academy and its Highway Research Board.

The needs for highway research are many, and the National Cooperative Highway Research Program can make significant contributions to the solution of highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement rather than to substitute for or duplicate other highway research programs.

NCHRP Synthesis 13

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This report is one of a series of reports issued from a continuing research program conducted under a three-way agreement entered into in June 1962 by and among the National Academy of Sciences-National Research Council, the American Association of State Highway Officials, and the Federal Highway Administration. Individual fiscal agreements are executed annually by the Academy-Research Council, the Federal Highway Administration, and participating state highway departments, members of the American Association of State Highway Officials.

The study reported herein was undertaken under the aegis of the National Academy of Sciences—National Research Council. The National Cooperative Highway Research Program, under which this study was made, is conducted by the Highway Research Board with the express approval of the Governing Board of the NRC. Such approval indicated that the Board considered that the problems studied in this program are of national significance; that solution of the problems requires scientific or technical competence, and that the resources of NRC are particularly suitable for the oversight of these studies. The institutional responsibilities of the NRC are discharged in the following manner: each specific problem, before it is accepted for study in the program, is approved as appropriate for the NRC by the NCHRP Program Advisory Committee and the Chairman of the Division of Engineering of the National Research Council.

Topics for synthesis are selected and defined by an advisory committee that monitors the work and reviews the final report. Members of the advisory committees are appointed by the Chairman of the Division of Engineering of the National Research Council. They are selected for their individual scholarly competence and judgment, with due consideration for the balance and breadth of disciplines. Responsibility for the definition of this study and for the publication of this report rests with the advisory committee.

Although reports in this category are not submitted for approval to the Academy membership nor to the Council, each report is reviewed and processed according to procedures established and monitored by the Academy's Report Review Committee. Such reviews are intended to determine *inter alia*, whether the major questions and relevant points of view have been addressed, and whether the reported findings, conclusions and recommendations arose from the available data and information. Distribution of the report is permitted only after satisfactory completion of this review process.

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PREFACE

There exists a vast storehouse of information relating to nearly every subject of concern to highway administrators and engineers. Much of it resulted from research and much from successful application of the engineering ideas of men faced with problems in their day-to-day work. Because there has been a lack of systematic means for bringing such useful information together and making it available to the entire highway fraternity, the American Association of State Highway Officials has, through the mechanism of the National Cooperative Highway Research Program, authorized the Highway Research Board to undertake a continuing project to search out and synthesize the useful knowledge from all possible sources and to prepare documented reports on current practices in the subject areas of concern.

This synthesis series attempts to report on the various practices without in fact making specific recommendations as would be found in handbooks or design manuals. Nonetheless, these documents can serve similar purposes, for each is a compendium of the best knowledge available concerning those measures found to be the most successful in resolving specific problems. The extent to which they are utilized in this fashion will quite logically be tempered by the breadth of the user's knowledge in the particular problem area.

FOREWORD

By Staff

Highway Research Board

This report should be of special interest to highway engineers responsible for radio communications services that include maintenance operations, motorist aid and assistance, and coordination of general operations.

Administrators, engineers, and researchers are faced continually with many highway problems on which information already exists either in documented form or in terms of undocumented experience and practice. Unfortunately, this information is often fragmented, scattered, and unevaluated. As a consequence, full information on what has been learned about the problem is frequently overlooked in seeking a solution. Costly research findings and experience may go unused and due consideration may not be given to recommended practices for solving or alleviating the problem. In an effort to resolve this situation, a continuing NCHRP project, carried out by the Highway Research Board as the research agency, has the objective of synthesizing and reporting on common highway problems—a synthesis being defined as a composition or combination of separate parts or elements so as to form a whole greater than the sum of the separate parts. Reports from this endeavor constitute an NCHRP report series that collects and assembles the various forms of information into single concise documents pertaining to specific highway problems or sets of closely related problems. This is the thirteenth report in the series.

The utilization of radio communication has increased at a fantastic rate since World War II. This is particularly true for the Land Mobile Radio Service authorized and regulated by the Federal Communications Commission (FCC). The Public Safety Radio Services, which includes the Highway Maintenance Radio Service, is a part of the Land Mobile Radio Service.

Frequency allocation and assignment problems were recognized in the United States as early as 1922, when the Secretary of Commerce convened the First National Radio Conference to study technical coordination and management of the radio spectrum. This led to the establishment of the FCC in 1934 “to regulate interstate and foreign commerce in communications by wire and radio.” The highway departments of the 50 states and the District of Columbia use a part of the radio spectrum so highly congested that almost every request for the assignment of a new frequency must be carefully appraised, and all factors that might affect either the new or present users must be considered.

This report of the Highway Research Board provides information on the importance of the management and assignment of radio frequencies for highway use. The role of the Highway Maintenance Radio Service Coordinator is presented in conjunction with other coordinators in the Public Safety Radio Services in the responsibility for over-all good technical judgment in reviewing applications for assignment of radio frequencies to qualified users.

To develop this synthesis in a comprehensive manner and to ensure inclusion of significant knowledge, the Board analyzed available information (e.g., current practices, manuals, and research recommendations) assembled from many highway departments and agencies responsible for highway planning, design, construction, and maintenance. A topic advisory panel of experts from this subject area was established to guide the researchers in organizing and evaluating the collected data, and to review the final synthesis report.

As a follow-up, the Board will attempt to evaluate the effectiveness of the synthesis after it has been in the hands of its users for a period of time. Meanwhile, the search for better methods is a continuing activity and should not be diminished. An updating of this document is ultimately intended so as to reflect the improvements that may be discovered through research or practice.

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Valuable assistance in the preparation of this synthesis was provided by the Topic Advisory Panel, consisting of Lyman R. Gillis, Assistant State Highway Engineer, California Division of Highways; Willis M. Green, Manager, Communications Section, Michigan Department of State Highways; Richard C. Hopkins, Highway Engineer, Signals and Communications Branch, Federal Highway Administration; Frank W. Howard, Administrative Assistant, Oklahoma Department of Highways; and Lyle G. Saxton, Chief, Systems Development and Technology Group, Federal Highway Administration.

K. B. Johns, Engineer of Traffic and Operations, Highway Research Board, assisted the Special Projects staff and the Advisory Panel.

Information on current practice and ongoing research was provided by many highway agencies and the Federal Communications Commission. Their cooperation and assistance were most helpful.

RADIO SPECTRUM FREQUENCY MANAGEMENT

SUMMARY

Improved frequency management and advances in radio technology are essential if the users of the Public Safety Radio Services are to receive the desired level of communications. Frequency coordination is a vital part of this management effort. Today's problems are the result of the increased use of radio and the number of federal, state, county, and city agencies involved.

Frequencies available to the Highway Maintenance Radio Service are in the low band (30 to 50 MHz), the high band (150 to 172 MHz), or the UHF band (450 to 512 MHz) sectors of the spectrum. The Federal Communications Commission (FCC) is responsible for the allocation of frequencies to radio services, the assignment of specific frequencies, and the issuance of operating licenses to individual users. Volume V, Part 89 of the FCC *Rules and Regulations* provides the primary guidance for the control and use of the Public Safety Radio Services. These regulations list three provisions, any of which may be used as the basis for making a request for frequency assignment. In one provision the assistance of a Frequency Advisory Committee made up of members of the individual radio services is required.

It is anticipated that the individual committee members will be qualified, or have ready access to a fellow employee who is qualified, in basic radio technology. Each request for frequency coordination should be carefully reviewed, particularly if there are co-channel or adjacent channel users.

The practice of identifying a specific budget for operations and the procurement of essential publications is encouraged. It is equally important to have a single location for maintaining publications and coordination records.

CHAPTER ONE

INTRODUCTION

The radio sector of the electromagnetic spectrum (Fig. 1) is one natural resource that is in immediate danger from saturation. Although this vital resource cannot be physically destroyed or consumed, its usefulness can be seriously limited by overcrowding. Any further expansion of radio use is possible only through advances in technology and improved frequency management practices. An important part of these practices is the assignment and reassignment of allocated frequencies. This includes the necessary coordination between co-channel and adjacent channel users.

Frequency allocation and assignment problems were recognized in the United States as early as 1922, when the Secretary of Commerce convened the First National Radio Conference to study technical coordination and management of the radio spectrum. This led to the establishment of the Federal Radio Commission and its successor, the Federal Communications Commission (FCC), created in 1934 "to regulate interstate and foreign commerce in communications by wire and radio" (1).

Radio use has increased at a fantastic rate since World

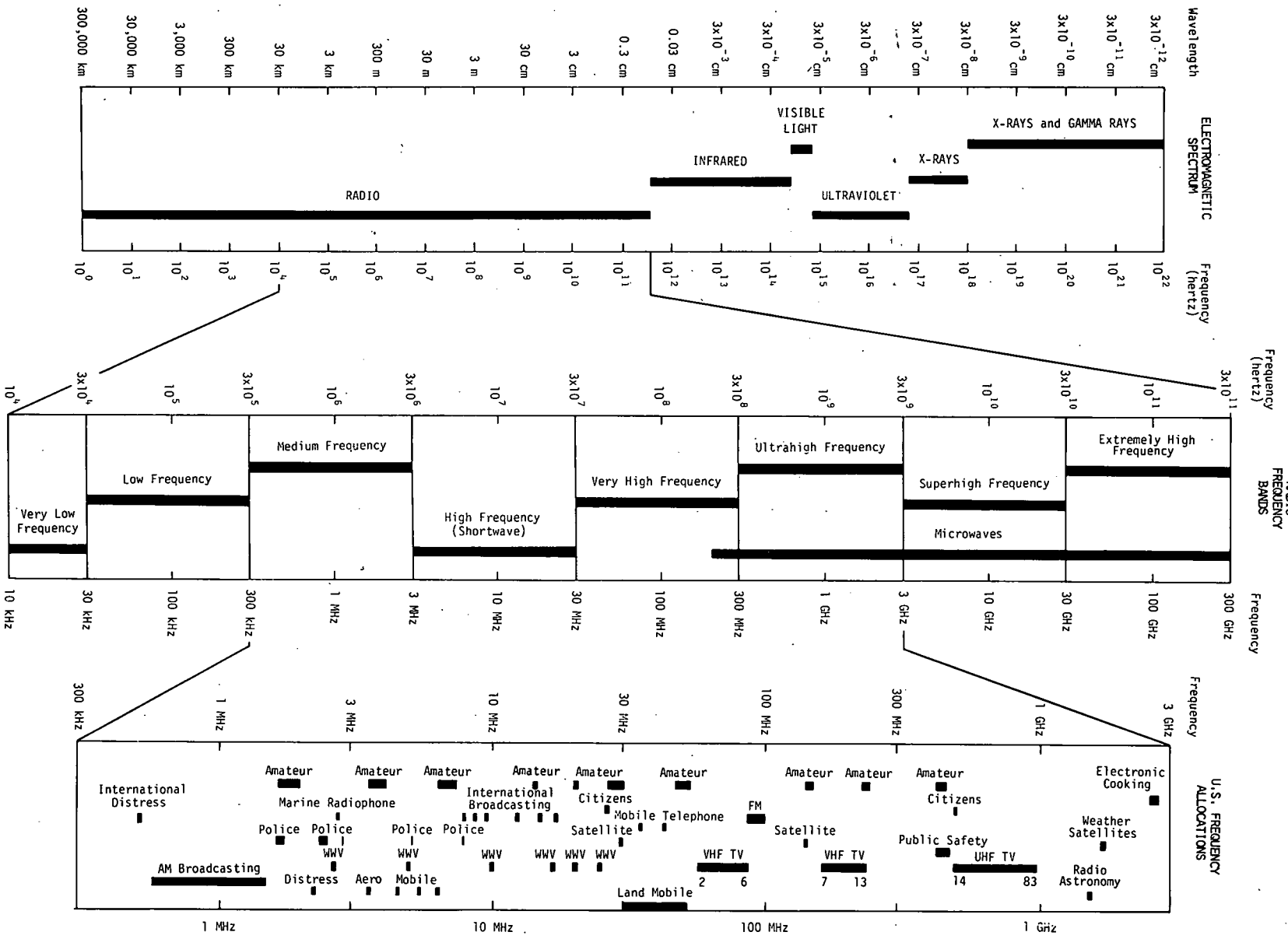


Figure 1. Electromagnetic spectrum.

War II. This is particularly true for the Land Mobile Radio Service. The Public Safety Radio Services, which includes the Highway Maintenance Radio Service, is a part of the Land Mobile Radio Service.

Numerous federal, state, and local government agencies are involved with frequency management. The following federal agencies are among those that are directly or indirectly concerned:

1. Federal Communications Commission.
2. Office of Telecommunications Policy (White House).
3. Office of Telecommunications (Department of Commerce).
4. Department of Housing and Urban Development.
5. Department of Transportation.
6. Department of Defense.

State agencies that are affected by frequency management decisions are:

1. Administration.
2. Agriculture.
3. Conservation.
4. Fire.
5. Forestry.
6. Game and fish.
7. Police.
8. Transportation.

Units of city and county government that have requirements for frequency use are:

1. Fire.
2. Highways and streets.
3. Police.
4. Sanitary.
5. Water.

The part of the radio spectrum that is available for use by state and local governments is so highly congested (Fig. 2) that almost every request for the assignment of a new frequency must be carefully appraised, and all factors that might affect either the new or present users must be considered.

The importance of frequency management has been illustrated by the attention given to this area during recent years by the Office of the President and the numerous panels and committees that have been directed to review the problem (1, 2, 3, 4, 5, 6). Although these studies have looked at the total spectrum from local to international levels, their findings are useful to the Public Safety Radio Services.

