FoxComm
Data and Voice Radio Network Design Report

Prepared for

FoxComm

Prepared by

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EXECUTIVE SUMMARY

The voice, data and paging systems currently in the FoxComm region do not meet the high coverage and reliability needs of Public Safety. These systems lack the capacity necessary to handle the current or future traffic requirements, and the majority of equipment is near the end of its useful life. Therefore, the systems need replacement before they become a liability in life or property to the public safety community or the citizens they serve.

In particular, the voice radio system suffers from congestion of channels, interference, and inadequate coverage. Because there are an insufficient number of interference free VHF channels that can be licensed for the FoxComm region, a 700 MHz system is proposed. The 700 MHz should use digital simulcast trunked technology and conform to the P-25 standard.

This type of system also allows for location data of subscriber units to be incorporated. This standard provides for a common air interface which allows for direct communications between various manufacturers of equipment in the same frequency band and allows for use of various manufacturers of vehicular or portable radios to be used in a system or systems. In order to obtain coverage 95% of the area 40 sites are required for base stations and receive only facilities.

Interoperability with other 700/800 MHz systems can be directly achieved. Interoperability with systems in other frequency bands will require cross band repeaters or use of two radios one from each system.

Two alternatives are suggested; one a FoxComm-wide system and the second, four individual county systems. The number of channels and estimated cost of the first alternative are considerably less than those of the second alternative.

The present 800 MHz Mobile Data System (MDC) involves three separate County systems, (one shared between two counties) also suffers from poor coverage and lacks capacity. Up to 20 minutes of waiting time is not uncommon and finding current location of vehicles is next to impossible.

A new MDC system is proposed which with the incorporation of 6 frequencies, currently used by Green Bay for voice, (assuming Green Bay's voice system is incorporated into one of the voice radio alternatives) will allow for expanded coverage and considerable improvement of

data applications. An interim step using the three (3) presently used 800 MHz MDC frequencies is also proposed, which by time sharing can allow for improved performance by reducing waiting time.

In both cases the same radio sites and interconnection networks used for the voice radio system would also be used for the MDC system, the MDC system would not be require to provide location information.

With regard to paging and alerting, the current VHF systems are in some cases on the same system as voice radio and are either delayed or can be interfere with voice messages. Coverage is also inadequate.

Two alternatives are proposed. One a FoxComm-wide paging system which can alert personnel and volunteer fire fighters, who are in any of the four counties. The second is for each of the four counties to utilize its own system. Again the same sites used for the voice radio system and the same interconnection network would be used to reduce cost.

A Central Data Center is also proposed to allow all data of the four individual County PSAP/Dispatch Centers to be backed up and stored in a central place.

Requirements for training, maintenance and system operation are also discussed.

SECTION I - INTRODUCTION

1.1 PURPOSE OF REPORT

CTO was retained by FOXCOMM to provide consulting services with the Data and Voice Radio Network Design Consulting for the purpose to assist the FoxComm Counties with:

- Assessment of the existing data networks and advice on needs considering inadequate or upgrades required such as analog to digital for future technology advances and/or migration.
- Research and provide options which include feature, initial cost investment and on-going cost associations for each option, and manageability.
- Develop a plan for redundancy of and interoperability between FoxComm Counties for Public Safety voice communications, and 9-1-1 answering points with differing wireless and wireline network designs.
- Design a system that complies with Federal and State mandates and grant funding initiatives.
- Network options should include but not limited to modern, future visioning, flexible media, i.e., dark fiber, sonic fiber ring, microwave and will provide conduit for voice radio communications, telephone communications, 9-1-1 service ability, VoIP, RadioIP, etc. and must provide and advanced secure environment.
- Design options should offer capacity for consolidation of other public safety systems such as public safety answering points that are not in place or planned for today.
- Review and provide recommendations for facility and staffing needs of FoxComm consortium (not individual County participants of FoxComm).

To determine the status of the existing systems as well as the future needs of the FoxComm agencies CTO conducted interviews with operational and technical personnel of the various involved counties, cities and Tribal Nation. Additional telephone meetings were conducted to obtain additional information. Visits were made to representative radio sites and dispatch centers for the Counties.

1.2 MEETINGS

Meetings were held to solicit and collect information from the various agencies that FoxComm services. The meetings were held at different times and locations to allow interested personnel to attend and voice their concerns with the existing systems and at the same time provide input and direction with the new systems.

Personnel attending and providing information at various meetings included:

S-Sgt. Mary Schuelke – Outagamie County Sheriffs Dept.
Captain Michael Jobe – Outagamie County Sheriffs Dept.
Bob Heimann, IT Director – Brown County
Kevin Raye, Network Manager – Brown County
Beth Rodgers, Project Manager for Public Safety Systems – Brown County
Paul Berndt, Information Technology – Brown County
Jim Nickel, Director – Brown County Public Safety Communications
Dave Panure, Shift Supervisor – Brown County Public Safety Communications
Jeff Stauber, Fire Chief – Green Bay City Fire Dept.
Lt. William Bongle, Operations – Green Bay City Police Dept.
Officer Jeremy Muraski, – Green Bay City Police Dept.
Kurt Wiese, IT Technician – City of Green Bay IS Dept.
Steve Meadowcroft, IT Technician – City of Green Bay Police Dept.
Tom Pynaker, Director of MIS – Outagamie County
Joan Mitchell, Assistant Director of MIS – Outagamie County
Tim Tanglin, Network Manager – Outagamie County MIS
Scott Liske, Director of Technology Services – City of Appleton
Jay Schaefer, Network Manager – Winnebago County IS
Paul Xiong, Network Technician – Winnebago County IS
Howard Mezera, Director of IS – Calumet County
Randy Howell, Network Manager – Calumet County IS
Roger Snyder, Sr. Systems Technician – BayCom
Roy Helms, Sr. Systems Technician – BayCom
Wayne Frank, Owner – Frank's Radio Service
Keith Kiesow, Fire Chief – Town of Menasha Fire Dept.
Len VanderWyst, Fire Chief – Neenah/Menasha Fire Dept.
Victor Voss, Captain – Neenah/Menasha Fire Dept.
Tim Bantes, Fire Chief – Town of Grand Chute Fire Dept.
Michael DeBruler, Asst. Chief – Town of Grand Chute Fire Dept.
Neil Cameron, Fire Chief – City of Appleton Fire Dept.
Gene Reece, Deputy Fire Chief – City of Appleton Fire Dept.
Paul Hirte, Fire Chief – City of Kaukauna Fire Dept.
Don Grindheim, Asst. Fire Chief – City of Kaukauna Fire Dept.
Lisa VanSchyndel, Town of Buchanen EMS Director
Bruce Corning, Chief – Town of Buchanen Fire Dept.
Kris VerVaeren, Commander – Village of Ashwaubenon Public Safety
Darrel Baker, Battalion Chief – City of Appleton Fire Dept.
Rudy Nyman, Lieuetenant – City of Appleton Police Dept.
Steve Schmeichel, Fire Chief – Town of Greenville Fire Dept.
Jeff Roemer, Fire Chief – Town of Suamico Fire Dept.
Randy Christopherson, Chief of Police – University of Wisconsin – Green Bay
Rich VanBoxtel, Chief of Police – Oneida Tribal Police
Paul Rusch, Captain – Calumet County Sheriff's Office
Kelly Sippel, Lieuetenant – Calumet County Sheriff's Office
Howard Fuerst, Lieuetenant – City of Neenah Police Dept.
Ty Thompson, Lieutenant – City of Neenah Police Dept.
Jeff Malcore, Lieutenant – City of Neenah Police Dept.
Keith Deneys, Lieutenant – Brown County Sheriff's Office

Tom Hermsen, Captain – Brown County Sheriff's Office
Jim Arts, Chief of Police – City of Green Bay Police Dept.
Bill Bongle, Lieutenant – city of Green Bay Police Dept.
Jerome Martin, Lieutenant – Town of Grand Chute Police Dept.
Ray Reimann, Chief – Village of Wrightstown Police Dept.
Cyndi Thaldorf, Lieutenant – City of Oshkosh Police Dept.
Kirk Schend, City of Brillion Police Dept.
Pat Matuszewski, Lieutenant – City of Appleton Police Dept.
Robert Kavanaugh – City of Appleton Police Dept.
Sally Dickinson – City of Appleton Police Dept.
Kevin McSorley, Lieutenant – FoxValley Metro Police Dept.
Tom Madigan, CEO/Director – County Rescue & Eagle III Headquarters
Steve Gerbers – Gold Cross Ambulance Service, Inc.
Karen Carlson – FoxComm

During the conduct of this study CTO has reviewed the following documents for the counties involved in FoxComm:

VHF radio systems
800 MHz radio system
800 MHz data system
VHF paging and alerting system
Interconnect systems for CAD and voice systems
Tower sites
Interoperability procedures

Also, frequency allocation and availability for the region was reviewed for all bands. CTO was provided with studies previously performed for 2 of the counties.

1.3 INTERVIEW RESULTS

To determine the status of the existing systems CTO conducted interviews with operational and technical personnel of the various involved counties and cities.

The results of the interviews and visits can be summarized as follows:

- **Poor coverage** – There are a considerable number of areas where low signal levels or no coverage at all is encountered.
- **Lack of capacity** – Because each county has different frequencies and operate several separate systems, there is not sufficient capacity to provide reliable communications. A number of agencies have only one channel. If there are concurrent incidents there is too much traffic on the channel resulting in "stepping on each other". A major incident would result in more traffic than can be accommodated by any of the existing systems.
- **Interference** – Interference occurs in several channels which dispatch communications.

- **Poor Mobile Data Communications (MDC)** – Several MDC systems are overloaded or have long delays.
- **Lack of interoperability** – Other than use of interoperability channels, if available on agency's mobile or portable radios, or by the use of someone else radios, there is no way of coordinating activities of incident responders from several jurisdictions.
- **Lack of redundancy** – The systems for each county generally are not setup with redundant links to sites.
- **Aging systems** – The systems are outdated and require updating
- **Medical information** – There is little or no use of the UHF medical telemetry channels. Rather information from a scene to a medical facility is done by voice which leads to channel congestion and can result in loss of life.
- **Encryption** – The present systems don't have security or encrypted capability incorporated in their current radio systems.
- **Paging and Alerting** – Paging and alerting systems suffer from poor coverage, use for dispatch voice for on scene operation as well as paging in other systems, do not provide voice dispatch messages to fire fighters until they reach the incident scene. Co-channel interference from other jurisdictions.

1.4 FOXCOMM

FoxComm is an initiative formed between Brown, Calumet, Outagamie, and Winnebago Counties for the purpose of regional operation.

FoxComm represent over 33 Law Enforcement agencies, 72 fire departments, 33 Emergency Medical Districts and four (4) Public Safety Answering Points (PSAP).

FoxComm presently operates a Motorola Premier Computer Aided Dispatch System (CAD) formerly Printrak to provide service to all four (4) Counties. The primary site for the CAD system is Brown County and the Redundant Tandem is at Winnebago County. Each county uses the system individually but can review and initiate calls for service of all public safety agencies in other member counties. Additionally, leased T1 lines provide connectivity to Brown and Winnebago Counties for supporting the primary and backup Tandems. The primary T1 connectivity path is from Brown County to Winnebago County, the redundant path is from Brown to Outagamie County and then to Winnebago County.

FoxComm in conjunction with the four counties provides integration services for the support and development of sharing information from various databases. There are three (3) Mobile Data Computer (MDC) systems utilized in the four (4) counties. Each one is a Motorola

19.2 kbps, 800 MHz radio network system. Each system has a separate server and radio network controller. The systems are integrated between the counties through the CAD system. The Brown County system has 170 users that include all law enforcement agencies and fire departments within the county via two channels at 2 sites in the county. The Outagamie County MDC system services all law enforcement and fire agencies in Outagamie and Calumet Counties via three channels located at three different radio sites in the counties. The County's MDC system has approximately 195 users. The Winnebago County MDC system has 145 users that include all law enforcement and fire agencies via two channels located at 2 sites (one channel at one of the sites is not licensed) within the county. The systems are used by law enforcement agencies in each county for dispatching, TIME system, records check and report writing to a local computer document. The systems have the ability to download pictures and fingerprints but is very time consuming because of the lack of speed and bandwidth. Some agencies have reported having to wait 20-30 minutes for a return because of the loading issues with the MDCs. As a result MDCs are not being used to the fullest.

1.5 BROWN COUNTY

Brown County Public Safety Communications Joint 9-1-1 Dispatch Center is located at 307 South Adams Street, in the City of Green Bay which is the County's Seat. The Center intends to relocate to the Brown County Jail at 3030 Curry La., Green Bay in 2009. The county is 529 square miles and serves an estimated 239,000 residents. The city of Green Bay is the largest city in Brown County with over 100,000 people. Brown County is home to the University of Wisconsin Green Bay (UWGB) with 5,500 students and several other colleges.

Austin Straubel International Airport with five commercial airlines providing service to the region is located in Brown County. The Port of Green Bay is an international port for domestic and foreign trade. Brown County is the transportation hub of Northeastern Wisconsin. Major gas pipelines and several oil storage are also located in Brown County.

The Lambau Field home of the Green Bay Packers attracts over 70,000 fans for National Football League games. Brown County is also the home for other large facilities such as the Resch Center, Brown County Arena, Shopko Hall, KI Convention Center, and Weidner Center at UWGB. Such facilities can accommodate between 5,000 to 10,000 people.

Also in Brown County is the Green Bay Correctional Institution, located in Allouez, has a population of approximate 1000.

Brown County Public Safety Communications Center answers all the emergency 9-1-1 calls in the County and most non-emergency calls for Brown County Sheriffs Department, nine (9) police agencies, nineteen (19) fire departments, and fourteen (14) ambulance/rescue agencies. Brown County Communications Center dispatches for all 42 agencies except Ashwaubenon and the Oneida Indian Nation.

Brown County representatives identified several issues with their present communications systems. The issues are:

- The equipment is at the end of useful life,
- There is no adequate radio coverage throughout the County,
- Poor portable in-building coverage,
- No interoperability between agencies (inter and intra operability),
- 2 GHz microwave frequencies need to be relocated.

In 2007, Brown County Communications Center dispatched a total of 200,947 calls for service as shown in **Table 1-1**.

The Communications Center dispatched 180,316 law enforcement calls for service.

Law Enforcement Total Calls Dispatched	Yearly * Radio Service Messages	Daily Radio Service Messages	Hourly Radio Service Messages	Busiest Hour **
180,316	1,803,160	4,940	206	227

* Using an average of 10 radio messages per incident.
** The busiest hour has about 10% more radio calls than the average hour

The communications center dispatched 20,631 fire and rescue calls for service.

Fire Total Calls Dispatched	Yearly * Radio Service Messages	Daily Radio Service Messages	Hourly Radio Service Messages	Busiest Hour **
20,631	515,775	1,413	59	65

* Using an average of 25 radio messages per incident.
** The busiest hour has about 10% more radio calls than the average hour

The communications center handled an estimated 408,000 telephone calls to include, 9-1-1, non-emergency, cellular and administrative calls. This is approximately 1,118 telephone calls per day.

The communications center utilizes Motorola Centracom Gold Elite consoles that were installed October 2000. There are 8 dispatching positions, 4 call taking positions and one training position.

TABLE 1-1 – BROWN COUNTY

FoxComm 2007 Incident Count by Agency							
County	Agency Name	Agency ID	# of Incidents	County	Agency Name	Agency ID	# of Incidents
All	Gold Cross Ambulance	GA	1,054	Brown	Hobart-Lawrence PD	HL	4,049
All	Wisconsin State Patrol	WT	3	Brown	Hollandtown FD	HO	45
Brown	Allouez FD	AL	1,065	Brown	Howard FD	HW	776
Brown	Ashwaubenon FD	AF	1,783	Brown	Lawrence FD	LA	189
Brown	Ashwaubenon PD	AS	18,301	Brown	Ledgeview FD	LV	271
Brown	Austin Straubel Airport-FD	BA	36	Brown	Morrison FD	MO	63
Brown	Bellevue FD	BV	744	Brown	New Franken FD	NF	336
Brown	Brown County Dispatch *	BD	8,053	Brown	Oneida PD	OB	6,407
Brown	Brown County Sheriff	BR	46,270	Brown	Pulaski FD	PF	320
Brown	County Rescue EMS	CR	776	Brown	Pulaski PD	PP	1,577
Brown	Denmark FD	DN	339	Brown	Suamico FD	SU	347
Brown	Denmark PD	DM	1,165	Brown	Tri County Rescue	TC	2
Brown	DePere FD	DP	1,891	Brown	UWGB Public Safety	UW	1,292
Brown	DePere PD	DE	14,138	Brown	Viking Rescue	VI	278
Brown	Green Bay FD	GN	9,741	Brown	Wayside FD	WS	43
Brown	Green Bay PD	GB	85,954	Brown	Wrightstown FD	WF	121
Brown	Greenleaf FD	GL	86	Brown	Wrightstown PD	WP	1,160
Brown	Hobart FD	HB	325				
TOTAL INCIDENTS							**200,947**

* Training calls only. NOT included in total incidents dispatched.

The Brown County radio system used by both police and fire departments in the county is a VHF conventional analog system. The system is about twenty five (25) years or older and parts to service the equipment are getting difficult to obtain. Both the police and fire departments have complained about dead spots in the County as well as poor communication on portable radios. The county has no tactical channels for the Sheriff or EMS use.

The City of Green Bay operates a 6 channel 800 MHz trunked radio system with about 970 users. The Oneida Indian Nation has a 10 channel 800 MHz trunked radio system which is not a part of the Brown County Public Safety communications system. The Green Bay Correctional Institution has an 800 MHz trunked radio system for use in and around the institution with a population of about 1,000.

CTO understands there are approximately 1,900 Minitor pagers, 990 portables and mobiles for the fire departments, an estimated 300 mobiles and portables for law enforcement on the current system.

The agencies within Brown County that are dispatched or contribute to the loading of the present system and have interoperability needs are listed below.

Law Enforcement Departments		
Ashwaubenon Public Safety	Green Bay	UWGB
Brown County Sheriff	Hobart/Lawrence	Wrightstown
De Pere	Oneida	
Denmark	Pulaski	
Fire Departments		
Allouez	Greenleaf	Morrison
Ashwaubenon	Hobart	New Franken
Bellevue	Holland	Pulaski/Tri County
Denmark	Howard	Swamico
De Pere	Lawrence	Wayside
Green Bay	Ledgeview	Wrightstown
Emergency Medical Services		
Allouez	Hobart	Star Rescue
Ashwaubenon	Howard/Swamico	Viking Rescue
Denmark	Morrison	County Rescue
De Pere	New Franken	Wrightstown
Green Bay	NE Wisconsin Paramedic Service	
Other Agencies		
Ashwaubenon School District	Brown County Jail	Maplegrove Fire
Green Bay DPW	Airport Maintenance	Airport Public Safety
Green Bay Housing	NE Wisconsin Paramedic Srvs	Surrounding County Sheriffs
Green Bay Parks	New Franklin	Wisconsin State Patrol
Green Bay Sirens	Green Bay Government	Chase Fire
Green Bay Transit	Brown County Highway	Green Bay State Corrections Institute
Green Bay Water	Ashwaubenon DPW	Angelica Fire
U.S. Coast Guard	Bay Park Mall Security	Brown Co Joint Drug Taskforce

1.5.1 CITY OF GREEN BAY

The City of Green Bay runs a six Channel single site 800 MHz trunked radio system at the Pullium Power Plant and a single 800 MHz channel data system. The system is non-redundant. The link between the site and the dispatch center is via T1 lines and radio link. The multiple agencies using the system are dispatched by the Brown County Public Safety Communications Center and they are: Green Bay Police, Green Bay Fire, Ashwaubenon Public

Safety, Green Bay DPW, Green Bay Transit, Green Bay Parks, Green Bay Water, Green Bay Housing, Brown County Jail, and the Brown County Joint Drug Task Force.

Coverage problems were reported in the northeast and west end of the City with limited voice on portable radios due to the shielding of the power plant stack. In the area west of Crestwood at the "King School" there is no talk-around and coverage is poor. Also was reported that in building coverage is poor. The repeater equipment at Lambeau Field has interference problems during the Packers football games.

1.5.2 ONEIDA INDIAN NATION

The Oneida Indian Nation (which has a portion in western Brown County and eastern Outagamie County) provides law enforcement in both portions of the counties. The Oneida Nation operates a 10 channel 800 MHz trunked radio system to provide service to their various departments of the Nation. The radio system is not a part of the Brown County Communications System but has a control station to access it. For in-building coverage there is an 800 MHz bi-directional amplifier system (BDA) at the Oneida casino across from the Airport. For interoperability in the County the Oneida Nation has programmed other 800 MHz talk groups in their units.

1.6 CALUMET COUNTY

Calumet County Public Safety serves a population of 45,000 in an area of 439 square miles. Calumet County Public Safety Answering Point is located in the Government Complex at 206 Court Street in Chilton, Wisconsin. The actual communications center is located inside the Sheriffs Department Jail Building.

There are three (3) Motorola, MCC5500 dispatch consoles that were installed early 2004. There is no room for expansion in the current center. There are additional consoles in the basement of the center for training, back up if needed and in the event of an evacuation.

Calumet County Communications Center is the primary dispatch for the county, City of Chilton, City of Brillion and primary dispatch on nights and weekends for the City of New Holstein. New Holstein Police Department is the back up center for Calumet County Communications Center.

In 2007, Calumet County Communications Center dispatched a total of 21,436 calls for service as shown in **Table 1-2**.

In 2007 Calumet County dispatched 18,524 law enforcement calls for service.

Law Enforcement Total Calls Dispatched	Yearly * Radio Service Messages	Daily Radio Service Messages	Hourly Radio Service Messages	Busiest Hour **
18,524	185,240	508	21	23

* Using an average of 10 radio messages per incident.
** The busiest hour has about 10% more radio calls than the average hour

There were 2,905 fire calls dispatched in 2007.

Fire Total Calls Dispatched	Yearly * Radio Service Messages	Daily Radio Service Messages	Hourly Radio Service Messages	Busiest Hour **
2,905	72,625	199	8	9

* Using an average of 25 radio messages per incident.
** The busiest hour has about 10% more radio calls than the average hour

The communications center handled an estimated 180,000 telephone calls to include 9-1-1, non-emergency, cellular and administrative. This equates to an average of 496 telephone calls per day.

Calumet County operates one primary VHF channel with one (1) transmit site and five (5) remote sites that are on a voting system for the Sheriffs Department and City police departments. The fire and EMS operate one combined channel that also serves as the primary pager/alerting for all fire and EMS departments in the county.

There are approximately 700 Minitor pagers, 360 portables and mobiles for fire and 120 portables and mobiles for law enforcement agencies on the system.

Besides the reported coverage problems for the voice system, the data system lack of capacity, and the paging system, there are serious concerns with in-building coverage.

TABLE 1-2 – CALUMET COUNTY

FoxComm 2007 Incident Count by Agency			
County	**Agency Name**	**Agency ID**	**# of Incidents**
All	Gold Cross Ambulance	GA	1,054
All	Wisconsin State Patrol	WT	3
Calumet	Brillion FD	BI	219
Calumet	Brillion PD	BN	2,222
Calumet	Calumet County Sheriff Dept.	CA	11,112
Calumet	Chilton FD	CH	707
Calumet	Chilton PD	CP	2,786
Calumet	Forest Junction FD	FJ	39
Calumet	Harrison #1 FD	H1	99
Calumet	Harrison #2 FD	H2	194
Calumet	Hilbert FD	HF	81
Calumet	Hollandtown FD	HN	4
Calumet	New Holstein FD	NR	309
Calumet	New Holstein PD	NH	2,404
Calumet	Potter FD	PT	43
Calumet	St. Ann FD	ST	59
Calumet	Stockbridge FD	SK	73
Calumet	Town of Calumet FD	CT	28
TOTAL INCIDENTS			**21,436**

The agencies within Calumet County that are dispatched or contribute to the loading of the present system and have interoperability needs are listed below.

Law Enforcement Departments		
Brillion	Chilton	
Calumet Sheriff	New Holstein	
Fire Departments		
Brillion	Harrison # 2	Potter
Chilton	Hilbert	St. Ann
Forest Junction	Hollandtown	Stockbridge
Harrison #1	New Holstein	Town of Calumet
Emergency Medical Services		
Gold Cross Ambulance	County Rescue/ Eagle III	Theda Star
Other Agencies		
Chilton DPW	Valley Transit	Surrounding County Sheriffs
Calumet County Highway	Calumet Emerg Management	U.S. Coast Guard
Calumet Parks	Calumet County Jail	Wisconsin State Patrol
Calumet Sirens		

1.7 OUTAGAMIE COUNTY

Outagamie County 9-1-1 Communications Center is located in the Public Safety Building at 320 S. Walnut Street, Appleton, Wisconsin. The County covers 640 square miles and serves a population of approximately 161,000 residents.

The Outagamie Communications Center dispatches to twelve (12) police departments, the Sheriffs Department, twenty five (25) fire and rescue departments. Outagamie Communications Center is the back up center for Winnebago County and Winnebago County Communication Center is the back up for Outagamie County.

In 2007, Outagamie County 9-1-1 Communications Center dispatched a total of 159,072 calls for service as shown in **Table 1-3**.

The Communications Center dispatched 148,416 law enforcement calls in 2007.

Law Enforcement Total Calls Dispatched	Yearly * Radio Service Messages	Daily Radio Service Messages	Hourly Radio Service Messages	Busiest Hour **
148,416	1,484,160	4,066	169	186

* Using an average of 10 radio messages per incident.
** The busiest hour has about 10% more radio calls than the average hour

There were 10,656 fire calls dispatched in 2007.

Fire Total Calls Dispatched	Yearly * Radio Service Messages	Daily Radio Service Messages	Hourly Radio Service Messages	Busiest Hour **
10,656	266,400	730	30	33

* Using an average of 25 radio messages per incident.
** The busiest hour has about 10% more radio calls than the average hour

The communications center handled over 325,000 telephone calls to include 9-1-1, cellular, non-emergency and administrative. This equates to about 893 daily telephone calls.

The Communications Center has seven (7) Motorola Gold Elite Dispatch consoles that were purchased January 2003.

TABLE 1-3 – OUTAGAMIE COUNTY

FoxComm 2007 Incident Count by Agency							
County	Agency Name	Agency ID	# of Incidents	County	Agency Name	Agency ID	# of Incidents
All	Gold Cross Ambulance	GA	1,054	Outagamie	Hortonville FD	HV	152
All	Wisconsin State Patrol	WT	3	Outagamie	Hortonville PD	HC	2,443
Outagamie	Bear Creek FD	BF	66	Outagamie	Kaukauna FD	KK	1,011
Outagamie	Black Creek FD	BK	135	Outagamie	Kaukauna PD	KC	11,480
Outagamie	Black Creek PD	BP	712	Outagamie	Kimberly FD	KM	280
Outagamie	Buchanen FD	BU	245	Outagamie	Little Chute FD	LC	370
Outagamie	Center FD	CF	106	Outagamie	New London FD	NL	51
Outagamie	City of Appleton FD	AP	3,897	Outagamie	New London PD	NW	6,668
Outagamie	City of Appleton PD	AC	56,664	Outagamie	Oneida FD	ON	279
Outagamie	Combined Locks FD	CL	75	Outagamie	Osborn FD	OS	28
Outagamie	Combined Locks PD	CC	2,209	Outagamie	Outagamie Airport	OA	182
Outagamie	Dale FD	DF	101	Outagamie	Outagamie County Sheriff Dept	OU	28,228
Outagamie	Ellington FD	EF	86	Outagamie	Outagamie dispatch *	OD	1,828
Outagamie	Fox Valley Metro PD	FV	13,573	Outagamie	Seymour FD	SE	271
Outagamie	Freedom FD	FF	143	Outagamie	Seymour PD	SP	2,683
Outagamie	Freedom PD	FC	1,595	Outagamie	Seymour Town FD	SY	43
Outagamie	Grand Chute FD	GF	1,544	Outagamie	Shiocton PD	SH	962
Outagamie	Grand Chute PD	GC	21,196	Outagamie	Shiocton-Bovina FD	SF	140
Outagamie	Greenville FD	GV	261	Outagamie	Vandenbroek FD	VB	121
Outagamie	Hollandtown FD	HT	15				
TOTAL INCIDENTS							**159,072**

* Training calls only. NOT included in total incidents dispatched.

Outagamie County operates on a VHF radio system. The City of Appleton Police uses VHF channels using a stand alone, separate infrastructure VHF channel with paging. The Sheriff's Department utilizes two (2) VHF channels which are simulcast using nine (9) sites. Kaukauna City uses one (1) channel with two (2) sites and Metro Police uses one (1) channel and one (1) site.

The Outagamie Fire Departments use one (1) VHF channel with eight (8) sites, with VHF repeaters on different PL codes for "talk-around" as well as fire station alerting/paging of volunteer first responders. The fire departments are using the allocated "State Fire Plan" and Standard Operating Procedures (SOP) for the use of Blue, Red, and White channels. There is a fire ground channel that is not monitored.

There are an estimated 1,500 Minitor pagers, and 750 portables and mobiles currently used by the fire departments on the system. CTO understands there are about 350 portables and mobiles for law enforcement on the radio system.

There are several coverage/problem areas concerning the radio system. There are various dead spots on the west and east sides of the county where law enforcement agencies can not transmit on portables. In the Greenville/Hortonville area officers can not transmit on Channel 2. There has been a skip VHF interference problem which seems to have gotten a little better. There has been an interference problem with Door County.

The agencies within Outagamie County that are dispatched or contribute to the loading of the present system and have interoperability needs are listed below.

Law Enforcement Departments		
Black Creek	Freedom	New London
City of Appleton	Grand Chute	Outagamie Sheriff
Combined Locks	Hortonville	Seymour
Fox Valley Metro	Kaukauna	Shiocton
Fire Departments		
Bear Creek	Freedom	New London
Black Creek	Grand Chute	Oneida
Buchanen	Greenville	Osborn
Center	Hollandtown	Outagamie Airport
City of Appleton	Hortonville	Seymour
Combined Locks	Kaukauna	Seymour Town
Dale	Kimberly	Shiocton-Bovina
Ellington	Little Chute	Vandenbroek
Emergency Medical Services		
Gold Cross Ambulance	County Rescue/Eagle III	Theda Star
Other Agencies		
Municipal DPW	Outagamie County Jail	Surrounding County Sheriffs
Outagamie County Highway	Valley Transit	U.S. Coast Guard
Outagamie Parks	Outagamie Water Authority	Wisconsin State Patrol
Outagamie Sirens	Outagamie Emergency Management	Schools

1.8 WINNEBAGO COUNTY

Winnebago County Public Safety Answering Point is located at the County's Sheriffs Office in Oshkosh, Wisconsin which is the County's Seat. The County has an estimated population of 160,000 from the 2000 Census and covers an area of 579 square miles.

The Communications Center is the primary dispatch for eight (8) police departments including the Sheriff's Department and twenty (20) fire departments. Winnebago County Communications is the back up center for Outagamie County Communications Center and Outagamie County is the back up center for Winnebago County.

In 2007, Winnebago County 9-1-1 Communications Center dispatched a total of 153,511 calls for service as shown in **Table 1-4**.

TABLE 1-4 – WINNEBAGO COUNTY

FoxComm 2007 Incident Count by Agency							
County	Agency Name	Agency ID	# of Incidents	County	Agency Name	Agency ID	# of Incidents
All	Gold Cross Ambulance	GA	1,054	Winnebago	Oshkosh PD	OP	46,315
All	Wisconsin State Patrol	WT	3	Winnebago	Poysippi	PS	4
Winnebago	Algoma FD	AG	225	Winnebago	Ripon FD	RF	7
Winnebago	Bay Boom FD	BB	57	Winnebago	Town of Menasha FD	TF	1,022
Winnebago	Berlin FD & Ambulance	BE	18	Winnebago	Town of Menasha PD	TP	12,606
Winnebago	Clayton-Winchester FD	CW	221	Winnebago	Town of Neenah FD	TN	151
Winnebago	Fremont FD	FM	23	Winnebago	Town of Oshkosh FD	TO	139
Winnebago	Menasha PD	MP	14,483	Winnebago	Tustin FD	TS	5
Winnebago	Neenah PD	NP	18,803	Winnebago	Utica FD	UT	50
Winnebago	Neenah-Menasha FD	NM	2,884	Winnebago	UWO PD	UO	2
Winnebago	Nekimi FD	NK	134	Winnebago	VanDyne FD	VD	86
Winnebago	Nichols FD	NC	56	Winnebago	Vinland FD	VL	100
Winnebago	Omro PD	OM	2,915	Winnebago	Winnebago Sheriff	WI	41,071
Winnebago	Omro-Rushford FD	OR	449	Winnebago	Winneconne PD	WC	2,540
Winnebago	Oshkosh FD	OF	7,773	Winnebago	Winneconne/Poygan FD	WN	315
TOTAL INCIDENTS							**153,511**

In 2007, the Communications Center dispatched a total of 138,735 law enforcement calls for service.

Law Enforcement Total Calls Dispatched	Yearly * Radio Service Messages	Daily Radio Service Messages	Hourly Radio Service Messages	Busiest Hour **
138,735	1,387,350	3,801	158	174

* Using an average of 10 radio messages per incident.
** The busiest hour has about 10% more radio calls than the average hour

The fire department(s) were dispatched on 14,769 fire calls for service.

Fire Total Calls Dispatched	Yearly * Radio Service Messages	Daily Radio Service Messages	Hourly Radio Service Messages	Busiest Hour **
14,769	369,225	1,012	42	46

* Using an average of 25 radio messages per incident.
** The busiest hour has about 10% more radio calls than the average hour

The communications center answered 300,000+ telephone calls which include 9-1-1, cellular, non-emergency and administrative calls.

The communications center utilizes Motorola Gold Elite dispatch consoles that were installed April 2003.

The Sheriff's departments operates on one (1) VHF radio channel which is the primary dispatch using ten (10) sites, with four (4) sites steered. There is a second VHF channel that is used for mobile only, simplex for "talk-around." The Sheriff's Department also supports the Town of Menasha Police, Neenah Police that has cross County Mutual Aid with Appleton.

Within Winnebago County the City of Oshkosh police department operates two (2) VHF channels; one (1) as a primary dispatch using five (5) sites, however three (3) sited do not work. The second channel has a mobile repeater used as a back up to support the SWAT Team. The Oshkosh Fire/EMS has one (1) VHF channel with five (5) sites, (3 transmit, voting and steered). The same channel is used for paging five (5) fire stations and the Airport.

Winnebago County fire has one (1) VHF channel for all operations, fire dispatch and paging/alerting fire stations. It operates from seven (7) receiving sites and four (4) transmitter sites with the repeater being manually steered at the communications center.

CTO understands there are an estimated 1,200 Minitor pagers, 600 portables and mobiles utilized by fire departments in the County, and 250 portables and mobiles utilized by law enforcement agencies on the system.

The agencies within Winnebago County that are dispatched or contribute to the loading of the present system and have interoperability needs are listed below.

Law Enforcement Departments		
Menasha	Oshkosh	Winnebago Sheriff
Neenah	Town of Menasha	Winneconne
Omro	UWO	
Fire Departments		
Algoma	Nichols	Tustin
Bay Boom	Omro-Rushford	Utica
Berlin	Oshkosh	VanDyne
Clayton-Winchester	Ripon	Vinland
Fremont	Town of Menasha	Winneconne/Pygan
Neenah-Menasha	Town of Neenah	
Nelkimi	Town of Oshkosh	
Emergency Medical Services		
Gold Cross Ambulance	City of Oshkosh Fire Department	Theda Star
Other Agencies		
Municipal DPW	Winnebago Transit	Surrounding County Sheriffs
Winnebago County Highway	Winnebago Water	U.S. Coast Guard
Winnebago Parks	Winnebago Emergency Management	Wisconsin State Patrol
Winnebago Sirens	Schools	

CTO understands the concerns with the current radio system in Winnebago County to include; can not talk to other counties, communications center personnel can not talk to fire personnel on fire ground channels. None of the TAC channels are recorded. Bleed over from one portable to another knocks the channel off the air. Portables can not monitor other frequencies. In-building coverage is almost non-existing. There is no consistency with the purchasing of equipment; specifications on portables are not the same within a fire station or County/State wide.

SECTION II – COMPARISON OF AVAILABLE RADIO SYSTEM DESIGN ALTERNATIVES

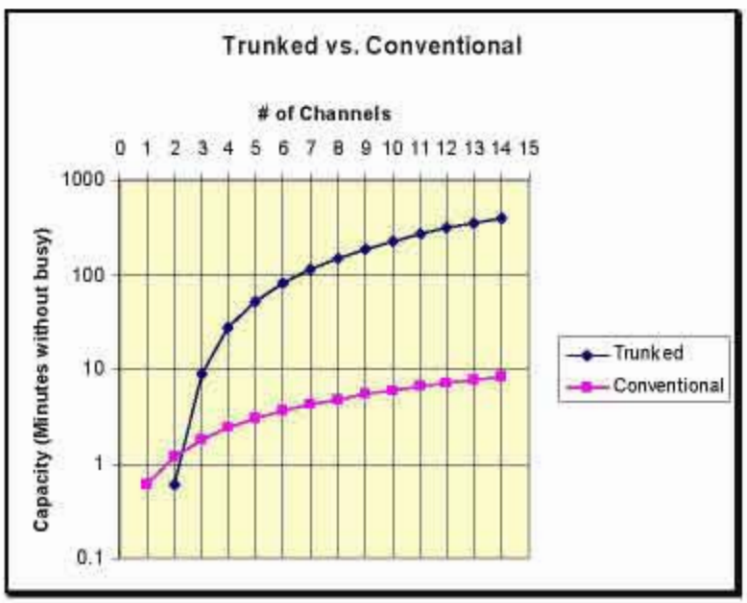
2.1 TRUNKED VERSUS CONVENTIONAL

A conventional radio system uses one (simplex) or two (duplex) radio frequencies to provide a single communications channel. When this channel is in use, other users must listen and wait for the current users to complete their conversations before they can use that same channel. Despite its obvious disadvantages, conventional radios have reliably served the public-safety community for many years. In addition, conventional radio systems are less expensive and easier to maintain than trunked systems.

Trunked systems automatically allocate an available channel from a pool of channels to a user requesting access. Following completion of the transmission, the user's frequency is returned to the pool of available channels to be reused. Channels are assigned as needed, and a single user may use several frequency channels over the course of a conversation. Not every one assigned to use the system needs it all the time. The system's capacity is used by whom ever needs it at a given time.