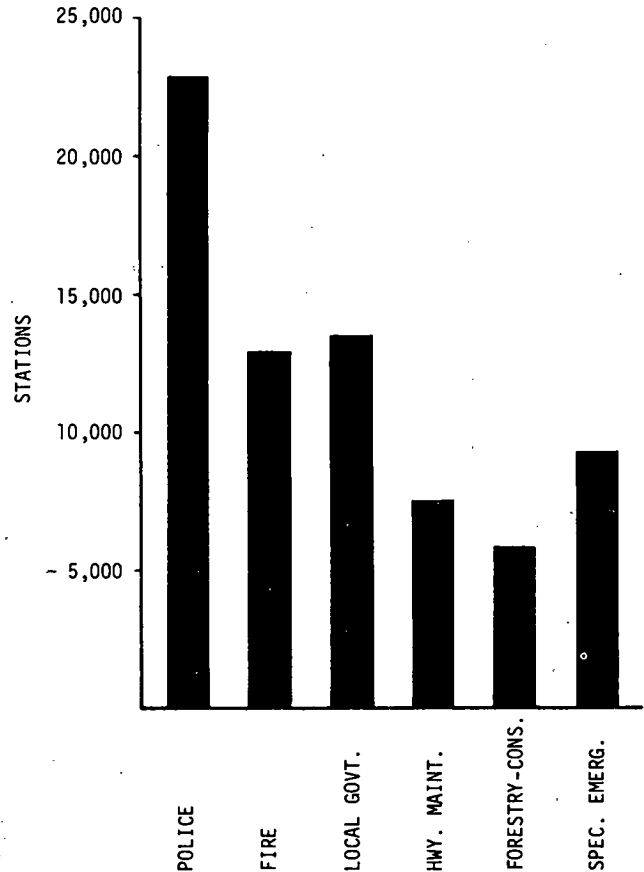


Figure 2. Radio station count (Public Safety Radio Services). Source: Communication News (Aug. 1971).

What is the role of the Highway Maintenance Radio Service coordinator in the management and assignment of radio frequencies? Simply stated, it is that the coordinator shares with other coordinators in the Public Safety Radio Services the responsibility for over-all good technical judgment in reviewing applications for assignment of radio frequencies to qualified users. It is stressed that the coordinator or coordinating group does not have the authority to approve applications. This authority is exercised by the FCC. However, coordinators can make suggestions to the applicant and are expected to make a recommendation to the FCC to approve, or disapprove, or suggest revisions.

CHAPTER TWO

FREQUENCY REGULATIONS AND MANAGEMENT

PUBLIC SAFETY RADIO SERVICES REGULATIONS

By authority of Title III of the Communications Act of 1934, the Federal Communications Commission regulates radio transmissions and issues licenses for the use of the Public Safety Radio Services. The increasing magnitude of the frequency assignment effort has been pointed out in FCC annual reports. In 1958, the spectrum was "congested"; in 1962, there was "extreme congestion"; and in 1964, "acute frequency shortage" was reported (3).

Specific guidance to the Public Safety Radio Services is provided in *FCC Rules and Regulations*, Vol. V, Part 89. Each frequency coordinator should become familiar with all subparts of Part 89. Although some of the information may not apply directly to frequency coordination, an understanding of Part 89 is essential for the frequency coordinator.

Frequency assignments are made by the FCC under one of the following provisions of §89.15:

§ 89.15 Frequency coordination procedures.

(a) Except for applications from States requesting frequencies in accordance with a geographical assignment plan, applications in the Special Emergency Radio Service, and applications requesting assignment of frequencies in the 27.23–27.28 MHz band or frequencies above 470 MHz, the following applications shall be accompanied by information required by either paragraph (b) or (c) of this section:

- (1) Requests for assignment of a new frequency; or
- (2) Requests to change existing facilities by increasing the authorized power input, or raising the authorized height of the antenna, or moving the authorized station location (including the antenna), or by adding a base station within the licensee's existing area of operation.

(b) A report, based on a field study, indicating the following:

(1) The degree of probable interference to existing stations operating on the same channel within 75 miles of the proposed station and a signed statement that all existing co-channel licensees within 75 miles of the proposed station have been notified of applicant's intention to file his application, and

(2) The degree of probable interference to existing stations located 10 to 35 miles from the proposed station operating on a frequency within 15 kHz and a signed statement that the licensees of all such stations have been notified of applicant's intention to file his application. In no instance will an application be granted where the proposed station is located less than 10 miles from an adjacent-channel station 15 kHz removed.

(c) A statement from a frequency advisory committee recommending the specific frequency which in the opinion of the committee will result in the least amount of interference to existing stations operating in the particular area or commenting upon the proposed changes in the station. The committee's recommendations may appro-

priately include comments on technical factors such as power, antenna height and gain, terrain, and other factors which may serve to mitigate any contemplated interference. The committee shall not recommend any adjacent-channel frequency (15 kHz removed) to existing stations which would result in a separation of less than 10 miles. The frequency advisory committee must be so organized that it is representative of all persons who are eligible for radio facilities in the service concerned in the area the committee purports to serve. The functions of such committees are purely advisory in character, and their recommendations cannot be considered as binding upon either the applicant or the Commission and must not contain statements which would imply that frequency advisory committees have any authority to grant or deny applications. Where the frequency or frequencies requested or assigned are within 15 kHz of a frequency which is available to another radio service, and is assignable only after coordination, the committee's statement shall affirmatively show that coordination with a similar committee for the other service has been accomplished.

[§ 89.15 (b) and (c) amended eff. 8-6-71; V(70)-4]

(d) In addition to the provisions of paragraph (a) of this section, in order to minimize possible harmful interference at the National Radio Astronomy Observatory site located at Green Bank, Pocahontas County, West Virginia, and at the Naval Radio Research Observatory site at Sugar Grove, Pendleton County, West Virginia, any applicant for a station authorization other than mobile, temporary base, or temporary fixed seeking a station license for a new station, a construction permit to construct a new station or to modify an existing station license in a manner which would change either the frequency, power, antenna height or directivity, or location of such a station within the area bounded by 39°15' N. on the north, 78°30' W. on the east, 37°30' N. on the south, and 80°30' W. on the west shall, at the time of filing such application with the Commission, simultaneously notify the Director, National Radio Astronomy Observatory, P. O. Box No. 2, Green Bank, West Virginia 24944, in writing, of the technical particulars of the proposed station. Such notification shall include the geographical coordinates of the antenna, antenna height, antenna directivity if any, proposed frequency, type of emission, and power. In addition, the applicant shall indicate in his application to the Commission the date notification was made to the Observatory. After receipt of such applications, the Commission will allow a period of 20 days for comments or objections in response to the notifications indicated. If an objection to the proposed operation is received during the 20-day period from the National Radio Astronomy Observatory for itself or on behalf of the Naval Radio Research Observatory, the Commission will consider all aspects of the problem and take whatever action is deemed appropriate.

Practice indicates that most assignments are made on the recommendation of a Frequency Advisory Committee. The geographic frequency assignments are given in Appendix C and Appendix D.

FREQUENCY MANAGEMENT

The selection and assignment of a specific radio frequency involves several factors. Foremost are the *FCC Rules and Regulations*. Also important are the current and future plans of management, technical considerations, and legal factors (Fig. 3).

Highway agencies should use or conserve allocated radio frequencies in the same manner as any other critical resource. Use of the frequencies presently assigned should be analyzed before additional frequencies are requested. Untimely use of allocated frequencies or careless frequency management often will result in administrative or operational problems and may involve unnecessary expenditures.

Legal guidance may be required in submittals to the FCC. Special requests, appeals, and answers to FCC *Reports and Orders* may also require legal assistance.

It is the technical considerations that most often confuse the highway administrator. Rarely does the administrator possess radio technical qualifications. Equipment type and manufacturer, antenna height and location, power requirements, and maintenance problems are a few of the areas where a knowledgeable electrical engineer with radio experience can prove invaluable to the highway administrator.

FREQUENCY CONSERVATION

Highway agencies often can improve the available radio service without an increase in the number of frequencies. One basic step is to use radio primarily for mobile communications. Radio between base stations, for other than the briefest messages, is not an efficient communication tool; telephone service should be used instead.

Other methods of improving radio service include:

1. Selective calling techniques.
2. Narrow voice channels.
3. Coded messages.
4. Frequency sharing.

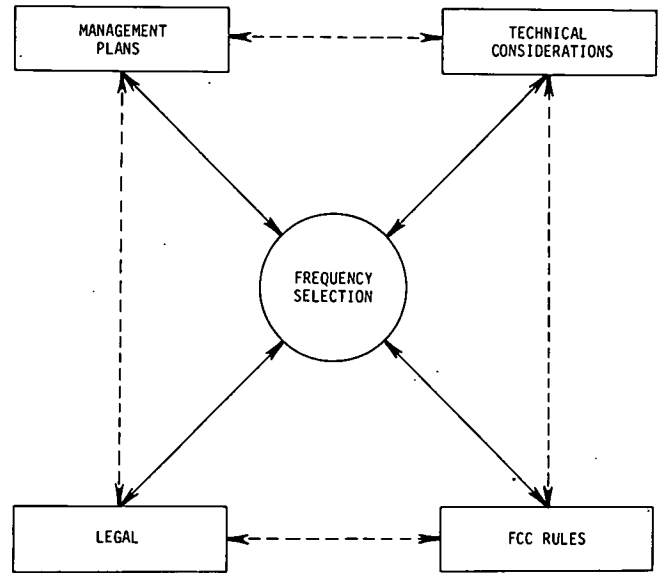


Figure 3. Participants in frequency management.

5. Duplex operation.
6. Control of antenna pattern.
7. Combined wire and radio.
8. Trunking of frequencies.
9. Multiplexing.
10. Operator training.
11. Improved management techniques.

A general discussion of measures to conserve frequencies is contained in the "Communication System Handbook for State Highway Departments" (7). There is no single system that can be standardized for use by all highway agencies. The needs of each agency should be analyzed by considering present and future requirements and on-hand communications equipment.

CHAPTER THREE

FREQUENCY COORDINATION

Frequency coordination is the process of reviewing a request for frequency assignment to ascertain the effect on other area radio users and to determine the level of service that should be available to the new user. General instructions for frequency coordination are included in Part 89, §89.15, of the *FCC Rules and Regulations*. These procedures mention that the coordinators or coordinating committee should consider distance, co-channel and ad-

jacent channel users, power, antenna height, and interference characteristics. Briefly stated, this is what the coordinator does when considering a request for frequency assignment. However, in practice much more is required.

Members (coordinators) of the Frequency Advisory Committee are selected by the public safety organization and recognized by the FCC. It is intended that the committee be representative of all persons or agencies that are

eligible for radio facilities in the service that the committee serves. The Public Safety Radio Services include the following:

1. Local Government Radio Service.
2. Police Radio Service.
3. Fire Radio Service.
4. Highway Maintenance Radio Service.
5. Forestry-Conservation Radio Service.
6. Special Emergency Radio Service.

Figures 4 and 5 show the current allocation of frequencies for these services.

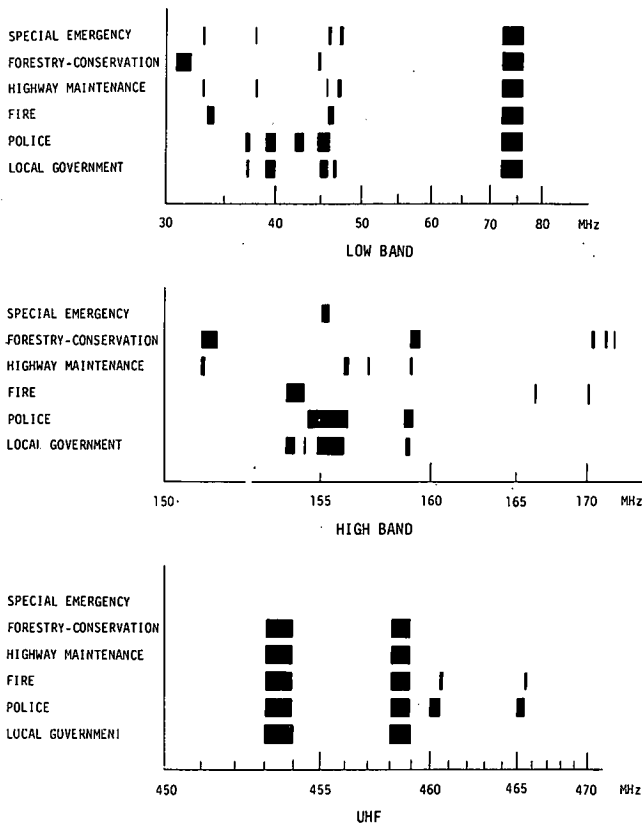


Figure 4. Frequency allocations.

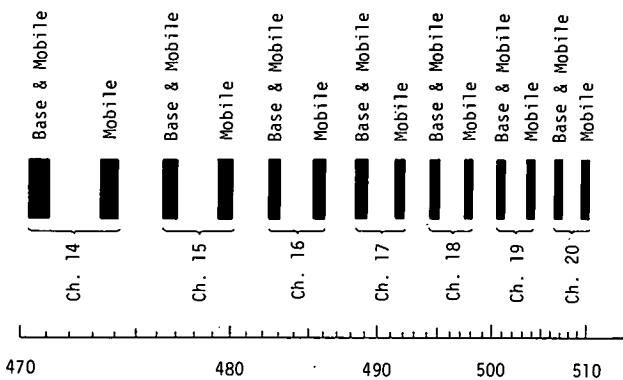


Figure 5. Frequency assignments for Public Safety Radio Service. Source: FCC Docket No. 18261.

The 1971 Frequency Advisory Committee for the Public Safety Radio Services is listed in Appendix B. Included are representatives from Highway Maintenance, Police, Fire, and Forestry-Conservation Radio Services. Names, addresses, and telephone numbers, where available, are given.

Selection and conservation of radio frequencies is a management function. Management is assisted in this effort by the telecommunications group and, when necessary, the legal staff. After a frequency or frequencies have been selected, requests for coordination are forwarded to a member of the appropriate Advisory Committee or the secretary of a local Associated Public-Safety Communications Officers (APCO) coordinating committee (Fig. 6). The coordination role is not clearly defined in Part 89 of the FCC Rules and Regulations; however, a recent manual by APCO provides detailed instructions and should prove useful to all coordinators (8). A copy of this manual should be obtained by each coordinator. Some general instructions prepared by one state are given in Appendix F.

The coordinator or the coordinating committee may make one or more of the following recommendations:

1. FCC approval.
2. FCC disapproval.
3. Alternate frequency.
4. Increase or decrease in output power.
5. Restricted broadcast pattern.
6. Other changes to improve service or reduce interference.

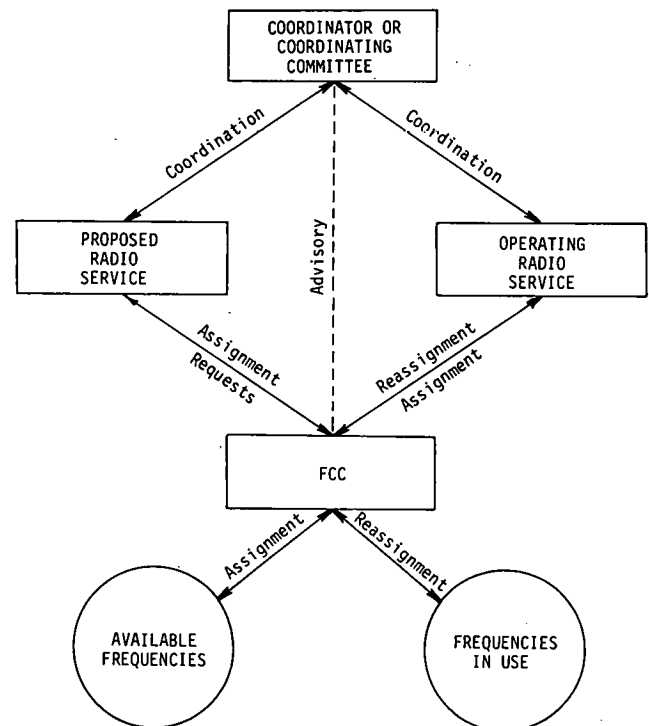


Figure 6. Frequency coordination and assignment.

It is stressed that only the FCC has the authority to assign frequencies and issue licenses.

What are the general qualifications for members of the Frequency Advisory Committee? Specific qualifications mentioned in the *APCO Manual* include:

1. Knowledge of local geography or terrain.
2. Engineering background in radio frequency power, antenna, etc.
3. Must be impartial.

Other factors that the coordinator should be familiar with are:

1. Agency telecommunications policy.
2. *FCC Rules and Regulations*.
3. Types and functions of radio equipment.
4. Propagation characteristics of Public Safety Radio frequencies.
5. Operating procedures.
6. Frequency utilization by area and radio service.

One problem that directly affects the frequency coordination effort is the difficulty some committee members experience in obtaining forms and maintaining records. Another problem is the absence of a budget for procurement of the technical publications that are essential. (At least one agency has a small budget for this purpose.) It appears that application forms are not always available to pass on to applicants. Some believe that Form PS4-A or a similar form should be reproduced and distributed by the FCC.

Some coordinators have, on retirement, termination, or transfer, taken with them all or most of the frequency assignment files and reference material that have been accumulated. Unfortunately, if this happens, the new coordinator will have considerable difficulty in reconstructing the files, because he cannot simply write to the FCC or some other agency for replacement documents. Much of the information is available only by a file search in the FCC office or through commercial data services (Appendix E) and fellow coordinators.

FCC REGIONAL SPECTRUM MANAGEMENT CENTER

The establishment of the Regional Spectrum Management Center in Chicago is perhaps the first step in a major revision of frequency coordination procedures. The purpose of this center is to provide new systems, techniques, and methodologies for more efficient management of the nongovernment portion of the radio spectrum, primarily the Land Mobile Radio Service. After July 1, 1972, new applications for base stations within the Chicago District (parts of Illinois, Indiana, Iowa, Michigan, Ohio, and Wisconsin) will comply with the new requirements as set out in *Docket No. 19150*. FCC Form 425 is used to make application for new frequency assignment. Figure 7 shows Graph 4B, "Power Output Related to 1 Watt." This information can simplify the calculations of the effective radiated power as required by Form 425.

It is safe to assume that additional centers will be estab-

lished if the Chicago Center meets expectations. This would eventually eliminate or severely curtail the coordinating committee participation.

COORDINATION PROCEDURE

By Individual Committee Members

One procedure for frequency coordination begins when an applicant sends a request to a member of the coordinating committee. The member reviews the request and assesses the impact of the proposed service in his area. He may contact other committee members for advice or approval. The applicant and the FCC are advised of the coordinator's action. A recommendation for approval by the coordinator does not imply approval by the FCC and does not give the applicant any authority to operate.

The foregoing procedure, although simple, can be time-consuming and in some cases ineffective. It may be particularly difficult if the other committee members who should be contacted are widely scattered. In Alabama, for example, the following coordinators could be involved:

1. The Highway Maintenance Radio Service Coordinator, located in Alabama.
2. The Fire Radio Service Coordinator, located in Greenville, S.C.
3. The Forestry-Conservation Radio Service Coordinator, located in Lufkin, Tex.
4. The Police Radio Service Coordinator, located in Tallahassee, Fla.

For these coordinators to act on a request for frequency coordination, they must use either mail or long-distance telephone communication. Neither may be completely satisfactory. This method of coordination could result in recommendations that are not in the best interests of the applicant or the other radio users.

By State Frequency Coordinating Committees

Some Public Safety Radio users have established practical and effective procedures for frequency coordination in individual states. The following procedures are used in Michigan by county highway departments.

County highway commissions in Michigan have been active users of radio communications since 1949. Almost 90 percent of the county highway commissions were using radios by 1959. To meet the problems of frequency assignment, their county association developed a "Frequency Coordination Plan," which was later coordinated with other plans and reviewed by the Office of Civil Defense. The plan provides that, after approval by the county association, requests are forwarded to the Secretary of the Michigan Public Safety Frequency Advisory Committee (Fig. 8).

The secretary of the Michigan Committee handles all correspondence and is instrumental in the coordination of the review process for all frequency requests. Members of the committee include representatives of the Association of Chiefs of Police, Michigan Sheriffs Association, State Police, Municipal League, Department of Natural Resources, and Department of State Highways.

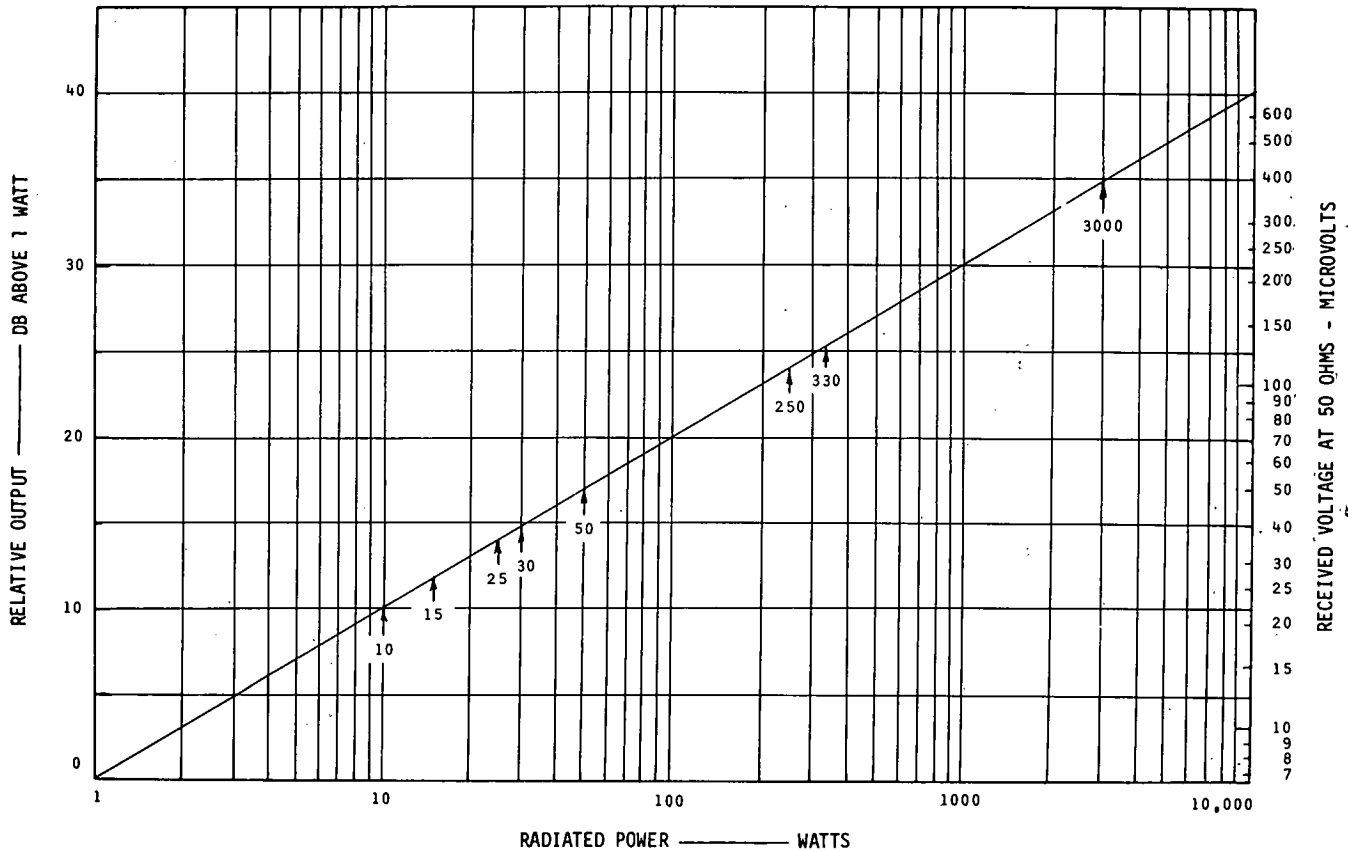


Figure 7. Graph 4B: Power output related to 1 watt.

In 1970, the Michigan Committee reviewed 274 applications for frequency consideration or changes in operating conditions or equipment. Fifty-five of these requests were submitted by adjoining states for concurrence. Of the 219 Michigan applications, approval was recommended for 96 in Police Service, 74 in Local Government, 11 in Highway Maintenance, and 26 in the Special Emergency Radio Service.

One practice followed by the Michigan Committee that might be considered by other coordinating groups is the

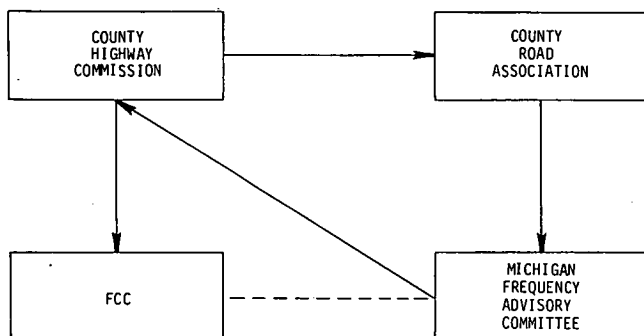


Figure 8. Frequency coordination for Michigan county highway departments.

scheduling of technical subcommittee meetings about one week prior to the main committee meeting. The subcommittee studies all of the technical considerations and is prepared to make a recommendation to the main committee. This spreads the work load and gives the committee the opportunity to review each request from a technical and management viewpoint.

COORDINATION STEPS

The practices of several coordination groups and individuals, discussion with the officials of the FCC, and the *APCO Manual* have been used to synthesize the following coordination steps.

Step 1—Request for Frequency Coordination

It is the applicant who is responsible for supplying all of the information for the planned radio service. Form PS4-A is suggested for recording this information (Fig. 9). (These forms should be stocked by each member of the coordinating committee.) The applicant can obtain technical data on his proposed installation from his equipment supplier. Highway agencies can assist with geographic information, such as position and elevation. Figure 10 shows the use of the 7.5-min U.S. Geological Survey topographic map to determine the position of the antenna tower.

PS4-A Request for Frequency Coordination

(FOR COORDINATOR'S USE ONLY)

FC NO. _____

Distribution Date to Coordinators _____

Date _____, 19____ RADIO SERVICE _____

Applicant _____ (Political Sub Division - City, County, State, etc.)

Mailing Address _____ City _____ County _____ State _____ Zip Code _____ Telephone No. _____

Station Location - Address and Land Mark _____ City _____ County _____ State _____

(See other side for Applicant instructions)

Land Station Frequency/ies	Emission	Use - (See Below)	Proposed Input Power	Antenna Gain - DB	Direction of Radiation	Antenna Ht. Above Ground (Ft.)	Ground Elev. at Ant. Site (Ft. above M.S.L.)	Area to be Covered - Sq. Mi.	Latitude	Longitude

Land Station Tone Frequency. CPS (if any)	Mobile Frequency/ies	Mobile Tone Frequency CPS (if any)	No. of Mobile Units

Enter proper initials in "Use" column as follows:

- FB Base
- FX Fixed
- FX1 Control
- FX2 Fixed Relay
- FX3 Repeater
- MO Mobile
- FB2 Mobile Relay
- LMO Land Mobile
- FXO Operational Fixed
- FBM Base and Mobile, stations licensed on the same frequency as base & mobile

- New Application
- Modification of License

(Call Letters) _____

Frequencies to be deleted: _____ mc. _____ mc.