A comparison of the ability of conventional and trunked systems capacity to handle radio traffic is shown in **FIGURE 2-1.**

FIGURE 2.1 TRUNKED VERSUS CONVENTIONAL



Some of the major benefits of trunked systems are:

- The system can be implemented in gradual stages or as fast as required, consistent with FCC regulations.
- Commonality of equipment could be achieved since every radio will be essentially identical which allows for economies of scale in the purchase and maintenance of radios.
- Various group and subgroup fleet configurations can be established and (if needed) changed after the system is in place since system priority and grouping assignments are controlled by software programs (dynamic regrouping).
- If one channel is not operational, the other channels are available for continued radio use with no significant, noticeable system degradation.
- A trunking system is self-diagnosing, resulting in easier and quicker maintenance and fewer noticeable system problems.

2.2 SIMULCAST VERSUS MULTICAST

Simulcast operation is a reference to the same radio signal being transmitted simultaneously from more than one site, all of which have the same carrier frequency. All communications applications must deal with the needs of the users by addressing the fundamental aspects of coverage and capacity. Simulcast operation is one way of addressing the coverage and capacity demands on the network.

Simulcast boosts the coverage probability over an area without the need to practice frequency reuse. Simulcasting can increase the probability of coverage with less spectrum than would be demanded by a multi-site frequency reuse plan (multi-cast system). Capacity demands can be served well in some applications by simulcast because the users of a trunked group can not be served by one site alone. Simulcast can keep these wireless users together because the group can be raised network-wide by one channel thus eliminating the need to coordinate roaming amongst the users in a mobile environment.

Public safety applications of simulcast increases coverage among groups that are highly mobile and have a need to communicate to each other. Simulcast offers a great deal of spectrum efficiency as well as increased coverage probability. The mobile user needs sufficient signal from any one of a number of sources to be covered. Therefore an increased coverage probability occurs in areas where there are two overlapping sites than exists in areas with one site.

2.3 DIGITAL VERSUS ANALOG

Digital radio systems, unlike analog systems, do not rely on signal strength alone to deliver a message. Digital RF modulation systems have sophisticated error detection and correction circuits to fill in missing parts of a weak signal. Noise and static is eliminated rather than being passed through to the receiver. The analog voice signal is digitized using sophisticated digital speech coding technology or vocoder. The digital system also adds features such as channel signaling, which synchronizes the signal at the receiver, as well as error detection and correction. However, an additional delay, up to one–half second, is introduce by vocoders and is sometimes found unacceptable for fire ground use by some agencies.

Although voice quality is not as pure as analog, the system performance is improved at levels where analog radios put out static, digital radios continue to deliver clear audio. Analog audio quality degrades gradually as the distance from the transmitter increases. Digital audio remains constant until it reaches its outer limit and then drops off rapidly. See **FIGURE 2-3**.

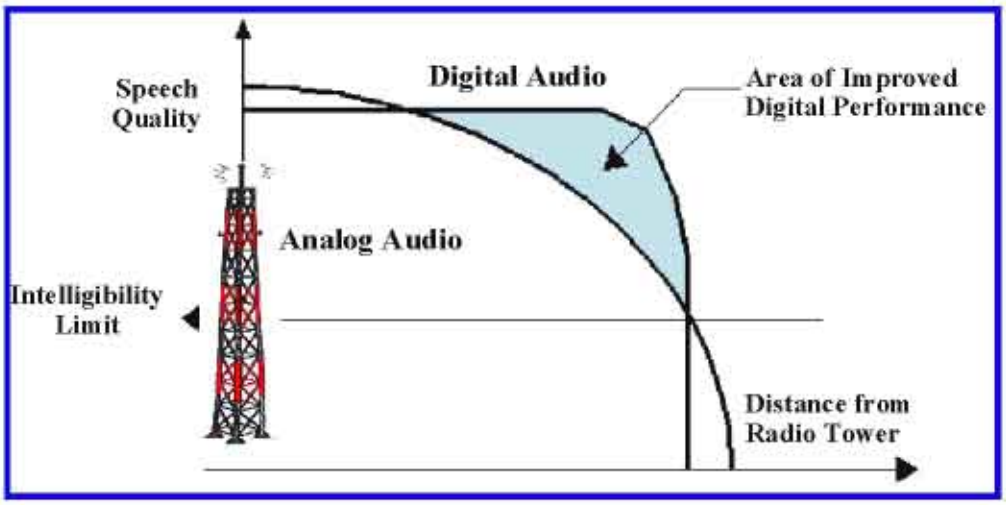
Digital systems also allows for data to be transmitted as well as voice over the same channels, reducing the need for separate voice and data systems.

Further, digital systems allow for reduced spacing between channels, now required for new radio equipment. The FCC has mandated that radios sold after established dates be capable of channel spacing reduction. Existing 25 kHz radio channel spacing must be reduced to 12.5 kHz and ultimately to 6.25 kHz spacing between channels. Only with digitized systems can this goal be accomplished without adjacent channel interference.

Presently a P25 Phase 1 standard has been developed which conforms to the 12.5 kHz spacing. Further this standard has been adopted by major manufacturers. This provides for use of different manufacturer equipment to be used on a system and for a common air interface (CAI) between systems.

P25 Phase 2 standard is currently being developed. The present P25 FDMA system in conjunction with a two-slot TDMA arrangement is of the prime candidate technologies being considered.

FIGURE 2-3: DIGITAL VERSUS ANALOG



2.4 FREQUENCY BAND

The choice of frequency band involves consideration of radio propagation and noise and interference conditions. VHF Lo-band frequencies, while having low path loss, are subject to skip interference from sources at great distance. They also have poor building penetration for voice communication and for paging. The VHF Hi-band and UHF frequencies have less path loss and foliage loss, but poorer building penetration characteristics than UHF, 700 MHz or 800 MHz. Shadow losses (behind gently rolling hills) are more severe for the 700 MHz or 800 MHz frequency band although, because of reflections, 700 MHz or 800 MHz systems perform well in very rugged terrain or where a large number of reflecting objects, such as buildings, exist. Both natural and man-made noises are more severe at VHF than at UHF and above. In general, 700 MHz or 800 MHz generally requires a larger number of sites than VHF or UHF to provide adequate coverage.

The VHF band is not organized into frequency pairs (base and mobile). Sufficient frequency separation may not be available to minimize interference. For example, interference from the base transmitter can cause interference to base receivers operating on a mobile transmit frequency using a different duplex channel.

2.5 IN-BUILDING COVERAGE SOLUTIONS

2.5.1 BI-DIRECTIONAL AMPLIFIER

The bi-directional amplifier (BDA) is perhaps one of the most commonly used solution to provide in-building coverage for above ground as well as underground. Designed to provide supplemental radio coverage in difficult coverage environments, the bi-directional amplifier can provide FoxComm agencies with an in-building projection of their radio network. A BDA system consists of one or more amplifiers located inside a confined environment and is connected to an internal and external antenna network. The external antenna, usually located on the roof of the building needing coverage, receives the signal coming from the radio site. The BDA amplifies the signal and retransmits it into the building or tunnel. A subscriber unit within the building can use the BDA to extend their portable radio coverage and communicate with an external system. The BDA listens for incoming traffic inside the confined space, amplifies it and retransmits it to the external system, hence bi-directional. A BDA can be relatively inexpensive. However, the supporting infrastructure of cabling, antennas, filters and power supplies require considerably more cost. Unless BDAs are adjusted correctly, they can create interference issues-with themselves, through negative feedback; with other BDAs; or with the existing radio system.

2.5.2 RADIATING COAXIAL CABLE

Radiating coaxial cable, also referred to as "leaky coax", can be installed to provide coverage in buildings. The low profile nature of this solution makes leaky coax attractive for building applications. It can be used where a BDA is impractical or unsuitable, such as underground parking lots where a low-profile antenna is required to avoid physical interference. The design of the radiating coaxial cable provides uniform coverage throughout the building or garage (where installed). In addition, radiating coaxial cable has provided coverage benefits for a wide band of frequencies. Radiating coaxial cables are not perfect solutions for every environment. Radiating coaxial cables are passive devices. They can be used in conjunction with BDAs or repeater systems to increase a system's in-building coverage.

2.5.3 FIBER OPTIC TRANSMISSION LINE

While leaky coax is ideal for some tunnel applications, it is not always the best choice, an RF transport medium not susceptible to EMI is fiber optic cable. This alternative can be used in conjunction with other in-building or in-tunnel solutions such as BDAs. In order to use a fiber optic transmission line, additional equipment is required to translate the radio signal into digital

light pulses for transmission on the fiber optic line. The fiber optic cable is therefore a point-to-point alternative. Fiber optic lines can be used in a multiplexing environment. Multiplexing is sending multiple signals or streams of information on a carrier at the same time in the form of a single, complex signal and then recovering the separate signals at the receiving end. Digital signals are commonly multiplexed using time-division multiplexing, in which the multiple signals are carried over the same channel in alternating time slots. In some optical fiber networks, multiple signals are carried together as separate wavelengths of light in a multiplexed signal using dense wavelength division multiplexing.

Like leaky coax, fiber optic lines have a low installation profile to avoid physical interference with their environment. The installation and supporting hardware required to use fiber optic transmission lines, however, is generally more expensive than a typical leaky coaxial cable or other transmission line.

2.5.4 DISTRIBUTED ANTENNA SYSTEM

In order to provide reasonably uniform coverage in buildings and in tunnels, a series of antennas throughout the structure may be necessary for use with a number of the alternatives previously described. This distributed antenna network handles both talk-out and talk-back signals.

Using a hybrid system of BDAs and fiber optic transmission lines combines the advantages gained by utilizing a high bandwidth medium, not susceptible to EMI, with the functionality of the BDA.

2.6 VEHICULAR OR TRANSPORTABLE REPEATERS

A vehicular repeater is a component used in conjunction with a mobile radio, which effectively expands the range of a portable radio in the field. For example an officer leaving his/her vehicle can begin transmitting on his/her portable radio, the 3-5 W portable radio signal is boosted through the vehicular repeater, thus enabling transmission at much greater distances and the enhanced ability to penetrate in buildings. For in-building scenarios, the vehicular repeater can be brought to the scene to improve the localized communications in the emergency response area. The vehicular repeater typically is not limited by a power source and is highly mobile. That can have limited versatility in confined or remote environments.

Vehicular repeaters generally operate on two different bands which may require a first responder to carry two portable radios; for example one for VHF which is used in areas where sufficient talk-back coverage exists and one at 800 MHz to couple with the vehicular repeater where VHF talk-back coverage is sufficient. However if frequencies with sufficient separation are available operation in one band can be carried by each first responder.

Another approach would be to have trunked radios in vehicles and repeaters in all vehicles. In this case the portable radio carried by a first responder would have to only communicate with the vehicle repeater which has better talk-back coverage. In this case the portable radio could be a single frequency analog radio which is considerably less costly than a P25 trunked portable. For example the first responder would always use an analog single frequency 800 MHz analog portable and the vehicular repeater would be used to provide talk-back on appropriate talk-group of the VHF digital simulcast P25 trunked system.

Generally there are four or five times as many portable radios than there are vehicular radios in a public safety radio system. The use of less expensive portable radios by first responders and the use of fewer fixed repeater sites needed for obtaining portable radio coverage, should provide considerable cost savings.

Vehicular repeaters could be available for use by any units that are assigned to or will be used in areas where low talk back coverage is predicted, including poor in-building coverage.

If an incident requires a large number of first responders in a low talk back coverage area, a transportable or suitcase repeater should be available and be used.

2.7 INTEROPERABILITY BETWEEN DIFFERENT SYSTEMS

Mutual aid becomes somewhat more complicated when adding advanced technologies such as trunking and digital operation. In particular, when a locality has a digital trunked system and must interface with another's analog trunked system, interoperability between these systems must exist. There are several levels of interoperability.

Each of these is outlined below:

On-site Talkaround: This can be performed between any units of any technology base, since they can all operate in the FM analog mode. For this reason, talkaround is not an issue in terms of interoperability (provided operations are in the same frequency band).

Shared Talk Groups: When two agencies operate trunked systems that were installed by the same vendor, it is possible to program the portables and mobiles to contain shared talk groups. Essentially, this is similar to equipping conventional users to operate on the other agency's channels. A user who is located in range of the other agency's system may switch talk groups (channels) to communicate with users from that other agency.

Cross-Patch: Users on incompatible trunking systems can communicate directly with one another via a console cross-patch or linking of frequencies. In this mode, the dispatcher activates the patch manually. Typically, this is done by hardwiring a control station from one system into the console from the other.

Mutual Aid Channels: A series of mutual aid channels have been allocated for public safety operations. Users may access these channels in the conventional mode. The dispatcher on the calling channels can monitor the mutual aid channels. Field personnel would be directed to tune their radios to one of the tactical channels to talk to another unit.

Cross-Band Repeaters: Users operating in different frequency bands can also communicate directly by the use of cross-band repeaters, which allow transmission in one band to be repeated in another band. This eliminates the need of having multiple radios in a vehicle. For example in a VHF system and 800 MHz system requiring interoperability, the system operating in the VHF band would have a channel which would transmit a signal to a cross band repeater which would then be repeated on one of the 800 MHz channels and vice-versa.

2.8 INTERNET PROTOCOL SYSTEMS

With the rapid advance of digital technology in the last two decades, IP (internet protocol) technology has reached a point of maturity. Its hardware, software, network configuration, maintenance and management are well understood and widely used. Today's internet with IP technology at its core has a proven record of providing reliable information services at an industrial scale around the world. With its very large installation base, growing demand and fast innovation, IP technology has supported diverse and reliable equipment and service providers. The price of IP technology continues to decline. Many organizations, including government entities, have built their own private IP networks. Each device on the network is given an unique IP address. At the core of the network are IP routers/switches, which are very efficient for routing data, in the form of packets to different devices on the network.

Digital technology such as P25 Phase 1, has gained wide-spread acceptance for public safety radio communications. P25 Phase 1 encodes analog voice into digital data at the transmitting end and decodes them at the receiving end. A back haul network, with IP routers/switches instead of traditional circuit switch at its core, is used to connect every base station. This kind of network can take advantage of mixture of microwave system, T1 lines, coax cable lines, fiber optic lines, and telephone lines, whether the networks are private or public. It is

usually isolated from the internet for security reasons. The non-proprietary nature of an IP network also makes it easier and less expensive to maintain and upgrade.

SECTION III – RADIO SYSTEM REQUIREMENTS

3.1 GENERAL

A radio system must be able to propagate or transmit a signal with enough strength to be received where needed with minimum delay. The system should have the capability to perform this function with a high degree of reliability under many different conditions in order to support FoxComm.

The last thing on an officer's or fire fighter's mind is whether he/she can communicate with the command center while performing their duties.

The time to be thinking about the communications systems is before events occurs, not as they are developing.

The volume of traffic required and the differing operational requirements of the users as well as the frequencies that are available can best be served by a trunked radio system.

3.2 CHANNEL LOADING

Channel loading requirements for a system to support the user agencies requires that sufficient total current airtime minutes be available during the busiest hour if a major emergency is to be supported. The peak load requirements assume that all of the units have peak load requirements during the same hour. A 12-channel simulcast trunked system for example, will handle approximately 300 minutes of airtime traffic at a Grade of Service of one busy in 100 attempts (GOS of 1/100) during a peak hour. However, it is unlikely that all of the counties various agencies would be involved in major incidents during the same hour.

The number of incidents (for 2007) handled by each agency in each of the four FoxComm counties is given in **Table 1-1** through **Table 1-4**. The total annual incidents for each county and the average hourly number of incidents handled are shown in **Table 3-1**. During the busiest hour the number of incidents handled is four (4) times the average hourly value. On average each incident requires one minute of airtime for the radio system. This is also shown in **Table 3-1** as well as the number of trunked channels required if each County has a trunked system and the total channels required if a County system serving all Counties is used.

TABLE 3-1 – INCIDENTS AND RADIO TIME REQUIRED BY COUNTY

County	Yearly Incidents	Average Hour	Peak hr/Peak min of Radio	Trunked Channels Required
BROWN	200,947	22.94	91.76	7
CALUMET	21,436	2.45	9.78	4
OUTAGAMIE	159,072	18.16	73.64	6
WINNEBAGO	153,511	17.52	70.09	6
Total for County FoxComm Combined System	534,966	61.07	244.28	11

Assuming a growth of 20% (1.8% compounded per year) over 2007 values the peak hour incidents required to be handled for FoxComm would be over approximately 294. This assumes that all agencies busy hour would occur at the same time. The 294 minutes with a Grade of Service of 1/100 would require a 12 channel trunked system. If each County used a separate trunked system 23 channels would be required, not considering 20% growth. If a 20% growth is considered then the same number of channels would apply with the exception that Outagamie County and Winnebago County would require and additional channel (7 instead of 6).

The above discussion concerned only the requirements to handle incidents for public safety first responders. If the radio systems are to be used to handle radio traffic to support other local government functions such as government operations, public works, highway and roads, jails, schools, utilities, etc. then more channels would be needed. If peak radio traffic is to include these additional functions then more channels would be required. As an example if all of these functions together were to increase radio traffic by 50% in a peak hour. **Table 3-2** reflects the channel requirements for 2007.

TABLE 3-2 – CHANNEL REQUIREMENTS BY COUNTY

County	First responder peak minutes	Additional for other functions	Total Peak min of Radio	Trunked Channels per County	Plus 20% growth *
BROWN	91.76	45.88	137.64	8	9
CALUMET	9.78	4.89	14.67	4	4
OUTAGAMIE	73.64	36.82	110.46	7	7
WINNEBAGO	70.09	35.05	105.14	7	7
FoxComm Total for 4 county combined system	244.28	122.14	366.42	14	16

* Assuming a 20% growth over the next ten years across the board.

3.3 FREQUENCY REQUIREMENTS

A 14 channel trunked system will require 28 frequencies (14 pairs) at VHF or 700 MHz for a simulcast P25 trunked system using the 366.42 peak minutes shown above. A 16 channel system can handle over 485 peak minutes.

There are only 10 pairs of VHF frequencies, shown in **TABLE 3-3,** which have been selected from frequencies presently in use by FoxComm counties and city agencies, that will not cause interference between base transmitter and receiver at a repeater site (less than 1.0 MHz separation). In addition a search of co-channel frequencies was made. All but about three (3) of the present used channels have co-channel stations within 70 miles which can interfere. These are shown in **Appendix B**. The interference potential to a trunked system precludes the use of VHF by FoxComm.

The 700 MHz band will be available for public safety agencies on a nationwide basis by February 17th 2009 when TV stations are to convert from analog to digital formats. FoxComm resides in region 45; a 700 MHz plan has been submitted. The current allotments for the FoxComm region are as follows:

- Brown County 18 channels
- Calumet County 4 channels
- Outagamie County 14 channels
- Winnebago County 13 channels

Each channel is 25 kHz wide.

There is sufficient number of 700 MHz Channels to support FoxComm requirements. The frequency for an additional channel for each county is to be determined.

Each County would have one additional channel, frequency to be determined in the future. A conversion to a P25 Phase 2 trunked system would result in a considerable increased peak capacity of over the projected 267 minutes required at a GOS of 1/100. This could accommodate future growth. However, more sites for outdoor portable coverage may be required for a P25 Phase II system.

TABLE 3-3 – VHF FREQUENCIES

#	TX	RX	#	TX	RX
1	151.1000	155.0550	6	153.9050	158.7450
2	151.2800	155.1900	7	153.9800	158.7750
3	151.1150	156.0450	8	153.9950	158.8950
4	151.4150	156.3000	9	154.3250	159.9550
5	153.8150	158.2050	10	154.4000	159.0750

3.4 SYSTEM COVERAGE

After an analysis for co-channel interference as well as separation of all VHF frequencies licensed to the counties, and a review of the present 800 MHz frequencies available in the region it was decided that 700 MHz was the best alternative. The FCC has allocated 700 MHz frequencies to be used by Public Safety and the equipment is presently available. Therefore, it was decided that 700 MHz was the best option for the Counties as well as for FoxComm.

3.4.1 ON-STREET RF COVERAGE

The users of FoxComm require extended wide area coverage for portable as well as vehicular radio with 95% of the locations, 95% of the time.

FIGURE 3-1 shows talk-out coverage from base stations to both vehicular and portable radios while **FIGURE 3-2** depicts talk-back coverage for a vehicular radio for a 700 MHz system using the same sites. **FIGURE 3-3** shows portable talk-back coverage. Several additional sites may be required to enhance coverage.

On all coverage diagrams areas depicted in **red** have high quality signal levels, areas depicted in **green** have acceptable signal levels, while those depicted in **white** have insufficient signal levels for reliable communications.

The sites required for outdoor coverage are shown in the figures. The coverage diagrams assume that all sites have both transmitters and receivers. It may be possible to use receive only sites in some cases. In each case, equipment necessary to accommodate a trunked radio system will be required.

FIGURE 3-1 – 700 MHZ TALK-OUT COVERAGE

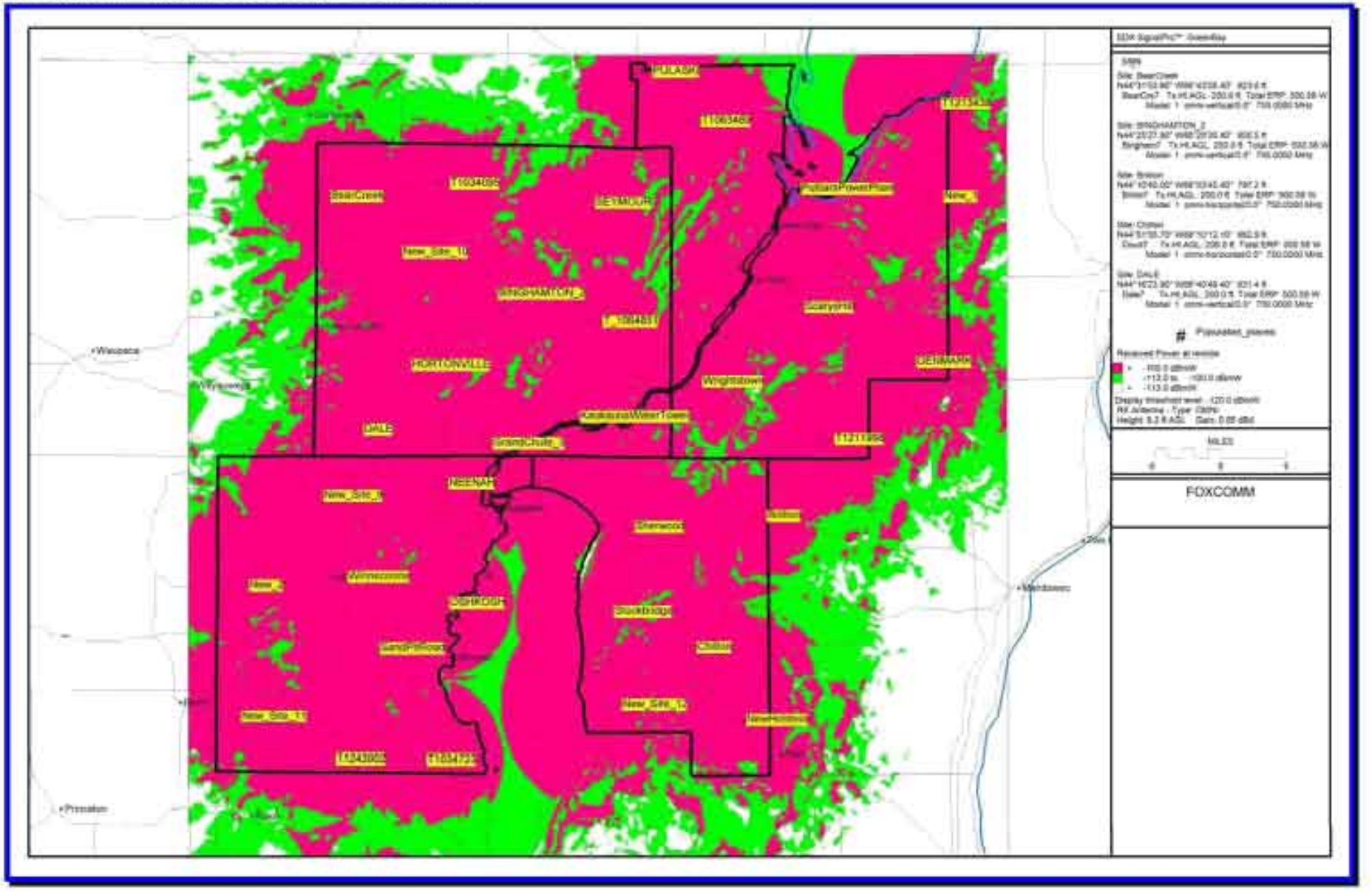


FIGURE 3-2 – 700 MHZ MOBILE TALK-BACK COVERAGE

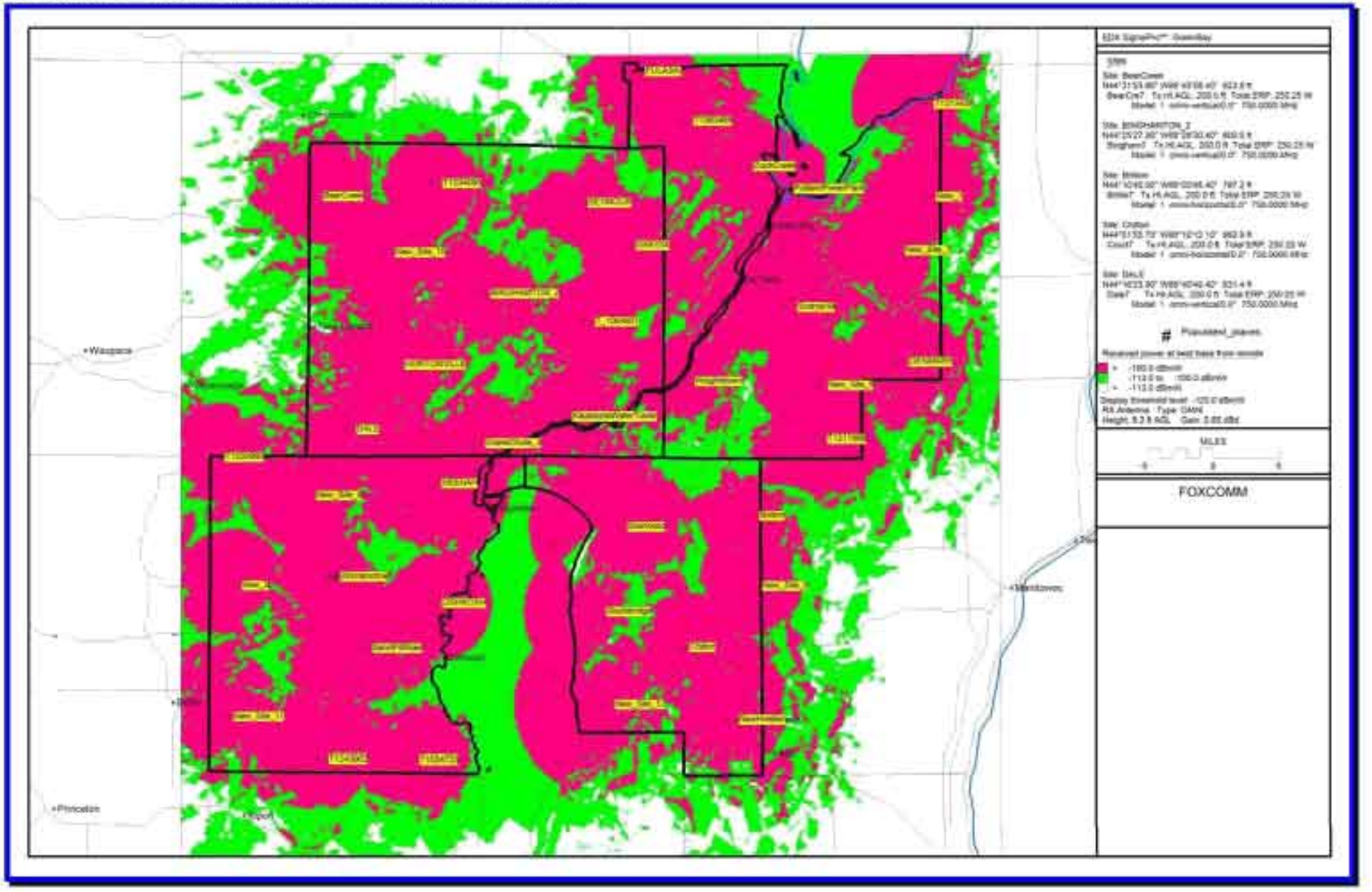
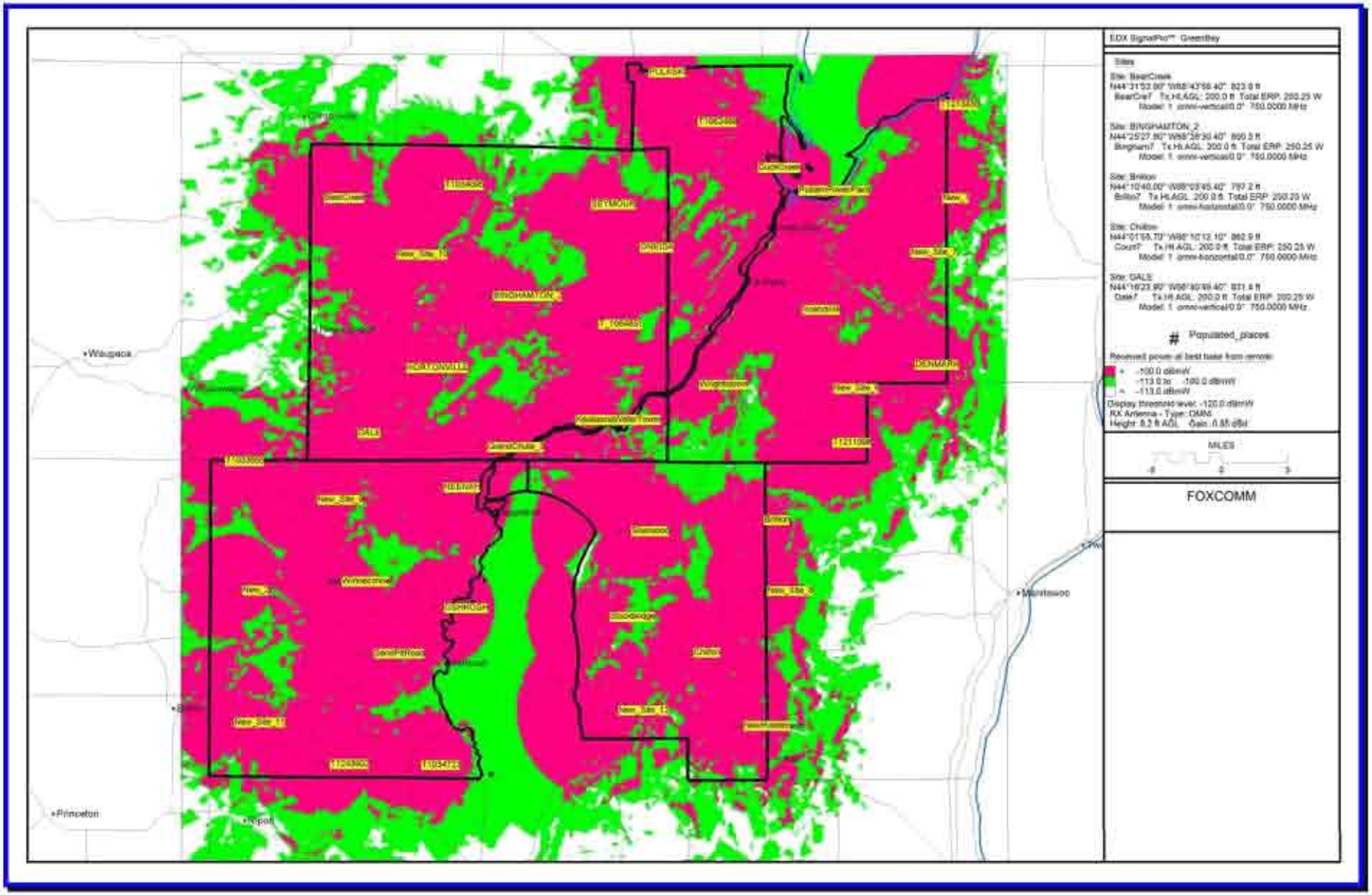


FIGURE 3-3 – 700 MHZ PORTABLE TALK-BACK COVERAGE



3.4.2 IN-DOOR RF COVERAGE

Radio propagation indoors is much more complicated than propagation in free space.

A number of factors affect radio coverage in a building. The building's relative location within the coverage footprint may determine a major part of a building's internal communication capabilities. The building's size, layout and the materials with which the building is constructed also contribute heavily to the communications lack of indoor radio coverage. Other indoor location such as basements and underground garages are generally blocked from direct outdoor RF signals.

Indoor communications can be defined in two possible ways:

- **Internal unit-to-unit communications** is the ability of subscriber units to communicate with each other within the confines of the building or other indoor locations.
- **Subscriber unit-to-external infrastructure communications** is the ability of a radio unit to communicate with infrastructure located outside of the building or other indoor locations.

Those indoor alternatives as discussed in **Section 2.5** should be capable for both internal unit-to-unit and subscriber unit-to-external infrastructure communications

Where indoor coverage is required various building locations the use of one or more of the various alternatives of **Section 2.5** may be applicable. Generally these will require a "donor" antenna on the building and a Bi-Directional Amplifier (BDA) along with a Distributed Antenna System (DAS). If fiber optic cable is presently installed in any of these locations consideration should be given to RF over fiber.

3.5 MOBILE 800 MHz DATA SYSTEM

The present talk-out coverage of mobile data systems used in FoxComm is shown in **Figure 3-4**. The present talk-back coverage from a vehicle MDC is shown in **Figure 3-5**. It is readily apparent that 95% area coverage can not be obtained with the present system.

In addition, extremely long times (reported up to 20 minutes) are required to access the system or obtain a vehicle's location using the present system.

By using the 800 MHz frequencies that became available from incorporating Green Bay's voice radio into the 700 MHz Brown County system or in an overall FoxComm voice radio system, six channels can be made available for 800 MHz mobile data use. These coupled with the three present channels can be used to enhance the 800 MHz mobile data system to allow for narrowband and wide band data application with vehicle location handled with voice radio system.

FIGURE 3-4 PRESENT MOBILE DATA SYSTEM TALK-OUT COVERAGE TO MDCS

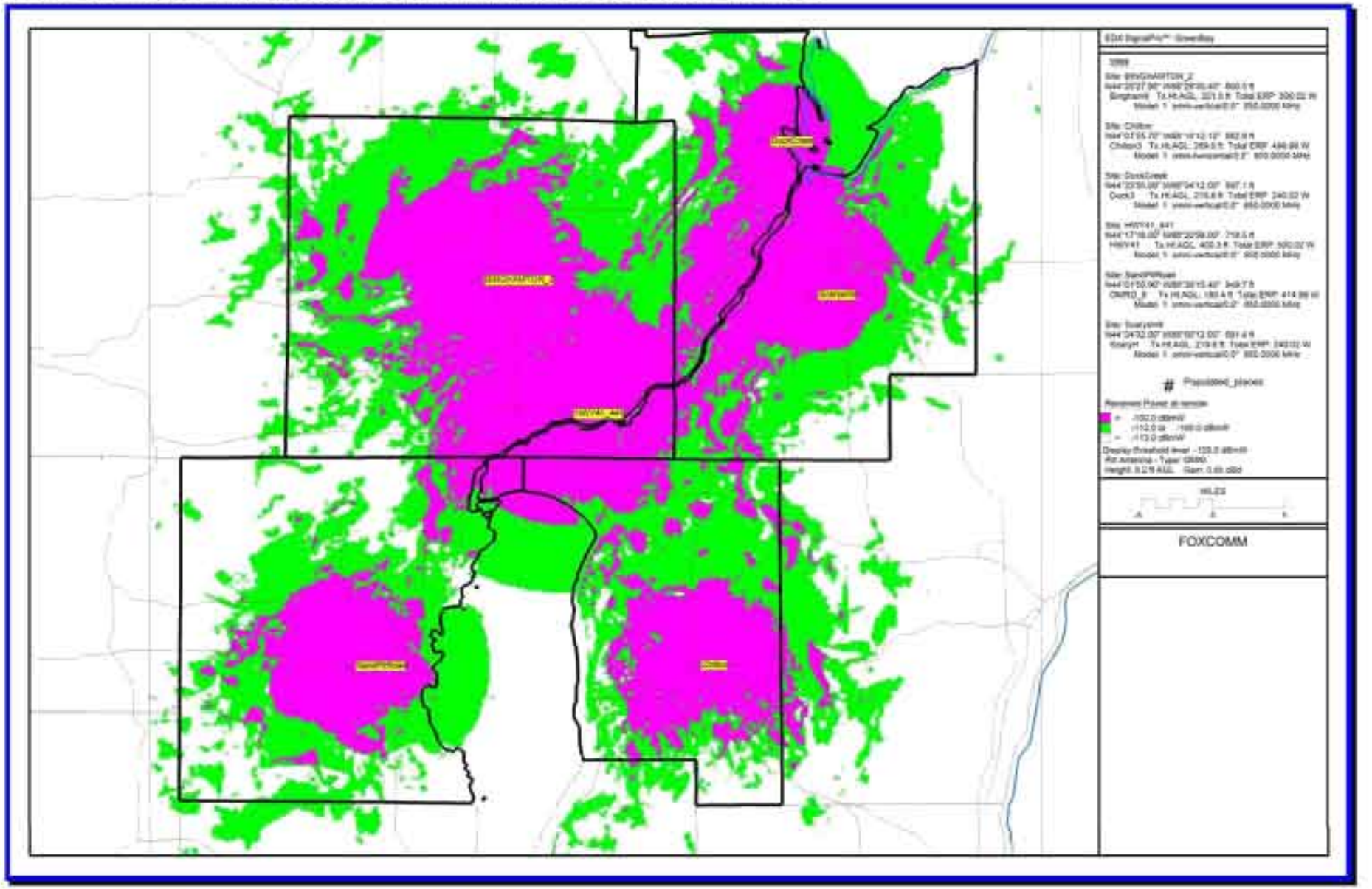
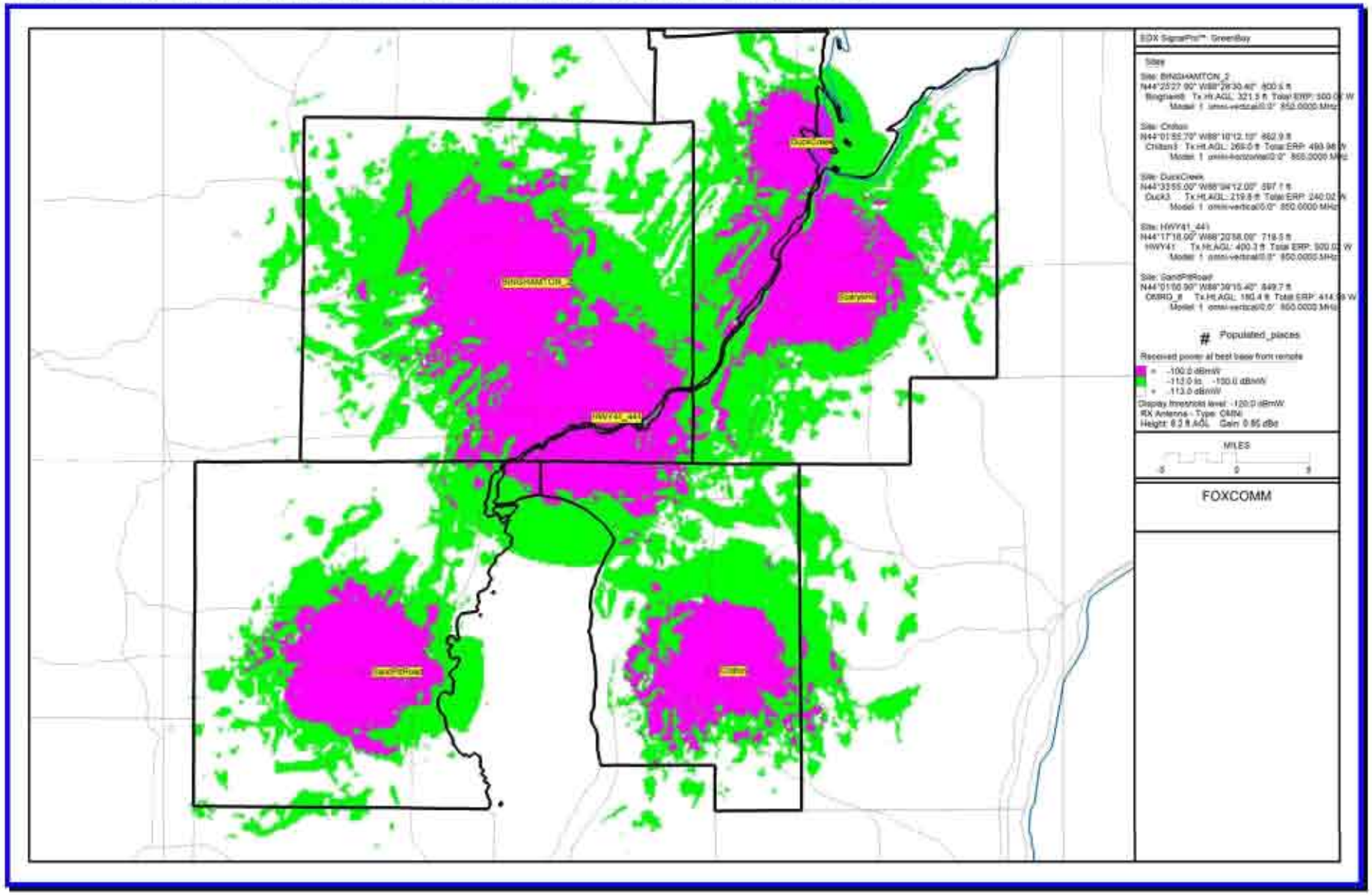


FIGURE 3-5 PRESENT MOBILE DATA SYSTEM TALK-BACK COVERAGE FROM MDCS



With nine (9) channels a "cellular-like" mobile data system can be established where channels with sufficient distance separation needed to avoid interference, can be reused. Separation between sites must account for mobile units being within range of one site using a talk-out portion of the channel while being separated at a sufficient distance to avoid interference to another sites talk-back receiver coverage and vice versa. A system of this type is shown in **Figure 3-6** where talk-out power is reduced to provide coverage essentially the same as talk-back coverage. The channels (number 1 through 9) each associated with particular sites are shown in the figure. These sites are a portion of those used by the 700 MHz voice system. This should reduce tower costs. Coverage for talk-back is shown in **Figure 3-7.**

This approach will not allow for live video and other broadband data transmissions to and from an incident scene because of bandwidth limitations of the mobile data system. A broadband system would be required. While such systems are available at 4.9 GHz for Public Safety use, they have limited range and an extremely large number of repeater sites would be required to provide on-scene coverage.