Remarks: _____

NOTE: You are cautioned against the use of any frequency until authorization is received from the Federal Communications Commission.

Signature of Applicant _____

Title _____

Figure 9. Accepted form for requested frequency coordination.

Step 2—Receipt by Committee Member

The secretary for the local Frequency Advisory Committee or the individual member should carefully check the application for completeness and accuracy. The request should be entered into a ledger as shown in Figure 11.

Step 3—Acknowledgment

Advise the applicant of receipt of his request and, if possible, the date that it will be considered (Fig. 12).

Step 4—Logging

Enter the necessary information about each request in the agenda notice for the next scheduled committee meeting. If coordination with others is required, copies of Form PS4-A should be forwarded as soon as possible to permit their early review. A completed Form PS4-A (Fig. 13) should be returned to the responsible coordinator or the local committee.

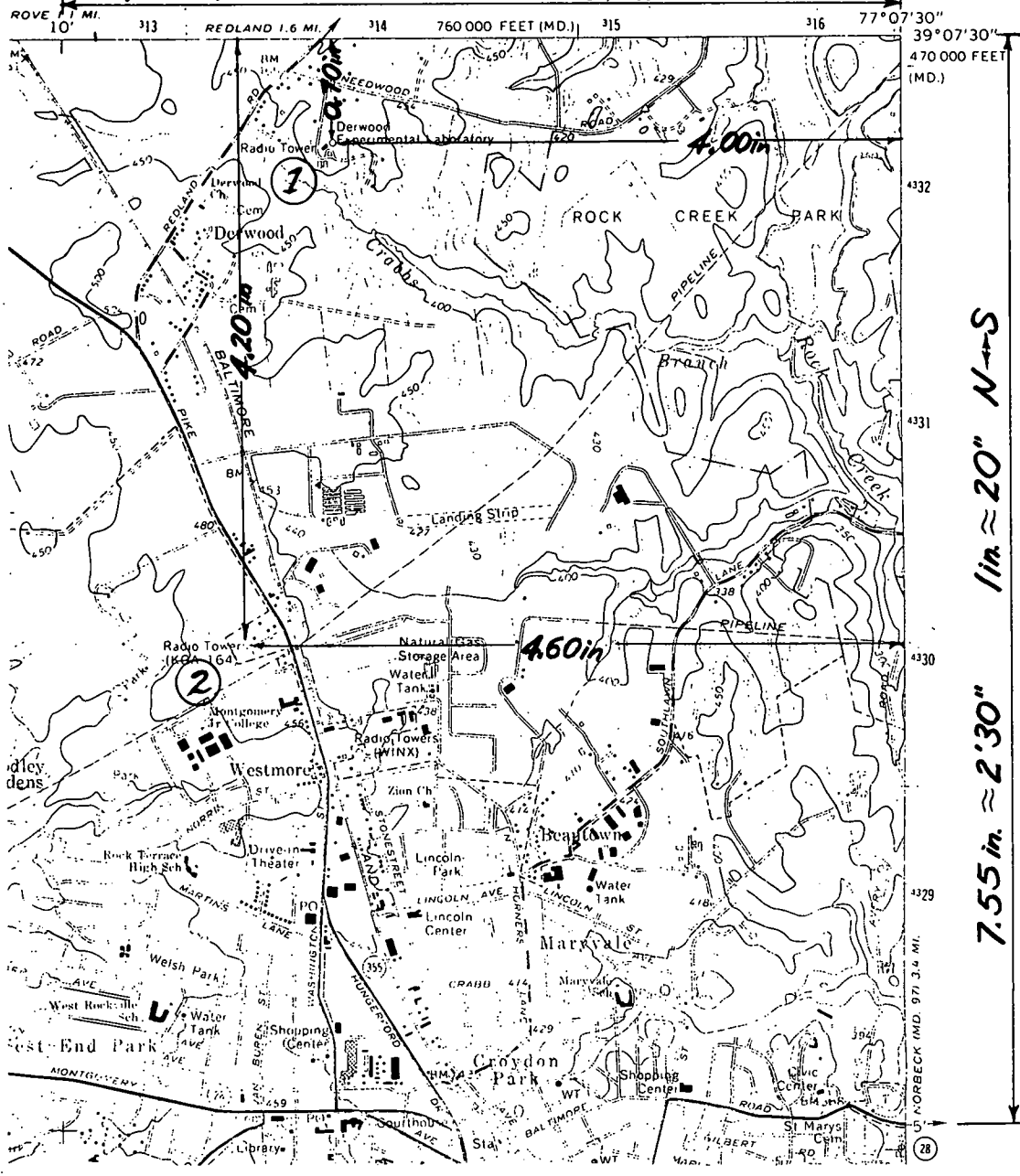
Step 5—Review

Review technical factors associated with the frequency request, equipment, and location. This is when the pro-

ROCKVILLE QUADRANGLE
 MARYLAND-VIRGINIA
 7.5 MINUTE SERIES (TOPOGRAPHIC)
 SW/4 ROCKVILLE 15' QUADRANGLE

5.9 in. \approx 2'30"
 1 in. \approx 25" E-W

5582 11 NE
 (SANDY SPRING)



TOWER ①

Latitude	Longitude
0.70 in \approx 14"	4.00 in \approx 100" = 1'40"
39°07'30"	77°07'30"
- 14"	+ 01'40"
N 39°07'16"	W 77°09'10"

TOWER ②

Latitude	Longitude
4.2 in \approx 84" = 1'24"	4.6 in \approx 115" = 1'55"
39°07'30"	77°07'30"
- 01'24"	+ 01'55"
N 39°06'06"	W 77°09'25"

Figure 10. Procedure for determining coordinates of antenna site.

YEAR 1970

Request Number	Agency	Frequency Requested	Radio Service	Request Received	Action	License Issued	Remarks
70-1	City of Los Angeles	460.4 465.4	Police	4-10-70	5-4-70	8-15-70	2 New
70-2	San Bernardino, County of	156.060	Police	4-17-70	5-4-70	7-11-70	1 Mod
70-3	Yuma Municipal Water Dist.	155.145	Local Gvt.	4-22-70	6-4-70	9-10-70	1 New
70-4							

Figure 11. Example of request ledger. After APCO Manual.

posed system is checked against the applicant's requirements and the effect on other systems. Specific factors to be reviewed are:

1. Power:
 - Applicant's requirements.
 - Effect on others.
 - Range of mobile units.
2. Location:
 - With respect to operating area.
 - Noise levels.
3. Adjacent channels:
 - Power.
 - Distance.
4. Co-channels:
 - Power.
 - Distance.
 - Use.
5. Service:
 - Number of base stations and mobile units.

The Advisory Committee may recommend that an actual field test be conducted. Special temporary authority can

be obtained from the FCC to determine the operating characteristics of the system and the effect on others.

Step 6—Recommendations

The Advisory Committee recommendations are noted on Form PS4-B, which is transmitted to the applicant together with a letter requesting that the committee be advised of FCC action (Figs. 14 and 15).

Step 7—Recording

On notification that the FCC has assigned a frequency for the applicant's use, the secretary posts this information in the appropriate files.

Coordination from Adjoining States

Request for coordination from adjoining states should be considered as soon as possible. In some cases this can be done by telephone calls or correspondence to enable the adjoining committee to give early consideration to the application.

CHAPTER NAME
FREQUENCY ADVISORY COMMITTEE

Dear Sir:

Your request for frequency coordination for _____ MHz has been received.

It is expected that your request will be on the agenda for the next meeting of this Committee to be held at _____ on _____ 19__ at _____

Many times questions concerning these requests arise, which, if they can be answered at the time, will expedite your request. It is suggested that you have a representative present if possible.

If your request was in the Local Government Service there may be about 2 weeks before your recommendation can be forwarded as the approval of other agencies is necessary.

REQUEST NO. _____ Chairman

Figure 12. Acknowledgment card. Source: APCO.

Request for Frequency Coordination

_____ RADIO SERVICE

Applicant				
(Political Sub Division — City, County, State, etc.)				
Mailing Address	City	County	State	Zip Code
Telephone No.				

FREQUENCY	APPROVED	DISAPPROVED	REMARKS

Signature	Area Coordinator
Organization F.A.C.	Date

Figure 13. Form for secondary coordination.

RECORDS

A complete, accurate, and up-to-date set of data, applications, and actions is essential for the coordinator. In some instances, these may be maintained partially or completely by each committee member, or a complete record system may be maintained by a secretary to a state committee. In either case, steps should be taken to ensure proper maintenance. The following requirements are considered to be the minimum:

1. List of all frequencies allocated to the Highway Maintenance Radio Service.
2. List of all co-channel and adjacent channel frequencies requiring coordination.
3. List of base stations in other states that are within 75 miles (120 km).
4. Application ledger or file.
5. Recommendation or action file.
6. List of assigned frequencies to such Public Safety Radio Services.

PS4-B Federal Communications Commission
 Washington, D.C. 20554
 Gentlemen:

This committee, after careful study and consideration of the probable interference conditions in this area, respectfully requests that the frequency or frequencies requested in this application be given favorable consideration by the Commission with the following comments or exceptions:

This frequency recommendation is purely advisory and is in accordance with section 89.15 (C) of Part 89 of the rules and regulations of the Federal Communications Commission. This recommendation will be void after 60 days if the applicant has not filed with the Federal Communications Commission for authorization and license.

WHEN APPLICABLE ACTION BY:	Approved	Disapproved	INSTRUCTIONS TO COORDINATOR Fill in appropriate blank, sign and return one copy to: _____ <div style="text-align: right; margin-right: 50px;">Coordinator</div>	
APCO Frequency Coordinator	<input type="checkbox"/>	<input type="checkbox"/>		
AASHO Frequency Coordinator	<input type="checkbox"/>	<input type="checkbox"/>		
ESPRL Frequency Coordinator	<input type="checkbox"/>	<input type="checkbox"/>		
FCCA Frequency Coordinator	<input type="checkbox"/>	<input type="checkbox"/>		
IMSA Frequency Coordinator	<input type="checkbox"/>	<input type="checkbox"/>		
NO OTHER AGENCY COORDINATION REQUIRED	<input type="checkbox"/>		Signature	Area Coordinator
			Organization F.A.C.	Date

Figure 14. Frequency recommendation form.

CHAPTER LETTERHEAD OR OTHER
APPROPRIATE HEADING

MEMORANDUM FOR THE APPLICANT:

Attached is the frequency recommendation of this Committee in accordance with your request. The original should be filed with your FCC Form 400 application to the Federal Communications Commission.

Enclosed is a stamped and addressed post card requesting information from the FCC. It is very important that our Committee be supplied with the information from the FCC document. This will inform the Committee that you are actually using the frequency, and future assignments to other applicants will be made bearing this factor in mind so as to cause a minimum of interference to your operation.

If we do not receive this card or another communication from you within six months from the date of the frequency recommendation, the Committee can only assume that the recommendation has expired and that you do not intend to make use of the frequencies recommended. The Committee, therefore, will place the frequencies in line for consideration with other applicants.

Your cooperation in this matter will be appreciated.

Yours very truly,

Figure 15. Suggested memorandum of transmittal of recommendation. Source: APCO.

7. Docket file (affecting Part 89 of the *FCC Rules and Regulations*).

Some coordinators may wish to plot antenna tower locations and transmitting radius on topographic maps or on state or regional maps. Appendix G may be helpful in determining transmitting radius.

RECOMMENDATIONS AND CONCLUSIONS

There is a wide range of practice in the coordination efforts of the Public Radio Services. Although present coordination efforts are largely successful, there is some need for general guidance and specific instruction for the newly appointed coordinator. There are several reports of little or no information being available from a predecessor, from the state, or from the FCC.

It is recommended that:

1. Each highway agency establish a reasonable budget (\$500) for the use of the Highway Maintenance Radio Service Frequency Advisory Committee member. This should include funds for office supplies, long-distance telephone calls, reproduction costs, and the purchase of publications required to adequately support coordination efforts.

2. A single office be established in each state, with secretary if necessary, to maintain a complete file of coordination data and records.

3. Standard forms be provided by the FCC to be used for requests for frequency coordination. This could also include the miscellaneous forms used to correspond with the applicant and the FCC.

4. Each of the Public Safety Radio Services have a coordinator located in each state.

The present policy of the FCC of using the support of the various Public Safety Radio Services in reviewing frequency requests is satisfactory and should be continued.

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APPENDIX A

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APPENDIX B

FREQUENCY ADVISORY COMMITTEE *

HIGHWAY MAINTENANCE RADIO SERVICE	POLICE RADIO SERVICE	FIRE RADIO SERVICE	FORESTRY-CONSERVATION RADIO SERVICE
ALABAMA			
James E. Caldwell State Highway Department 3702 Fairground Road Montgomery, Ala. 36104 Phone: (205) 269-7719	Earl O. Burchard Florida Highway Patrol Neil Kirkman Bldg. Tallahassee, Fla. 32301 Phone: (305) 877-4151	Sgt. P. D. Macky 22 W. Broad Street Greenville, S. C. 29601	Travis Flournoy Chairman, Region II, FCCA Texas Forest Service P. O. Box 310 Lufkin, Tex. 78901
ALASKA			
Charles L. Buck Rt. 1, Box 1382 Juneau, Alaska 99801 Phone: (907) 586-5333	Charles L. Buck, Director Division of Communications Department of Public Works Pouch Z Juneau, Alaska 99801 Phone: (907) 586-5333		William F. Sanders Chairman, Region IV, FCCA Oregon Dept. of Forestry 2600 State Street P. O. Box 2289 Salem, Ore. 97310
ARIZONA			
Bernard H. Flood Chief Communications Engineer Arizona Dept. of Public Safety P. O. Box 6638 Phoenix, Ariz. 85005 Phone: (602) 262-8011	Neal Kahler Quality Control Engineer Arizona Highway Patrol 2010 West Encanto Phoenix, Ariz. 85009	Rae A. Echols Fire Communications Supt. City of Phoenix 313 N. 9th Street Phoenix, Ariz. 85006 Phone: (602) 262-6741	William F. Sanders Chairman, Region IV, FCCA Oregon Dept. of Forestry 2600 State Street P. O. Box 2289 Salem, Ore. 97310
ARKANSAS			
Clarence D. Page Arkansas State Highway Dept. P. O. Box 2261 Little Rock, Ark. 72203 Phone: (501) 569-2460	Preston Todd Radio Engineer Arkansas State Police Little Rock, Ark. 72201	C. L. Wilford Communications Supervisor Houston Fire Department 410 Bagby Houston, Tex. 77002	Travis Flournoy Chairman, Region II, FCCA Texas Forest Service P. O. Box 310 Lufkin, Tex. 78901
CALIFORNIA			
Rolind E. Mahan Department of Public Works Division of Highways P. O. Box 1499 Sacramento, Calif. 95807 Phone: (916) 445-6052	<i>(Northern)</i> Art McDole Communications Director Monterey County Comm. Dept. P. O. Box 1883 Salinas, Calif. 93901 Phone: (408) 424-7329 <i>(Southern)</i> Vaughn Parry Route 4 P. O. Box 405-T Escondido, Calif. 92025	<i>(Northern)</i> John H. Atkinson Communications Director Marin County Room L-2, Civic Center San Rafael, Calif. 94903 Phone: (415) 472-2411 <i>(Central)</i> William E. Whiting Director of Communications Kern County P. O. Box 643 Bakersfield, Calif. 93302 Phone: (805) 323-1788 <i>(Southern)</i> Max S. Elliott Chief Radio Engineer Orange County 481 S. Manchester Avenue Orange, Calif. 92668 Phone: (714) 834-2122	William F. Sanders Chairman, Region IV, FCCA Oregon Dept. of Forestry 2600 State Street P. O. Box 2289 Salem, Ore. 97310
COLORADO			
Darrell G. Vail 4201 E. Arkansas Avenue Denver, Colo. 80222 Phone: (303) 757-9242	A. J. Anderson Asst. Communications Engr. Colorado State Patrol 4201 E. Arkansas Ave. Denver, Colo. 80222	Max S. Elliott Chief Radio Engineer Orange County 481 S. Manchester Avenue Orange, Calif. 92668 Phone: (714) 834-2122	William F. Sanders Chairman, Region IV, FCCA Oregon Dept. of Forestry 2600 State Street P. O. Box 2289 Salem, Ore. 97310

Source: "Directory of Field Contacts for the Coordination of the Use of Radio Frequencies." FCC, Office of Telecommunications Policy (July 1, 1971).

HIGHWAY MAINTENANCE RADIO SERVICE	POLICE RADIO SERVICE	FIRE RADIO SERVICE	FORESTRY-CONSERVATION RADIO SERVICE
CONNECTICUT			
H. A. Kerr Electrical Division Chief Connecticut Dept. of Trans. Bureau of Highways P. O. Drawer A Wethersfield, Conn. 06109 Phone: (203) 566-2082	Clifford Fraser Connecticut State Police 100 Washington Street Hartford, Conn. 06115	Robert Callahan Box 175 Keene, N. H. 03431 Phone: (603) 352-1291	William F. Vanidestine Chairman, Region I, FCCA Division of Protection Pa. Dept. of Forests & Waters Harrisburg, Pa. 17101
DELAWARE			
Major George J. Bundek State Communications Division P. O. Box 462 Dover, Del. 19901 Phone: (302) 734-5973	Captain Marshall Dull Wilmington Communication Bureau 1208 N. E. Blvd. Wilmington, Del. 19802	Frank O. Schierff Supt., Communications 630 City Hall Philadelphia, Pa. 19107 Phone: (215) 686-4503	William F. Vanidestine Chairman, Region I, FCCA Division of Protection Pa. Dept. of Forests & Waters Harrisburg, Pa. 17101
DISTRICT OF COLUMBIA			
John E. Hartley Assistant Director Dept. of Highways & Traffic 415 12th Street N.W., Rm. 502 Washington, D. C. 20004 Phone: (202) 629-4715	Captain W. C. McVey Communications Officer Maryland State Police Jessup, Md. 20794 Phone: (301) 776-6711	Andrew S. Adams Communications Engineer 10600 Page Avenue Fairfax, Va. 22030 Phone: (703) 273-1300	
FLORIDA			
Robert W. Grafe Dept. of Transportation Haydon Burns Building Tallahassee, Fla. 32304 Phone: (904) 599-6375	Earl O. Burchard Florida Highway Patrol Neil Kirkman Bldg. Tallahassee, Fla. 32301 Phone: (305) 877-4151	Sgt. P. D. Macky 22 W. Broad Street Greenville, S. C. 29601	Travis Flournoy Chairman, Region II, FCCA Texas Forest Service P. O. Box 310 Lufkin, Tex. 78901
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HIGHWAY MAINTENANCE RADIO SERVICE	POLICE RADIO SERVICE	FIRE RADIO SERVICE	FORESTRY-CONSERVATION RADIO SERVICE
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KANSAS			
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Philip M. Young Maine State Highway Commission State House Augusta, Maine 04330 Phone: (207) 289-3427	Sgt. Leroy Hunter 154 Berkeley Street Boston, Mass. 02108	Robert Callahan Box 175 Keene, N. H. 03431 Phone: (603) 352-1291	William F. Vanidestine Chairman, Region I, FCCA Division of Protection Pa. Dept. of Forests & Waters Harrisburg, Pa. 17101
MARYLAND			
A. F. Yurek, Chief Bureau of Communications Maryland Dept. of Trans. 300 West Preston Street P. O. Box 717 Baltimore, Md. 21203 Phone: (301) 383-3013 Ext. 770	Captain W. C. McVey Communications Officer Maryland State Police Jessup, Md. 20794 Phone: (301) 776-6711	Andrew S. Adams Communications Engineer 10600 Page Avenue Fairfax, Va. 22030 Phone: (703) 273-1300	William F. Vanidestine Chairman, Region I, FCCA Division of Protection Pa. Dept. of Forests & Waters Harrisburg, Pa. 17101

HIGHWAY MAINTENANCE RADIO SERVICE	POLICE RADIO SERVICE	FIRE RADIO SERVICE	FORESTRY-CONSERVATION RADIO SERVICE
MASSACHUSETTS			
Robert F. Pyne, Dy. Ch. Engr. Highway Maintenance Mass. Dept. of Public Works 100 Nashua Street Boston, Mass. 02114 Phone: (617) 727-5000	Sgt. Leroy Hunter 154 Berkeley Street Boston, Mass. 02108	Robert Callahan Box 175 Keene, N. H. 03431 Phone: (603) 352-1291	William F. Vanidestine Chairman, Region I, FCCA Division of Protection Pa. Dept. of Forests & Waters Harrisburg, Pa. 17101
MICHIGAN			
Willis M. Green, Manager Communications Section Mich. Dept. of State Highways P. O. Drawer K Lansing, Mich. 48904 Phone: (517) 373-2367	Staff Sgt. Kenneth O. Winberg Operations & Communication Div. Department of State Police 714 South Harrison Road East Lansing, Mich. 48823	Edwin C. Denstaedt Chairman, Technical Comm. Michigan Pub. Safety Freq. Allocation Committee 5926 Whittier Detroit, Mich. 48224 Phone: (313) 885-7361	Harold J. McGinnis Chairman, Region III, FCCA Wisconsin Dept. of Natural Resources Forest Protection Headquarters Tomahawk, Wisc. 54487
MINNESOTA			
Arthur D. Lane, Chief Electronic Communications Minnesota Dept. of Highways Rm. G-18, State Hwy. Bldg. St. Paul, Minn. 55101 Phone: (612) 221-6465	Arthur D. Lane Minnesota Highway Patrol Rm. 312, State Hwy. Bldg. St. Paul, Minn. 55101 Phone: (612) 221-3138	Edwin L. Heath Supt. of Communications Minneapolis Fire Department Room 5, City Hall Minneapolis, Minn. 55415 Phone: (612) 330-2715	Harold J. McGinnis Chairman, Region III, FCCA Wisconsin Dept. of Natural Resources Forest Protection Headquarters Tomahawk, Wisc. 54487
MISSISSIPPI			
Wayne M. Layman Equipment Manager Miss. State Highway Dept. P. O. Box 1850 Jackson, Miss. 39205 Phone: (601) 354-6207	Francis G. Gill Radio Technician 1900 Woodrow Wilson Avenue Jackson, Miss. 39205 Phone: (601) 982-1212	Sgt. P. D. Macky 22 West Broad Street Greenville, S. C. 29601	Travis Flournoy Chairman, Region II, FCCA Texas Forest Service P. O. Box 310 Lufkin, Tex. 78901
MISSOURI			
W. H. Dill Asst. to the Chief Engineer Missouri State Highway Comm. State Highway Building Jefferson City, Mo. 65101 Phone: (314) 636-3121	Harry W. Duncan Director of Radio Division Missouri State Highway Comm. State Highway Building Jefferson City, Mo. 65101 Phone: (314) 636-7141	Glenn Smith, Director North Central Fire Alarm 8847 St. Charles Rock Road Overland, Mo. 63114 Phone: (815) 247-3400	Harold J. McGinnis Chairman, Region III, FCCA Wisconsin Dept. of Natural Resources Forest Protection Headquarters Tomahawk, Wisc. 54487
MONTANA			
Eugene F. Pfeiffer Communications Engineer Mont. State Highway Commission 6th Avenue & Roberts Helena, Mont. 59601 Phone: (406) 449-2605	Richard D. Harbaur Assoc. Prof. of Elec. Eng. Electrical Engineering Dept. Washington State University Pullman, Wash. 99163 Phone: (509) 335-4950	Temple V. Ehmsen Bureau of Communications 419 S. W. Market Street Portland, Ore. 97201 Phone: (503) 227-3941	William F. Sanders Chairman, Region IV, FCCA Oregon Dept. of Forestry 2600 State Street P. O. Box 2289 Salem, Ore. 97310
NEBRASKA			
D. G. Drda Nebraska Dept. of Roads So. Jct. US-77 and N-2 Box 94759 Lincoln, Nebraska 68509 Phone: (402) 473-4543	Captain Leonard V. Montgomery Communications Supervisor Police Radio Building 2000 Gentry Drive Wichita, Kans. 67208 Phone: (316) 262-2611 Ext. 227	George E. Winkler Chief of Communications City of Omaha 101 South 11th Street Omaha, Nebraska 68102 Phone: (402) 342-2345	Harold J. McGinnis Chairman, Region III, FCCA Wisconsin Dept. of Natural Resources Forest Protection Headquarters Tomahawk, Wisc. 54487
NEVADA			
Daniel M. Harvey Communications Specialist Nevada Dept. of Highways 1263 South Stewart Street Carson City, Nev. 89701 Phone: (702) 882-7782	Captain Arthur Sowle Police Department P. O. Box 1900 Reno, Nev. 89502 Phone: (702) 323-4141	Max S. Elliott Chief Radio Engineer Orange County 481 S. Manchester Avenue Orange, Calif. 92668 Phone: (714) 834-2122	William F. Sanders Chairman, Region IV, FCCA Oregon Dept. of Forestry 2600 State Street P. O. Box 2289 Salem, Ore. 97310