The FCC has recently issued a license in the 700 MHz band to operate a public safety nationwide broadband data system. This system would be built by a commercial operator with a similar license for a block of frequencies which could use both the public safety and commercial blocks except in an emergency situation. During such a situation the public safety entities could use both blocks of frequencies. The combined system was to be in operation in most of the Country in 10 years with urban areas covered first. Unfortunately, only one bid was received in the 700 MHz auction for the commercial license which was about one-third of the minimum price established by the FCC. As a result the FCC is considering different options and the availability of the broadband 700 MHz system will be delayed for some time beyond the 10 years.

The use of 4.9 GHz could be achieved near local government sites for real time broadband data transmission at reasonable costs. These sites are not necessarily near where an incident would occur. However, this approach could be used to provide transmission of recorded broadband data to and from dispatch centers.

Commercially available "wireless broadband" can be contracted from companies such us AT&T, Sprint Nextel, Verizon, and other carriers. These usually cover most of the populated areas and most highways.

FIGURE 3-6 PROPOSED MOBILE DATA SYSTEM TALK-OUT COVERAGE TO MDCS

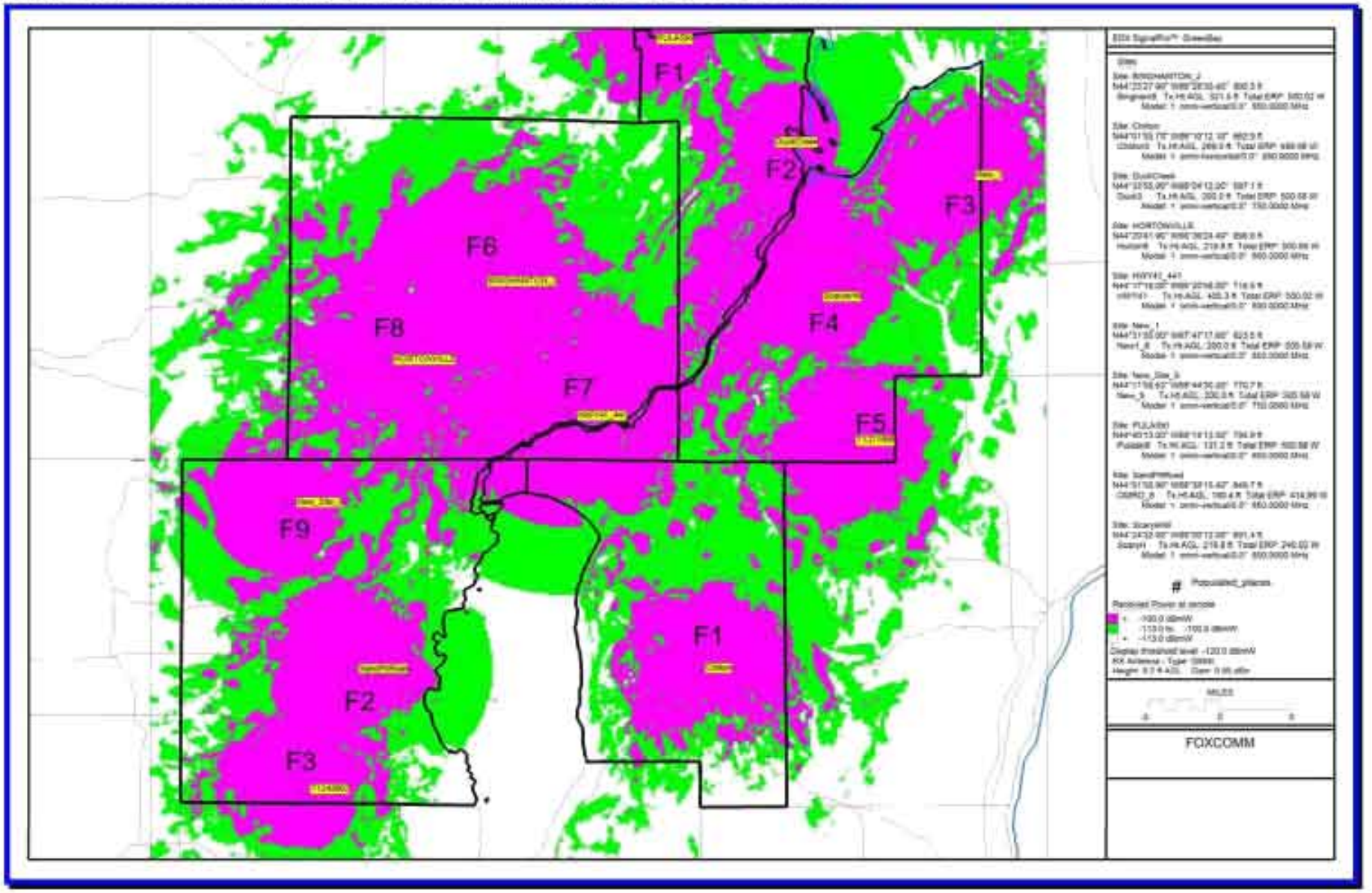
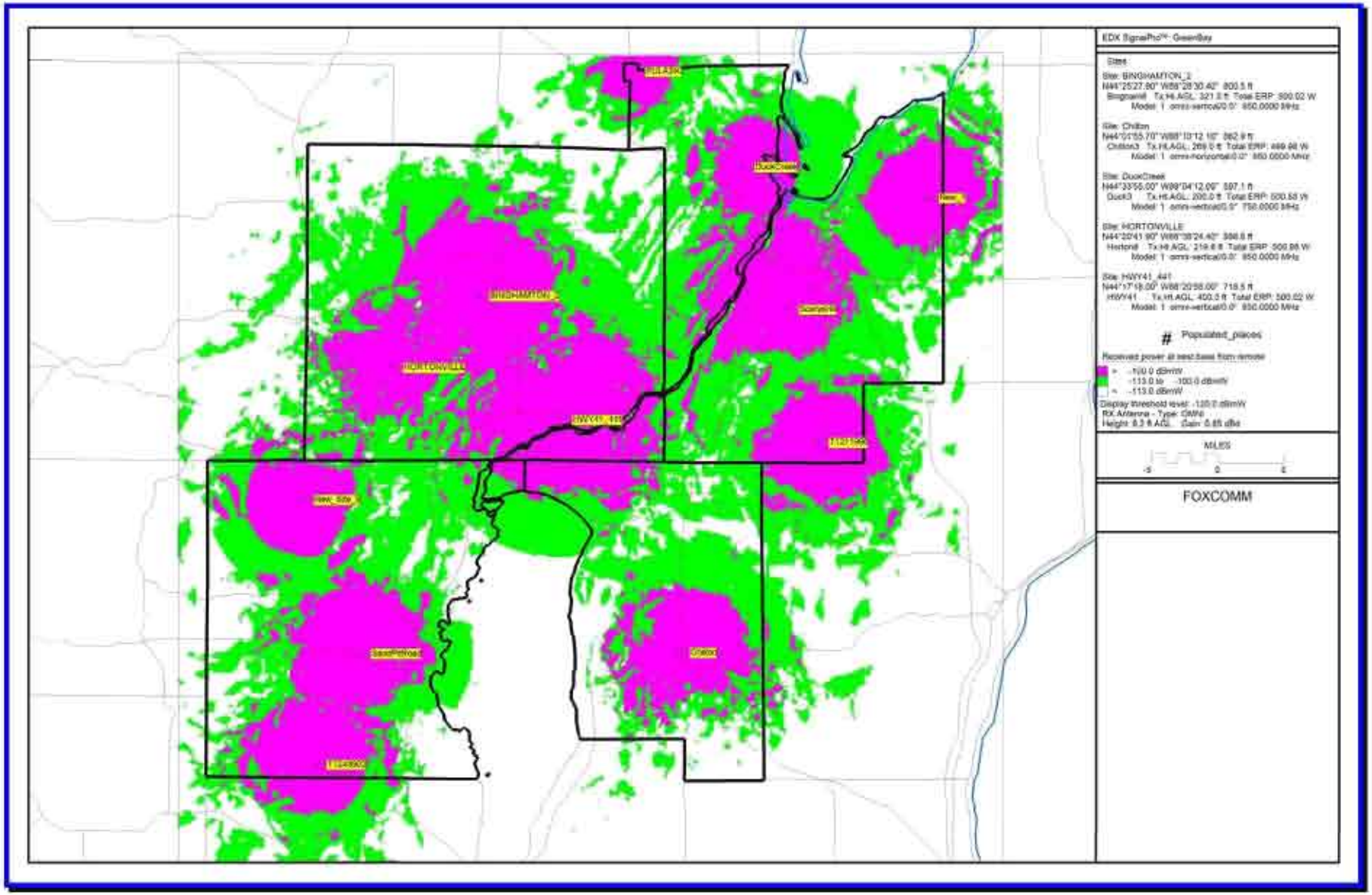


FIGURE 3-7 PROPOSED MOBILE DATA SYSTEM TALK-BACK COVERAGE FROM MDCS



3.6 PAGING AND ALERTING

Paging and alerting are presently handled in various ways in the four FoxComm Counties. In some cases this function is handled on the voice radio system using PL Tones to identify a page or alert message as contrasted to a normal voice dispatch conversation. In other cases separate channels are used for dispatch, and paging and alerting are handled on a different channel with patching of voice messages. Minitor pagers appear to be used in all cases for firefighters. All systems use VHF frequencies.

The current VHF paging channels can be used in a FoxComm-wide or four County-wide simulcast paging and alerting systems. Many of the same sites used for the 700 MHz voice radio system and for a mobile data system could be used which would result in significant cost savings.

The use of simulcasting will improve coverage and provide for a common paging and alerting system which, with the use of PL tones, can allow retention of the present Minitor pagers and alerting equipment at Fire Companies.

The FoxComm-wide system would have the advantage of reaching volunteer Fire Fighters that have employment or are visiting in other FoxComm counties than the one in which they are assigned. Alerting could also be given to Fire Companies who are stationed in other FoxComm counties.

3.7 INTEROPERABILITY

Interoperability partner agencies include Public Safety agencies in counties adjacent to FoxComm. In all cases, with the exception of those agencies operating with P25 on the same band, some type of interoperability should be included in the Radio System. The use of gateways (cross band repeaters) which links the audio signals of a system to another system presents an approach which could be used. This would allow talk groups of the other system to be capable of operating on a FoxComm talk group and vice versa.

The use of a 700 MHz system (which also has subscriber equipment covering the 800 MHz band) would allow interoperability with Sheboygan County which has an 800 MHz system. Interoperability with other neighboring Counties that use VHF systems can also be achieved by

retaining present VHF subscriber equipment for use in mutual aid situations with these Counties.

The interoperability subcommittee of the PSWAC defined *interoperability* as "an *essential* communication link within public safety service wireless communications systems which permits units from two or more different agencies to interact with one another and to exchange information according to a prescribed method in order to achieve predictable results." In addition the *PSWAC Final Report* described three different types of interoperability:

- Day-to-day interoperability
- Mutual aid interoperability
- Task force interoperability

3.7.1 INTEROPERABILITY BACKGROUND

Major incidents or situations can require aid from nearby jurisdictions and Federal agencies and require interoperability with state police.

3.7.1.1 DAY-TO-DAY INTEROPERABILITY

Is the most commonly encountered and is typically associated with areas of concurrent jurisdiction where agencies monitor each other's routine traffic. Such interoperability minimizes the need for dispatcher-to-dispatcher interaction to arise in the exchange of information among units in the field.

3.7.1.2 MUTUAL AID INTEROPERABILITY

Often involves multiple agencies under conditions that allow for little planning for the specific event. This type of communications is called tactical, and when responders are on the scene, typically involves the use of portable radios.

3.7.1.3 TASK FORCE INTEROPERABILITY

Usually involves communications among agencies representing several units and/or levels of government under conditions that do allow for planning. This type of communications usually involves the use of portable and/or covert equipment, often requires extensive close-range communications, and due to the nature of the communications traffic involved, long-range transmission is undesirable.

3.7.1.4 INTEROPERABILITY PARTNERS

The system to be procured should be capable of providing interoperability with the following agencies:

- Federal
  - FBI
  - US Coast Guard/ Homeland Security
  - Secret Service
- State and Local
  - Wisconsin State Police
  - Police, fire and EMS agencies
    - Adjacent Counties
    - Cities and Towns
  - Tribal Public Safety units

Where different frequencies are used by these agencies the system should have cross band repeaters or carry portable radios for use by command personnel on the other agencies system.

3.8 BACK-UP REQUIREMENTS

3.8.1 POWER

Back-up power requirements for UPS and generators are shown on the floor layouts for various types of sites (see **Appendix C** for examples). The power requirements at each site can be determined after the various alternatives (for radio, MDC, and paging and alerting) are chosen and the Final Design is completed. The UPS back-up power can be obtained from batteries alone, which are charged by the normal power supply at the site, or can be supplemented by an emergency generator activated when the normal power supply is disabled. If only batteries are used at the site a longer period for which they must supply power is required.

3.8.2 TRUNKED SYSTEM RECOVERY

The fault tolerant features of a trunked system and the coverage afforded to vehicular radios will be used for recovery. The failure of a transmitter at a site, for example, is immediately recognized by the self-diagnosing features of a trunked system, which results in easier and quicker maintenance. The loss of one (1) channel will cause little noticeable system degradation because all of the other channels are available and only a small reduction in Grade

of Service (GoS) will result. If a control channel fails, a voice channel can quickly be converted to become a control channel.

3.8.3 SECURITY/ENCRYPTION

3.8.3.1 CURRENT SECURITY CAPABILITY

None of the agencies in the four counties have security or encrypted capability incorporated in the current radio system with the exception of the 800 MHz Green Bay trunked system. The radio users would like to have capability to have secure encrypted interoperable communications.

The new system should have the ability to support voice encryption on all the RF channels within the system. Both the infrastructure and the subscriber equipment should be able to support P25 compliant, FIPS 140-2 Certified, Type III encryption (AES 256 bit).

Field units and radio consoles should be capable of detecting encrypted radio communication and automatically receive and decrypt the message should it be programmed and authorized to do so. Consoles will have the capability to monitor and transmit to different encrypted channels and talk groups simultaneously. The consoles will notify the dispatcher if an unencrypted signal has been received.

3.8.3.2 ADVANCED ENCRYPTION STANDARD

The Advanced Encryption Standard (AES) specifies a FIPS-approved cryptographic algorithm that can be used to protect electronic data. The AES algorithm is a symmetric block cipher that can encrypt (encipher) and decrypt (decipher) information. Encryption converts data to an unintelligible form called ciphertext; decrypting the ciphertext coverts the data back into its original form, called plaintext.

3.8.3.3 OVER THE AIR REKEYING

P25 includes a standardized Over-The-Air- Rekeying (OTAR) function. OTAR is a way to greatly increase the utility of encryption systems by allowing transfer of encryption keys via radio. This remote rekey ability, controlled from a Key Management Facility, or KMF, means that radios no longer have to be physically touched in order to install a new replacement key into a radio saving time and money over time.

3.8.4 INTERCONNECTION NETWORKS

The existing interconnection network is shown in **Figure 3-8** some Microwave links use analog 2 GHz frequencies which are not capable of being used in the new system.

The use of "loop" type of equipment should be used between sites. In a "loop" arrangement each site is connected to two other sites such that signals flow initially in one direction around the "loop". If a link between two sites is disabled the signal flow is reversed and the signals to and from each of these sites will be connected to the origination point. Loop networks should be used if the interconnection network uses fiber optics, microwave, T-1 lines or combination of these links. For receive only sites spurs off of the loop can be used.

The interconnection networks can make use of most existing fiber optics and digital microwave links or T-1 links between sites.

An upgraded interconnection network is required to support a new radio system. The same network should link all PSAP/Dispatch Centers to all sites and to each other for back-up. A central Back-Up Data Center should also be provided which will store all voice radio calls, mobile data, 9-1-1 telephone transcriptions, paging and alerting actions and CAD information for all PSAP/Dispatch Centers. Interconnection to this Center and existing PSAP/Dispatch Centers should be required.

FIGURE 3-8 – EXISTING INTERCONNECTION NETWORKS

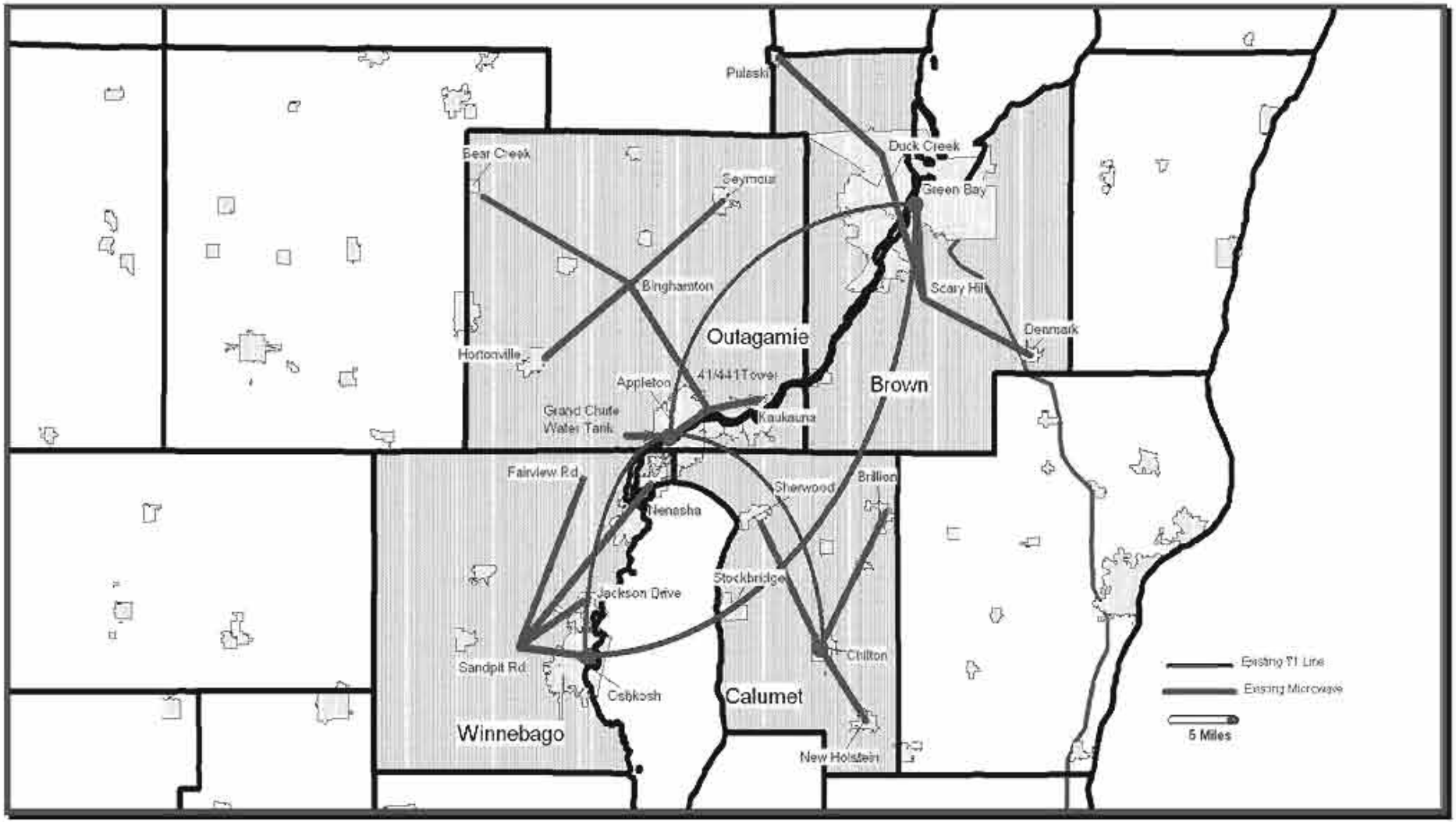
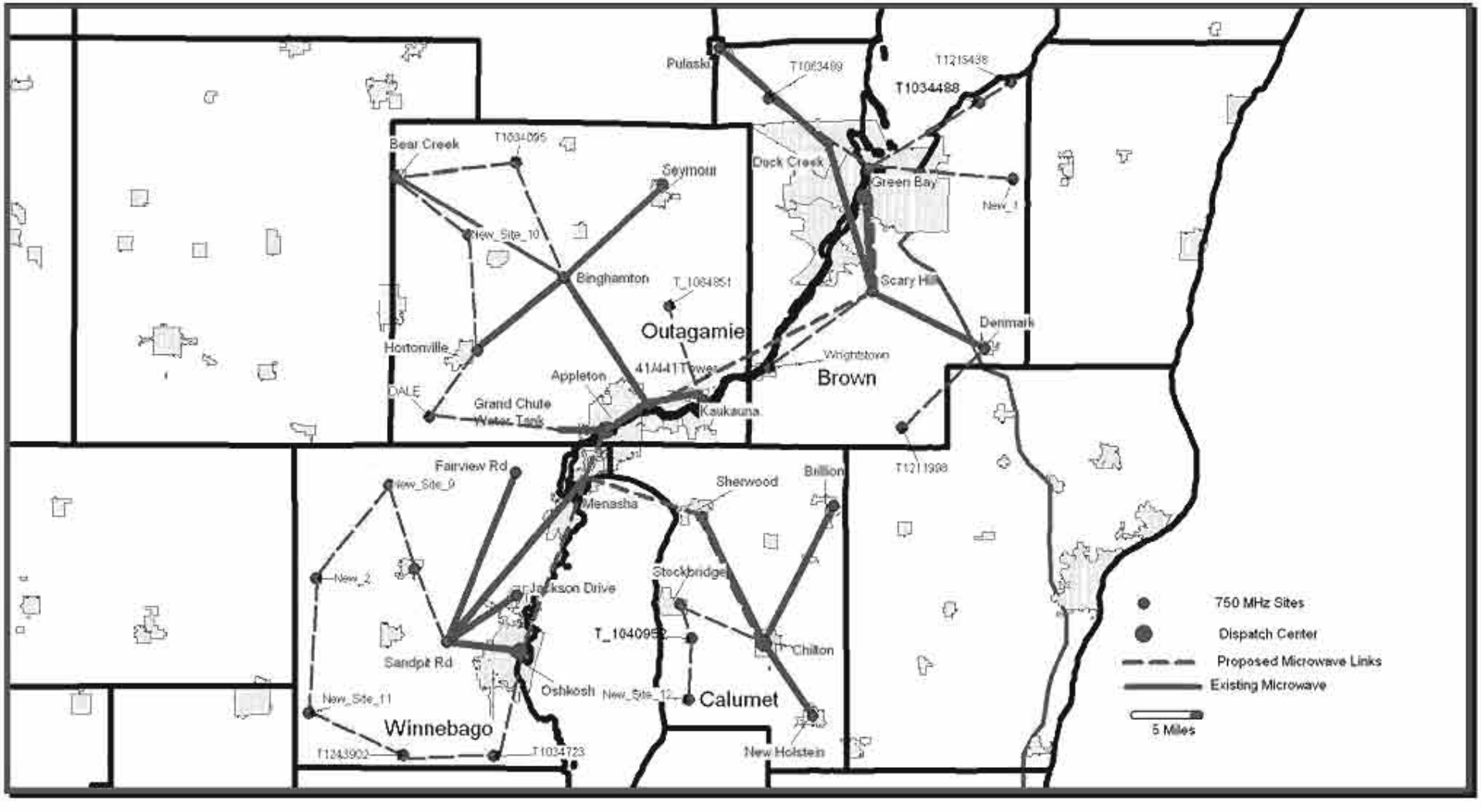


Figure 3-9 shows the required interconnection networks. Where replacement to existing interconnecting paths, i.e. 2 GHz microwave are necessary, these are shown. All repeater sites PSAP/Dispatch Centers and the Back-Up Data Center are interconnected in loop networks. Spur links to this network are shown to receive only sites. All new sites are shown using microwave links for connection to the network. Where these sites have available connections to T-1 or fiber optic paths substitution of these media must be considered. The quality that fiber optics offers can exceed that of microwave. However, microwave interconnection to all sites should be used. The other media, because of their vulnerability to breakage, should be used for additional backups. Path profiles and Fresnel zone clearance are shown in **Appendix D** for all microwave links.

FIGURE 3-9 – PROPOSED INTERCONNECTION NETWORKS



3.9 FUTURE RADIO SYSTEM MIGRATION CONSIDERATIONS

Future upgrades of a simulcast trunked system should consider a P25 Phase 1 FDMA system, combined with a defined migration to TDMA or P25 Phase 2 system with equivalent 6.25 kHz per voice channel spectral efficiency.

This should be appropriate for the operational and performance requirements of public safety/public service agencies and will have the ability to increase system channel capacity.

The narrow band (12.5 kHz bandwidth) digital FDMA system would allow for a common air interface (CAI) with other users in the same band with P25 Phase 1 compliant FDMA systems. Further, migration to P25 Phase II operations should also be possible. P25 Phase 2 will allow for the equivalent of 6.25 kHz spectrum occupancy, which can increase efficiency and allow for increased traffic handling capacity through the use of FDMA/TDMA. However, some problems can arise due to timing of TDMA pulses. This can be reduced by the use of additional sites for simulcast operations. The use of 6.25 kHz equivalent operations, although increasing traffic capacity by use of FDMA/TDMA, will not quite double the capacity as compared to a 12.5 kHz FDMA system.

The P25 Phase 2 systems are also capable of handling both voice and some data traffic. For example, vehicular location data could be handled by a P25 Phase 2 System.

SECTION IV – TRAINING

4.1 GENERAL

It is imperative that training be provided to all involved personnel. There should be basic training designed to familiarize the personnel with all aspects of the new system, enabling them to understand its operation features, functions, mobile and portable radios and repair. Repair/maintenance training is required to be the same as that given to the vendor's own personnel who service comparable equipment.

The training should not be more then two (2) months prior to going live on the new system.

CTO recommends a certified Training Coordinator position be established to continually assess the training program, and able to maintain accurate and detailed training records.

4.1.1 SYSTEM TRAINING

Training of personnel for the new radio system operation, use, and repair/maintenance should be conducted at a site where classroom space can be provided. The training should include the necessary instructors, equipment and test apparatus for demonstration and practice purposes, instruction books and/or literature and any other material (aids) required for the presentation of the program. The sessions will be given by competent personnel experienced in techniques in adult learning. A manual indicating the content of the session should be provided for each participant. Copies of all repair/maintenance manuals, including schematic diagrams should be provided to the appropriate personnel. Operational training should begin as soon as is practical in the installation of the system so as to be completed before placing the systems in operation.

There should be comprehensive operator training for the appropriate personnel before the new system is placed in service. Training should be conducted on-site. The classes could be scheduled one class in the afternoon and one class in the evening, or at such other times as specified by FoxComm.

4.1.2 FIELD OFFICERS TRAINING

The field officers, fire fighters and other user personnel should be provided with training in the use and features of a trunked radio system. This should include talk-groups assignments, dynamic regrouping, priority, pre emption, OTAR, OTAP, and how channel assignments are made.

4.1.3 CALL TAKERS/DISPATCHERS TRAINING

In general, training for calltakers and dispatchers can be handled on-site through on-the-job training programs or through packaged programs that can be taught on or off site. Strictly in-house, on-the-job training programs can not ensure that proper levels of training are achieved. This can be especially important if the center becomes the subject of a civil action for improper or negligent action. Being able to show adequate levels of training is paramount to a successful defense in such cases.

Some on-the-job training is always essential. None of the packaged courses are capable of teaching calltakers and dispatchers the mechanics of operating the specific equipment to be utilized in a Communications Center. Neither can packaged programs teach the specific policies and procedures peculiar to a given jurisdiction. Having said this, packaged training programs are essential to properly equip calltakers and dispatchers to effectively perform their duties.

There should be training designed to familiarize personnel with all aspects of the new system, enabling them to understand its operation features, functions, and repair. Repair training is required to be the same as that given to the vendor's own personnel who service comparable equipment.

Training of personnel for the new radio system operation and repair is required at a site where classroom space can be provided. If it is proven beneficial, repair training may take place at the vendor's facilities, but the vendor must bear any additional costs for travel and lodging expenses. The training should include the necessary instructors, equipment and test apparatus for demonstration and practice purposes, instruction books and/or literature and any other material (aids) required for the presentation of the program. The sessions are to be given by competent personnel experience in techniques in adult learning. A manual indicating the content of the session is to be provided by the successful vendor for each participant. These

manuals will be subject to the approval of the user agency. Training should be sufficient to all involved personnel to operate the system. Copies of all repair manuals, including schematic diagrams should be provided to the necessary personnel. Operational training should begin as soon as is practical in the installation of the system so as to be completed before placing the systems in operation.

There should be comprehensive operator training for personnel before the new system is placed in service. Training should be conducted on-site in a minimum of two (2) classes per day. The classes should be scheduled at the convenience of FoxComm; one class in the afternoon and one class in the evening, or at such other times as specified by FoxComm.

The training should not be more then two (2) months prior to going live on the new system.

CTO recommends a certified Training Coordinator position be established to continually assess the training program, and able to maintain accurate and detailed training records.

The duties of a Training Coordinator should include (but limited to):

- Providing basic training for all newly hired Telecommunicators;
- Monitoring on-the-job training of new hires once they are assigned to senior Telecommunicators to ensure consistency;
- Maintain basic training files for new hires to ensure that all aspects of the operation are covered and competency levels are met;
- Provide instructor training for communications training officers;
- Developing clear training objectives and lesson plans for all levels of training;
- Developing and delivering scheduled in-service training to all employees;
- Maintaining training files for all employees and monitoring required certifications to ensure that qualifications are preserved;
- Maintaining comprehensive records of training class outlines, as well as class development and approval processes; and
- Monitoring the overall performance of the communications operation so that problems or issues may be identified and corrected prior to them having an adverse affect on citizens, field personnel or the center itself;

The Training Coordinator ensures that instruction meets all appropriate state, local and federal standards. Each calltaker/dispatcher (Telecommunicator) is taught in the same manner to meet the same level of competency. This not only provides for a smoother operation and

more professional Telecommunicators, but also aids the department when public scrutiny or civil litigation occurs.

Some of the Standard Operating Procedures (SOP), General Orders, and Protocols appear to be outdated and confusing from a communications center stand point. CTO recommends while procuring a new system some changes to the SOP, General Orders and protocols may need to be made, the manuals should be evaluated, updated and changed to adjust to the trends and to take into consideration the current amount of radio traffic on the system.

Once the manual(s) are updated and approved all personnel would need to follow the new protocols, Standard Operating Procedures, etc.

SECTION V – SYSTEM MAINTENANCE

5.1 MAINTENANCE

The present radio systems *do not* have a standard system maintenance program. The systems are maintained on a crisis basis. Some of the equipment is becoming unserviceable and is degrading the system capability.

For the performance of the system not to degrade Public Safety operations a comprehensive maintenance program should be in place. There are two types of maintenance that a system should undergo:

1. Preventive Maintenance
2. Corrective Maintenance

5.1.1 SYSTEM MAINTENANCE

Once the new P25 system is installed, tested and accepted it is imperative that the maintenance schedule of the system be strictly enforced. Together with the purchase of the system a service and maintenance program will be included. This plan should be specified in detail.

The new P25 system will require a service facility with certified service technicians for service and repair. This facility should have 24/7, 365 days per year response capability and should provide a certified service technician on-site within a maximum of two (2) hours.

It is recommended that the purchase of any new system includes the contracting of a dedicated system manager to monitor the system once finally accepted. This would greatly increase the success of the transfer and operation of the new system.

Copies of all repair manuals, including schematic diagrams will be available to trained personnel.

SECTION VI – PERSONNEL REQUIREMENTS

6.1 TRAINING COORDINATOR

One (1) training coordinator with knowledge of the radio system operation should be added to the staff to ensure that proper training is provided to dispatchers and to new field officers and others that will use the new radio system.

6.2 SYSTEM MANAGER

The System Manager should oversee the operation and maintenance of the systems and should be a full-time employee.

6.3.1 TECHNICIANS

Technicians that are fully certified and fully acquainted with the systems should be considered to be part of the staff to maintain and run the day to day operation of the systems.

SECTION VII – RECOMMENDATIONS

7.1 RADIO SYSTEM

There are two alternative approaches that can be used by FoxComm for an upgraded radio system. Both involve trunked digital P25 Systems.

1) A combined digital simulcast trunked P25 system in the 700 MHz band that will be used by all Counties and municipalities. A 16 channel trunked system would be required to handle future growth. This will also improve interoperability between the four FoxComm Counties and municipalities.
2) A zoned system with separate digital simulcast trunked P25 system for each of the four Counties and municipalities with the City of Green Bay traffic handled by Brown County's system. Channel requirements are Brown County 9, Calumet County 4, Outagamie County 8, and Winnebago County 8. Interoperability between the FoxComm Counties would be provided by having each County's subscriber equipment capable of operating on all of the Counties systems.

To avoid delays which occur in digital trunked systems voice messages, it is recommended that portable radios have a mixed mode (analog and digital) capability for use in fire-ground, swat teams, other time critical events. There are sufficient additional 700 MHz channels that can be set aside for such time critical purposes using analog modulation.

The primary reason for the choice of the 700 MHz over existing VHF band is because of frequency availability. As covered previously, there are an insufficient number of VHF interference free frequencies available to support the requirements. The capacity of a trunked system greatly exceeds that of a conventional system. For examples, a four channel trunked system will handle over 10 times the traffic of a four channel conventional system while a 16 channel trunked system will handle over 50 times the traffic of a 16 channel conventional system.

Further benefits are:

- Freeing VHF frequencies for use in an improved simulcast paging system for FoxComm.
- Freeing 800 MHz frequencies used by the present Green Bay system to allow for improvements in the FoxComm Mobile Data System.
- Allowing for vehicle location information to be carried on the voice system will provide for considerably improved and timely availability of information.
- Allow for personnel location (if portable radio speaker/microphone equipped with GPS are used) outside of buildings.

- A digital system provides more uniform voice coverage which maintains until signal strength reaches a low value, while an analog system voice fades as signal strength weakens.
- A simulcast system allows for a channel to provide a larger operating range because the system uses multiple sites, while a non-simulcast system requires more channels to provide similar coverage.
- Use of P25 standard allows for different manufacturers systems in the same band to "talk" to each other through a "common air interface" and allows for expansion to a TDMA system which provides increased channel capacity without requiring additional frequencies.
- A trunked system allows for priority assignment, which would allow for higher priority for emergency use and reduce channel congestion.
- Use of the priority assignments for emergency situations could allow a reduction of channels required for implementing either alternative 1 or 2

7.2 MOBILE DATA SYSTEM

There are two alternative approaches for improving the mobile data system (MDC). The first alternative would be to implement all three present 800 MHz channels used for MDC at each of the six (6) MDC sites. By time sharing and assigning (via the voice radio) each MDC that is to send or receive information on one of the three (3) channels. This would allow for an increase in MDC capacity but would not aid significantly in location information application. This alternative might be used as a first step in improvement and could be used until the improved capacity that would be available by implementing the second alternative.

The second alternative involves the use of additional 800 MHz channels. If the Green Bay voice system is either combined with the combined FoxComm or Brown County voice system, as recommended in Section 7.1, a total of nine channels at 800 MHz could be available to use in a cellular like system as described in Section 3.5. A total of 12 sites would be used. This would allow for a considerable increase in overall capacity and improved coverage. **Figure 3-7** shows a 12 site 9 channel system.

7.3 PAGING AND ALERTING SYSTEM

There are two alternatives for paging and alerting system, both are VHF and allow for use of the existing Minitor equipment.

The first is a single simulcast system to be used by all of the Counties in FoxComm with tone activation of appropriate pagers and fire stations.

The second alternative is to implement a separate system for each county used to activate appropriate pagers and fire stations.

In either alternative the same voice dispatch information that is sent on the voice radio system would be transmitted on the paging and alerting system as associated with the incident to be handled and continued until all volunteer fire fighters arrive on scene. The same sites as the corresponding radio system would be used to minimize costs.

The first alternative has the advantage of alerting volunteer fire fighters who are employed in or visiting any of the FoxComm Counties.

7.4 DATA CENTER

FoxComm should develop a data center that will be responsible for the up-keep and training of a standard system maintenance program. The center will also be responsible for the personnel to maintain the radio system. The center should be located in a central location for logistic purposes and not attached to or in the same building housing a present PSAP/Dispatch Communication Center. The data center would also have the responsibility of the current CAD system and the controllers of the new radio system. Security will need to be addressed for the data center as well as the Systems Manager having the ability to access and monitor the radio system anywhere. Microwave links to the Data Center from the existing County PSAPs are required. Fiber optics links could also be used, if available, or require short extentions of existing fiber optic networks.

7.5 INTERCONNECTION NETWORK

The interconnection network for the radio system should employ redundant loops for all repeater sites with spur links only for receive-only sites. The same sites can be used for the mobile data system and paging and alerting system, thus providing interconnection for these systems. The Data Center should be linked to each PSAP/Dispatch Center by microwave links.

The use of Internet Protocol (see **Section 2.8**) should be incorporated in the interconnection network. This will allow for any transmission media to be used (microwave, optical fiber, T-1 or telephone) and will provide for interconnection by providing redundant paths if fiber or T-1 paths are broken.

7.6 DISPATCH CONSOLES

The existing Dispatch Consoles where possible should be upgraded to accommodate the new radio system, mobile data system, and the new paging and alerting system, as chosen by FoxComm and/or the FoxComm member Counties, from the alternatives presented for each of these systems. If any of the existing consoles cannot be upgraded, then new consoles should be obtained.

SECTION VIII – BUDGETARY COSTS

8.1 ALTERNATIVES

Budgetary Costs were developed and are presented in two alternatives for each of the systems. **Tables 8-1** and **Table 8-2** present the cost estimates for alternatives for the 700 MHz Radio System Infrastructure and Interconnection System. **Table 8-3** and **Table 8-4** present the alternative cost estimates for the VHF Paging System. **Table 8-5** and **Table 8-6** present the alternative cost estimates for the Mobile Data System. **Table 8-7** provides an average cost for the radio system user equipment.

TABLE 8-1

ALTERNATIVE I – COMBINED 4 COUNTY SYSTEM FOXCOMM 700 MHz Radio System & Interconnection – Conceptual Design Budgetary Cost Estimates			
Item	**Equipment Hardware Costs**	**QTY**	**700 MHz**
1	Radio Network – P25 narrowband digital trunked simulcast system for outdoor coverage, one console operator position and system managerial terminals at main and hot alternate Centers	14 Chan 40 Sites	23,000,000
2	Interoperability (ACU1000 or Gateway)	5	750,000
3	Towers – 200 ft. self supported towers	10	2,000,000
4	Interconnection System – Equipment (microwave)	38	3,040,000
5	Alarm and Monitoring – Equipment	38	2,027,000
6	Shelters – Outdoor type	40	2,000,000
7	Spares – System equipment		225,000
8	Consoles	15	1,500,000
9	Test Equipment – All test and programming equipment required		1,000,000
10	**In-door Coverage Equipment for:** Buildings and Basements		72,000
11	SUB TOTAL INFRASTRUCTURE EQUIPMENT:		35,614,000
12	**Professional Services:** Project Management, Design Engineering, Field Engineering and Factory Testing, Acceptance Testing, Training, Infrastructure Installation/Optimization, Documentation, Warranty on infrastructure, Quality assurance contractor. At 40% of Infrastructure equipment		14,245,600
13	**TOTAL BUDGETARY COST**		**49,859,600**

TABLE 8-2

ALTERNATIVE II - SEPARATE COUNTY SYSTEM

FOXCOMM 700 MHz Radio System & Interoperability – Conceptual Design

Budgetary Cost Estimate

	COUNTY	BROWN		CALUMET		OUTAGAMIE		WINNEBAGO	
Item	**Equipment Hardware Costs**	**QTY**	**700 MHz**	**QTY**	**700 MHZ**	**QTY**	**700 MHz**	**QTY**	**700 MHz**
1	Radio Network – P25 narrowband digital trunked simulcast system for outdoor coverage, one console operator position and system managerial terminals at main and hot alternate Centers	9 Cha 12 Sites	7,700,000	4 Cha 7 Sites	4,420,000	7 Cha 11 Sites	6,720,000	7 Cha 10 Sites	6,250,000
2	Interoperability (ACU1000 or Gateway)	2	300,000	2	300,000	2	300,000	2	300,000
3	Towers – 200 ft. self supported towers	5	1,000,000	2	400,000	2	400,000	3	600,000
4	Interconnection System – Equipment (microwave)	9	720,000	6	480,000	11	880,000	11	880,000
5	Alarm and Monitoring – Equipment	9	360,000	6	240,000	11	440,000	11	440,000
6	Shelters – Outdoor type	13	650,000	6	150,000	10	500,000	11	550,000
7	Spares – System equipment		100,000		50,000		100,000		100,000
8	Consoles	4	400,000	3	300,000	4	400,000	4	400,000
9	Test Equipment – All test and programming equipment required		900,000		400,000		800,000		800,000
10	**In-door Coverage Equipment for:** Buildings and Basements		**17,500**		17,500		17,500		17,500
11	SUB TOTAL INFRASTRUCTURE EQUIPMENT:		12,147,500		6,757,500		10,557,500		10,337,500
12	**Professional Services:** 40% of Infrastructure Equipment cost		**4,859,000**		**2,703,000**		**4,223,000**		**4,135,000**
13	**TOTAL BUDGETARY COST**		**17,000,000**		**9,460,500**		**14,780,500**		**14,472,500**

TABLE 8-3

ALTERNATIVE I – COMBINED 4 COUNTY SYSTEM FOXCOMM VHF Paging System & Interconnect – Conceptual Design Budgetary Cost Estimates			
Item	**Equipment Hardware Costs**	**QTY**	**VHF**
1	VHF Paging system site equipment	20 Sites	500,000
2	Control equipment	1	250,000
3	Spares	4	100,000
4	SUB TOTAL INFRASTRUCTURE EQUIPMENT:		850,000
5	**Professional Services:** Project Management, Design Engineering, Field Engineering and Factory Testing, Acceptance Testing, Training, Infrastructure Installation/Optimization, Documentation, Warranty on infrastructure, Quality assurance contractor. At 40% of Infrastructure equipment		300,000
6	**TOTAL BUDGETARY COST ***		**1,150,000**

TABLE 8-4

ALTERNATIVE II - SEPARATE COUNTY SYSTEM FOXCOMM VHF Paging System & Interconnect– Conceptual Design Budgetary Cost Estimate									
	COUNTY	**BROWN**		**CALUMET**		**OUTAGAMIE**		**WINNEBAGO**	
Item	**Equipment Hardware Costs**	**QTY**	**VHF**	**QTY**	**VHF**	**QTY**	**VHF**	**QTY**	**VHF**
1	Site equipment – Simulcast system for outdoor coverage.	5 Sites	125,000	5 Sites	125,000	6 Sites	150,000	5 Sites	125,000
2	Control equipment	1	200,000	1	200,000	1	200,000	1	200,000
3	Spares – System equipment	2	50,000	2	50,000	2	50,000	2	50,000
4	SUB TOTAL INFRASTRUCTURE EQUIPMENT:		375,000		375,000		400,000		375,000
5	**Professional Services:** 40% of Infrastructure Equipment cost		**150,000**		**150,000**		**160,000**		**150,000**
6	**TOTAL BUDGETARY COST ***		**525,000**		**525,000**		**560,000**		**525,000**

TABLE 8-5

ALTERNATIVE I – COMBINED 4 COUNTY SYSTEM FOXCOMM Mobile Data System & Interconnect – Conceptual Design (3 channel, 6 sites) Budgetary Cost Estimates			
Item	**Equipment Hardware Costs**	**QTY**	**800 MHz**
1	800 MHz Mobile Data system site equipment (add 2 channels to each site)	3 Chan 6 Sites	540,000
2	Control equipment	1	250,000
3	Spares	4	180,000
4	SUB TOTAL INFRASTRUCTURE EQUIPMENT:		970,000
5	**Professional Services:** Project Management, Design Engineering, Field Engineering and Factory Testing, Acceptance Testing, Training, Infrastructure Installation/Optimization, Documentation, Warranty on infrastructure, Quality assurance contractor. At 40% of Infrastructure equipment.		288,000
6	**TOTAL BUDGETARY COST ***		**1,258,000**

TABLE 8-6

ALTERNATIVE II – COMBINED 4 COUNTY SYSTEM FOXCOMM Mobile Data System & Interconnect – Conceptual Design (9 channel, 12 sites) Budgetary Cost Estimates			
Item	**Equipment Hardware Costs**	**QTY**	**800 MHz**
1	800 MHz Mobile Data system site equipment (using 6 existing MDC base stations)	1 Chan 12 Sites	270,000
2	Control equipment	2	500,000
3	Spares	6	270,000
4	SUB TOTAL INFRASTRUCTURE EQUIPMENT:		1,040,000
5	**Professional Services:** Project Management, Design Engineering, Field Engineering and Factory Testing, Acceptance Testing, Training, Infrastructure Installation/Optimization, Documentation, Warranty on infrastructure, Quality assurance contractor. At 40% of Infrastructure equipment		408,000
6	**TOTAL BUDGETARY COST ***		**1,448,000**

TABLE 8-7

ALTERNATIVE II - SEPARATE COUNTY SYSTEM FOXCOMM 700 MHz User Equipment – Conceptual Design Budgetary Cost Estimate									
	COUNTY	**BROWN**		**CALUMET**		**OUTAGAMIE**		**WINNEBAGO**	
Item	Subscriber Equipment Cost	**QTY ***	**700 MHz**	**QTY ***	**700 MHZ**	**QTY ***	**700 MHz**	**QTY ***	**700 MHz**
1	Public Safety Portable, Mobile Radios Average cost $6,000 including encryption and installation	1,290	7,740,000	480	2,800,000	1,100	6,600,000	850	5,100,000
2	Non-Public Safety Portable, Mobile Radios Average cost $5,000 including installation	686	3,430,000	255	1,275,000	586	2,930,000	453	2,265,000
3	TOTAL USER EQUIPMENT	1,976	11,170,000	735	4,075,000	1,686	9,530,000	1,303	7,365,000
	Control Stations average cost $9,000 including installation and antenna system								

* Estimated number of units

TABLE 8-8

ALTERNATIVE I – COMBINED 4 COUNTY SYSTEM FOXCOMM Tower Rent – Conceptual Design Budgetary Cost Estimates			
Item	**Tower Rental Cost**	**QTY**	
1	Rental cost of tower space to mount antennas, transmission lines, and shelter space per year	1	50,000

APPENDIX A–

GLOSSARY

A

ACU1000	A product made by Raytheon/JPS Company for Homeland Security interoperability operations. It is an electronic, programmable crossconnect system used to connect disparate radio systems together.
AES	Advance Encryption Standard
ANSI	American National Standards Institute
APCO	Association of Public-Safety Communication Officers-International, Inc.

B

Band	The frequency spectrum between two defined limits. For example, the ultra High Frequency (UHF) is located from 300 MHz to 3,000 MHz in the radio frequency spectrum.
Bandwidth	A relative range of frequencies that can carry a signal without distortion on a transmission medium.
BDA	Bi-Directional Amplifier
BTU	A BTU, short for British Thermal Unit, is a basic measure of thermal (heat) energy. One BTU is the amount of energy needed to heat one pound of water one degree Fahrenheit, measured at its heaviest point.

C

CAD	Computer Aided Dispatch
CAI	Common Air Interface
CDMA	Code Division Multiple Access
Channel	A bandwidth path along which a communications signal is transmitted.
Conventional Radio System	A LMR system architecture similar to a telephone party-line in that the user determines availability by listening for an open channel before transmitting. Conversely, a trunked radio system automatically and dynamically assigns an available channel.
Coverage	The geographic area included within the range of a wireless radio system.
Cross-band Repeaters	Users operating in different frequency bands can also communicate directly by the use of cross-band repeaters, which allow transmission in one band to be repeated in another band. This eliminates the need of having multiple radios in a vehicle.

D

DAQ	Delivered Audio Quality
dB	Decibel
dBd	Decibels over a dipole
Dead Spots	The area, zone, or volume of space that is within the expected range of a radio signal, but in which the signal is not detectable and therefore can not be received. Common causes of dead spots include depressions in the terrain and physical structures.
Digital Modulation Technique	A communications mode that places a digital data sequence on a carrier signal for transmission through a cannel.

E

EIA	Electronics Industry Association

F

FCC	Federal Communications Commission
FDMA	Frequency Division Multiple Access
FIPS	Federal Information Processing Standards
FM	Frequency Modulation
Frequency	The number of radio waves per unit of time. For example, a frequency of 150 Megahertz (MHz) equates to 150,000,000 radio waves per second.
ft	Feet

G

Global Positioning System	Or GPS is a satellite-based navigation service that allows users to locate their position and in some cases, their velocity anywhere on the Earth.
GOS	Grade of Service
GPS	Global Position System

I

Interference	In general, extraneous energy, from natural or man-made sources, that impedes the reception of desire signals.

K

kHz	kilohertz
KMF	Key Management Facility

L

LMR	Land Mobile Radio

M

MHz	Megahertz
MOU	Memorandum of Understanding
Mutual Aid Channel	A national or regional cannel that has been set aside for use only in mutual aid interoperability situations, usually with restrictions and guidelines governing usage.

N

NAWAS	National Warning System
NCIC	National Crime Information Center
NFPA	National Fire Protection Association
NIJ	National Institute of Justice
NIST	National Institute of Standards and Technology
NPSPAC Guidelines	National Public Safety Planning Advisory Committee's nationwide public safety plan in the United States for the 821-824 MHz and 866-869 MHz frequency bands.

O

OTAP	Over The Air Programming
OTAR	Over The Air Rekeying

P

Patch	A system that permits a mobile or portable radio on one system to communicate with one or more radios on a different system.
P25	APCO Project 25
P25 Standards	A joint government/industry standards-setting effort
PSWAC	Public Safety Wireless Advisory Committee
PSWN	Public Safety Wireless Network

R

RF	Radio Frequency
RFI	Radio Frequency Interference
RFOF	Radio Frequency Over Fiber
RX	Receiver

S

Spectrum	Radio spectrum refers to the array of channels (frequencies), like the channels on a television, available for communications transmissions. Specific frequencies that have been allocated to the public safety community include: Low-band VHF 25- 50 MHz High-band VHF 150-174 MHz UHF 406-512 MHz 700 MHz 746-806 MHz 800 MHz 806-869 MHz

T

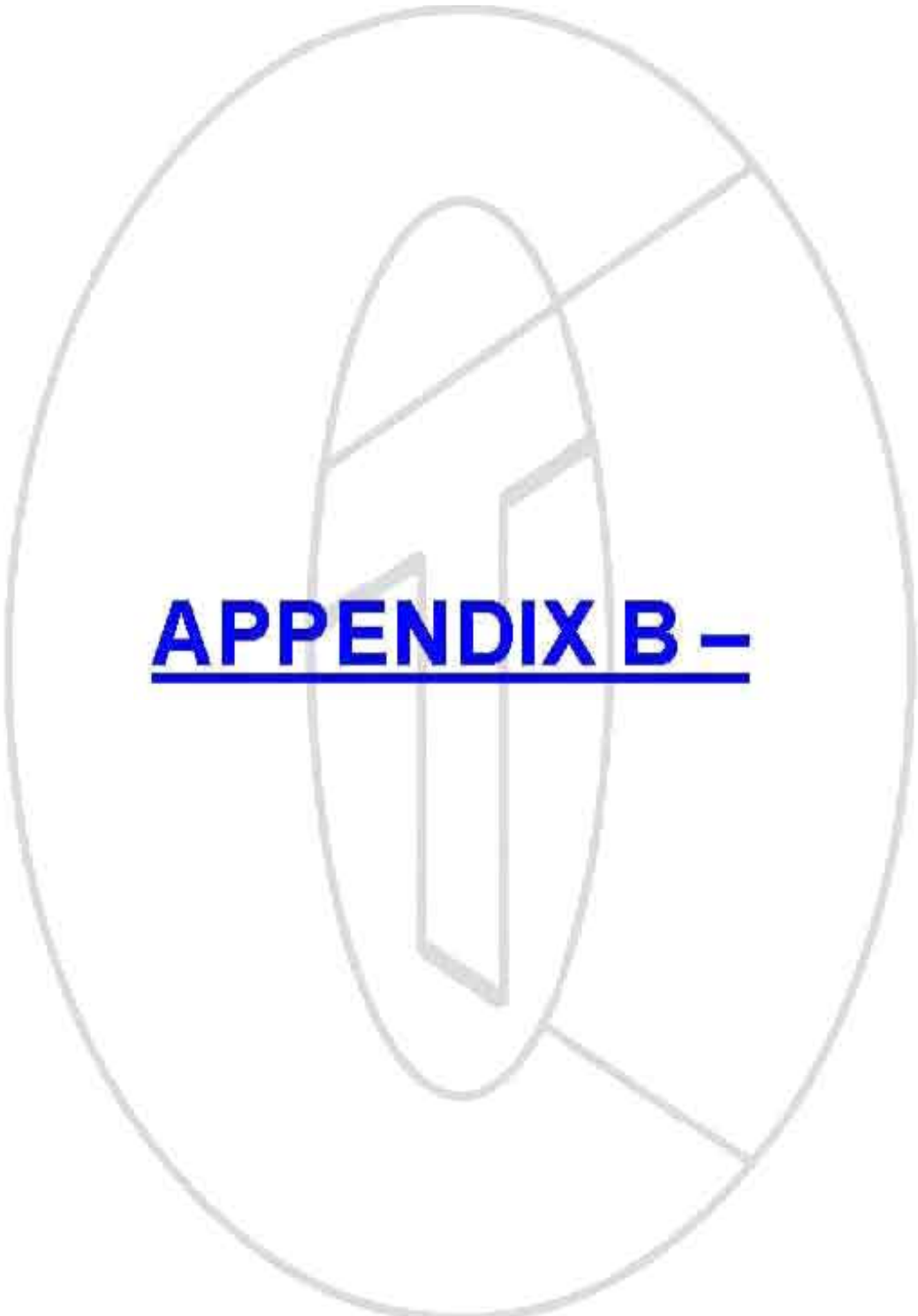
Talk Group	A pre-programmed subgroup of radio users within a trunked LMR system that allows for communications among the subgroup without transmitting to all users of the system.
TDMA	Time Division Multiplex Access
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance.
TIA-E102 Specifications	The Telecommunications Industry Association (TIA) issues technology standards related to telecommunications. The E102 specifications are a series of TIA specifications base don APCO Project 25 Standards for the next generation of public safety radios, both voice and data.
Trunk	A line of communication between switching systems.
Trunked Radio System	An LMR system architecture that automatically and dynamically assigns an available cannel to users. The term trunking connotes sharing of a number of channels by a group of users.
TTY	Text Telephone or TDD or Telecommunication Device for the Deaf
TX	Transmitter