HIGHWAY MAINTENANCE RADIO SERVICE	POLICE RADIO SERVICE	FIRE RADIO SERVICE	FORESTRY-CONSERVATION RADIO SERVICE
NEW HAMPSHIRE			
Howard N. Smith Assistant Division Engineer Maintenance Division Five Dept. of Public Works & Hwys. P. O. Box 194 Hooksett, N. H. 03106 Phone: (603) 485-9526, 485-3851	Sgt. Leroy Hunter 154 Berkeley Street Boston, Mass. 02108	Robert Callahan Box 175 Keene, N. H. 03431 Phone: (603) 352-1291	William F. Vanidestine Chairman, Region I, FCCA Division of Protection Pa. Dept. of Forests & Waters Harrisburg, Pa. 17101
NEW JERSEY			
John H. Fairchild New Jersey Department of Transportation 1035 Parkway Avenue Trenton, N. J. 08625 Phone: (609) 292-7707	Sgt. Edward Doran Communications Bureau New Jersey State Police P. O. Box 68 West Trenton, N. J. 08625 Phone: (609) 882-2000 Ext. 230	George Baumann 476 German Town Road W. Milford Twp. R.D. 3 Butler, N. J. 07405	William F. Vanidestine Chairman, Region I, FCCA Division of Protection Pa. Dept. of Forests & Waters Harrisburg, Pa. 17101
NEW MEXICO			
Raymond E. Howell Administrative Director New Mexico State Hwy. Comm. P. O. Box 1149 Santa Fe, N. M. 87501 Phone: (505) 983-7381 Ext. 231	William C. Dwire Supervising Radio Technician Dept. of Radio Communications State of New Mexico 218 Montezuma Avenue Santa Fe, N. M. 87501 Phone: (505) 827-2904	William C. Dwire Supervising Radio Technician Dept. of Radio Communications State of New Mexico 218 Montezuma Avenue Santa Fe, N. M. 87501 Phone: (505) 827-2904	William F. Sanders Chairman, Region IV, FCCA Oregon Dept. of Forestry 2600 State Street P. O. Box 2289 Salem, Ore. 97310
NEW YORK			
Raymond G. Durrin Radio Engineer N. Y. Dept. of Transportation Building 5, State Campus Albany, N. Y. 12226 Phone: (518) 457-2123	(South of City of Kingston) Insp. Frederick C. Johannsen Commanding Officer Communications Bureau Suffolk County Police Dept. Hauppauge, N. Y. 11787 (North of City of Kingston) Richard L. Schoenberger 107 Cobbs Hill Drive Rochester, N. Y. 14610	Wilfred L. Parsons Department of Fire County Courthouse Cortland, N. Y. 13045 Phone: (607) 753-3116	William F. Vanidestine Chairman, Region I, FCCA Division of Protection Pa. Dept. of Forests & Waters Harrisburg, Pa. 17101
NORTH CAROLINA			
Harry G. Long Asst. State Equipment Engineer State Highway Commission Raleigh, N. C. 27611 Phone: (919) 829-7132	W. B. Sloop 1300 Blue Ridge Boulevard Raleigh, N. C. 27607	Buren Parks Traffic Department City Hall Durham, N. C. 27701	Travis Flournoy Chairman, Region II, FCCA Texas Forest Service P. O. Box 310 Lufkin, Tex. 78901
NORTH DAKOTA			
Brandt V. Hjelle, Chief Reports & Special Studies State Highway Department Capitol Grounds Bismarck, N. D. 58501 Phone: (701) 224-2560	Paul Carufel, Director Radio Communications Dept. State Capitol Bismarck, N. D. 58501	Max S. Elliott Chief Radio Engineer Orange County 481 S. Manchester Avenue Orange, Calif. 92668 Phone: (714) 834-2122	Harold J. McGinnis Chairman, Region III, FCCA Wisconsin Dept. of Natural Resources Forest Protection Headquarters Tomahawk, Wisc. 54487
OHIO			
John T. Corrodi Bureau of Operational Services Ohio Dept. of Highways 1620 West Broad Street Columbus, Ohio 43223 Phone: (614) 469-4920	Charles Johnston Chief Radio Engineer Ohio Highway Patrol Box 7037, Sta. E. Columbus, Ohio 43205 Phone: (614) 469-2898	Lawrence J. Hradek 2203 West Sprague Road Cleveland, Ohio 44141 Phone: (216) 842-1472	Harold J. McGinnis Chairman, Region III, FCCA Wisconsin Dept. of Natural Resources Forest Protection Headquarters Tomahawk, Wisc. 54487

HIGHWAY MAINTENANCE RADIO SERVICE	POLICE RADIO SERVICE	FIRE RADIO SERVICE	FORESTRY-CONSERVATION RADIO SERVICE
OKLAHOMA			
<p>Frank W. Howard Administrative Assistant Oklahoma Dept. of Highways Room 487, Jim Thorpe Building Oklahoma City, Okla. 73105 Phone: (405) 521-2674</p>	<p>Kenneth E. Fields Chief Radio Officer Okla. Dept. of Public Safety Box 11415 Oklahoma City, Okla. 73111 Phone: (405) 427-3383</p>	<p>John Burns Superintendent of Fire Alarm Oklahoma Cith Fire Dept. 400 West California Oklahoma City, Okla. 73102</p>	<p>Travis Flournoy Chairman, Region II, FCCA Texas Forest Service P. O. Box 310 Lufkin, Tex. 78901</p>
OREGON			
<p>Robert N. Bothman Maintenance Engineer Oregon Dept. of Transportation Room 138, Highway Building Salem, Ore. 97310 Phone: (503) 378-6528</p>	<p><i>(East of 120°)</i> Richard D. Harbour Assoc. Prof. of Elec. Eng. Electrical Engineering Dept. Washington State University Pullman, Wash. 99163 Phone: (509) 335-4950</p> <p><i>(West of 120°)</i> Charles Arthur Cameron Communications Engineer 419 S. W. Market Street Portland, Ore. 97201 Phone: (503) 227-3941</p>	<p>Temple V. Ehmsen Bureau of Communications 419 S. W. Market Street Portland, Ore. 97201 Phone: (503) 227-3941</p>	<p>William F. Sanders Chairman, Region IV, FCCA Oregon Dept. of Forestry 2600 State Street P. O. Box 2289 Salem, Ore. 97310</p>
PENNSYLVANIA			
<p>J. W. Flory Bureau of Maintenance Pennsylvania Dept. of Trans. Highway and Safety Bldg. Commonwealth & Forster Streets Harrisburg, Pa. 17120 Phone: (717) 787-3090</p>	<p>Robert I. Kimmel Communications Division Pennsylvania State Police P. O. Box 2771 Harrisburg, Pa. 17120</p>	<p><i>(East of Susquehanna River)</i> Frank O. Schierff Supt., Communications 630 City Hall Philadelphia, Pa. 19107 Phone: (215) 686-4503</p> <p><i>(West of Susquehanna River)</i> Lawrence J. Hradek 2203 West Sprague Road Cleveland, Ohio 44141 Phone: (216) 842-1472</p>	<p>William F. Vanidestine Chairman, Region I, FCCA Division of Protection Pa. Dept. of Forests & Waters Harrisburg, Pa. 17101</p>
RHODE ISLAND			
<p>Ronald E. DelVecchio Contracts & Specifications Rhode Island Dept. of Trans. Room 225, State Office Bldg. Providence, R. I. 02903 Phone: (401) 277-2434</p>	<p>Sgt. Leroy Hunter 154 Berkeley Street Boston, Mass. 02108</p>	<p>Robert Callahan Box 175 Keene, N. H. 03431 Phone: (603) 352-1291</p>	<p>William F. Vanidestine Chairman, Region I, FCCA Division of Protection Pa. Dept. of Forests & Waters Harrisburg, Pa. 17101</p>
SOUTH CAROLINA			
<p>T. H. Hewitt Supply & Equipment Engineer South Carolina State Highway Department P. O. Drawer 191 Columbia, S. C. 29202 Phone: (803) 758-2721</p>	<p>Ray Harvey Radio Engineer South Carolina State Highway Department P. O. Drawer 191 Columbia, S. C. 29202 Phone: (803) 758-2473</p>	<p>Sgt. P. D. Macky 22 West Broad Street Greenville, S. C. 29601</p>	<p>Travis Flournoy Chairman, Region II, FCCA Texas Forest Service P. O. Box 310 Lufkin, Tex. 78901</p>
SOUTH DAKOTA			
<p>Ray Stepanek Chief Engineer State Radio Communications State Capitol Building Pierre, S. D. 57501 Phone: (605) 224-4212</p>	<p>Ray Stepanek Chief Engineer State Radio Communications State Capitol Building Pierre, S. D. 57501 Phone: (605) 224-8141</p>	<p>Max S. Elliott Chief Radio Engineer Orange County 481 S. Manchester Avenue Orange, Calif. 92668 Phone: (714) 834-2122</p>	<p>William F. Sanders Chairman, Region IV, FCCA Oregon Dept. of Forestry 2600 State Street P. O. Box 2289 Salem, Ore. 97310</p>

HIGHWAY MAINTENANCE RADIO SERVICE	POLICE RADIO SERVICE	FIRE RADIO SERVICE	FORESTRY-CONSERVATION RADIO SERVICE
TENNESSEE			
Gerald D. Cabe Maintenance Engineer Tennessee Dept. of Highways 603 Highway Building Nashville, Tenn. 37219 Phone: (615) 741-3366	Captain P. E. Griffith Dept. of Public Safety Cordell Hull Building Nashville, Tenn. 37214	Sgt. P. D. Macky 22 West Broad Street Greenville, S. C. 29601	Travis Flournoy Chairman, Region II, FCCA Texas Forest Service P. O. Box 310 Lufkin, Tex. 78901
TEXAS			
Archie J. Sherrod Chief Engineer of Maintenance Operations Maintenance Operations Div. Texas Highway Department Austin, Tex. 78701 Phone: (512) 475-3588	Ralph S. Wilson, Jr. Dept. of Communications Services City of Dallas 3920 Forest Avenue-Fair Park Dallas, Tex. 75226 Phone: (214) 823-6101	C. L. Wilford Communications Supervisor Houston Fire Department 410 Bagby Houston, Tex. 77002	Travis Flournoy Chairman, Region II, FCCA Texas Forest Service P. O. Box 310 Lufkin, Tex. 78901
UTAH			
Craig M. Jorgensen Communications Supervisor Utah State Dept. of Highways Room 617, State Office Bldg. Salt Lake City, Utah 84114 Phone: (801) 328-5555	Robert Marz 569 - 43rd Street South Ogden, Utah 84403 Phone: (801) 825-9758	Max S. Elliott Chief Radio Engineer Orange County 481 S. Manchester Avenue Orange, Calif. 92668 Phone: (714) 834-2122	William F. Sanders Chairman, Region IV, FCCA Oregon Dept. of Forestry 2600 State Street P. O. Box 2289 Salem, Ore. 97310
VERMONT			
Loyd W. Brownell Vermont Dept. of Highways State Administration Bldg. Montpelier, Vt. 05602 Phone: (802) 223-2311 Ext. 247	Sgt. Leroy S. Hunter 154 Berkeley Street Boston, Mass. 02108	Robert Callahan Box 175 Keene, N. H. 03431 Phone: (603) 352-1291	William F. Vanidestine Chairman, Region I, FCCA Division of Protection Pa. Dept. of Forests & Waters Harrisburg, Pa. 17101
VIRGINIA			
James R. Miller Equipment Engineer Virginia Dept. of Highways 1221 E. Broad Street Richmond, Va. 23219 Phone: (703) 770-6166	Marvin S. Godsey P. O. Box 1299 Richmond, Va. 23210 Phone: (703) 272-1431	Andrew S. Adams Communications Engineer 10600 Page Avenue Fairfax, Va. 22030 Phone: (703) 273-1300	William F. Vanidestine Chairman, Region I, FCCA Division of Protection Pa. Dept. of Forests & Waters Harrisburg, Pa. 17101
WASHINGTON			
V. L. Dorsey Asst. Director (Maintenance) Washington State Hwy. Comm. Highway Administration Bldg. Olympia, Wash. 98501 Phone: (206) 753-6014	(East of 120°) Richard D. Harbour Assoc. Prof. of Elec. Eng. Electrical Engineering Dept. Washington State University Pullman, Wash. 99163 Phone: (509) 335-4950 (West of 120°) Lt. Col. R. G. Quantz 2803 - 156th Ave., S. E. Bellevue, Wash. 98007	Temple V. Ehmsen Bureau of Communications 419 S. W. Market Street Portland, Ore. 97201 Phone: (503) 227-3941	William F. Sanders Chairman, Region IV, FCCA Oregon Dept. of Forestry 2600 State Street P. O. Box 2289 Salem, Ore. 97310
WEST VIRGINIA			
Thomas L. Craig Director, Equipment Division West Virginia Department of Highways P. O. Box 610 Buckhannon, W. Va. 26201 Phone: (304) 472-1750	Emory Wright Chief Radio Engineer West Virginia Department of Public Safety Charleston, W. Va. 25305	Lawrence J. Hradek 2203 West Sprague Road Cleveland, Ohio 44141 Phone: (216) 842-1472	William F. Vanidestine Chairman, Region I, FCCA Division of Protection Pa. Dept. of Forests & Waters Harrisburg, Pa. 17101

HIGHWAY MAINTENANCE RADIO SERVICE	POLICE RADIO SERVICE	FIRE RADIO SERVICE	FORESTRY-CONSERVATION RADIO SERVICE
WISCONSIN			
Wayne N. Volk Chief Traffic Engineer Division of Highways Wisconsin Dept. of Trans. 4802 Sheboygan Avenue Madison, Wisc. 53702 Phone: (608) 266-0459	Norvel H. Rollins Communicator Enforcement Bureau Wisc. Motor Vehicle Division Madison, Wisc. 53702 Phone: (608) 266-3212	Frank J. Sepic Assistant Superintendent of Communications Milwaukee Police Department 749 West State Street Milwaukee, Wisc. 53233 Phone: (414) 273-8660 Ext. 471	Harold J. McGinnis Chairman, Region III, FCCA Wisconsin Dept. of Natural Resources Forest Protection Headquarters Tomahawk, Wisc. 54487
WYOMING			
Melvin Webb Assistant Chief Engineer (Operations) Wyoming State Highway Dept. P. O. Box 1708 Cheyenne, Wyo. 82001 Phone: (307) 777-7771	Richard F. Eversull Chief Radio Engineer Wyoming State Highway Dept. P. O. Box 931 Cheyenne, Wyo. 82001 Phone: (307) 632-9381 Ext. 258	Max S. Elliott Chief Radio Engineer Orange County 481 S. Manchester Avenue Orange, Calif. 92668 Phone: (714) 538-8825	William F. Sanders Chairman, Region IV, FCCA Oregon Dept. of Forestry 2600 State Street P. O. Box 2289 Salem, Ore. 97310