U

UHF	Ultra High Frequency
UPS	Uninterruptible Power Supply

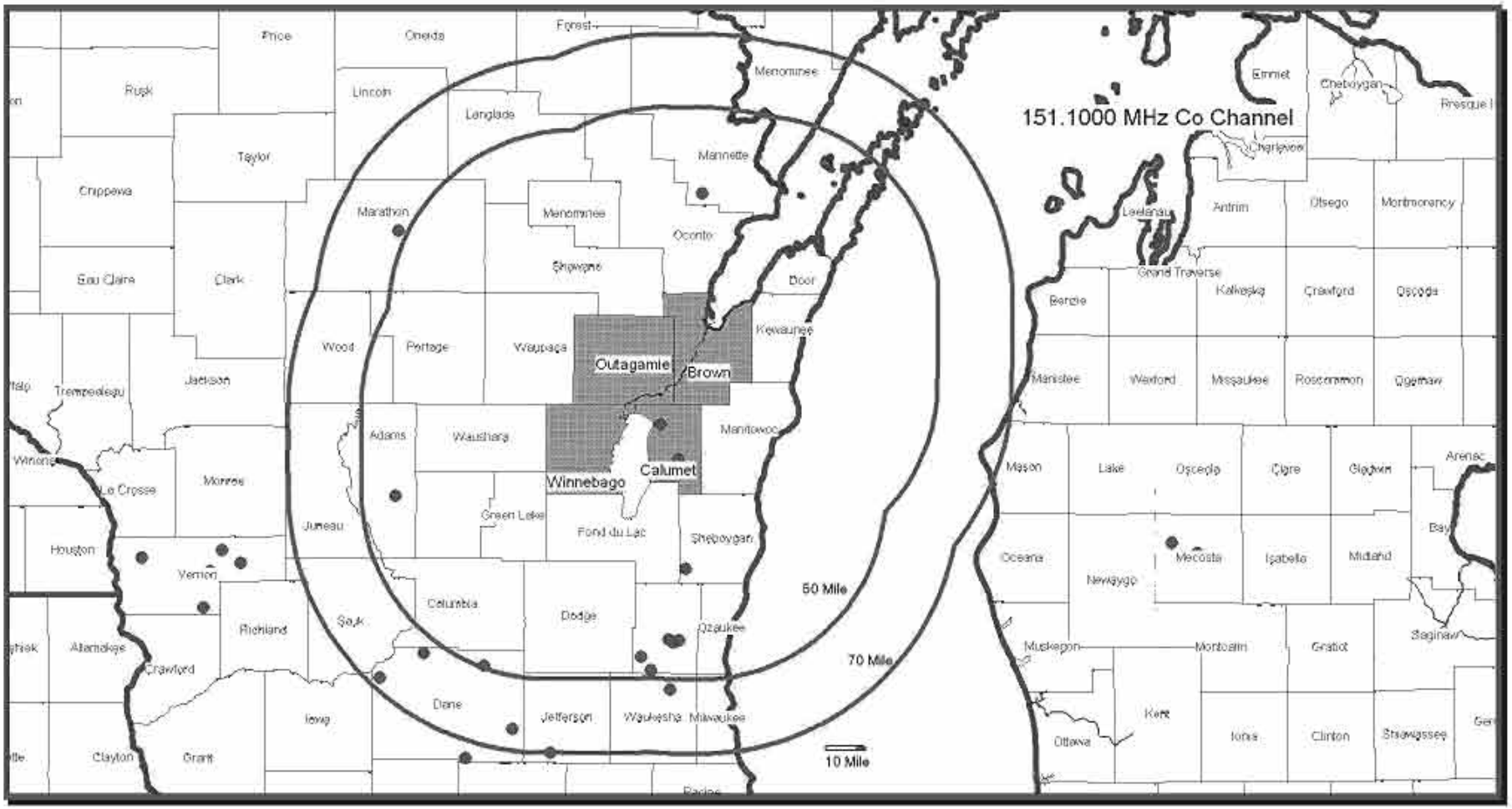
V

VHF	Very High Frequency
VoIP	Voice over Internet Protocol

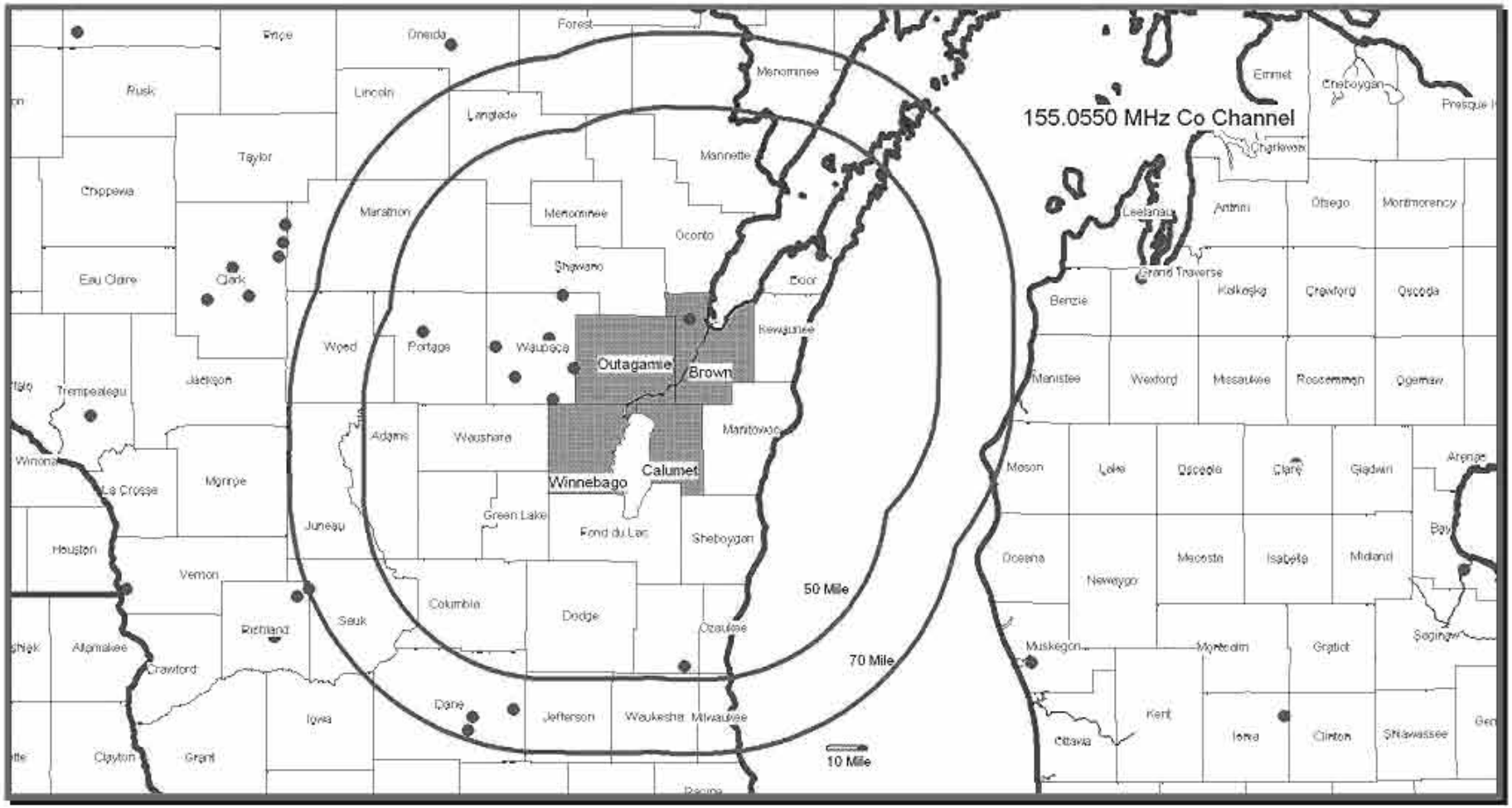


APPENDIX B –

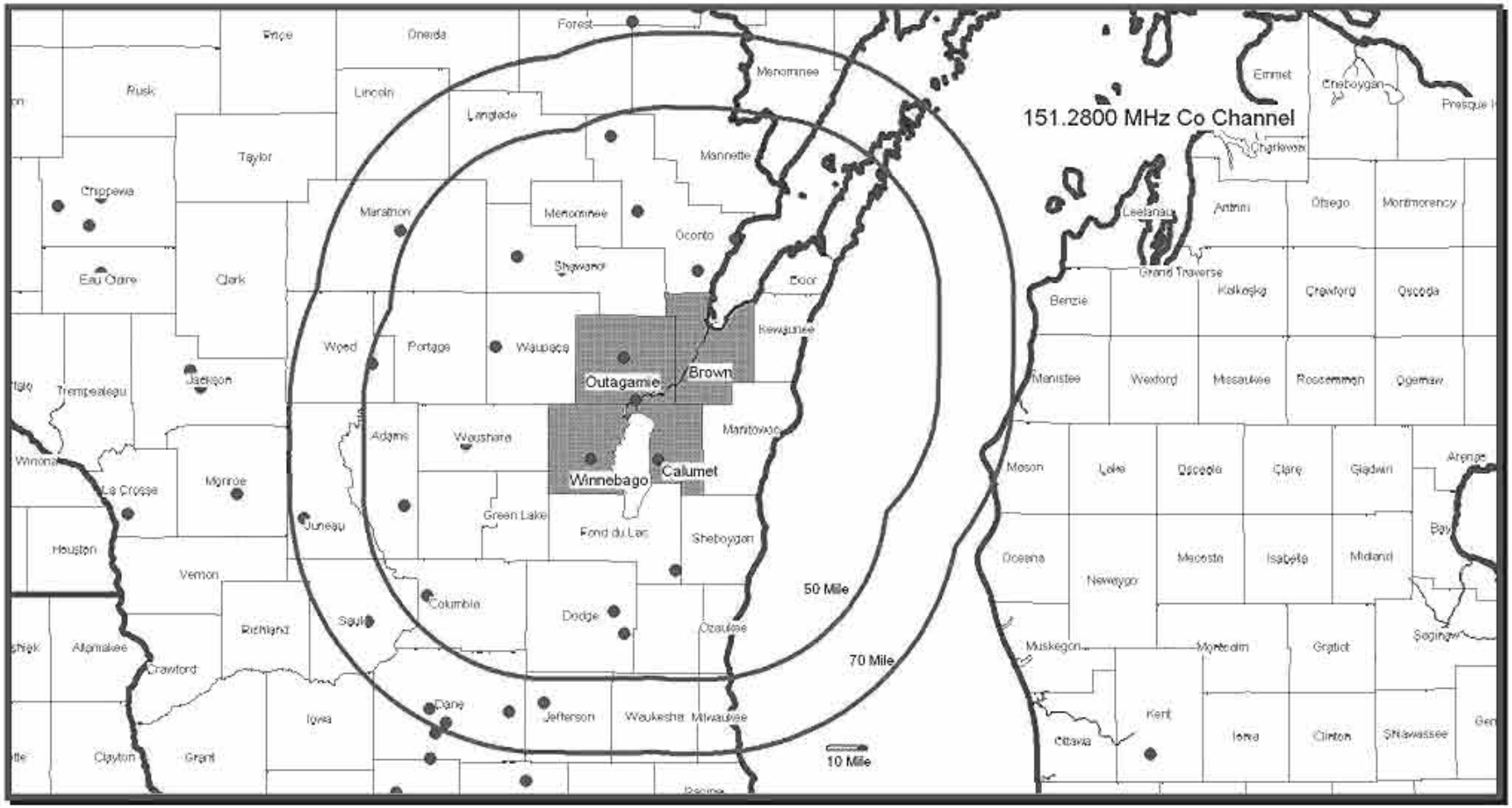
CHANNEL 1 TRANSMIT 151.1000 MHZ



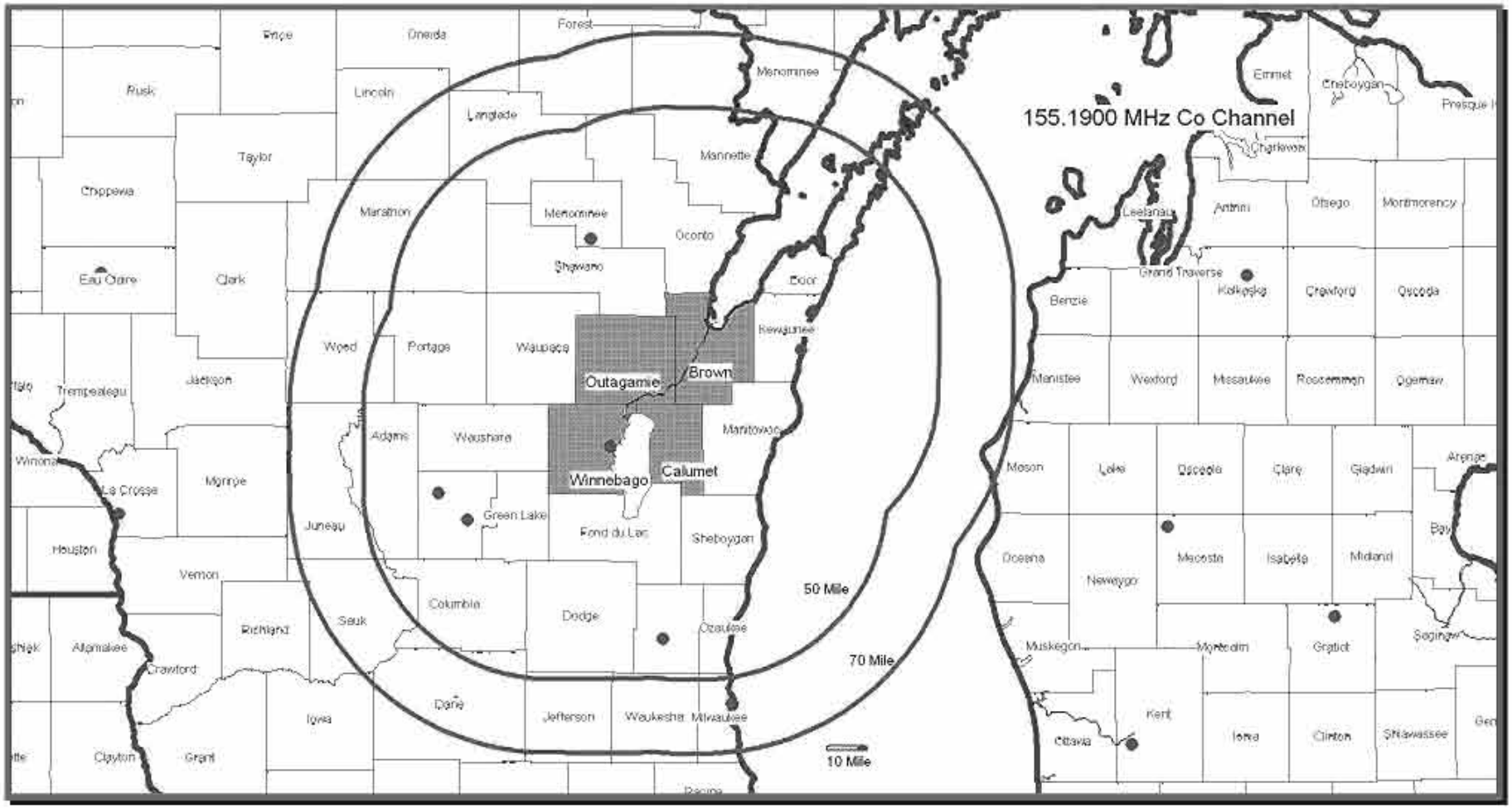
CHANNEL 1 RECEIVE 155.0550 MHZ



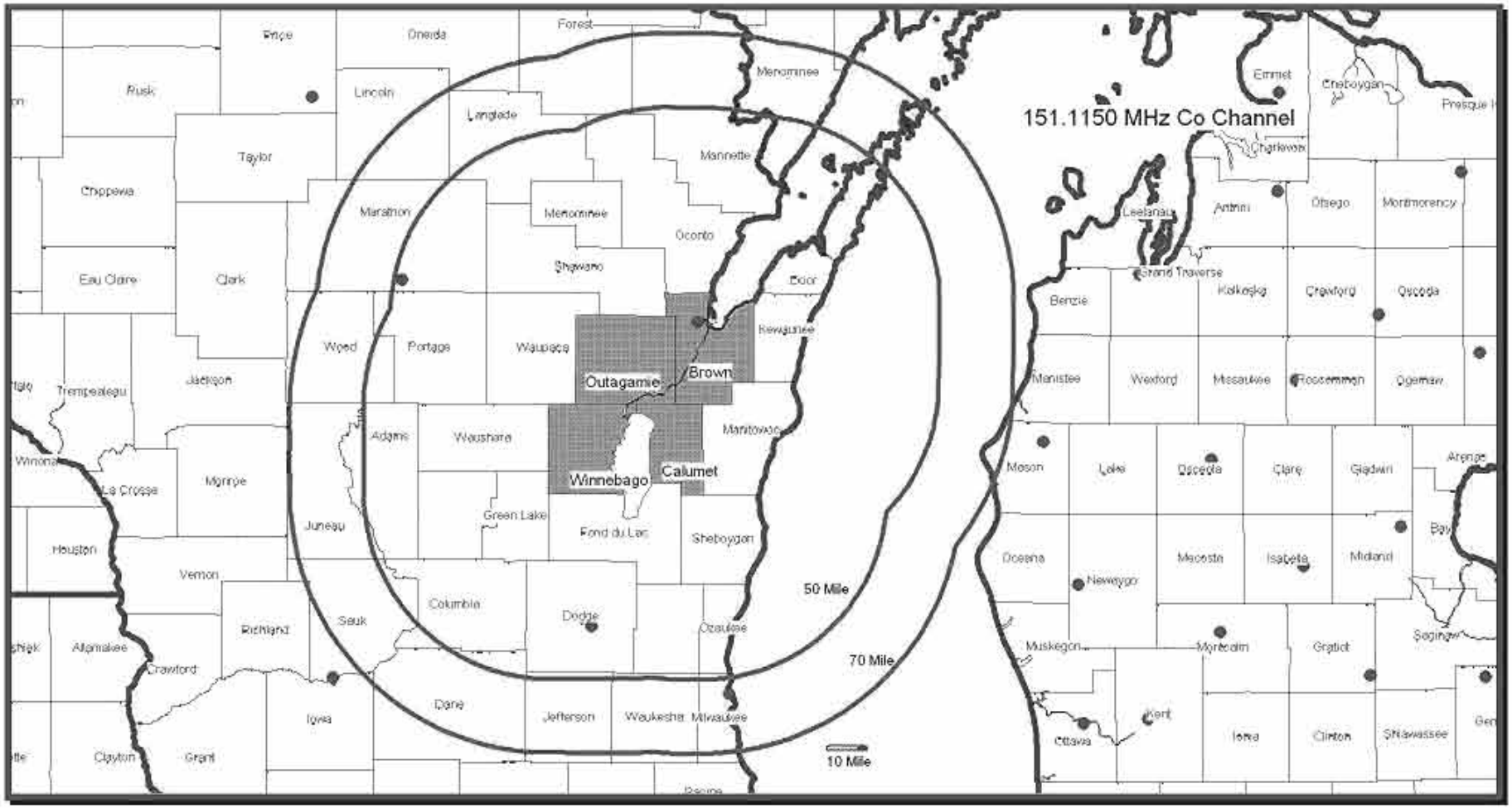
CHANNEL 2 TRANSMIT 151.2800 MHZ



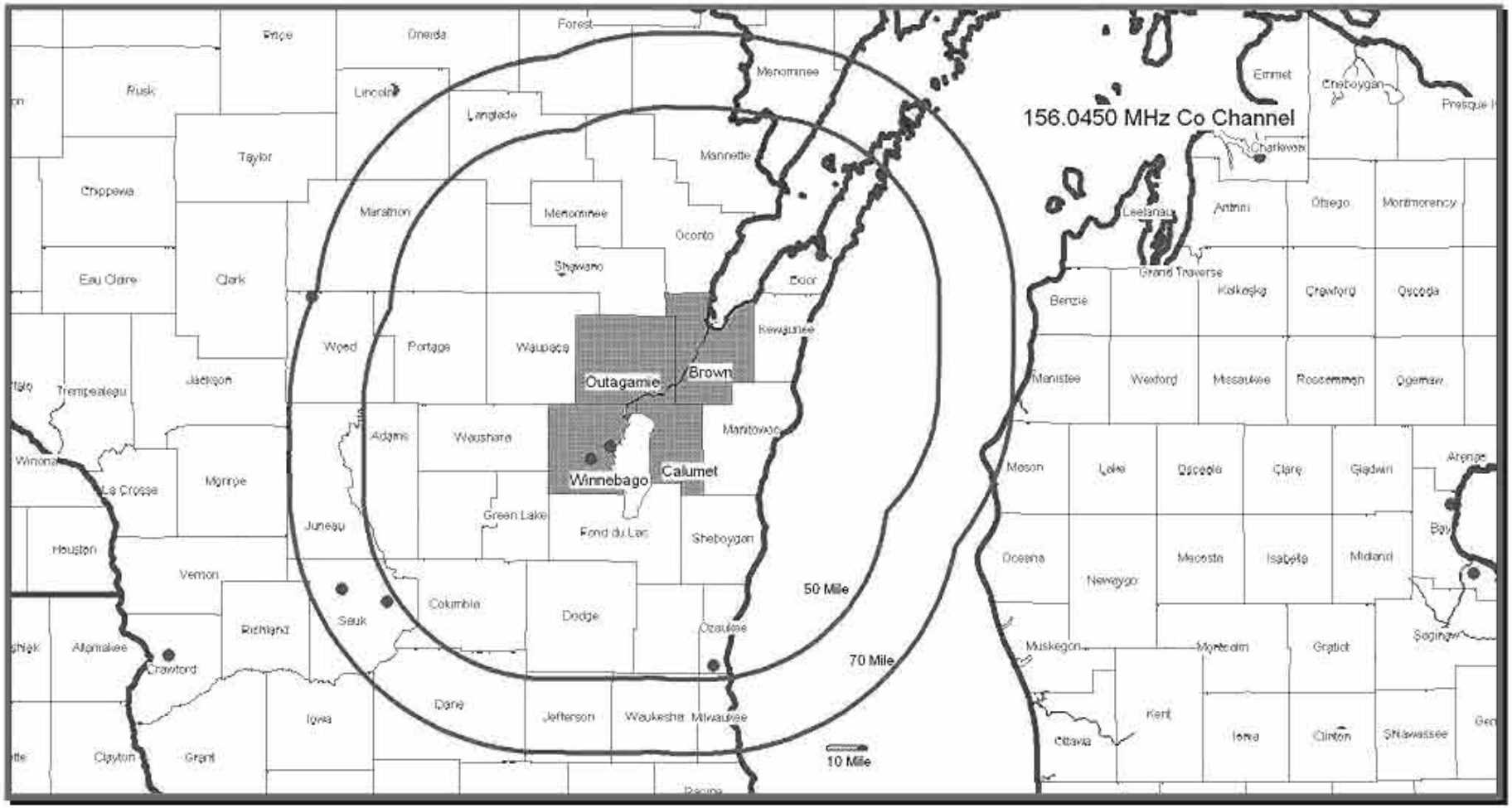
CHANNEL 2 RECEIVE 155.1900 MHZ



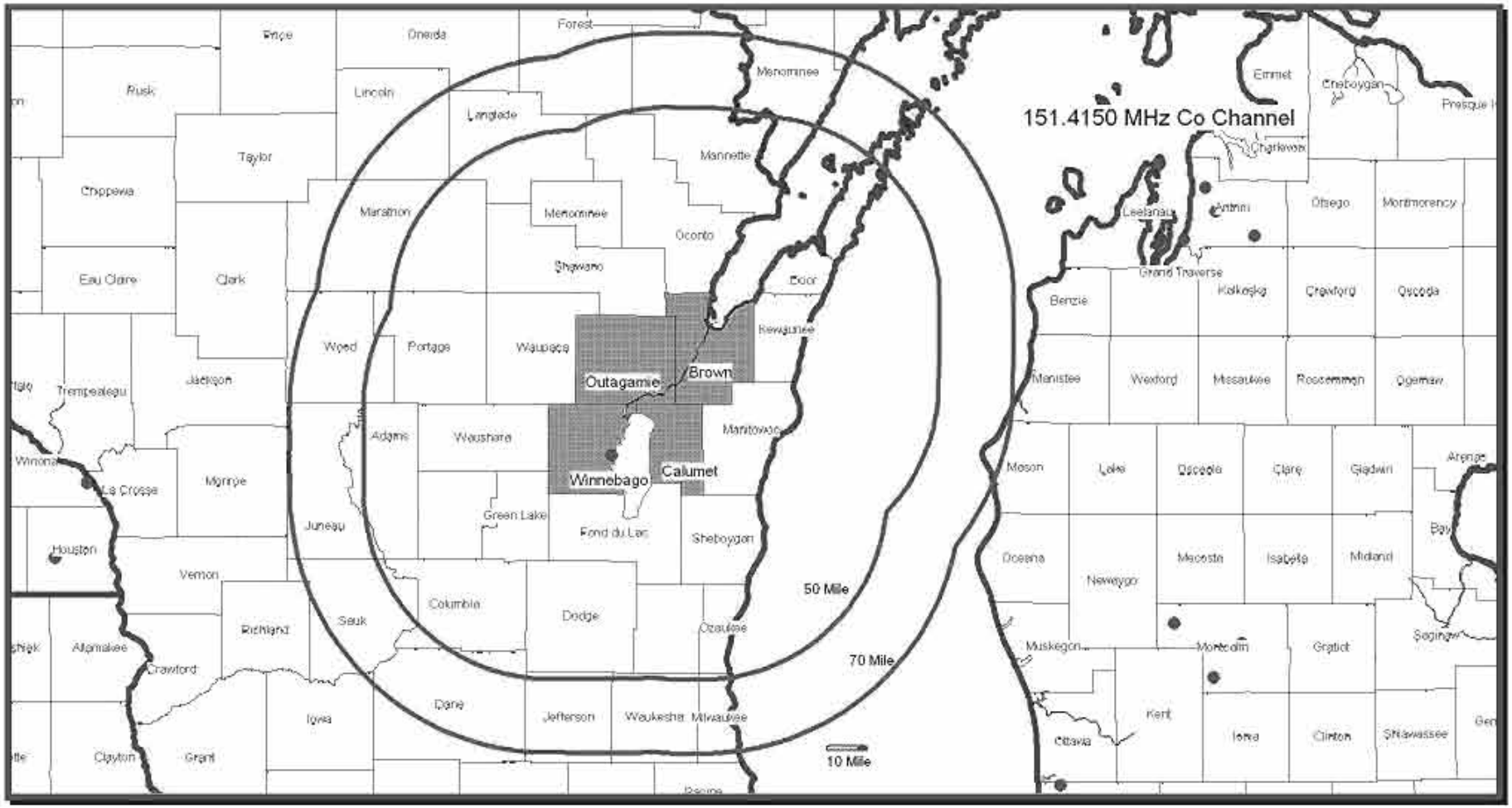
CHANNEL 3 TRANSMIT 151.1150 MHZ



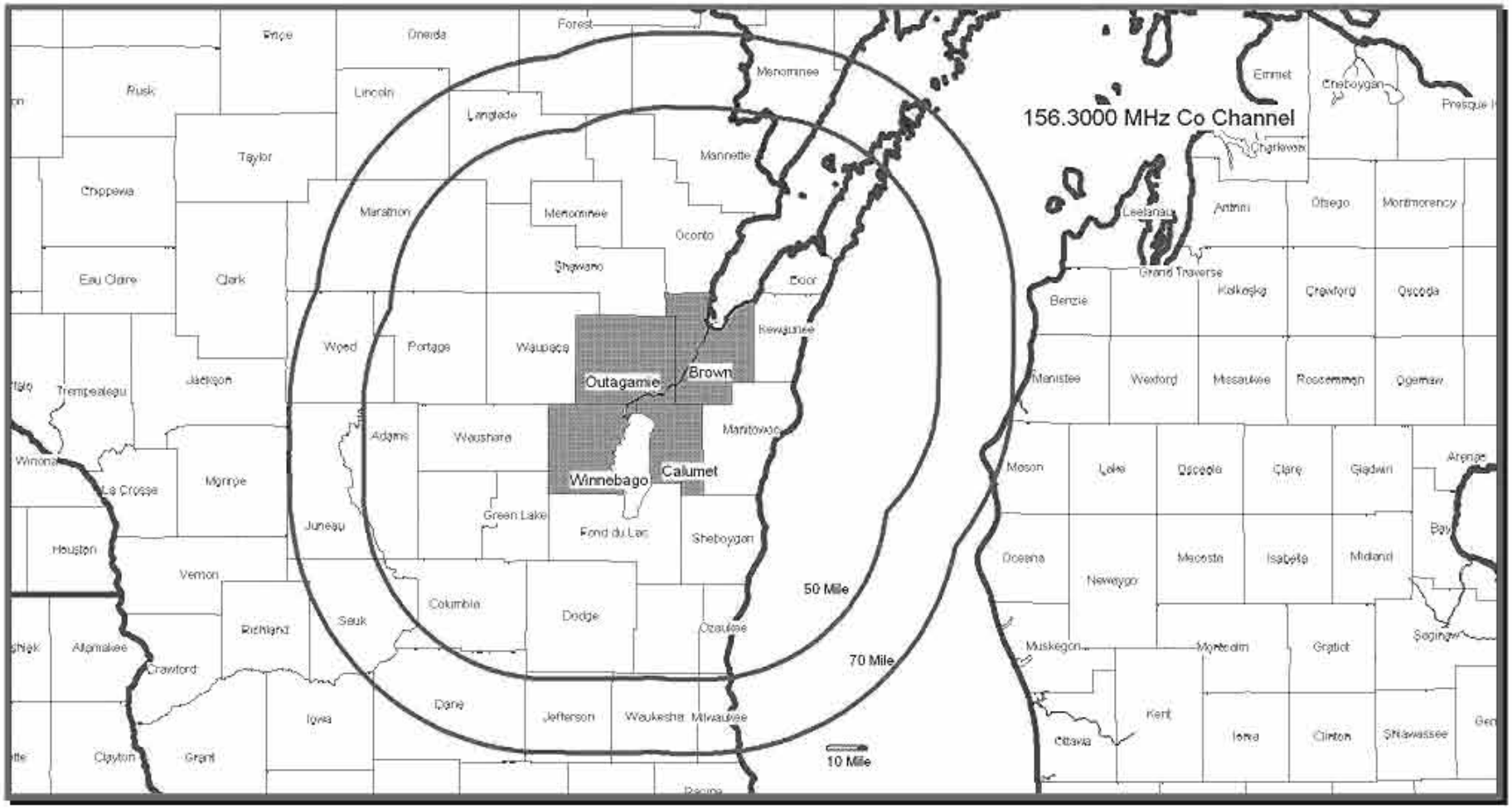
CHANNEL 3 RECEIVE 156.0450 MHZ



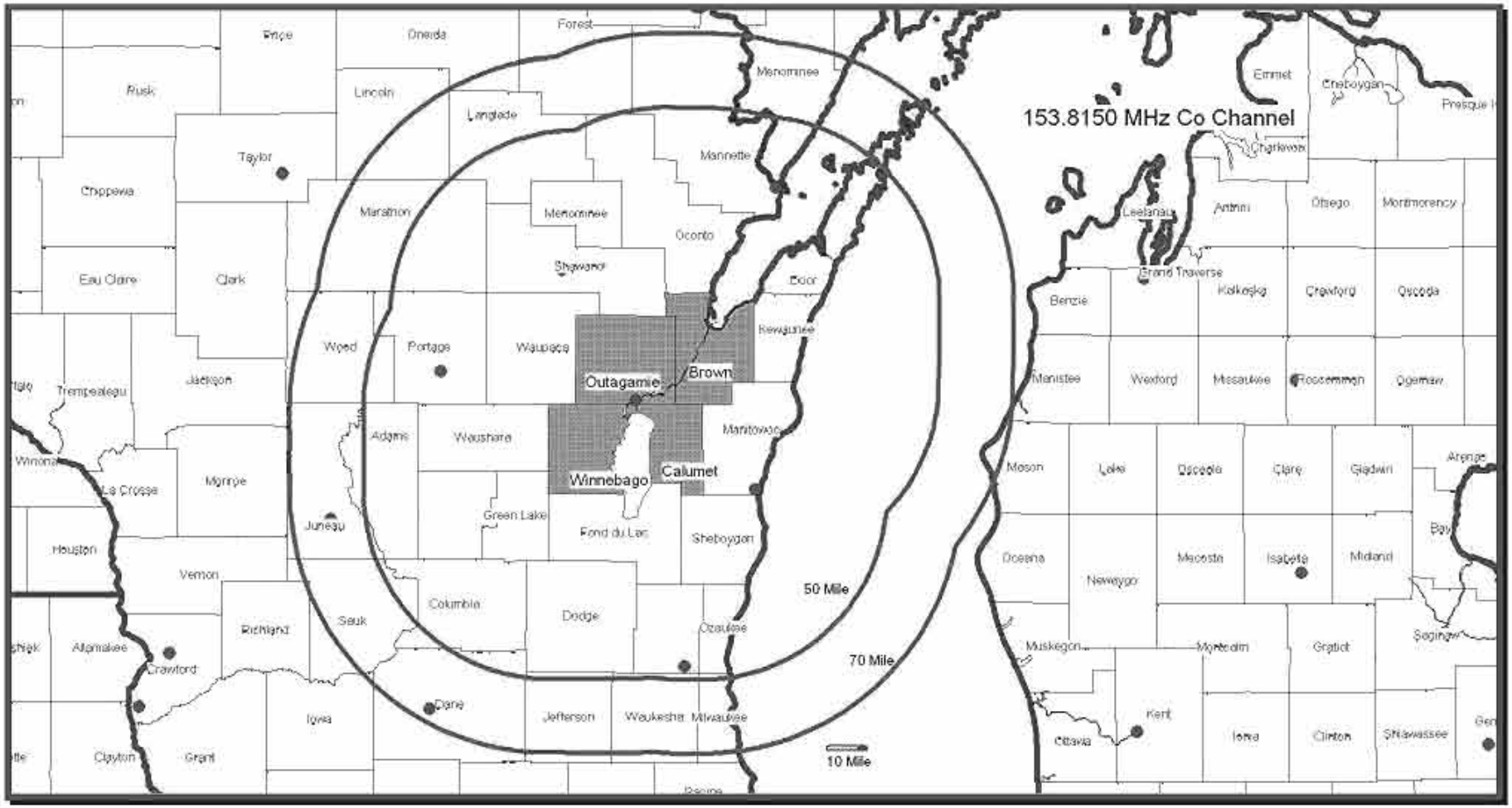
CHANNEL 4 TRANSMIT 151.4150 MHZ



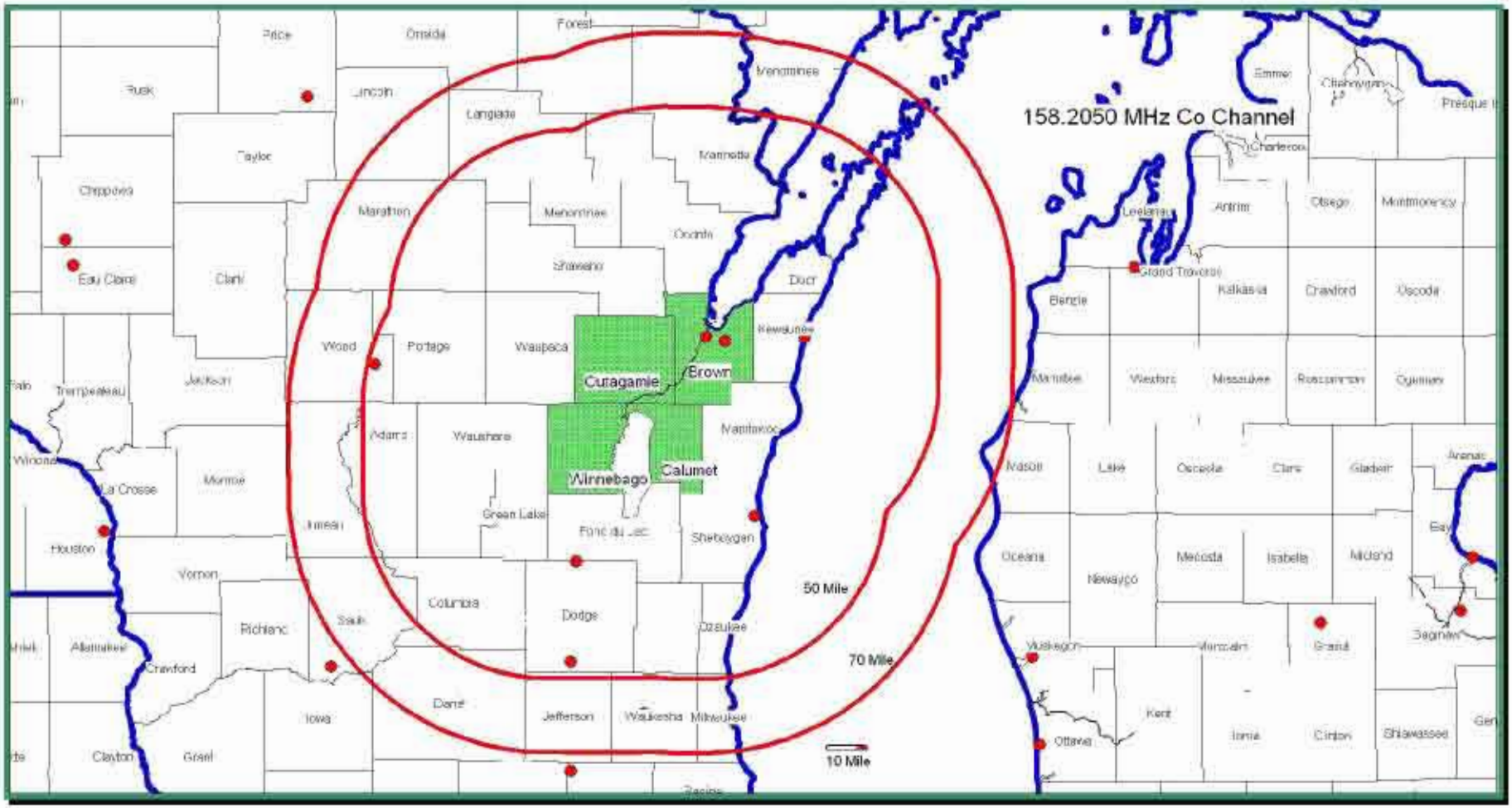
CHANNEL 4 RECEIVE 156.3000 MHZ



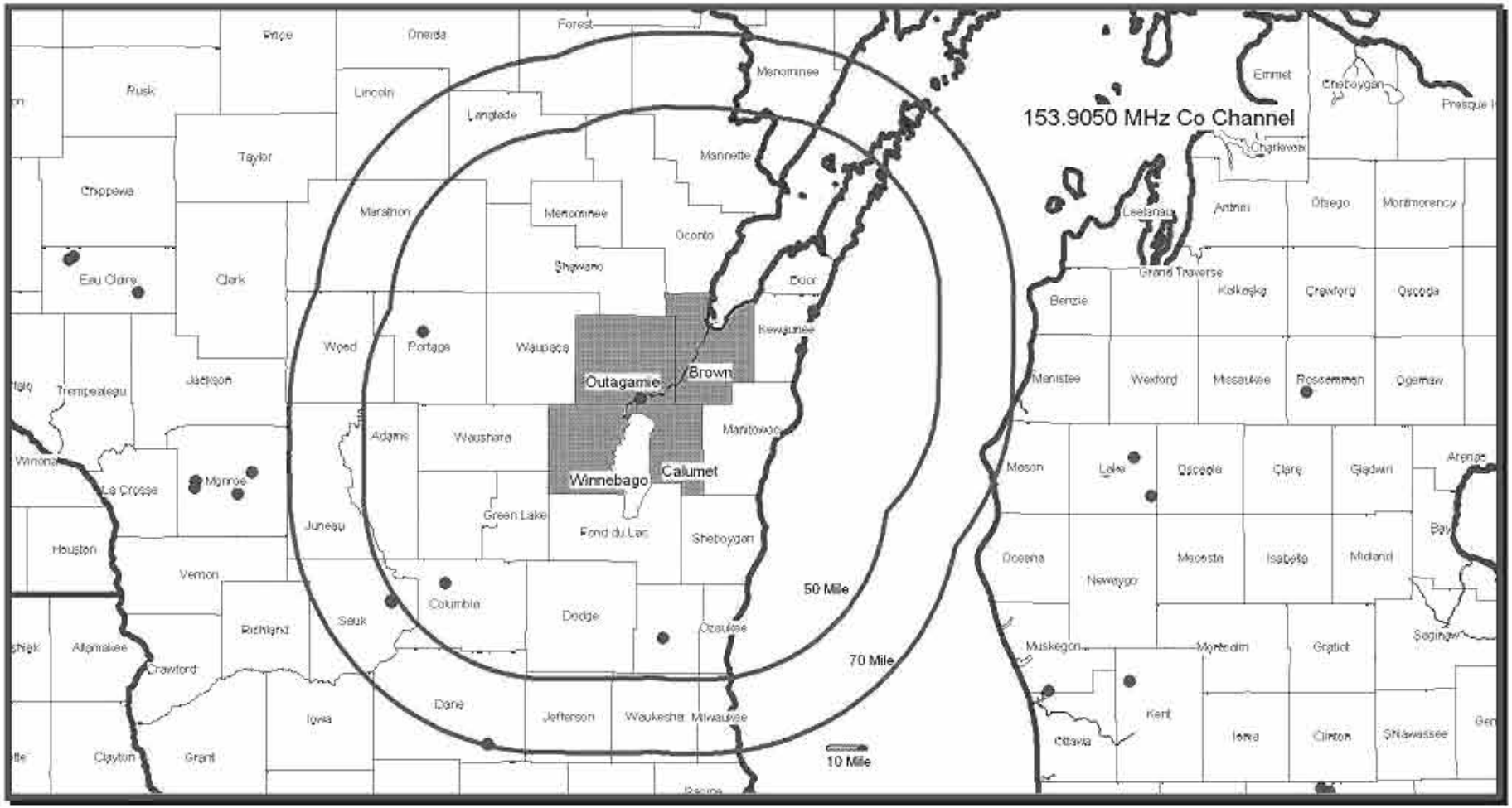
CHANNEL 5 TRANSMIT 153.8150 MHZ



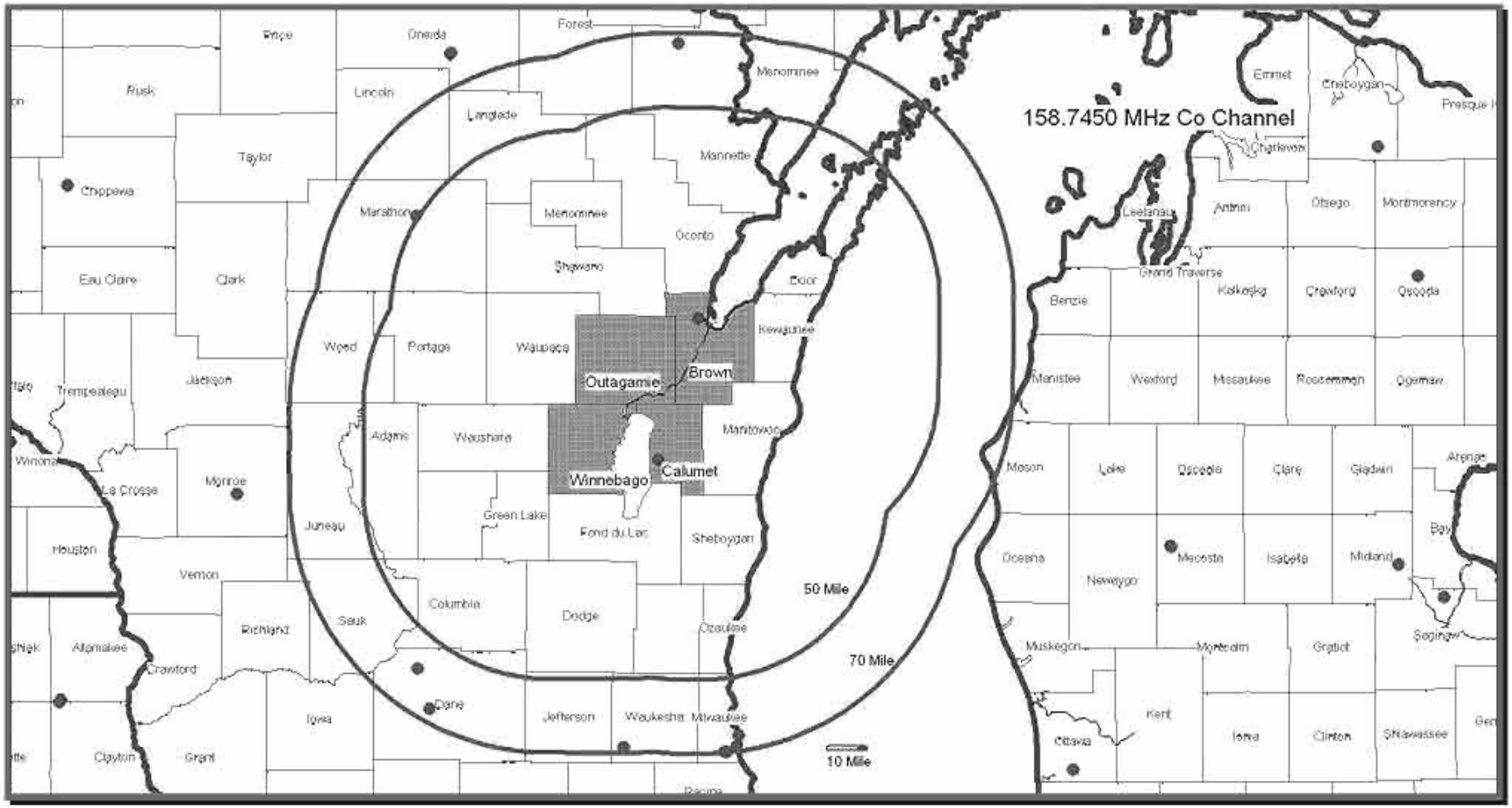
CHANNEL 5 RECEIVE 158.2050 MHZ



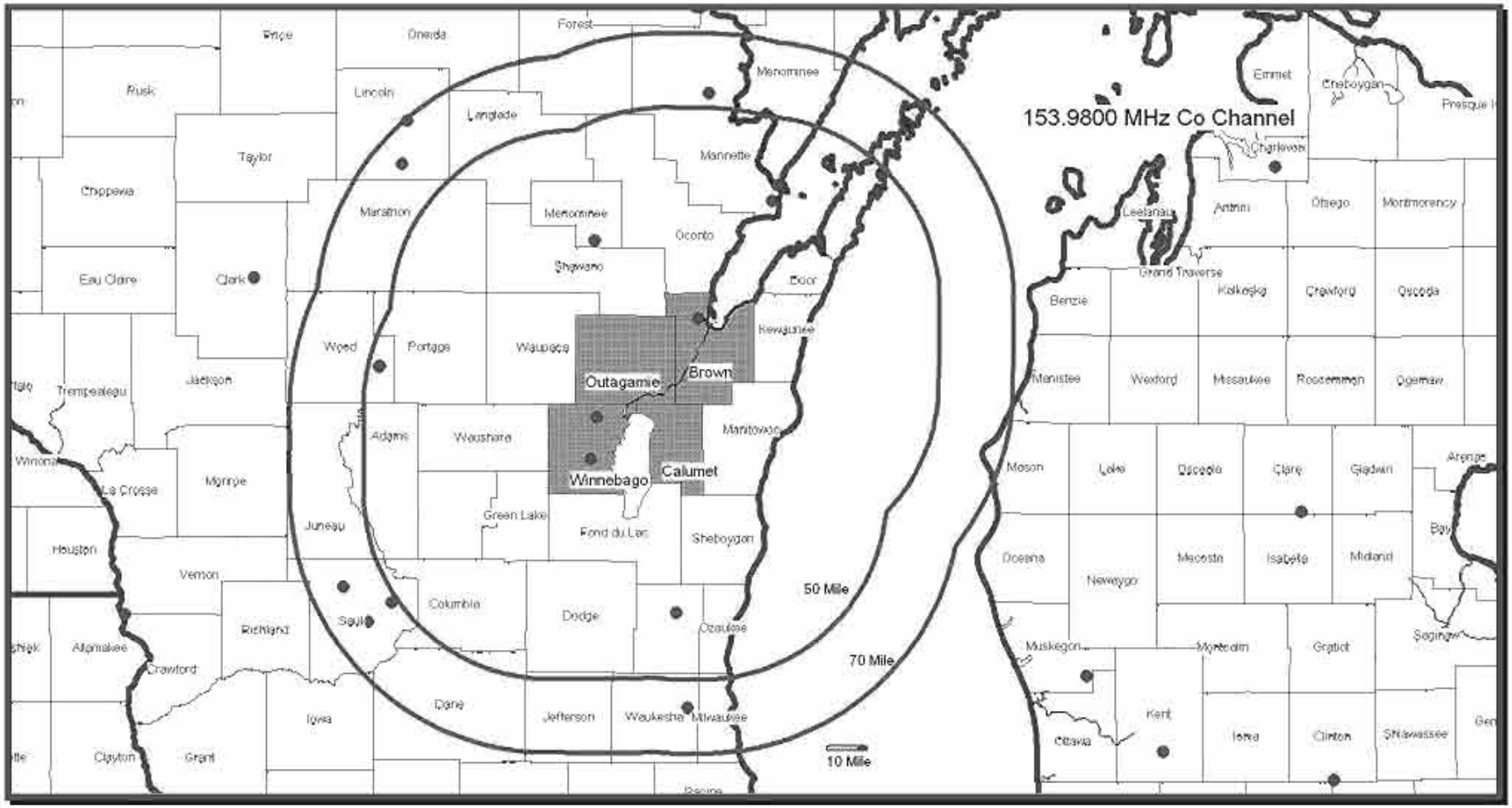
CHANNEL 6 TRANSMIT 153.9050 MHZ



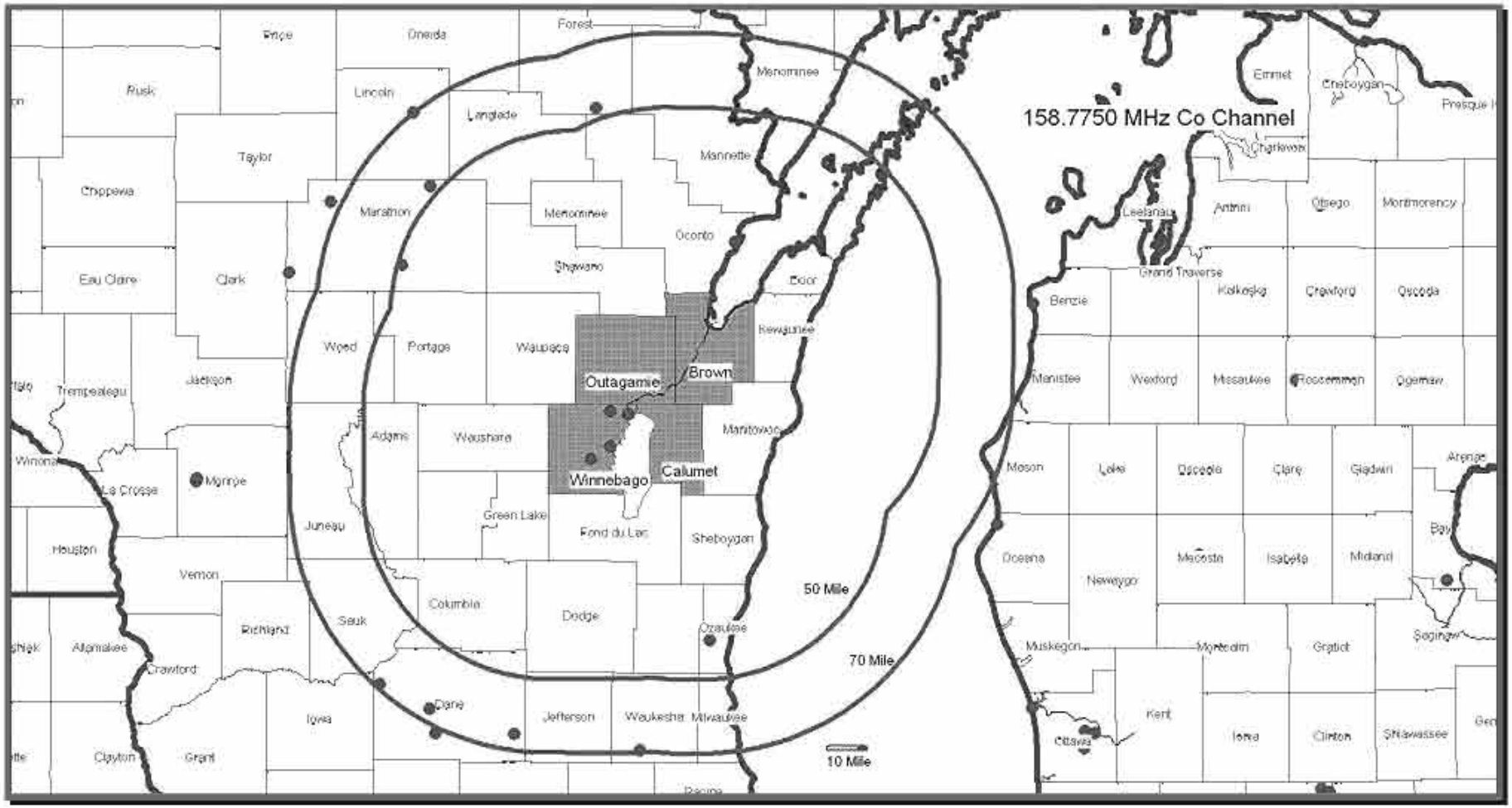
CHANNEL 6 RECEIVE 158.7450 MHZ



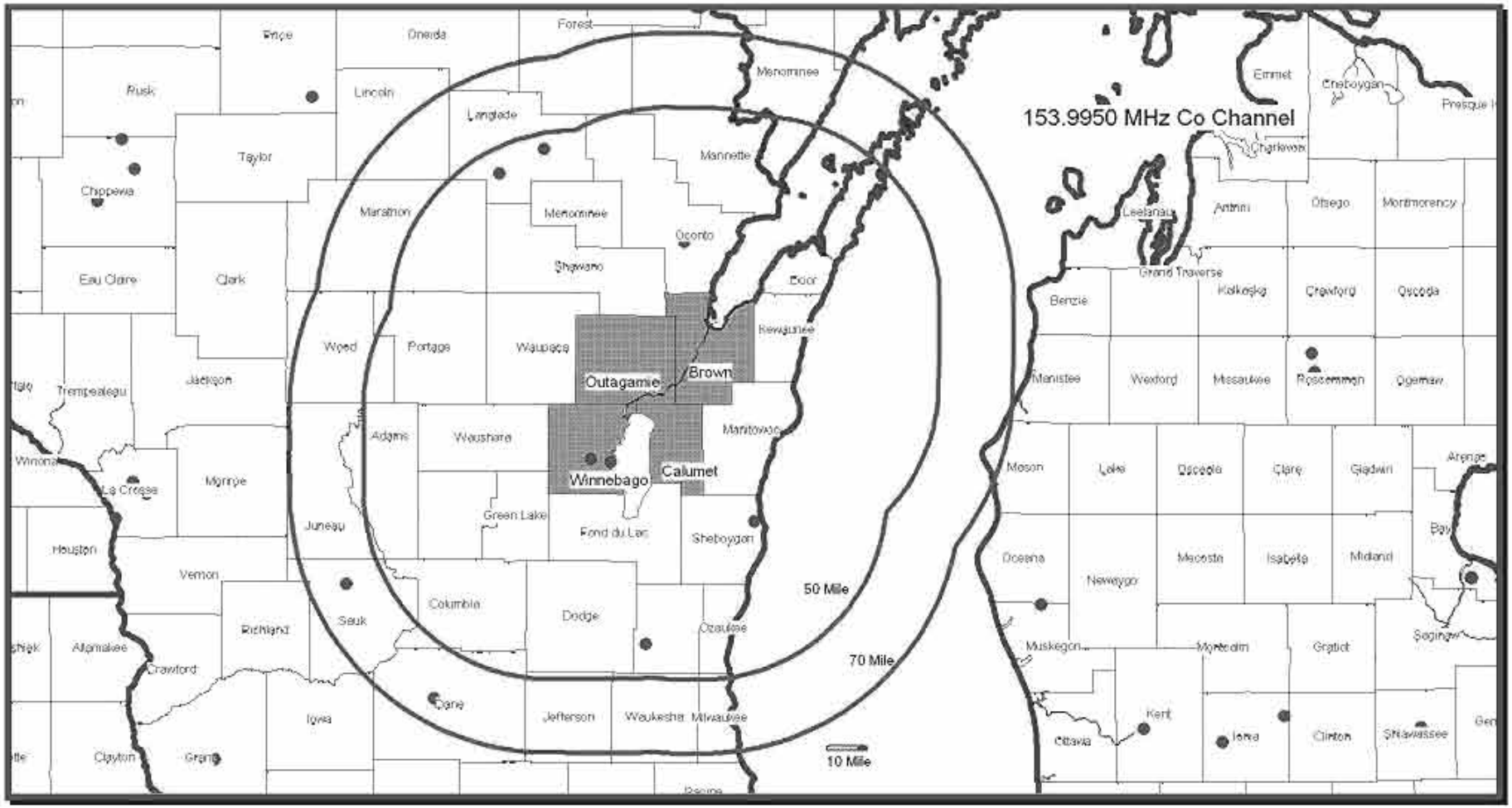
CHANNEL 7 TRANSMIT 153.9800 MHZ



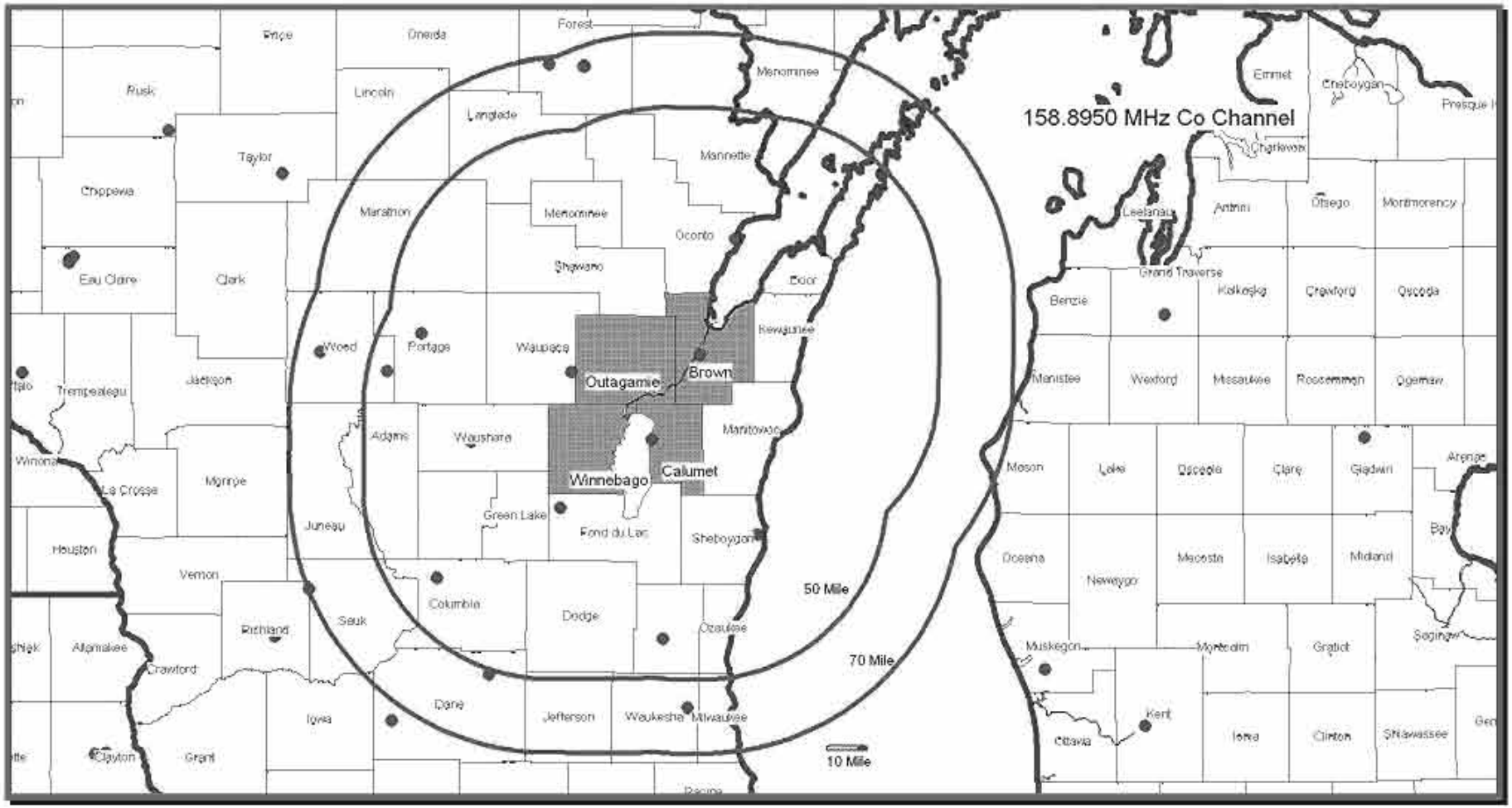
CHANNEL 7 RECEIVE 158.7750 MHZ



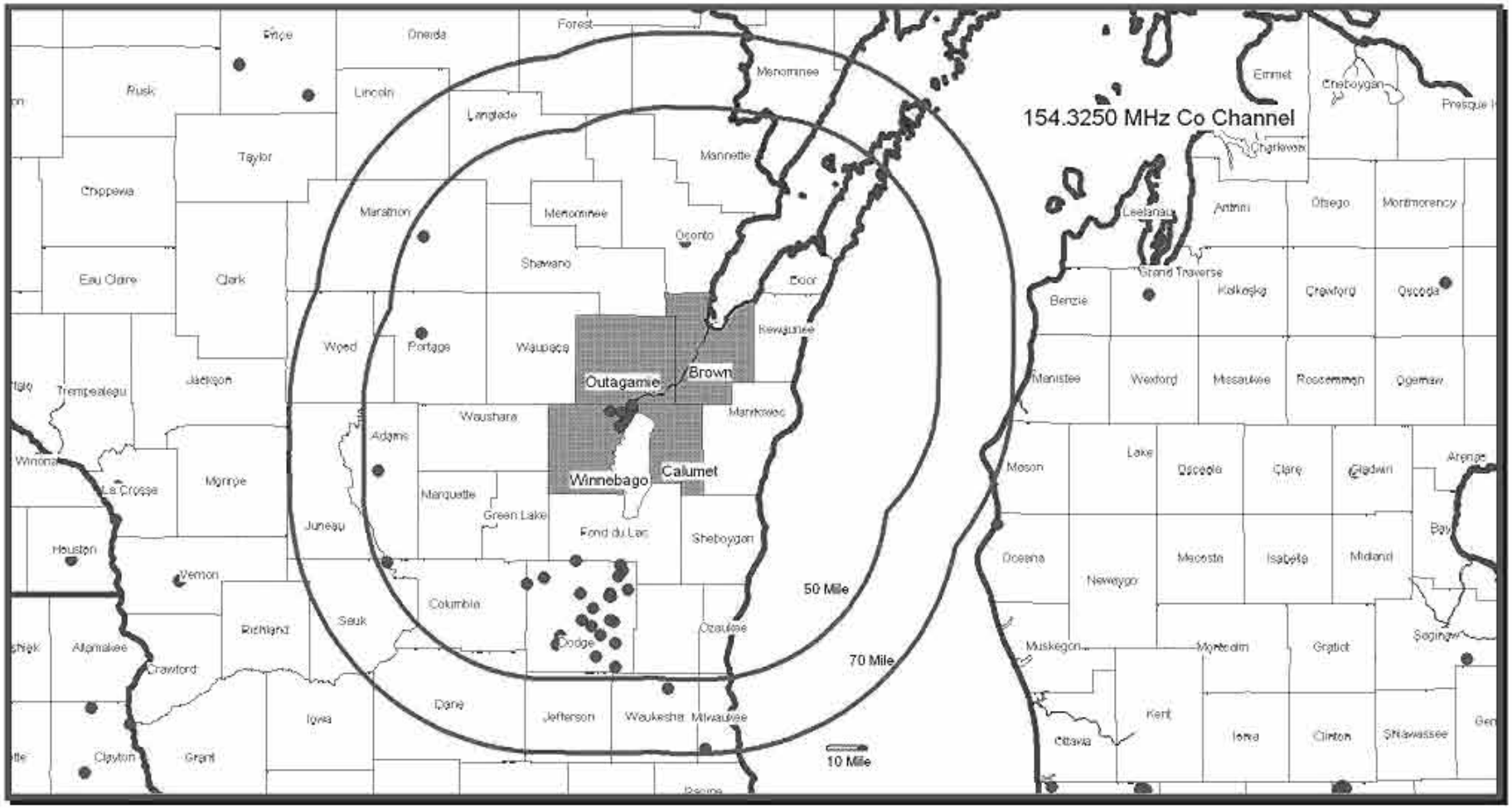
CHANNEL 8 TRANSMIT 153.9950 MHZ



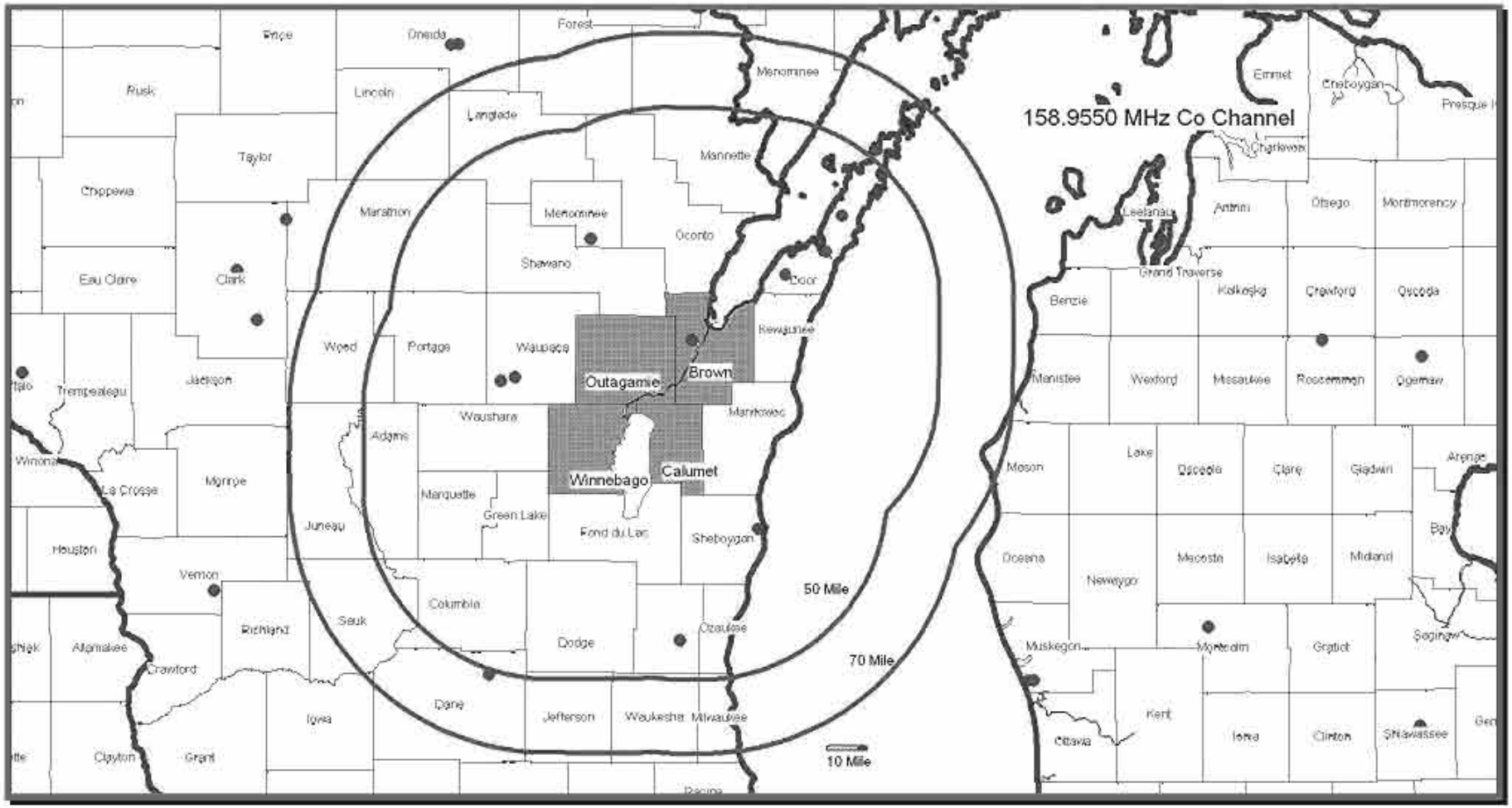
CHANNEL 8 RECEIVE 158.8950 MHZ



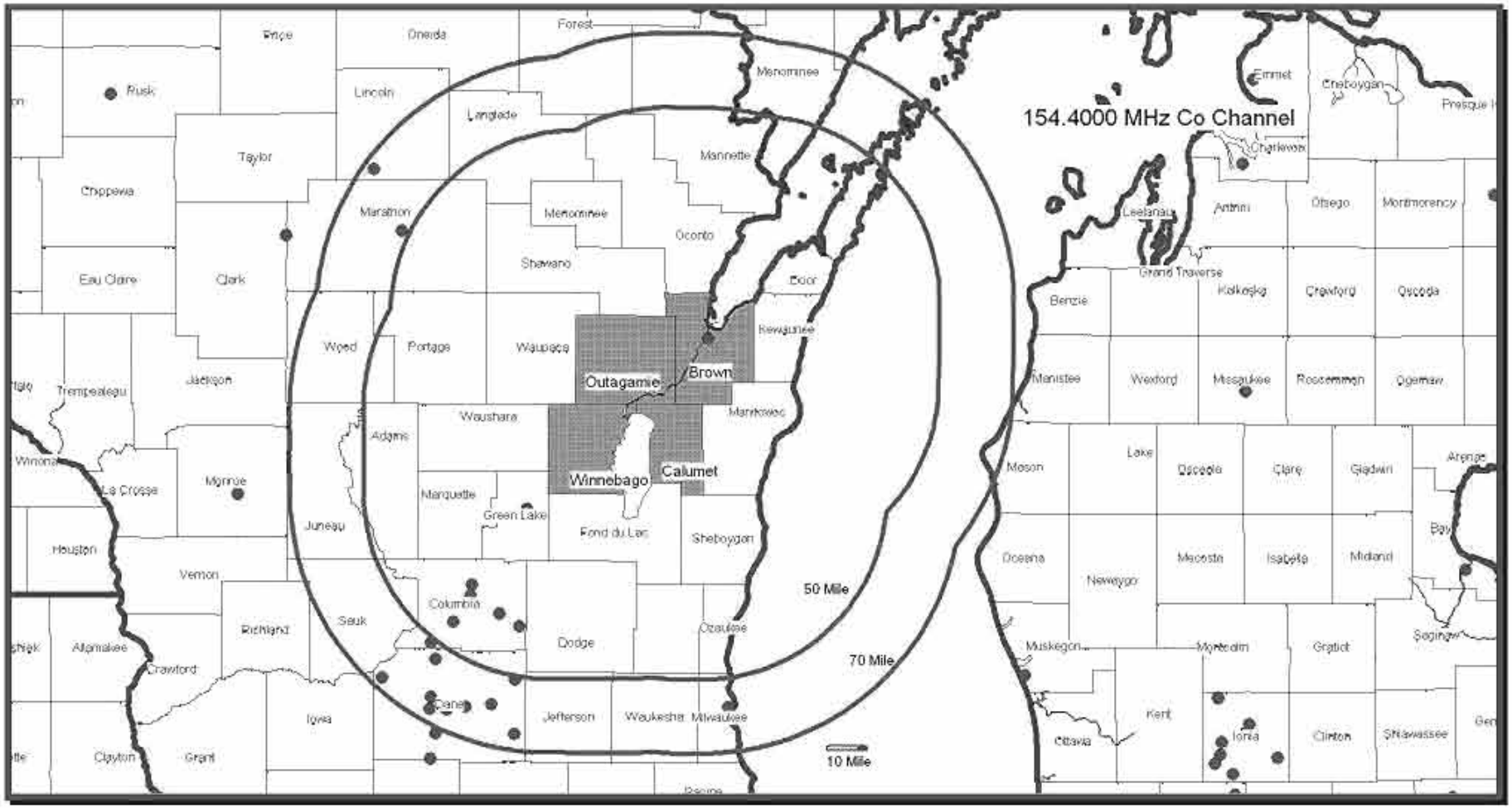
CHANNEL 9 TRANSMIT 154.3250 MHZ



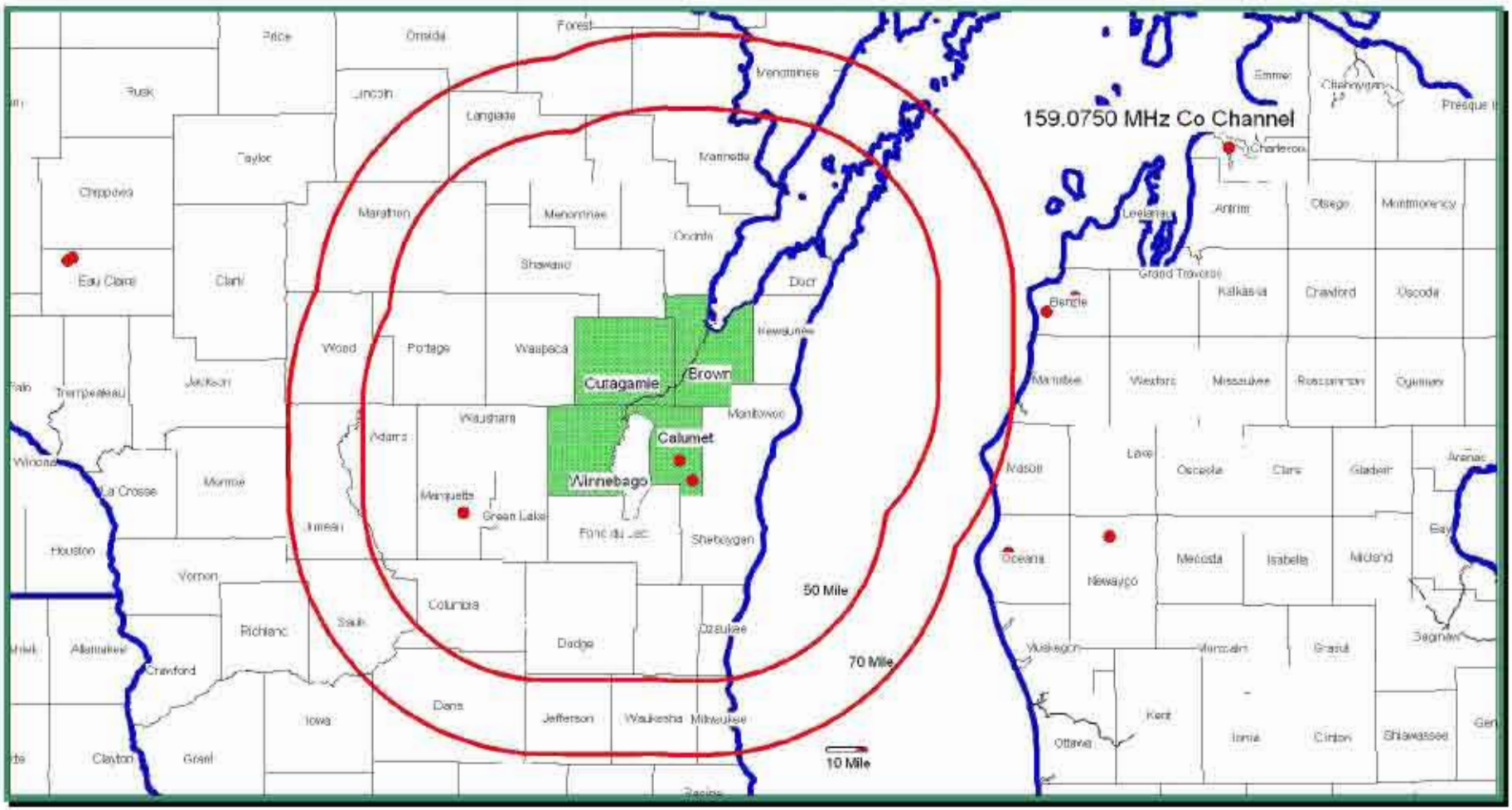
CHANNEL 9 RECEIVE 158.9550 MHZ



CHANNEL 10 TRANSMIT 154.4000 MHZ

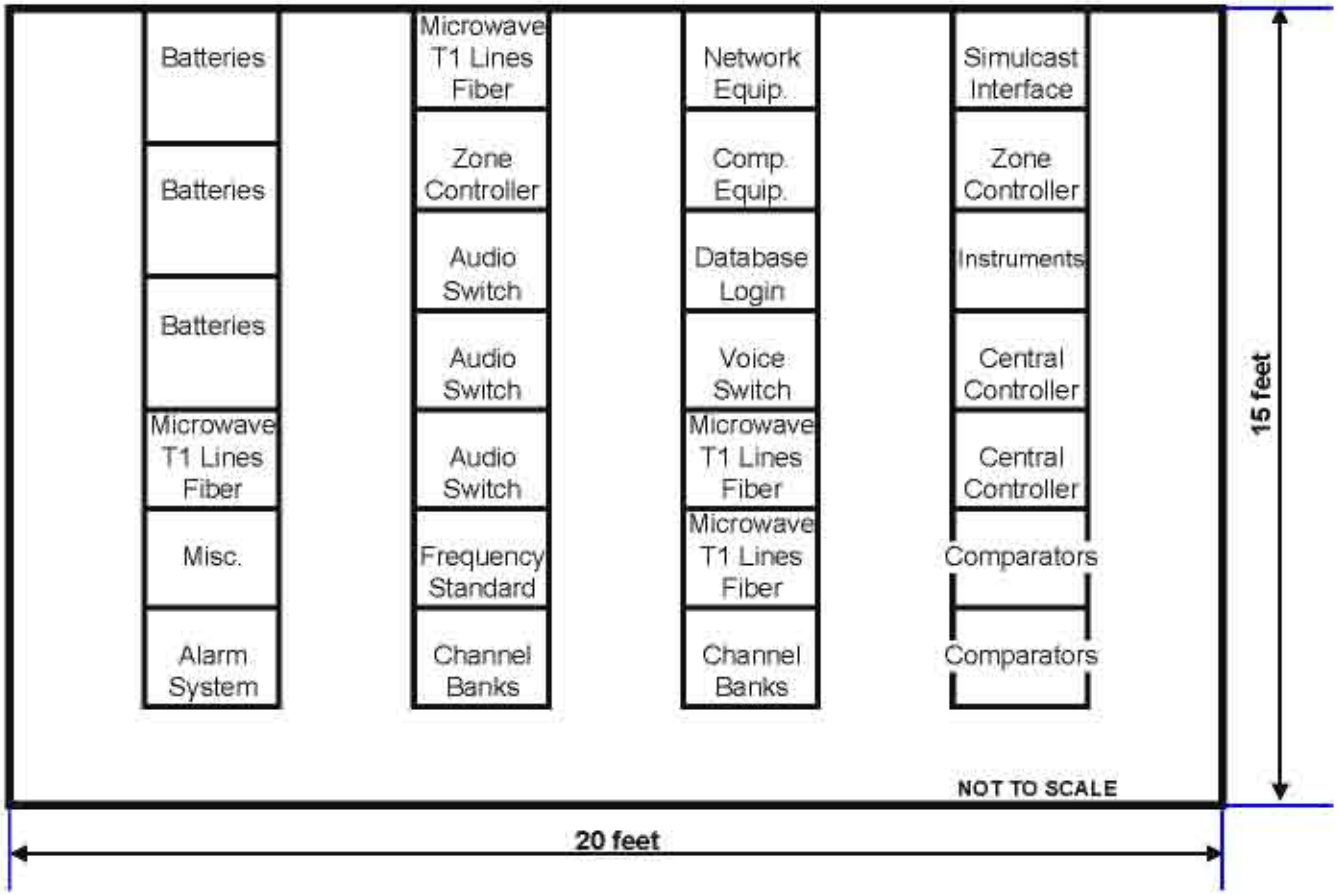


CHANNEL 10 RECEIVE 159.0750 MHZ



APPENDIX C –

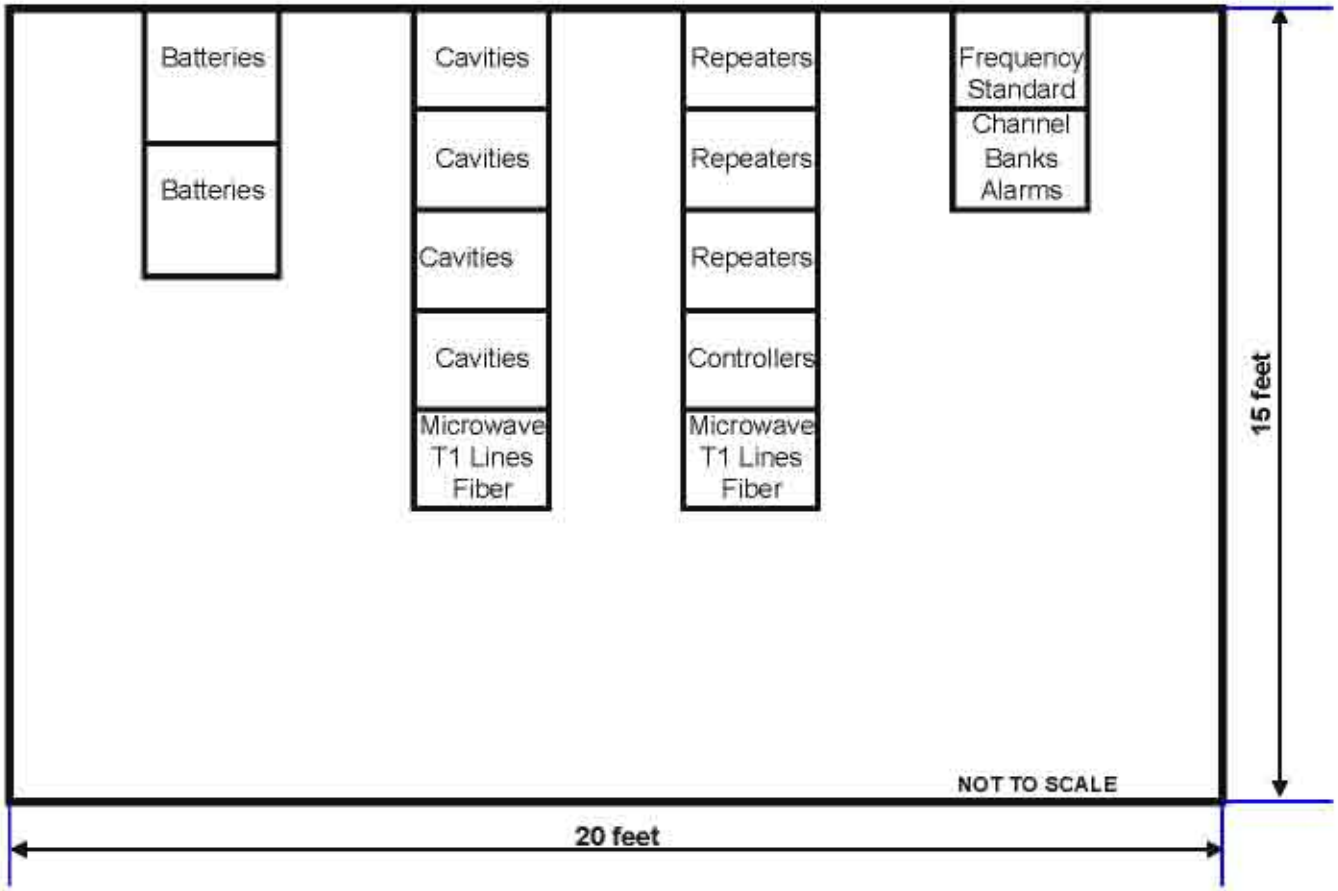
FIGURE C-1: CENTRAL CONTROL SITE FLOOR LAYOUT



Recommended Size	
UPS Watts	50,000
Generator kVA	75,000
Cooling in BTU	125,000
Cooling in Ton	10

Total Equipment Weight: 10,000 lb.(Approx.)

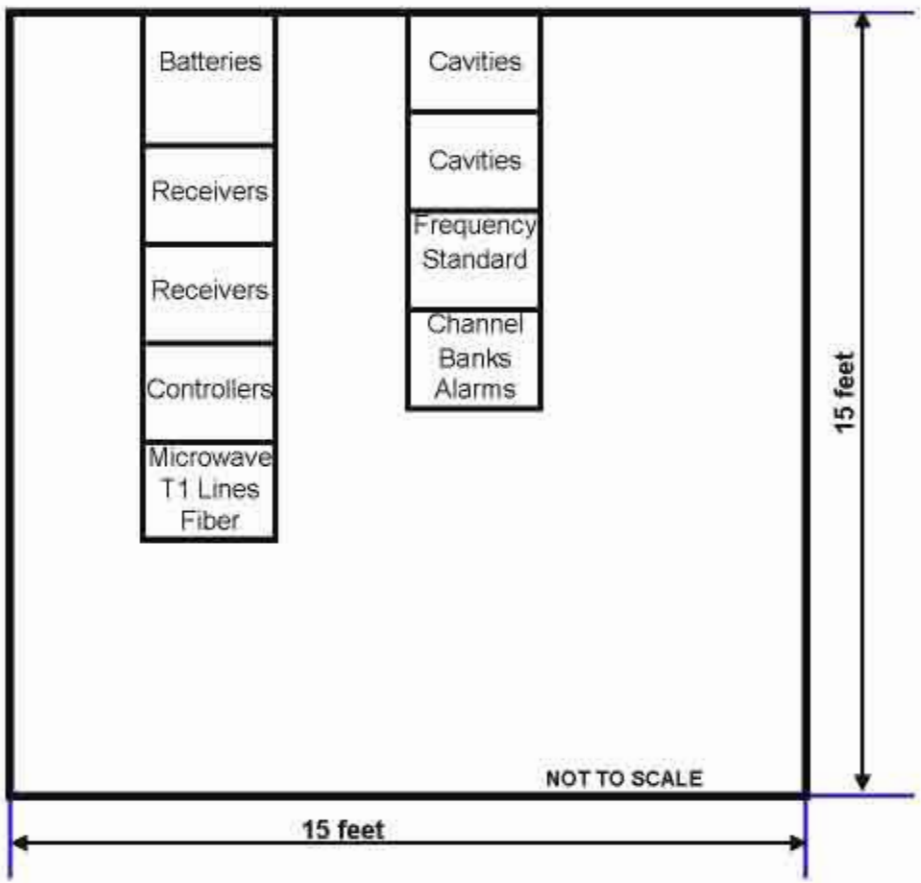
FIGURE C-2: TRUNKED REPEATER SITE FLOOR LAYOUT



Recommended Size	
UPS Watts	15,000
Generator kVA	20,000
Cooling in BTU	32,000
Cooling in Ton	2.6

Total Equipment Weight: 6,000 lb. (Approx.)

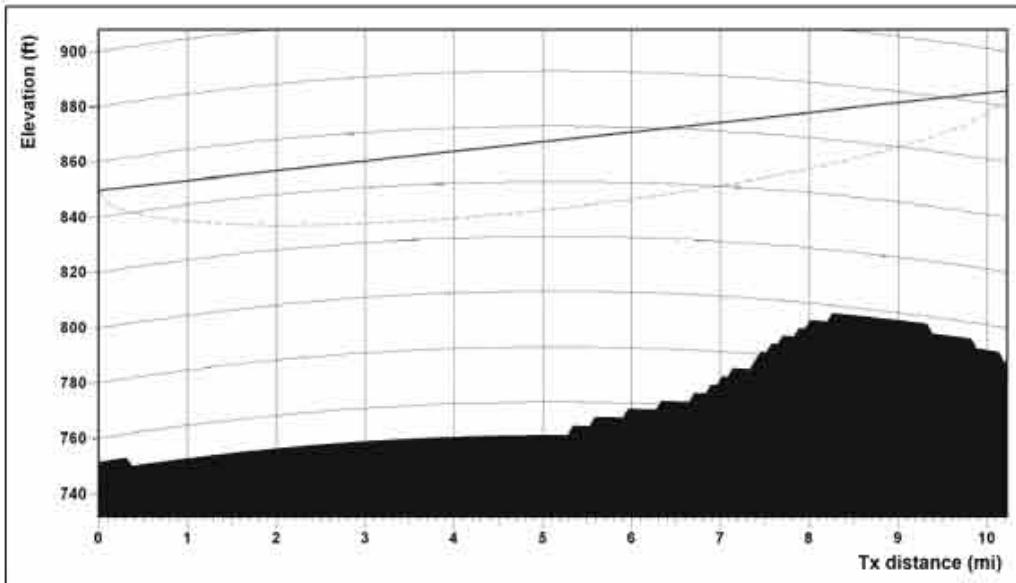
FIGURE C-3: REMOTE RECEIVER SITE FLOOR LAYOUT



Recommended Size	
UPS Watts	3,100
Generator kVA	5,000
Cooling in BTU	7,500
Cooling in Ton	0.75

Total Equipment Weight:4,000 lb. (Approx.)

PATH PROFILE FROM MENASHA TO OSHKOSH



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

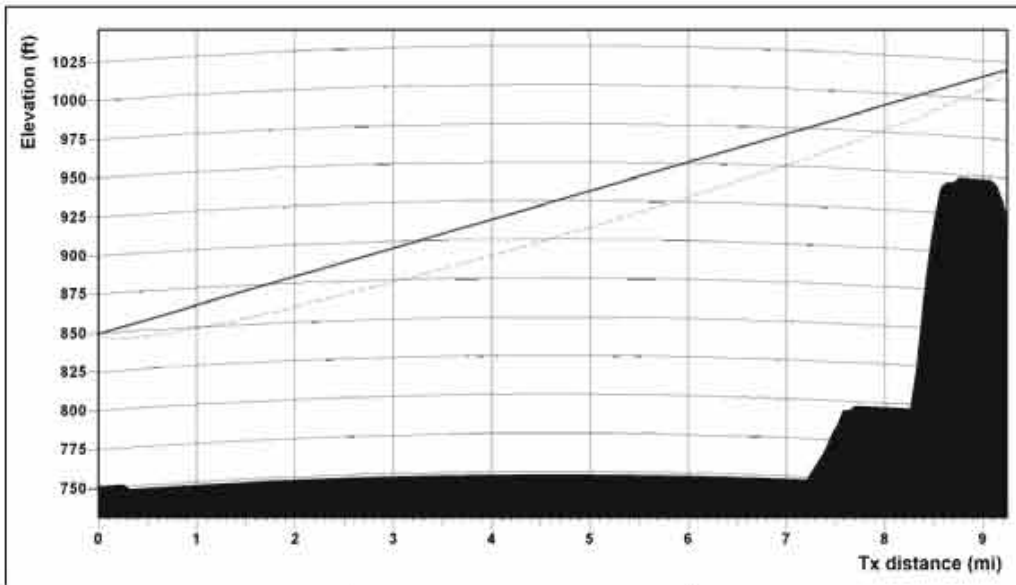
Transmitter Site: Nenasha4
Name: Nenasha
Location:
N44°12'29.00" W88°26'30.00"
Site elevation: 751.3 ft
Antenna height: 98.4 ft
Pointing azimuth: 211.1 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000000.00 W

Name: Nenasha4 ->Oshkosh3
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 10.23 mi
Number of obstacles: 0
Excess path loss: -0.06 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 130.53 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.01 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: Oshkosh3
Name: Oshkosh_PSAP
Location:
N44°04'51.90" W88°32'53.00"
Site elevation: 787.4 ft
Antenna height: 98.4 ft
Pointing azimuth: 31.1 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 4.47 dBmW

Notes

PATH PROFILE FROM MENASHA TO SHERWOOD



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

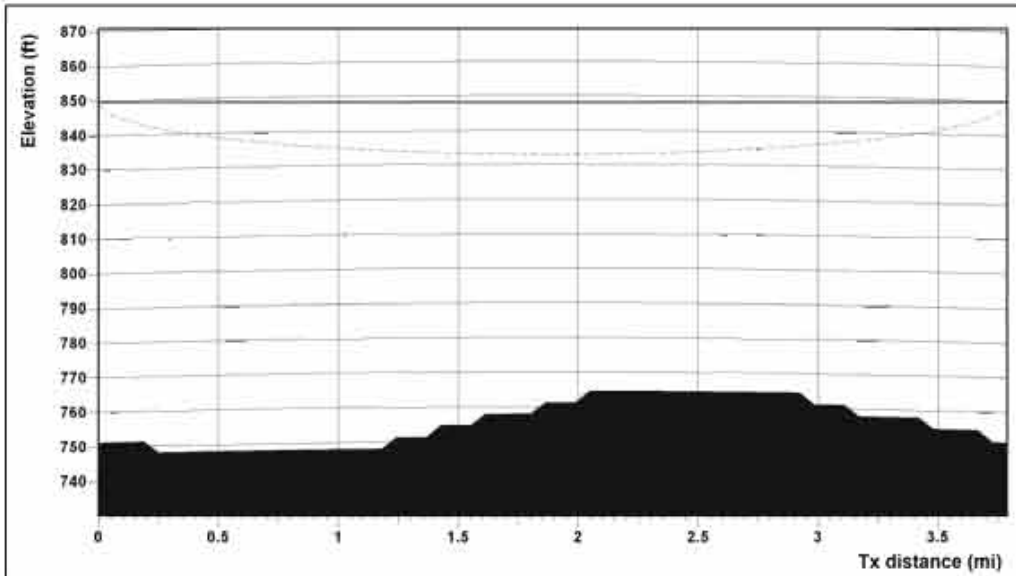
Transmitter Site: Nenasha3
Name: Nenasha
Location:
N44°12'29.00" W88°26'30.00"
Site elevation: 751.3 ft
Antenna height: 98.4 ft
Pointing azimuth: 108.1 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: Nenasha3 ->Sherwood
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 9.25 mi
Number of obstacles: 0
Excess path loss: -0.03 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 129.68 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: Sherwood
Name: Sherwood
Location:
N44°09'59.00" W88°15'51.00"
Site elevation: 921.9 ft
Antenna height: 98.4 ft
Pointing azimuth: 288.1 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 5.32 dBmW