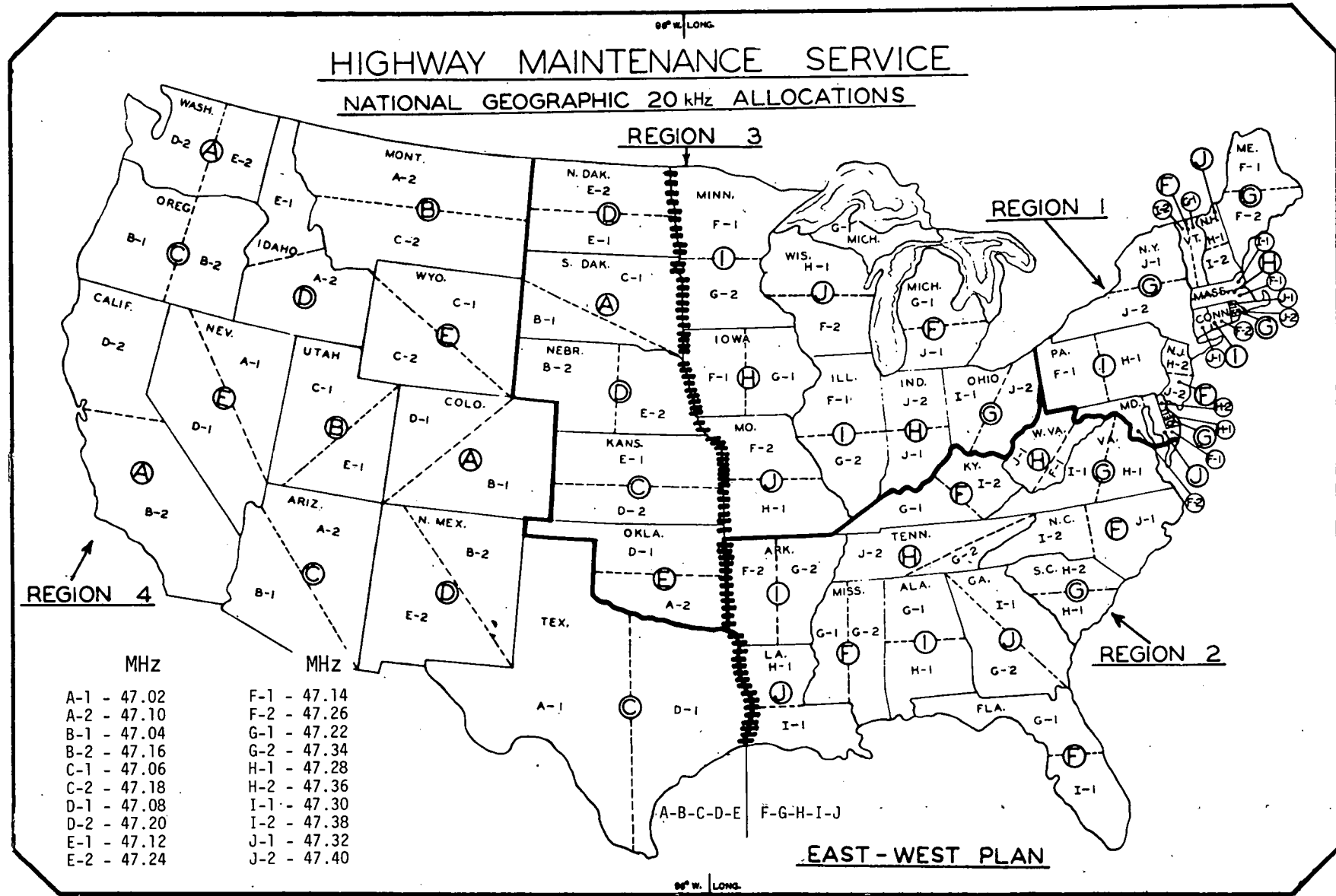
APPENDIX C

EAST-WEST 20 kHz GEOGRAPHICAL FREQUENCY ASSIGNMENT PLAN

STATE	PRIORITY 1	PRIORITY 2	PRIORITY 3	PRIORITY 4
Alabama	I-1 47.30	I-2 47.38	G-1 47.22 N	H-1 47.28 S
Arizona	C-1 47.06	C-2 47.18	A-2 47.10 NE	B-1 47.04 SW
Arkansas	I-1 47.30	I-2 47.38	F-2 47.26 W	G-2 47.34 E
California	A-1 47.02	A-2 47.10	D-2 47.20 N	B-2 47.16 S
Colorado	A-1 47.02	A-2 47.10	D-1 47.08 NW	B-1 47.04 SE
Connecticut	I-1 47.30	I-2 47.38	J-1 47.32 W	F-2 47.26 E
Delaware	G-1 47.22	G-2 47.34	H-2 47.36 N	H-1 47.28 S
Florida	F-1 47.14	F-2 47.26	G-1 47.22 N	I-1 47.30 S
Georgia	J-1 47.32	J-2 47.40	I-1 47.30 NE	G-2 47.34 SW
Idaho	D-1 47.08	D-2 47.20	E-1 47.12 N	A-2 47.10 S
Illinois	I-1 47.30	I-2 47.38	F-1 47.14 N	G-2 47.34 S
Indiana	H-1 47.28	H-2 47.36	J-2 47.40 N	J-1 47.32 S
Iowa	H-1 47.28	H-2 47.36	F-1 47.14 W	G-1 47.22 E
Kansas	C-1 47.06	C-2 47.18	E-1 47.12 N	D-2 47.20 S
Kentucky	F-1 47.14	F-2 47.26	I-2 47.38 NE	G-1 47.22 SW
Louisiana	J-1 47.32	J-2 47.40	H-1 47.28 N	I-1 47.30 S
Maine	G-1 47.22	G-2 47.34	F-1 47.14 N	F-2 47.26 S
Maryland	J-1 47.32	J-2 47.40	F-2 47.26 W	F-1 47.14 E
Massachusetts	H-1 47.28	H-2 47.36	I-1 47.30 N	F-1 47.14 S
Michigan	F-1 47.14	F-2 47.26	G-1 47.22 N	J-1 47.32 S
Minnesota	I-1 47.30	I-2 47.38	F-1 47.14 N	G-2 47.34 S
Mississippi	F-1 47.14	F-2 47.26	G-1 47.22 W	G-2 47.34 E
Missouri	J-1 47.32	J-2 47.40	F-2 47.26 N	H-1 47.28 S
Montana	B-1 47.04	B-2 47.16	A-2 47.10 N	C-2 47.18 S
Nebraska	D-1 47.08	D-2 47.20	B-2 47.16 W	E-2 47.24 E
Nevada	E-1 47.12	E-2 47.24	A-1 47.02 NE	D-1 47.08 SW
New Hampshire	J-1 47.32	J-2 47.40	H-1 47.28 N	I-2 47.38 S
New Jersey	F-1 47.14	F-2 47.26	H-2 47.36 N	J-2 47.40 S
New Mexico	D-1 47.08	D-2 47.20	B-2 47.16 NE	E-2 47.24 SW
New York	G-1 47.22	G-2 47.34	J-1 47.32 N	J-2 47.40 S
North Carolina	F-1 47.14	F-2 47.26	I-2 47.38 W	J-1 47.32 E
North Dakota	D-1 47.08	D-2 47.20	E-2 47.24 N	E-1 47.12 S
Ohio	G-1 47.22	G-2 47.34	I-1 47.30 NW	J-2 47.40 SE
Oklahoma	E-1 47.12	E-2 47.24	D-1 47.08 N	A-2 47.10 S
Oregon	C-1 47.06	C-2 47.18	B-1 47.04 W	B-2 47.16 E
Pennsylvania	I-1 47.30	I-2 47.38	F-1 47.14 W	H-1 47.28 E
Rhode Island	G-1 47.22	G-2 47.34	J-1 47.32 N	J-2 47.40 S
South Carolina	G-1 47.22	G-2 47.34	H-2 47.36 N	H-1 47.28 S
South Dakota	A-1 47.02	A-2 47.10	C-1 47.06 NE	B-1 47.04 SW
Tennessee	H-1 47.28	H-2 47.36	J-2 47.40 NW	G-2 47.34 SE
Texas	C-1 47.06	C-2 47.18	A-1 47.02 W	D-1 47.08 E
Utah	B-1 47.04	B-2 47.16	C-1 47.06 NW	E-1 47.12 SE
Vermont	F-1 47.14	F-2 47.26	I-2 47.38 W	G-1 47.22 E
Virginia	G-1 47.22	G-2 47.34	I-1 47.30 W	H-1 47.28 E
Washington	A-1 47.02	A-2 47.10	D-2 47.20 W	E-2 47.24 E
West Virginia	H-1 47.28	H-2 47.36	J-1 47.32 W	F-1 47.14 E
Wisconsin	J-1 47.32	J-2 47.40	H-1 47.28 N	F-2 47.26 S
Wyoming	E-1 47.12	E-2 47.24	C-1 47.06 NE	C-2 47.18 SW

APPENDIX D

NATIONAL GEOGRAPHIC 20 KHz ALLOCATIONS



APPENDIX E

DATA SOURCES—PUBLIC SAFETY RADIO SERVICES

Federal Communications Commission
1919 M Street, N.W.
Washington, D.C.

Nearly all of the information that affects the operation of the Public Safety Radio Services is generated within the FCC. The volume of information and the extensive list of interested radio users combine to create an almost insolvable distribution problem. This has led to the authorization of commercial organizations to reproduce select information or to prepare their own lists for sale to the public. The FCC has prepared a series of "Information Bulletins" that describe the facilities and services available at their office in Washington, D.C., and lists of their publications, with prices and procurement sources. The three bulletins of specific interest to Frequency Advisory Committee members are:

1. "Information Services"—Describes services and facilities at FCC headquarters.
 2. "FCC Publications" ED1
 3. "Printed Publications" 1-A
- } Listing of bulletins,
pamphlets, and other
publications. Includes
source and price.

Each FCC field engineering office listed in Figure E-1 is a source of specific information to all of the Public Safety Radio Services.

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

The complete set of volumes of the *FCC Rules and Regulations* is available through the Government Printing Office (GPO). Volume V, which is available separately, contains

Part 89, "Public Safety Radio Services." Also available from GPO is the *Federal Register*, which contains the FCC dockets. Other publications available from the GPO are listed in the FCC "Information Bulletins" and in *Price List 82 (PL-82)*, "Radio and Electricity."

ARCATA
Communications Information Service
665 National Press Building
Washington, D.C. 20004
(202) 783-2482

ARCATA is a commercial source of information services, publications, and radio data. Note that *Radio Data Books* are no longer published by ARCATA, but are available from Action Radio Information Systems.

Action Radio Information Systems
817 Silver Spring Avenue
Silver Spring, Maryland 20910
(301) 587-0558

Radio Data Books for Land Mobile Radio Service, including the Public Safety Radio Services, are available through this new organization.

Keuffel & Esser Company (K&E)
1521 N. Danville Street
Arlington, Virginia 22201
(703) 524-9000

K&E is authorized by the FCC to reproduce copies of all documents that are available to the public at a contract price per sheet. They will also provide research service for specific documents in FCC files.

Alabama, Mobile 36602	Massachusetts, Boston 02109
Alaska, Anchorage 99501 P.O. Box 644	Michigan, Detroit 48266
California, Los Angeles 90014	Minnesota, St. Paul 55102
California, San Diego 92101	Missouri, Kansas City 64106
California, San Francisco 94126	New York, Buffalo 14203
Colorado, Denver 80202	New York, New York 10014
District of Columbia, Washington 20555	Oregon, Portland 97205
Florida, Miami 33101 P.O. Box 150	Pennsylvania, Philadelphia 19106
Florida, Tampa 33606	Puerto Rico, San Juan 00903
Georgia, Atlanta 30303	P.O. Box 2987
Georgia, Savannah 31402 P.O. Box 77	Texas, Beaumont 77701
Hawaii, Honolulu 96808 P.O. Box 1021	Texas, Dallas 75202
Illinois, Chicago 60604	Texas, Houston 77002
Louisiana, New Orleans 70130	Virginia, Norfolk 23510
Maryland, Baltimore 21202	Washington, Seattle 98104

Figure E-1. Locations of FCC field engineering offices.

APPENDIX F

EXAMPLE OF "GENERAL INFORMATION—HIGHWAY MAINTENANCE RADIO SERVICE"

1. Highway Maintenance Radio Service is governed by Subpart L, Part 89, *FCC Rules and Regulations*.

2. All 47-MHz frequencies are assignable to states only and in accordance with the geographical assignment plan.

3. The 150-MHz frequencies fall into three groups: 151 MHz, 156 MHz, and 159 MHz. The 151-MHz group is block assignment and may be assigned directly without coordination with other services with the exception of 151.130 MHz, which is adjacent to the Forestry-Conservation Radio Service. All 156-MHz and 159-MHz frequencies should be coordinated, as they are split channel with the Police Radio Service.

4. All applicants should fully complete the request for frequency coordination and the form should be signed by the applicant. Typed signature or submission of unsigned forms by manufacturers should be discouraged.

5. Requests for frequency clearances should be processed as rapidly as possible.

6. Applicants should be encouraged to use the 150-MHz or 450-MHz band wherever possible.

7. Where coordination with other services is necessary, it is suggested this be handled by the frequency coordinator. The coordinator has the information as to whom to contact and what is required. The applicant would receive a complete package in much less time and ready for submission to the FCC.

8. Frequency coordination is best handled by requesting

a frequency clearance from the other service concerned. For example, if a request is received or it is proposed to assign Highway Maintenance frequency of 156.120 MHz, a frequency clearance for this specific frequency should be requested from the Police Service. The Police Service is assigned 156.09 MHz and 156.150 MHz which are 30 kHz removed each side and adjacent to the specific Highway Maintenance frequency. The Highway Maintenance and the Police frequency clearance would be returned to the applicant. This indicates to the FCC that frequency coordination has been effected.

9. Wherever possible, reassign the same frequency to conserve frequency usage. By so doing this will also provide a greater flexibility in solving frequency compatibility problems.

10. It is equally as important to prevent interference to presently licensed and operating systems as it is to assign a frequency to a new system that would result in minimum interference to the new system.