Notes

PATH PROFILE FROM OUTAGAMIE PSAP TO MENASHA



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

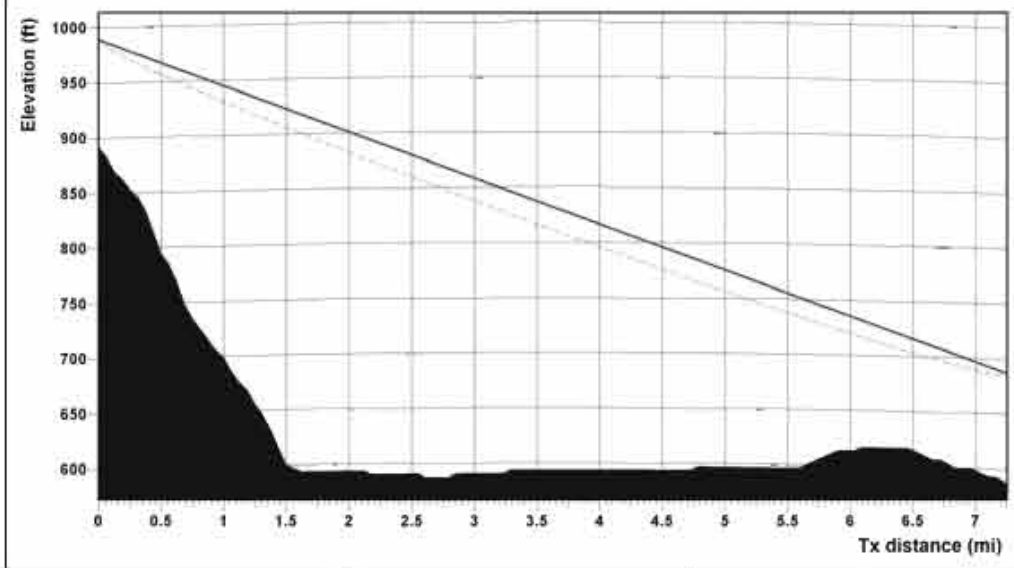
Transmitter Site: Outa_PSA
Name: Outagamie_PSAP
Location:
N44°15'32.00" W88°24'43.00"
Site elevation: 751.3 ft
Antenna height: 98.4 ft
Pointing azimuth: 202.7 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000000.00 W

Name: Outa_PSA ->Nenasha
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 3.81 mi
Number of obstacles: 0
Excess path loss: -0.01 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 121.95 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: Nenasha
Name: Nenasha
Location:
N44°12'29.00" W88°26'30.00"
Site elevation: 751.3 ft
Antenna height: 98.4 ft
Pointing azimuth: 22.7 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 13.05 dBmW

Notes

PATH PROFILE FROM SCARY HILL RD TO GREEN BAY PSAP



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

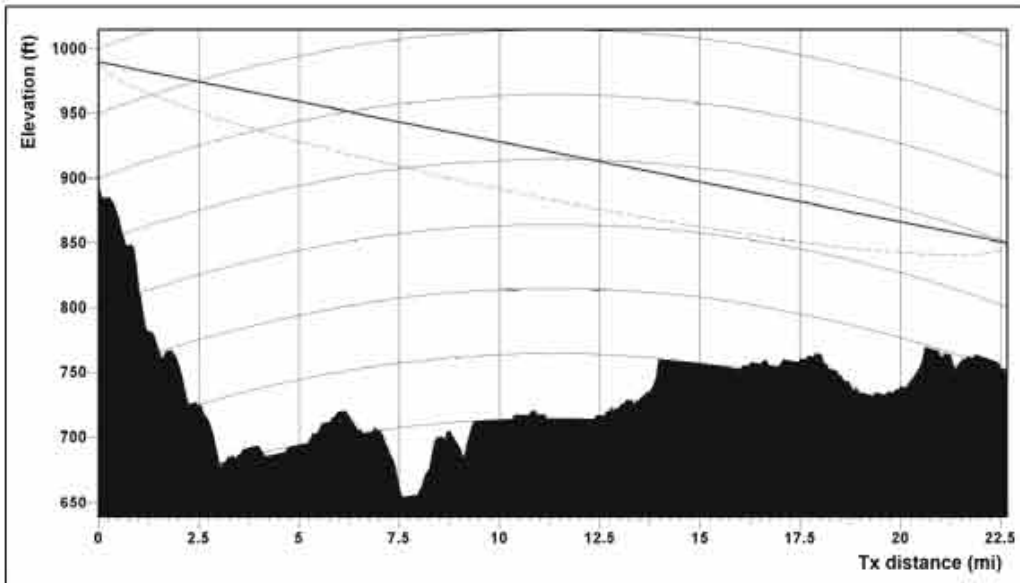
Transmitter Site: ScarysHi
Name: ScarysHill
Location:
N44°24'32.00" W88°00'12.00"
Site elevation: 891.3 ft
Antenna height: 98.4 ft
Pointing azimuth: 355.6 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000000.00 W

Name: ScarysHi ->GBPD1
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 7.25 mi
Number of obstacles: 0
Excess path loss: -0.02 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 127.58 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: GBPD1
Name: GBPD
Location:
N44°30'49.00" W88°00'52.30"
Site elevation: 588.5 ft
Antenna height: 98.4 ft
Pointing azimuth: 175.6 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 7.42 dBmW

Notes

PATH PROFILE FROM SCARY HILL RD TO OUTAGAMIE PSAP



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

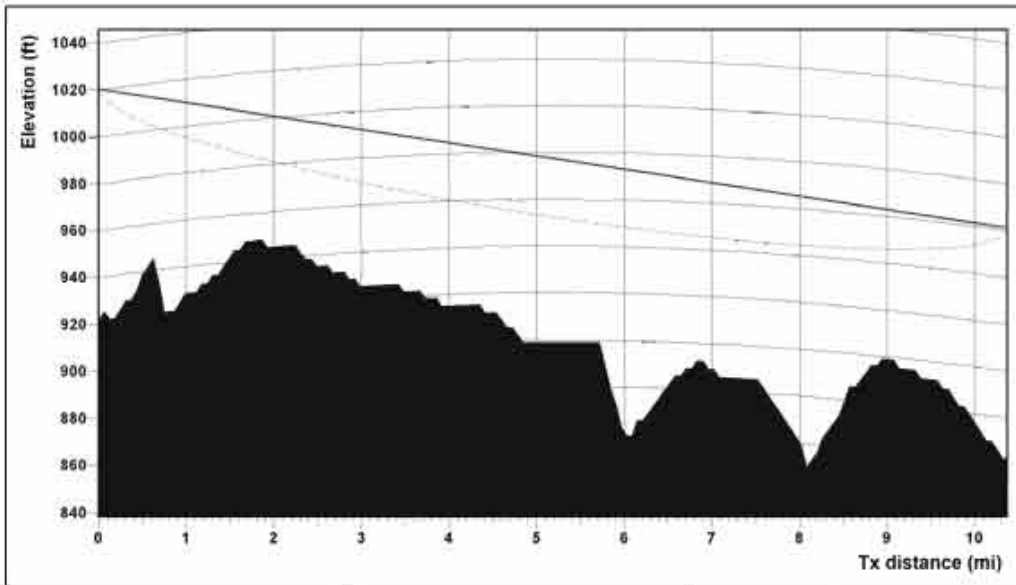
Transmitter Site: ScarysHi
Name: ScarysHill
Location:
N44°24'32.00" W88°00'12.00"
Site elevation: 891.3 ft
Antenna height: 98.4 ft
Pointing azimuth: 243.0 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: ScarysHi ->Outa_PSA
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 22.69 mi
Number of obstacles: 0
Excess path loss: 0.47 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 137.97 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.06 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: Outa_PSA
Name: OutagamiePSAP
Location:
N44°15'32.00" W88°24'43.00"
Site elevation: 751.3 ft
Antenna height: 98.4 ft
Pointing azimuth: 63.0 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: -2.97 dBmW

Notes

PATH PROFILE FROM SHERWOOD TO CHILTON



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

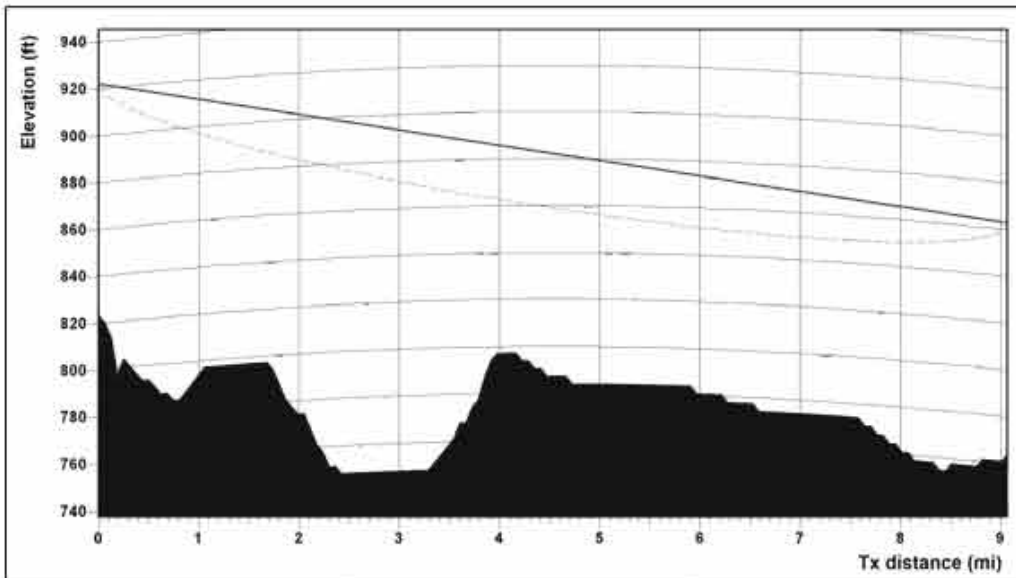
Transmitter Site: Sherwo6
Name: Sherwood
Location:
N44°09'59.00" W88°15'51.00"
Site elevation: 921.9 ft
Antenna height: 98.4 ft
Pointing azimuth: 153.2 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000000.00 W

Name: Sherwo6 ->Chilton
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 10.38 mi
Number of obstacles: 0
Excess path loss: 0.97 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 131.68 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.01 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: Chilton
Name: Chilton
Location:
N44°01'55.70" W88°10'12.00"
Site elevation: 862.9 ft
Antenna height: 98.4 ft
Pointing azimuth: 333.2 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 3.32 dBmW

Notes

PATH PROFILE FROM BEAR CREEK TO T1034095



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

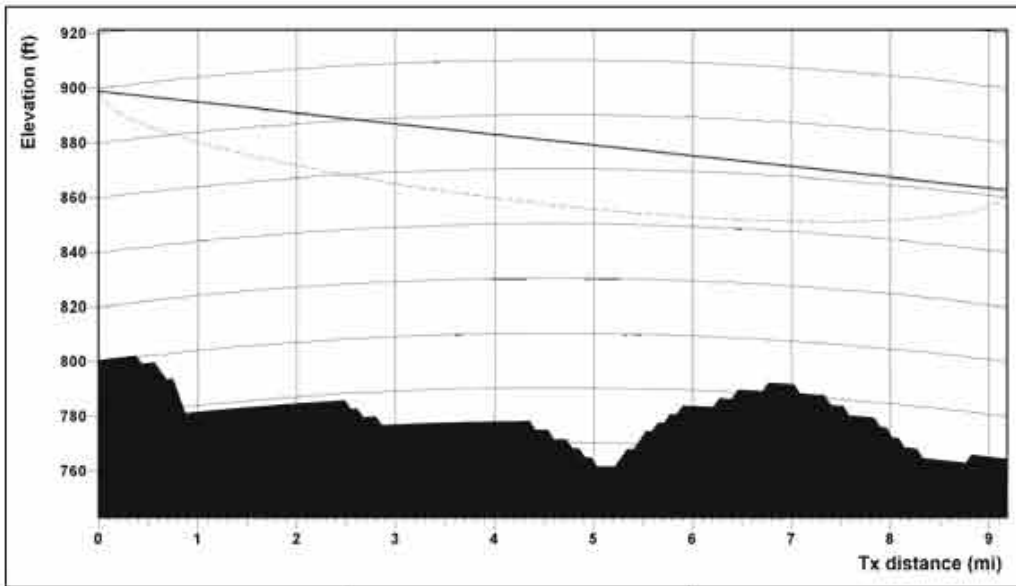
Transmitter Site: BearCree
Name: BearCreek
Location:
N44°31'53.76" W88°43'58.44"
Site elevation: 823.8 ft
Antenna height: 98.4 ft
Pointing azimuth: 83.5 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: BearCree ->T1034095
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 9.10 mi
Number of obstacles: 0
Excess path loss: -0.04 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 129.50 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: T1034095
Name: T1034095
Location:
N44°32'47.04" W88°32'57.12"
Site elevation: 764.4 ft
Antenna height: 98.4 ft
Pointing azimuth: 263.5 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 5.50 dBmW

Notes

PATH PROFILE FROM BINGHAMTOM TO T1034095



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

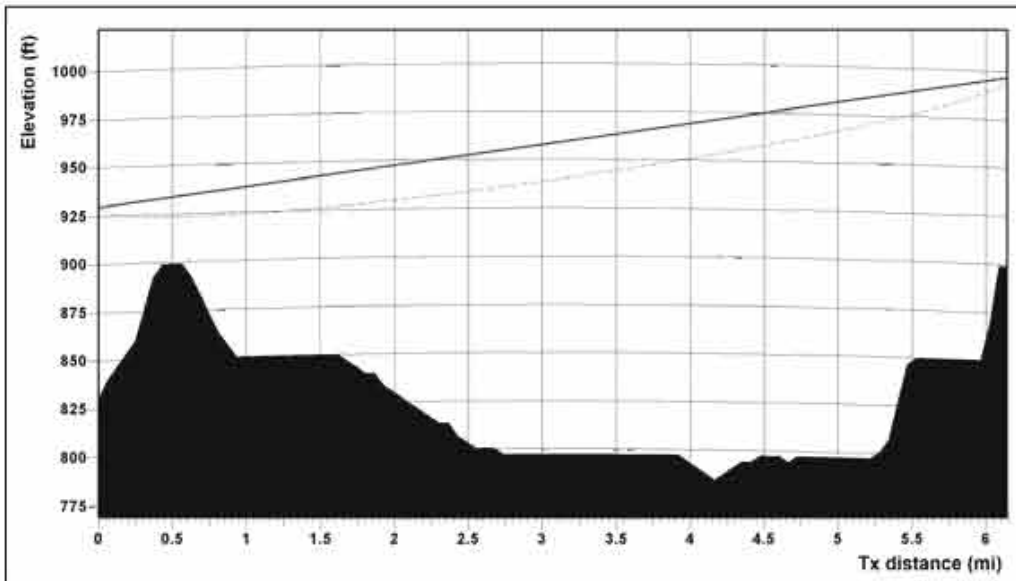
Transmitter Site: BINGHAMT
Name: BINGHAMTON_3
Location:
N44°25'27.84" W88°28'30.36"
Site elevation: 800.5 ft
Antenna height: 98.4 ft
Pointing azimuth: 336.6 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: BINGHAMT ->T1034095
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 9.18 mi
Number of obstacles: 0
Excess path loss: -0.05 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 129.60 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: T1034095
Name: T1034095
Location:
N44°32'47.04" W88°32'57.12"
Site elevation: 764.4 ft
Antenna height: 98.4 ft
Pointing azimuth: 156.6 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 5.40 dBmW

Notes

PATH PROFILE FROM DALE TO HORTONVILLE



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

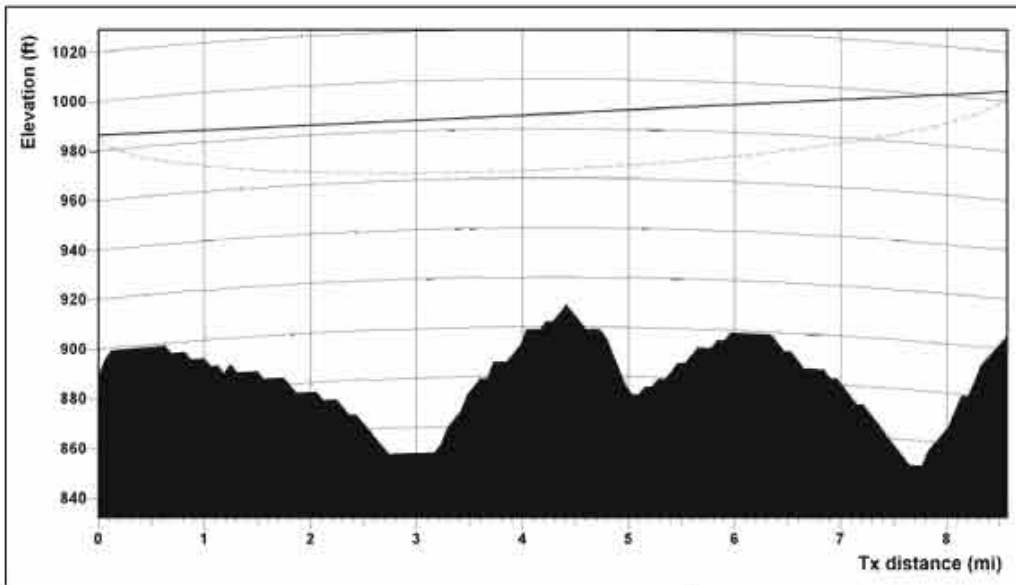
Transmitter Site: DALE
Name: DALE
Location:
N44°16'23.88" W88°40'49.44"
Site elevation: 831.3 ft
Antenna height: 98.4 ft
Pointing azimuth: 36.3 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: DALE ->HORTONVI
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 6.14 mi
Number of obstacles: 0
Excess path loss: -0.02 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 126.14 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: HORTONVI
Name: HORTONVILLE_3
Location:
N44°20'42.00" W88°36'24.48"
Site elevation: 898.4 ft
Antenna height: 98.4 ft
Pointing azimuth: 216.3 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 8.86 dBmW

Notes

PATH PROFILE FROM DENMARK TO T1211998



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

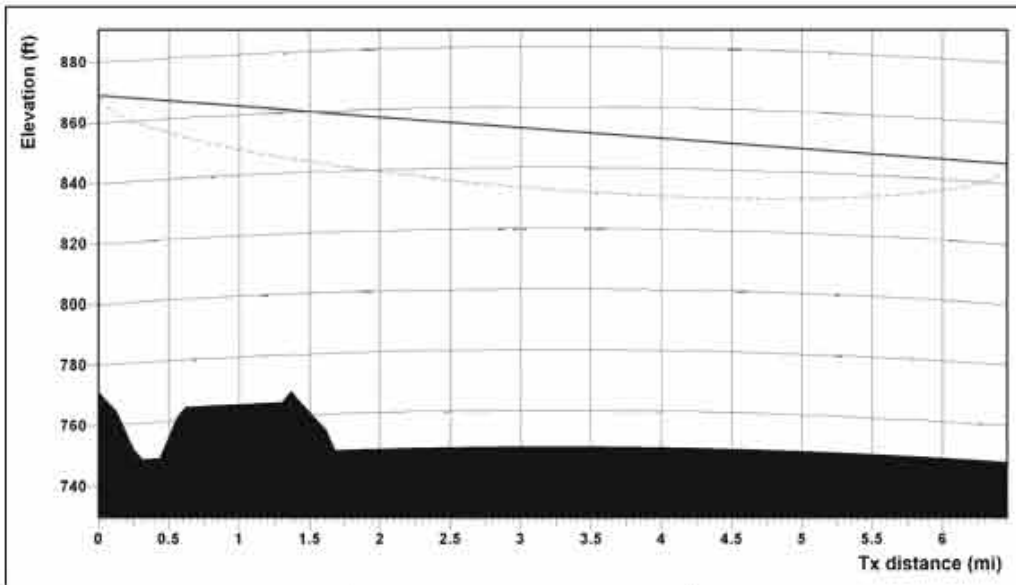
Transmitter Site: DENMARK
Name: DENMARK
Location:
N44°20'52.08" W87°49'54.12"
Site elevation: 888.1 ft
Antenna height: 98.4 ft
Pointing azimuth: 226.8 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: DENMARK ->T1211998
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 8.59 mi
Number of obstacles: 0
Excess path loss: -0.04 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 129.01 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: T1211998
Name: T1211998
Location:
N44°15'45.36" W87°57'29.88"
Site elevation: 905.5 ft
Antenna height: 98.4 ft
Pointing azimuth: 46.8 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 5.99 dBmW

Notes

PATH PROFILE FROM SITE 9 TO WINNECONNE



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

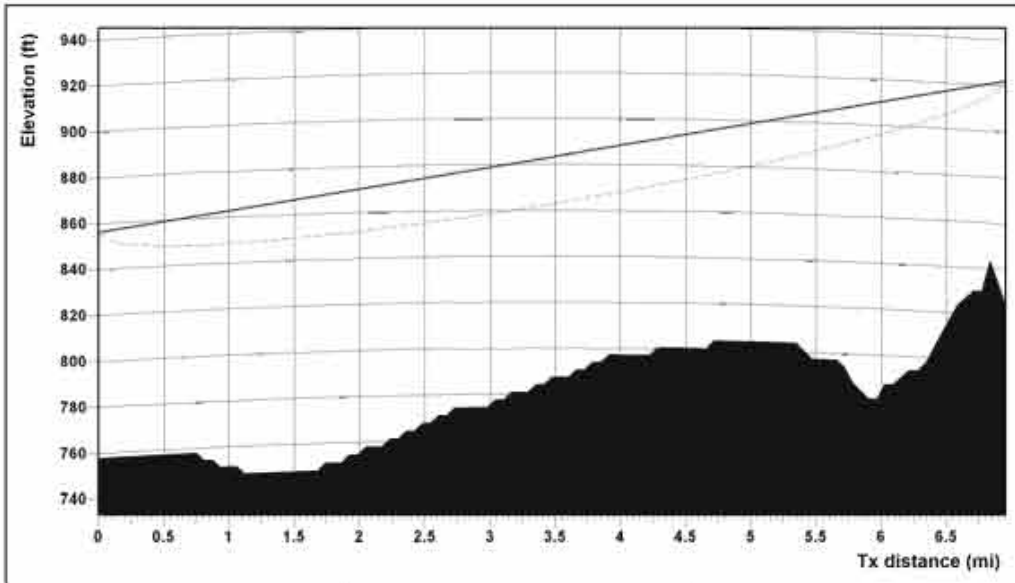
Transmitter Site: New_Site
Name: New_Site_9
Location:
N44°11'59.64" W88°44'30.12"
Site elevation: 770.6 ft
Antenna height: 98.4 ft
Pointing azimuth: 163.2 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: New_Site ->Winnecon
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 6.48 mi
Number of obstacles: 0
Excess path loss: -0.02 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 126.57 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: Winnecon
Name: Winneconne
Location:
N44°06'36.00" W88°42'14.40"
Site elevation: 748.0 ft
Antenna height: 98.4 ft
Pointing azimuth: 343.2 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 8.43 dBmW

Notes

PATH PROFILE FROM SITE 10 TO BEAR CREEK



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

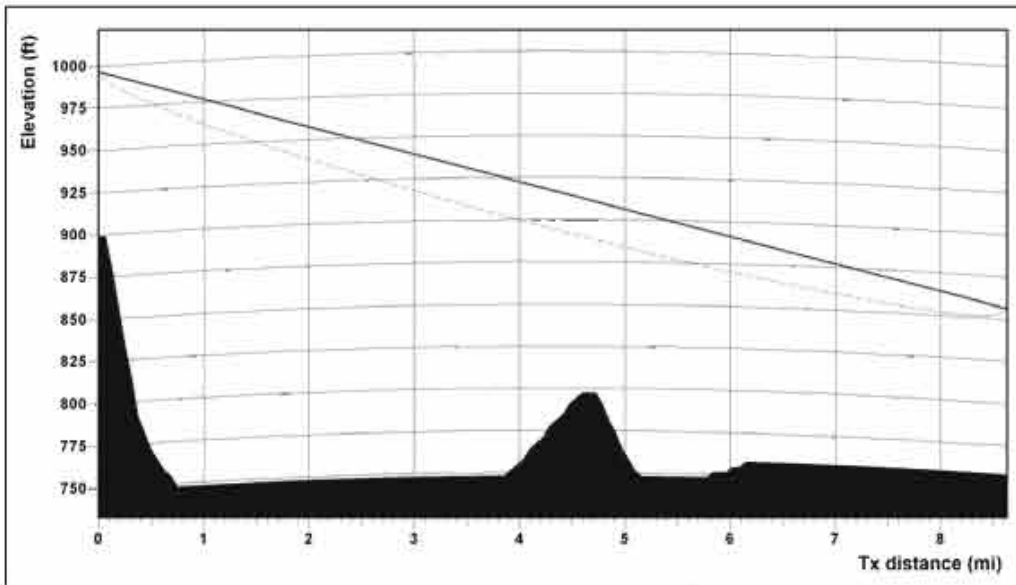
Transmitter Site: New_Site
Name: New_Site_10
Location:
N44°28'10.92" W88°37'17.40"
Site elevation: 757.9 ft
Antenna height: 98.4 ft
Pointing azimuth: 308.0 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: New_Site ->BearCree
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 6.96 mi
Number of obstacles: 0
Excess path loss: -0.03 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 127.21 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: BearCree
Name: BearCreek
Location:
N44°31'53.76" W88°43'58.44"
Site elevation: 823.8 ft
Antenna height: 98.4 ft
Pointing azimuth: 128.0 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 7.79 dBmW

Notes

PATH PROFILE FROM SITE 10 TO HORTONVILLE



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

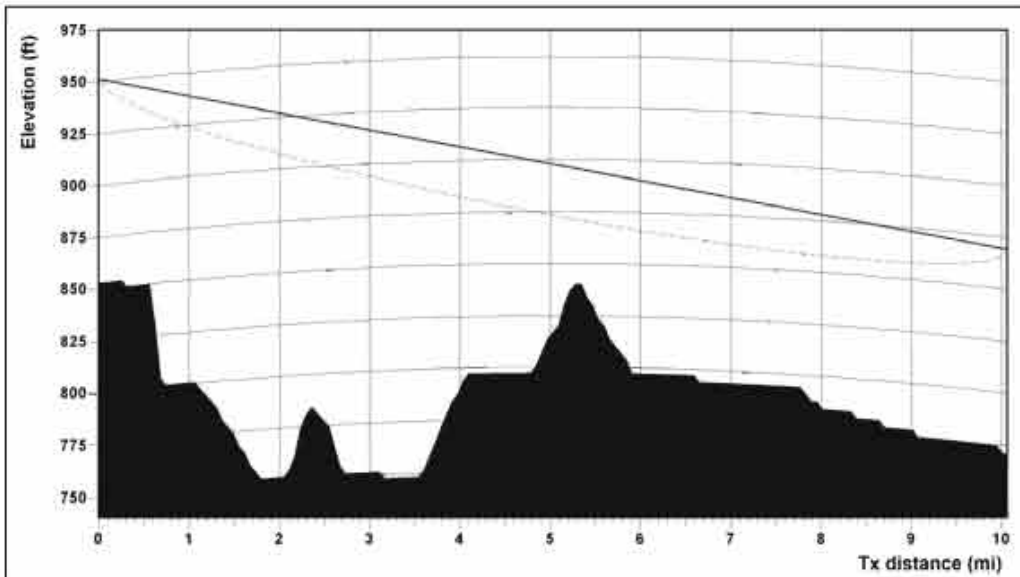
Transmitter Site: Horton
Name: HORTONVILLE_3
Location:
N44°20'42.00" W88°36'24.48"
Site elevation: 898.4 ft
Antenna height: 98.4 ft
Pointing azimuth: 355.2 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: Horton ->New_Site
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 8.64 mi
Number of obstacles: 0
Excess path loss: -0.03 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 129.08 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: New_Site
Name: New_Site_10
Location:
N44°28'10.92" W88°37'17.40"
Site elevation: 757.9 ft
Antenna height: 98.4 ft
Pointing azimuth: 175.2 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 5.92 dBmW

Notes

PATH PROFILE FROM SITE 11 TO SITE 2



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

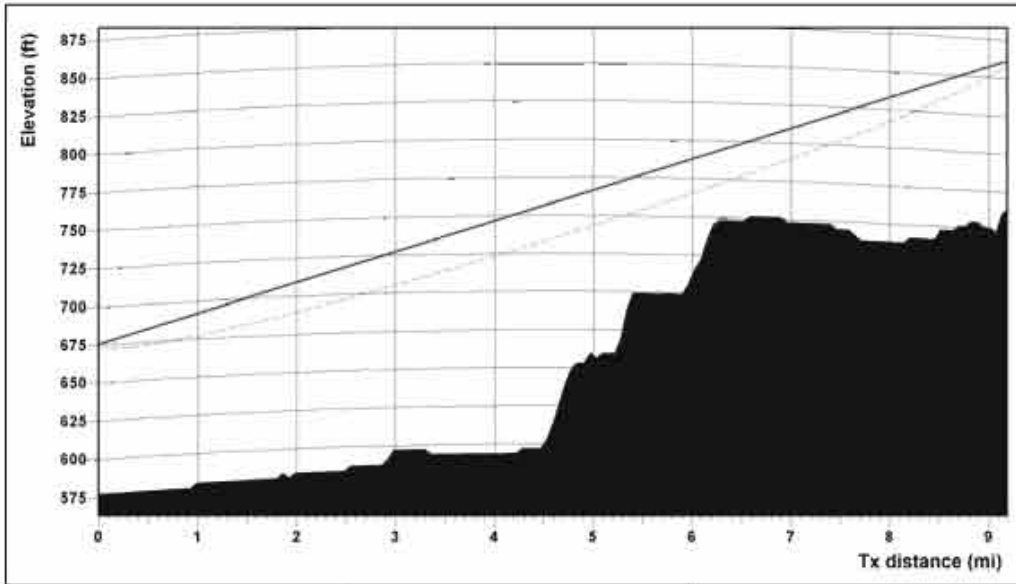
Transmitter Site: NewSite1
Name: New_Site_11
Location:
N43°57'14.40" W88°51'55.80"
Site elevation: 853.0 ft
Antenna height: 98.4 ft
Pointing azimuth: 3.1 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: NewSite1 ->New_2
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 10.08 mi
Number of obstacles: 0
Excess path loss: -0.05 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 130.39 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: New_2
Name: New_2
Location:
N44°05'58.92" W88°51'15.84"
Site elevation: 771.0 ft
Antenna height: 98.4 ft
Pointing azimuth: 183.1 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 4.61 dBmW

Notes

PATH PROFILE FROM PULLIAM POWER PLANT TO T1063489



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

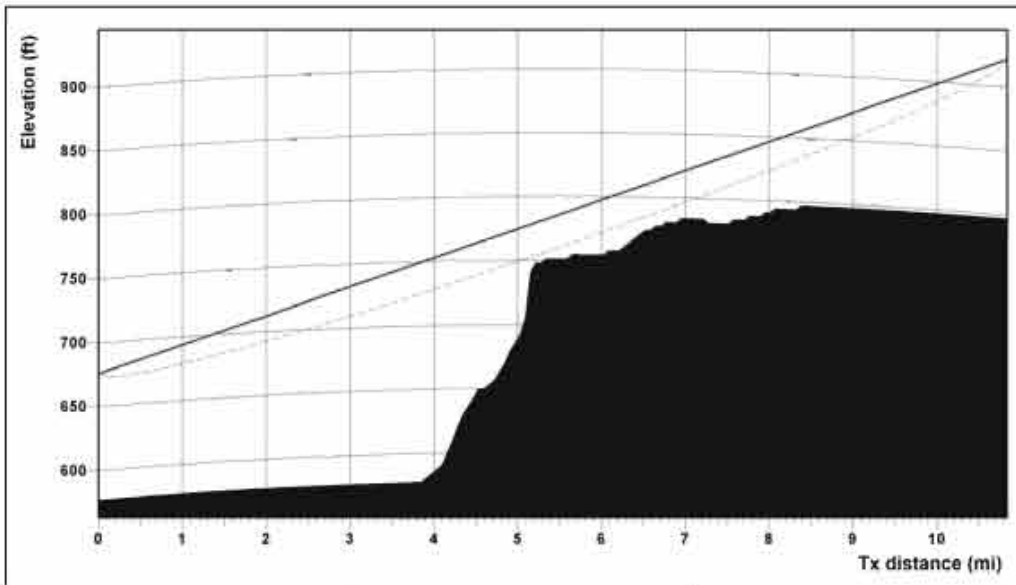
Transmitter Site: Pulliam
Name: PulliamPowerPlant
Location:
N44°32'24.00" W88°00'29.16"
Site elevation: 577.4 ft
Antenna height: 98.4 ft
Pointing azimuth: 304.6 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: Pulliam ->T1063489
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 9.19 mi
Number of obstacles: 0
Excess path loss: -0.04 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 129.61 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: T1063489
Name: T1063489
Location:
N44°36'55.44" W88°09'43.20"
Site elevation: 763.5 ft
Antenna height: 98.4 ft
Pointing azimuth: 124.6 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 5.39 dBmW

Notes

PATH PROFILE FROM PULLIAM POWER PLANT TO SITE 1



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

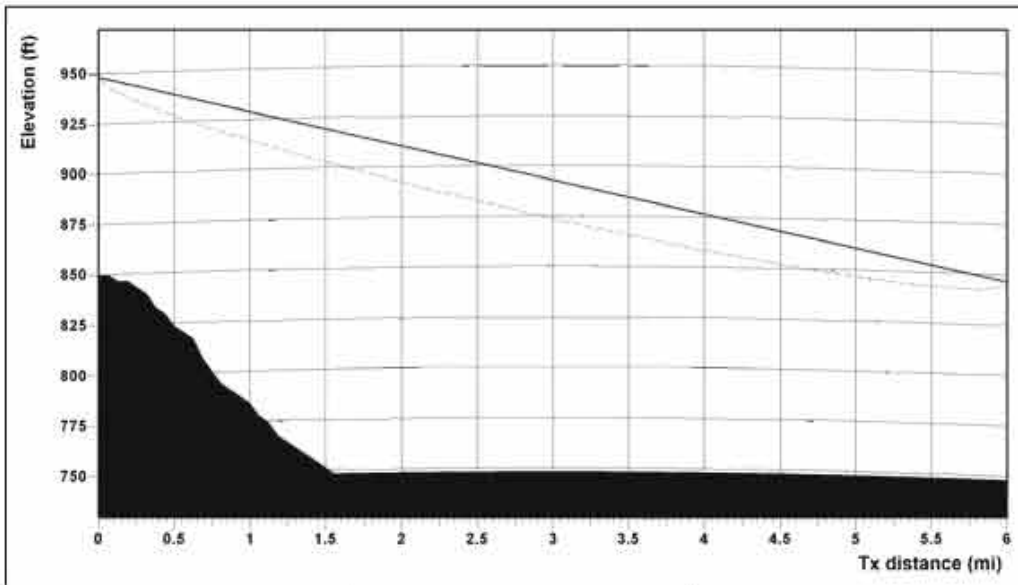
Transmitter Site: PulliamP
Name: PulliamPowerPlant
Location:
N44°32'24.00" W88°00'29.16"
Site elevation: 577.4 ft
Antenna height: 98.4 ft
Pointing azimuth: 93.4 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: PulliamP ->New_1
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 10.84 mi
Number of obstacles: 0
Excess path loss: 2.22 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 133.32 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.01 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: New_1
Name: New_1
Location:
N44°31'50.16" W87°47'17.52"
Site elevation: 823.5 ft
Antenna height: 98.4 ft
Pointing azimuth: 273.4 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 1.68 dBmW

Notes

PATH PROFILE FROM SAND PIT RD TO WINNECONNE



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

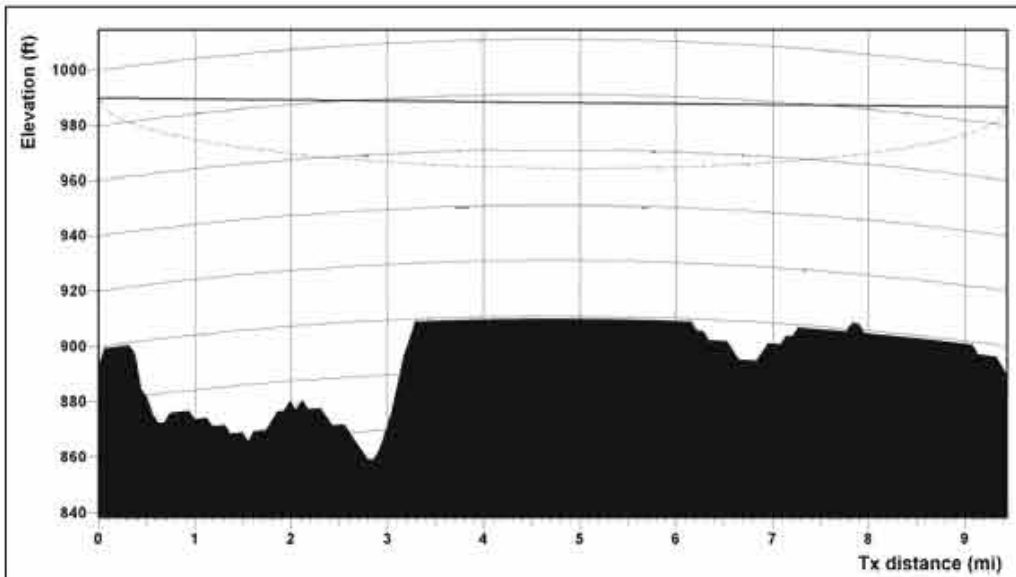
Transmitter Site: SandPitR
Name: SandPitRoad
Location:
N44°01'50.88" W88°39'15.48"
Site elevation: 849.7 ft
Antenna height: 98.4 ft
Pointing azimuth: 335.7 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: SandPitR ->Winnecon
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 6.00 mi
Number of obstacles: 0
Excess path loss: -0.02 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 125.94 dB
Flat fade margin: 84.98 dB
Total fade margin: 72.74 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: Winnecon
Name: Winneconn1
Location:
N44°06'36.00" W88°42'14.40"
Site elevation: 748.0 ft
Antenna height: 98.4 ft
Pointing azimuth: 155.7 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 20.00 dBi
Antenna file:
Received signal level: -5.94 dBmW

Notes

PATH PROFILE FROM SCARY'S HILL 10 TO DENMARK



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

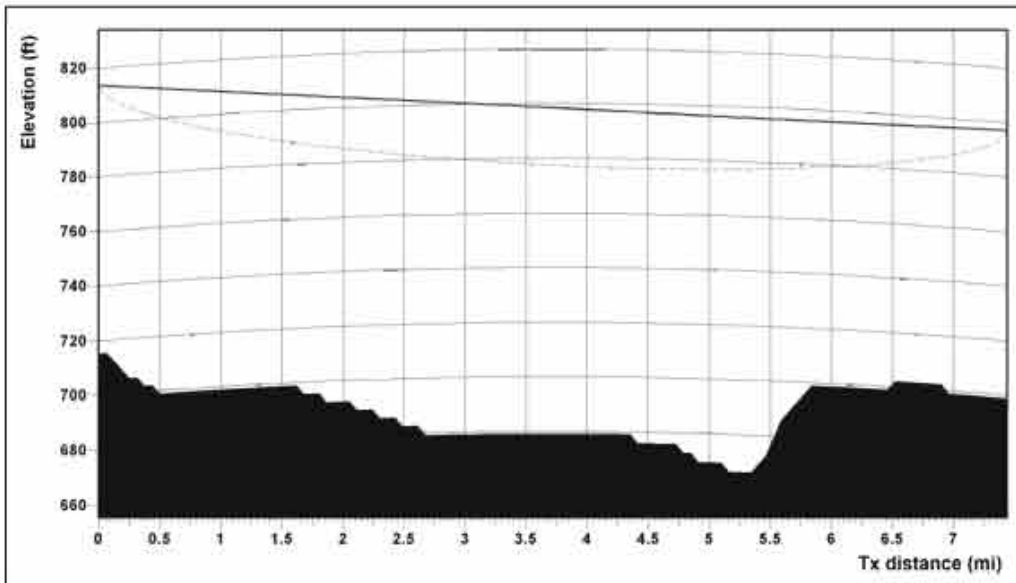
Transmitter Site: ScarysHi
Name: ScarysHill
Location:
N44°24'32.04" W88°00'11.88"
Site elevation: 891.4 ft
Antenna height: 98.4 ft
Pointing azimuth: 116.4 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: ScarysHi ->DENMAR
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 9.46 mi
Number of obstacles: 0
Excess path loss: -0.05 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 129.84 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: DENMAR
Name: DENMARK
Location:
N44°20'52.08" W87°49'54.12"
Site elevation: 888.1 ft
Antenna height: 98.4 ft
Pointing azimuth: 296.4 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 5.16 dBmW