11. There is no set guide in assigning specific frequencies. Each assignment should be considered on its own merit.

12. Be cautious in assigning frequencies adjacent to or near state borders to prevent interference in adjoining states. It is suggested that the frequency be coordinated with the State Highway Maintenance Chairman in the adjoining state.

APPENDIX G

NOMINAL MOBILE COVERAGE

NOMINAL MOBILE COVERAGE AT 40 MHz

CURVES VALID FOR SMOOTH EARTH
 USING DIPOLE BASE STATION ANTENNA
 AND QUARTER WAVE MOBILE WHIP ANTENNA*

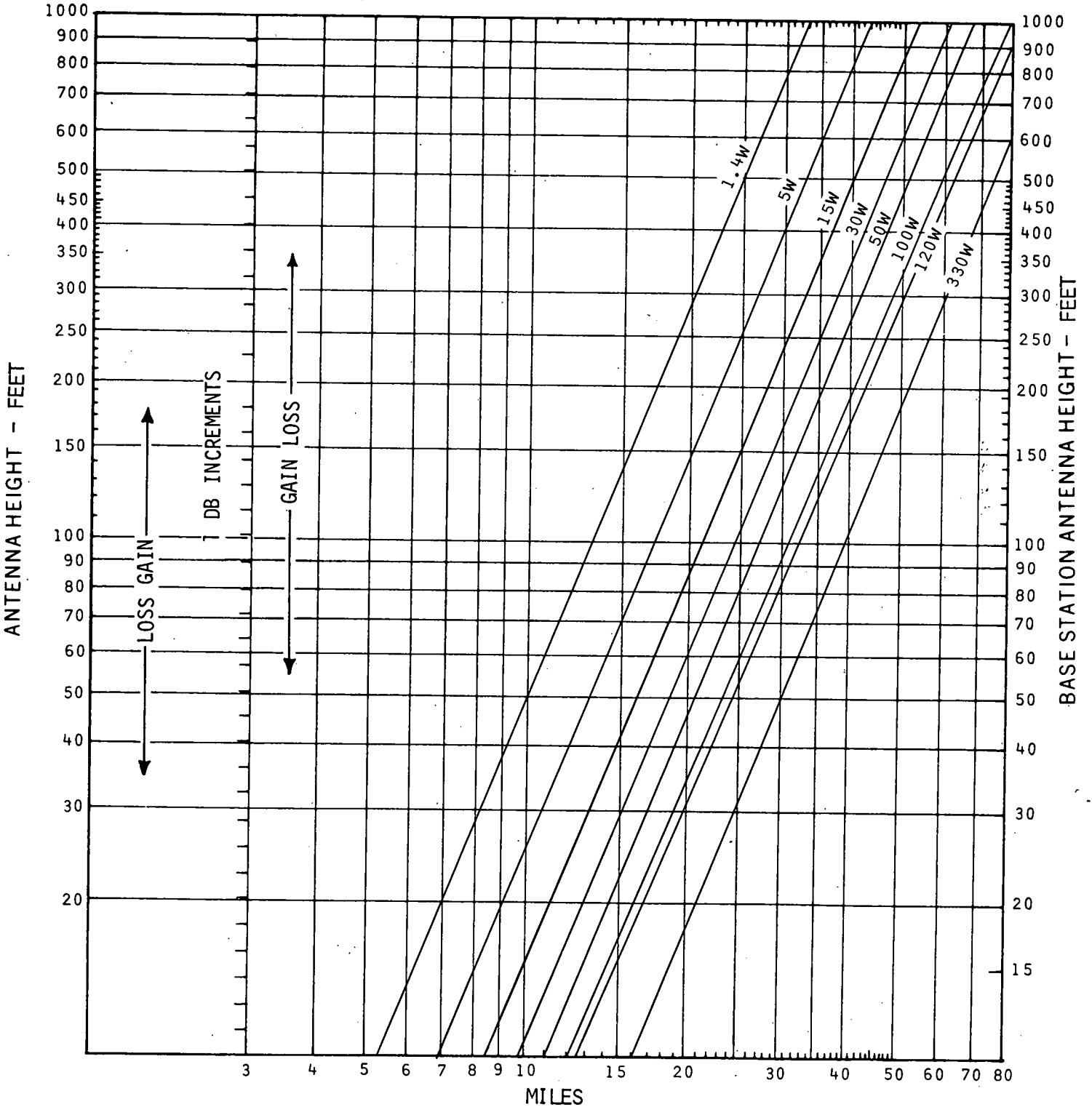


CHART BASED ON PROPAGATION CALCULATION PROCEDURES DEVELOPED BY KENNETH BULLINGTON, BELL TELEPHONE LABORATORIES, WITH CORRECTION FACTORS ADDED TO COMPENSATE FOR LOSSES EXPERIENCED IN AVERAGE ACTUAL SITUATIONS.

* Portable radio antennas normally will not provide this caliber of efficiency, so range estimates should be lowered.

NOMINAL MOBILE COVERAGE AT 160 MHz

CURVES VALID FOR SMOOTH EARTH
USING DIPOLE BASE STATION ANTENNA
AND QUARTER WAVE MOBILE WHIP ANTENNA*

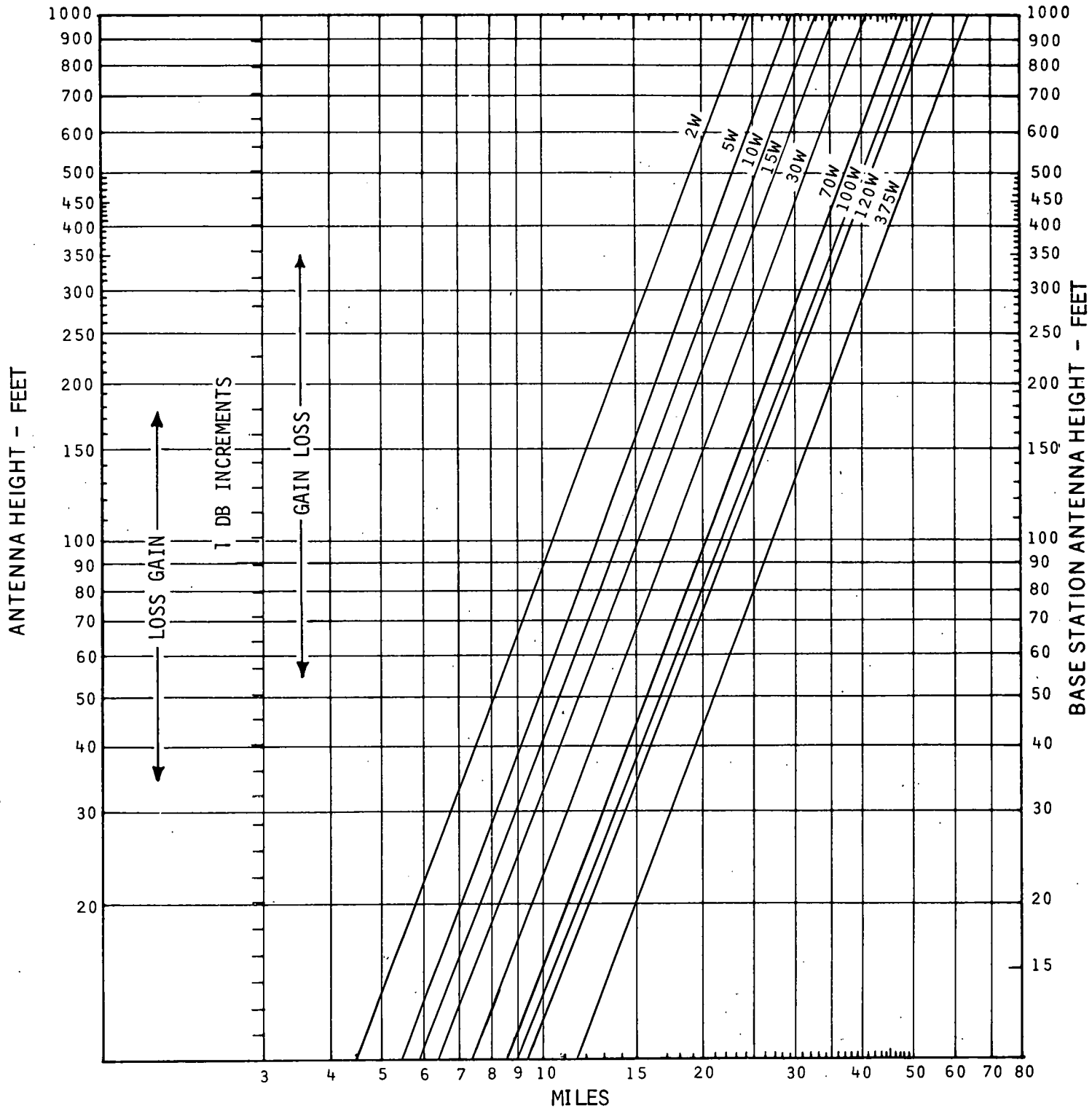
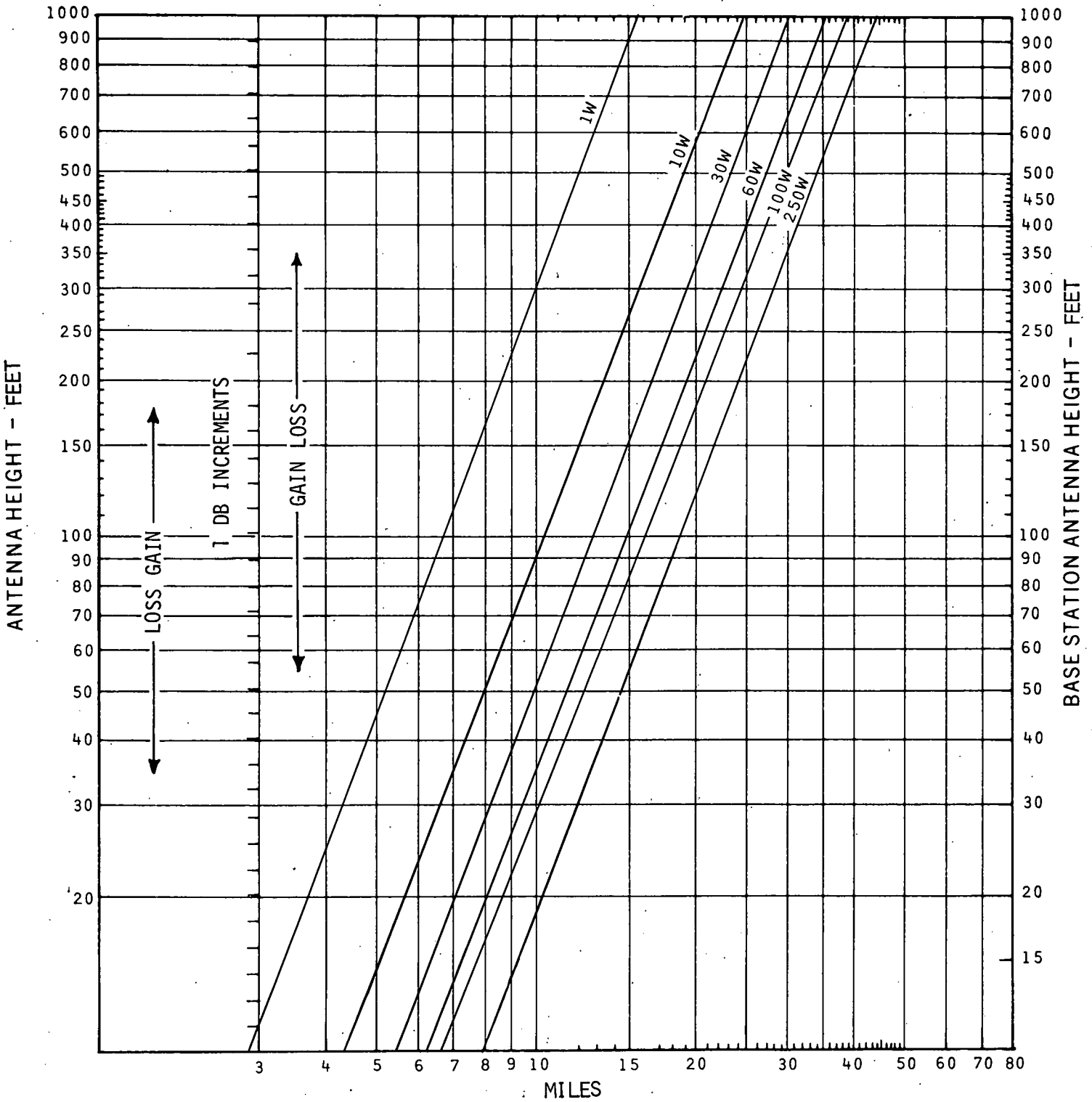


CHART BASED ON PROPAGATION CALCULATION PROCEDURES DEVELOPED BY KENNETH BULLINGTON, BELL TELEPHONE LABORATORIES, WITH CORRECTION FACTORS ADDED TO COMPENSATE FOR LOSSES EXPERIENCED IN AVERAGE ACTUAL SITUATIONS.

* Portable radio antennas normally will not provide this caliber of efficiency, so range estimates should be lowered.

NOMINAL MOBILE COVERAGE – 450 MHz

CURVES VALID FOR SMOOTH EARTH
 USING DIPOLE BASE STATION ANTENNA
 AND QUARTER WAVE MOBILE WHIP ANTENNA



CAUTION: THESE ARE STRICTLY AVERAGE CURVES AND ARE PUBLISHED FOR REFERENCE ONLY. DO NOT USE THIS NOMOGRAPH AS A BASIS FOR ABSOLUTE RANGE PREDICTIONS.

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