Notes

PATH PROFILE FROM T1064851 TO KAUKAUNA



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

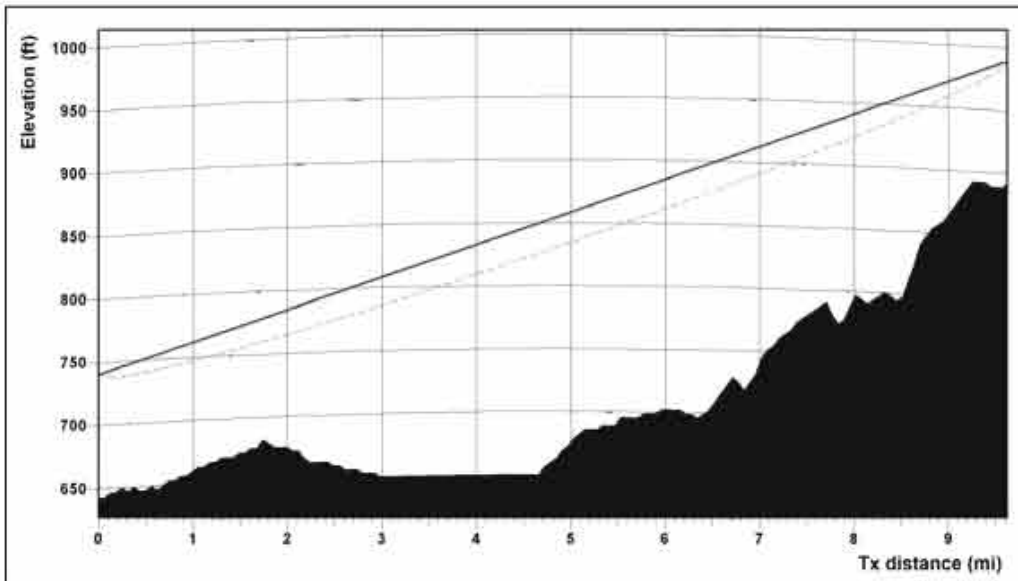
Transmitter Site: T_106485
Name: T_1064851
Location:
N44°23'35.88" W88°18'50.04"
Site elevation: 715.2 ft
Antenna height: 98.4 ft
Pointing azimuth: 160.2 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: T_106485 ->KAUKAUNA
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 7.44 mi
Number of obstacles: 0
Excess path loss: -0.03 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 127.79 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: KAUKAUNA
Name: KAUKAUNA
Location:
N44°17'30.84" W88°15'46.44"
Site elevation: 698.8 ft
Antenna height: 98.4 ft
Pointing azimuth: 340.2 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 7.21 dBmW

Notes

PATH PROFILE FROM WRIGHTSTOWN TO SCARY HILL



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

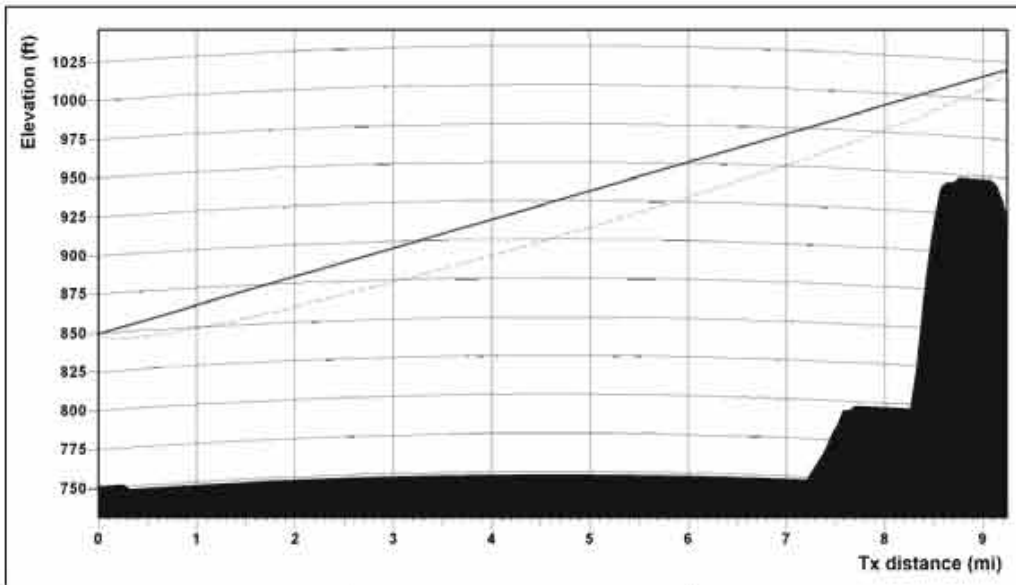
Transmitter Site: Wr
Name: Wrightstown
Location:
N44°19'36.84" W88°09'39.24"
Site elevation: 642.1 ft
Antenna height: 98.4 ft
Pointing azimuth: 53.9 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: Wr ->ScarysHi
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 9.62 mi
Number of obstacles: 0
Excess path loss: -0.04 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 130.02 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: ScarysHi
Name: ScarysHill
Location:
N44°24'32.04" W88°00'11.88"
Site elevation: 891.4 ft
Antenna height: 98.4 ft
Pointing azimuth: 233.9 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 4.98 dBmW

Notes

PATH PROFILE FROM MENASHA TO SHERWOOD



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

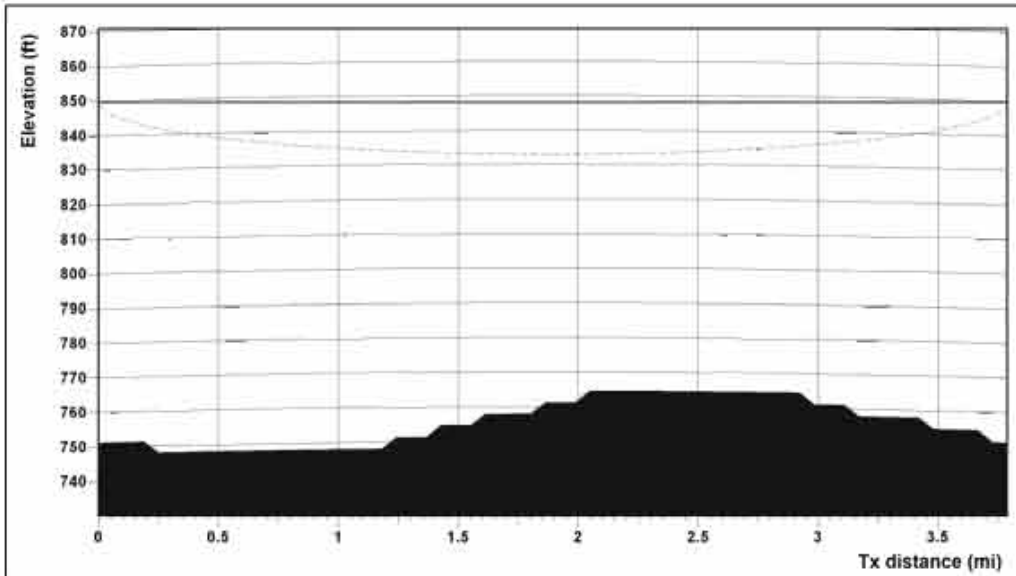
Transmitter Site: Nenasha3
Name: Nenasha
Location:
N44°12'29.00" W88°26'30.00"
Site elevation: 751.3 ft
Antenna height: 98.4 ft
Pointing azimuth: 108.1 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: Nenasha3 ->Sherwood
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 9.25 mi
Number of obstacles: 0
Excess path loss: -0.03 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 129.68 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: Sherwood
Name: Sherwood
Location:
N44°09'59.00" W88°15'51.00"
Site elevation: 921.9 ft
Antenna height: 98.4 ft
Pointing azimuth: 288.1 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 5.32 dBmW

Notes

PATH PROFILE FROM OUTAGAMIE PSAP TO MENASHA



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

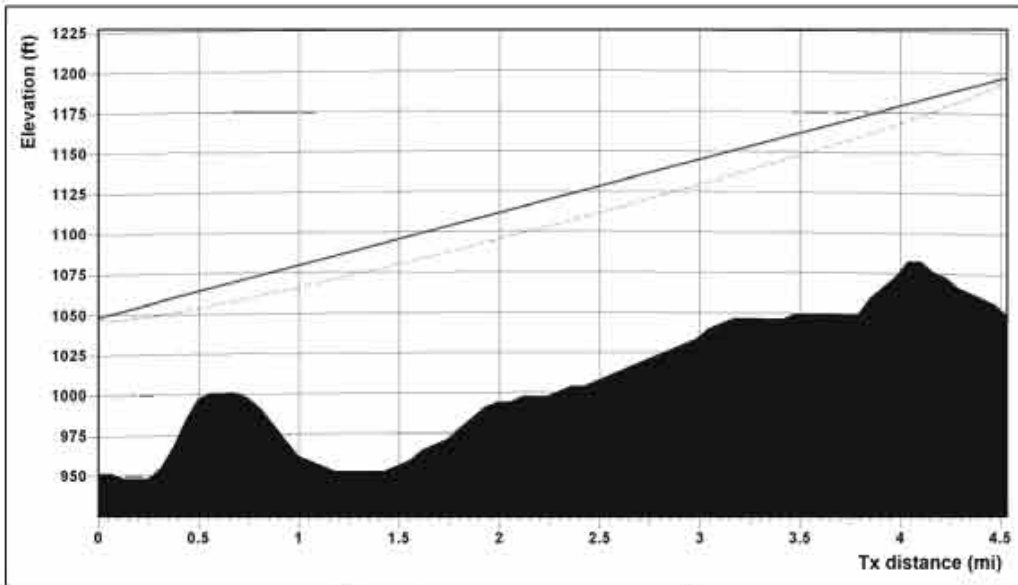
Transmitter Site: Outa_PSA
Name: Outagamie_PSAP
Location:
N44°15'32.00" W88°24'43.00"
Site elevation: 751.3 ft
Antenna height: 98.4 ft
Pointing azimuth: 202.7 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000000.00 W

Name: Outa_PSA ->Nenasha
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 3.81 mi
Number of obstacles: 0
Excess path loss: -0.01 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 121.95 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: Nenasha
Name: Nenasha
Location:
N44°12'29.00" W88°26'30.00"
Site elevation: 751.3 ft
Antenna height: 98.4 ft
Pointing azimuth: 22.7 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 13.05 dBmW

Notes

PATH PROFILE FROM SITE 12 TO T1040952



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

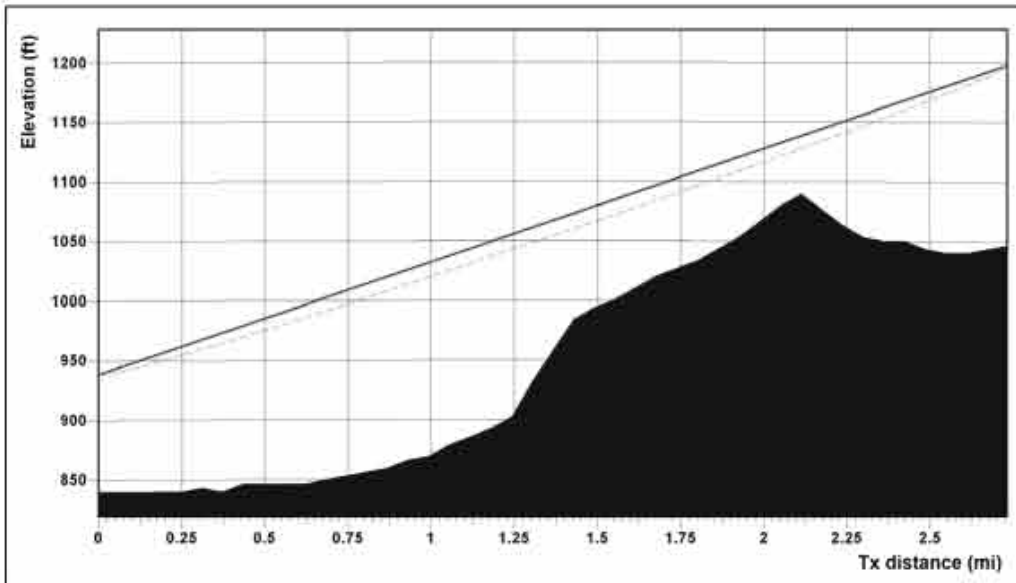
Transmitter Site: New12b
Name: New12b
Location:
N43°58'06.60" W88°17'04.56"
Site elevation: 950.1 ft
Antenna height: 98.4 ft
Pointing azimuth: 3.2 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: New12b ->T1040952
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 4.56 mi
Number of obstacles: 0
Excess path loss: -0.01 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 123.51 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: T1040952
Name: T1040952
Location:
N44°02'04.00" W88°16'46.00"
Site elevation: 1047.7 ft
Antenna height: 150.0 ft
Pointing azimuth: 183.2 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 11.49 dBmW

Notes

PATH PROFILE FROM STOCKBRIDGE TO T1040952



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

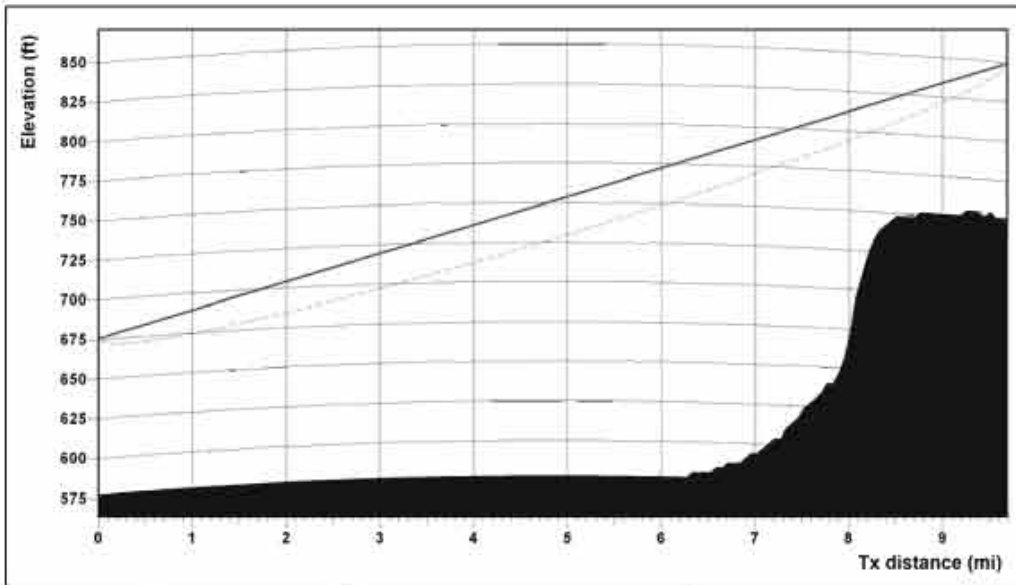
Transmitter Site: Stockbri
Name: Stockbridge
Location:
N44°04'18.84" W88°17'49.92"
Site elevation: 839.9 ft
Antenna height: 98.4 ft
Pointing azimuth: 161.2 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: Stockbri ->T1040952
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 2.73 mi
Number of obstacles: 0
Excess path loss: 0.00 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 119.12 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: T1040952
Name: T1040952
Location:
N44°02'04.00" W88°16'46.00"
Site elevation: 1047.7 ft
Antenna height: 150.0 ft
Pointing azimuth: 341.2 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 15.88 dBmW

Notes

PATH PROFILE FROM PULLIAM POWER PLANT TO T1034488



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

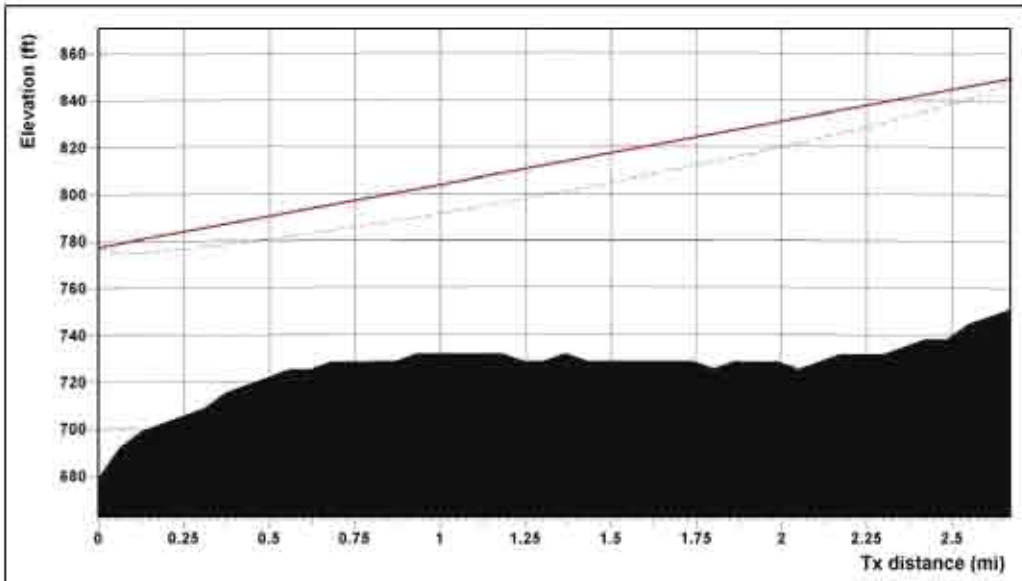
Transmitter Site: Pullia
Name: Pulliam
Location:
N44°32'24.00" W88°00'29.00"
Site elevation: 577.4 ft
Antenna height: 98.4 ft
Pointing azimuth: 59.6 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: Pullia ->T1034488
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 9.69 mi
Number of obstacles: 0
Excess path loss: -0.04 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 130.08 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: T1034488
Name: T1034488
Location:
N44°36'39.20" W87°50'16.80"
Site elevation: 751.1 ft
Antenna height: 98.4 ft
Pointing azimuth: 239.6 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 4.92 dBmW

Notes

PATH PROFILE FROM T1213438 TO T1034488



EDX SignalPro®

Prop. model: Longley-Rice v1.2.2
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis
Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 20.0 %
External interf.: -150.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 ft
Rain outage method: Crane
Rain region: f

Transmitter Site: T1213438
Name: T1213438
Location:
N44°37'49.00" W87°47'27.00"
Site elevation: 679.1 ft
Antenna height: 98.4 ft
Pointing azimuth: 240.0 °
Transmitter power: 3162.28 W
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Total ERPi: 10000007.40 W

Name: T1213438 ->T1034488
Frequency: 4900.0000 MHz
Polarization: horizontal
Length: 2.68 mi
Number of obstacles: 0
Excess path loss: 0.00 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 118.92 dB
Flat fade margin: 96.89 dB
Total fade margin: 72.99 dB
Annual fade outage: 0.00 s
Annual rain outage: 0.00 s
Link availability: 99.9999 %

Receiver Site: T1034488
Name: T1034488
Location:
N44°36'39.20" W87°50'16.80"
Site elevation: 751.1 ft
Antenna height: 98.4 ft
Pointing azimuth: 60.0 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 35.00 dBi
Antenna file:
Received signal level: 16.08 dBmW

Notes

APPENDIX E–

VHF FREQUENCIES

Callsign	Frequency	Entity	Expiration Date	Elegibility Rule	Location				Ground Elevation	N. Latitude			W. Longitude			overall_height_of_structure	Structure Type	Height to tip	Power		Station Class
					Address	City	County	State		Deg	Min	Sec	Deg	Min	Sec				Output	ERP	
KAT543	150.99500	Outagamie, County of	3/25/2012	90.23A	N5155 Hample Rd	Binghamton	Outagamie	WI	249	44	25	27.9	88	28	30.4	66.0	Tower	73.0	110.0	140.0	FB2
WNMQ277	151.08500	Shiocton, Village of	9/26/2013	90.2	W7746 Pine St	Shiocton	Outagamie	WI	228	44	26	37.2	88	34	41.4	39.3	Tank	39.3	45.0	14.0	FB2
KUU390	151.10000	Calumet, County of	2/13/2013	90.23A	206 Court St	Chilton	Calumet	WI	278	44	1	49.0	88	10	7.0	82.0	Tower	82.0	250.0	206.0	FB2
KUU390	151.10000	Calumet, County of	2/13/2013	90.23A	n 205 hwy 55	Sherwood	Calumet	WI	213	44	9	57.0	88	15	51.4	43.0	Tower	43.0	110.0	220.0	FB2S
KBE501	151.11500	Brown, County of	12/18/2011	90.23A	2198 Glendale Ave	Green Bay	Brown	WI	180	44	33	55.0	88	4	12.4	0.0		73.0	250.0	650.0	FB2
KBE501	151.11500	Brown, County of	12/18/2011	90.23A	2198 Glendale Ave	Green Bay	Brown	WI	180	44	33	55.0	88	4	12.4	0.0		73.0	60.0	140.0	FB2
KBE501	151.11500	Brown, County of	12/18/2011	90.23A	2198 Glendale Ave	Green Bay	Brown	WI	180	44	33	55.0	88	4	12.4	0.0		85.0	60.0	140.0	FB2
KBE501	151.11500	Brown, County of	12/18/2011	90.23A	2198 Glendale Ave	Green Bay	Brown	WI	180	44	33	55.0	88	4	12.4	0.0		85.0	250.0	650.0	FB2
WPVC329	151.13000	Grand Chute, Town of	6/17/2012	90.20a	502 W Northland Ave	Appleton	Outagamie	WI	250	44	17	15.0	88	24	54.4	12.0	Tower	12.0	40.0	152.0	FB
WPVC329	151.13000	Grand Chute, Town of	6/17/2012	90.20a	207 Misty Ln	Appleton	Outagamie	WI	240	44	15	30.0	88	28	58.4	58.0	Tank	58.0	10.0	32.0	FB2
WPWH499	151.22000	Suamico Fire Department	11/18/2012	90.20(A)	3093 Bowling Green Ln	Suamico	Brown	WI	198	44	37	32.9	88	3	23.3	60.9	B	60.9	20.0	31.0	FB2
WNBN234	151.26500	Appleton, City of	8/31/2013	90.20A	2006 E Newberry St	Appleton	Outagamie	WI	227	44	15	53.0	88	22	58.4	24.0	Tower	24.0	25.0	70.0	FB2
WNBN234	151.26500	Appleton, City of	8/31/2013	90.20A	100 N Appleton St	Appleton	Outagamie	WI	240.6	44	15	42.6	88	24	26.3	39.2	Bant	39.2	100.0	80.0	FB2
KBB201	151.28000	Brown, County of	9/20/2015	90.2	4070 County X	De Pere	Brown	WI	274	44	24	36.0	88	0	38.4	61.0	Tower	30.0	100.0	206.0	FB2
KBB201	151.28000	Brown, County of	9/20/2015	90.2	4070 County X	De Pere	Brown	WI	274	44	24	36.0	88	0	38.4	61.0	Tower	23.0	100.0	206.0	FB2
KBB201	151.28000	Brown, County of	9/20/2015	90.2	4070 County X	De Pere	Brown	WI	274	44	24	36.0	88	0	38.4	61.0	Tower	58.0	100.0	206.0	FB2
KBB201	151.28000	Brown, County of	9/20/2015	90.2	4070 County X	De Pere	Brown	WI	274	44	24	36.0	88	0	38.4	61.0	Tower	15.0	100.0	206.0	FB2
KFZ899	151.28000	Winnebago, County of	5/8/2015	90.2	3843 Sand Pit Rd	Omro	Winnebago	WI	259	44	1	50.9	88	39	15.4	67.0	Tower	56.0	100.0	138.0	FB2
KFZ899	151.28000	Winnebago, County of	5/8/2015	90.2	3843 Sand Pit Rd	Omro	Winnebago	WI	259	44	1	50.9	88	39	15.4	67.0	Tower	67.0	100.0	138.0	FB2
KGL593	151.28000	Calumet, County of	3/10/2012	90.20A	206 Court St	Chilton	Calumet	WI	281	44	1	55.7	88	10	12.1	82.3	Tower	68.0	100.0	115.0	FB2
KGL593	151.28000	Calumet, County of	3/10/2012	90.20A	206 Court St	Chilton	Calumet	WI	281	44	1	55.7	88	10	12.1	82.3	Tower	68.0	100.0	133.0	FB
KGL593	151.28000	Calumet, County of	3/10/2012	90.20A	206 Court St	Chilton	Calumet	WI	281	44	1	55.7	88	10	12.1	82.3	Tower	82.3	100.0	115.0	FB2
KGL593	151.28000	Calumet, County of	3/10/2012	90.20A	206 Court St	Chilton	Calumet	WI	281	44	1	55.7	88	10	12.1	82.3	Tower	82.3	100.0	133.0	FB
KGL593	151.28000	Calumet, County of	3/10/2012	90.20A	206 Court St	Chilton	Calumet	WI	281	44	1	55.7	88	10	12.1	82.3	Tower	27.4	100.0	115.0	FB2
KGL593	151.28000	Calumet, County of	3/10/2012	90.20A	206 Court St	Chilton	Calumet	WI	281	44	1	55.7	88	10	12.1	82.3	Tower	27.4	100.0	133.0	FB
KNCG848	151.28000	Outagamie, County of	6/10/2012	90.2	N5155 Hample Rd	Binghamton	Outagamie	WI	249	44	25	27.9	88	28	30.4	66.0	Tower	30.0	100.0	128.0	FB2
KNCG848	151.28000	Outagamie, County of	6/10/2012	90.2	N5155 Hample Rd	Binghamton	Outagamie	WI	249	44	25	27.9	88	28	30.4	66.0	Tower	43.0	100.0	128.0	FB2
KNCG848	151.28000	Outagamie, County of	6/10/2012	90.2	N5155 Hample Rd	Binghamton	Outagamie	WI	249	44	25	27.9	88	28	30.4	66.0	Tower	73.0	100.0	128.0	FB2
KNCG848	151.28000	Outagamie, County of	6/10/2012	90.2	N5155 Hample Rd	Binghamton	Outagamie	WI	249	44	25	27.9	88	28	30.4	66.0	Tower	85.0	100.0	128.0	FB2
KNAB465	151.32500	Brown, County of	1/21/2012	90.20a	2077 Airport Dr	Green Bay	Brown	WI	212	44	29	31.0	88	7	36.4	31.0		14.0	140.0	104.0	FB
KNAB465	151.32500	Brown, County of	1/21/2012	90.20a	2077 Airport Dr	Green Bay	Brown	WI	212	44	29	31.0	88	7	36.4	31.0		11.7	140.0	104.0	FB
KNAB465	151.32500	Brown, County of	1/21/2012	90.20a	2077 Airport Dr	Green Bay	Brown	WI	212	44	29	31.0	88	7	36.4	31.0		14.0	140.0	104.0	FB2
KNAB465	151.32500	Brown, County of	1/21/2012	90.20a	2077 Airport Dr	Green Bay	Brown	WI	212	44	29	31.0	88	7	36.4	31.0		11.7	140.0	104.0	FB2
KNAB465	151.32500	Brown, County of	1/21/2012	90.20a	2077 Airport Dr	Green Bay	Brown	WI	212	44	29	31.0	88	7	36.4	31.0		14.0	140.0	104.0	FB
KNAB465	151.32500	Brown, County of	1/21/2012	90.20a	2077 Airport Dr	Green Bay	Brown	WI	212	44	29	31.0	88	7	36.4	31.0		11.7	140.0	104.0	FB
KNAB465	151.32500	Brown, County of	1/21/2012	90.20a	2077 Airport Dr	Green Bay	Brown	WI	212	44	29	31.0	88	7	36.4	31.0		14.0	140.0	104.0	FB2
KNAB465	151.32500	Brown, County of	1/21/2012	90.20a	2077 Airport Dr	Green Bay	Brown	WI	212	44	29	31.0	88	7	36.4	31.0		11.7	140.0	104.0	FB2
WPCA267	151.41500	Oshkosh, City of	4/13/2013	90.25A	805 Witzel Ave	Oshkosh	Winnebago	WI	232	44	2	45.9	88	32	23.4	20.0		26.0	100.0	320.0	FB2
KNAB465	153.78500	Brown, County of	1/21/2012	90.20a	2077 Airport Dr, Public Safety Bldg	Green Bay	Brown	WI	212	44	29	26.7	88	7	26.4	7.6	B	7.6	5.0	5.0	FX1
KNAB465	153.78500	Brown, County of	1/21/2012	90.20a	2077 Airport Dr, Public Safety Bldg	Green Bay	Brown	WI	212	44	29	26.7	88	7	26.4	7.6	B	7.6	5.0	5.0	FX1
KB80210	153.80000	De Pere, City of	2/22/2011	90.21A			Brown	WI	0	44	26	35.0	88	3	40.4	0.0		0.0	40.0	40.0	MO
KBB201	153.84500	Brown, County of	9/20/2015	90.2	307 S Adams St	Green Bay	Brown	WI	180	44	30	28.0	88	0	58.4	56.0	Pole	10.0	20.0	44.0	FX1
KBB201	153.84500	Brown, County of	9/20/2015	90.2	307 S Adams St	Green Bay	Brown	WI	180	44	30	28.0	88	0	58.4	56.0	Pole	47.0	20.0	44.0	FX1
KSD759	153.95000	Appleton, City of	3/31/2013	90.20A	1801 S Matthias St	Appleton	Outagamie	WI	237	44	14	47.0	88	22	15.4	15.0	Tower	15.0	5.0	8.0	FX1
KSD759	153.95000	Appleton, City of	3/31/2013	90.20A	801 W Grove St	Appleton	Outagamie	WI	237	44	14	35.0	88	25	2.4	15.0	Tower	15.0	5.0	8.0	FX1
KSD759	153.95000	Appleton, City of	3/31/2013	90.20A	700 N Drew St	Appleton	Outagamie	WI	237	44	16	8.0	88	24	1.4	22.0	BTwr	22.0	5.0	10.0	FX1
KSD759	153.95000	Appleton, City of	3/31/2013	90.20A	1701 W Brewster St	Appleton	Outagamie	WI	246	44	16	32.0	88	23	54.4	15.0	Tower	15.0	5.0	8.0	FX1
KSD759	153.95000	Appleton, City of	3/31/2013	90.20A	724 E Greenfield St	Appleton	Outagamie	WI	237	44	17	9.0	88	23	47.4	15.0	Tower	15.0	5.0	8.0	FX1
KFZ899	153.99500	Winnebago, County of	5/8/2015	90.2	415 Jackson St	Oshkosh	Winnebago	WI	234.1	44	1	17.0	88	32	35.0	45.7	Bant	46.0	25.0	18.0	FB
KFZ899	153.99500	Winnebago, County of	5/8/2015	90.2	415 Jackson St	Oshkosh	Winnebago	WI	234.1	44	1	17.0	88	32	35.0	45.7	Bant	30.0	25.0	18.0	FB
KLL469	154.04000	Brown, County of	3/4/2011	90.20(A)	4070 County X	De Pere	Brown	WI	277.3	44	24	32.0	88	0	12.0	82.2	Tower	52.0	110.0	240.0	FB2
KLL469	154.04000	Brown, County of	3/4/2011	90.20(A)	2198 Glendale Ave	Green Bay	Brown	WI	179.8	44	33	49.9	88	4	12.3	98.5	Tower	67.0	110.0	210.0	FB2
KLL469	154.04000	Brown, County of	3/4/2011	90.20(A)	229 Williams St	Pulaski	Brown	WI	243.2	44	40	13.0	88	14	13.0	55.4	Tower	55.4	110.0	240.0	FB2
KNIQ332	154.05500	Chilton, City of	3/1/2014	90.17A	908 S Maple St	Chilton	Calumet	WI	274	44	1	25.0	88	9	37.4	0.0		7.0	25.0	35.0	FB

VHF FREQUENCIES

Callsign	Frequency	Entity	Expiration Date	Elegibility Rule	Location				Ground Elevation	N. Latitude			W. Longitude			overall_height_of_structure	Structure Type	Height to tip	Power		Station Class
					Address	City	County	State		Deg	Min	Sec	Deg	Min	Sec				Output	ERP	
KNIQ332	154.05500	Chilton, City of	3/1/2014	90.17A	42 School St	Chilton	Calumet	WI	274	44	1	46.0	88	9	52.4	0.0		18.0	25.0	35.0	FB
WPTR423	154.05500	Calumet, County of	11/29/2011	90.20A1	206 Court St	Chilton	Calumet	WI	278	44	1	49.0	88	10	7.0	82.0	Tower	27.0	45.0	55.0	FB
WPTR481	154.08500	Grand Chute, Town of	11/29/2011	90.2	207 Misty Ln	Grand Chute	Outagamie	WI	240	44	15	30.0	88	28	58.0	58.0	Tank	58.0	10.0	32.0	FB2
WPTR481	154.08500	Grand Chute, Town of	11/29/2011	90.2	502 W. Northland Ave	Appleton	Outagamie	WI	250	44	17	15.0	88	24	54.0	12.0	Tower	12.0	40.0	152.0	FB
WPMB862	154.10000	Calumet, County of	5/20/2013	90.2	N6150 County EE	Hilbert	Calumet	WI	277	44	6	25.0	88	19	17.4	17.0	Tower	17.0	25.0	15.0	FB2
WQFS596	154.10000	Black Creek Rescue Service	9/22/2016	90.2	W5200 Hwy B	Black Creek	Outagamie	WI	250	44	28	2.4	88	26	45.0	16.7	Tower	16.7	45.0	70.0	FB2
WQGA623	154.10000	Ashwaubenon, Village of	11/28/2016	90.2	2623 Babcock	Ashwaubenon	Brown	WI	204	44	29	37.0	88	6	1.4	24.6	Tank	24.6	50.0	100.0	FB2
KNFE839	154.16000	De Pere, City of	6/10/2014	90.20A1	400 Lewis St	De Pere	Brown	WI	186	44	30	2.0	88	0	44.4	15.0	Tank	15.0	35.0	35.0	FB
KRO245	154.19000	Oshkosh, City of	3/14/2011	90.20(A)	4311 Jackson Dr	Oshkosh	Winnebago	WI	233	44	4	51.9	88	32	53.4	58.0	Tower	44.4	100.0	150.0	FB2
KRO245	154.19000	Oshkosh, City of	3/14/2011	90.20(A)	926 Dempsey Trl	Oshkosh	Winnebago	WI	229	44	1	8.9	88	33	38.4	21.0	Tower	21.0	100.0	112.0	FB2
KRO245	154.19000	Oshkosh, City of	3/14/2011	90.20(A)	3843 Sandpit Rd	Omro	Winnebago	WI	259	44	1	50.9	88	39	15.4	67.0	Tower	67.0	100.0	100.0	FB2
WNPD493	154.19000	Allouez, Village of	4/19/2014		135 Dauphin St	Allouez	Brown	WI	198	44	28	53.0	88	1	24.4	0.0		34.0	40.0	80.0	FB2
KMD400	154.22000	Calumet, County of	3/11/2012	90.20a1ii	N205 Hwy 55	Sherwood	Calumet	WI	297	44	9	57.0	88	15	51.4	43.0	Tower	43.0	110.0	280.0	FB
KMD400	154.22000	Calumet, County of	3/11/2012	90.20a1ii	130 Calumet St	Brillion	Calumet	WI	253	44	10	40.0	88	3	45.4	42.6	Tower	42.6	110.0	280.0	FB
KMD400	154.22000	Calumet, County of	3/11/2012	90.20a1ii	2110 Washington St	New Holstein	Calumet	WI	300	43	57	5.0	88	5	41.4	40.0	Tower	40.0	110.0	280.0	FB
KMD400	154.22000	Calumet, County of	3/11/2012	90.20a1ii	206 Court St	Chilton	Calumet	WI	278	44	1	49.0	88	10	7.4	82.0	Tower	82.0	250.0	208.0	FB2
KMD400	154.22000	Calumet, County of	3/11/2012	90.20a1ii	N205 Hwy 55	Sherwood	Calumet	WI	297	44	9	57.0	88	15	51.4	43.0	Tower	43.0	110.0	280.0	FB2S
KMD400	154.22000	Calumet, County of	3/11/2012	90.20a1ii	800 E Lake St	Stockbridge	Calumet	WI	256	44	4	18.8	88	17	49.8	48.7	Tower	36.5	110.0	280.0	FB2
WNHU968	154.22000	Hilbert, Village of	10/20/2012	90.21A	45 N 5th St	Hilbert	Calumet	WI	253	44	8	24.0	88	9	50.4	12.0		15.0	25.0	50.0	FB
WPFQ858	154.22000	Brillion, City of	6/2/2015	90.50A1	130 Calumet St	Brillion	Calumet	WI	253	44	10	40.0	88	3	45.4	25.0	Tower	22.0	45.0	75.0	FB
KDM243	154.25000	Outagamie, County of	1/30/2015	90.20a	207 Misty Ln	Grand Chute	Outagamie	WI	240	44	15	29.9	88	28	58.4	0.0	Tank	58.0	110.0	155.0	FB2
KDM243	154.25000	Outagamie, County of	1/30/2015	90.20a	501 E Bronson Rd	Seymour	Outagamie	WI	241	44	31	30.0	88	19	30.4	0.0	Tank	55.0	100.0	168.0	FB
KDM243	154.25000	Outagamie, County of	1/30/2015	90.20a	1451 Tower Dr	Kaukauna	Outagamie	WI	207	44	17	31.0	88	15	46.4	0.0	Tank	62.0	100.0	100.0	FB
KDM243	154.25000	Outagamie, County of	1/30/2015	90.20a	412 W Willow St	Bear Creek	Outagamie	WI	262	44	31	53.9	88	43	58.4	0.0	Tank	45.0	110.0	110.0	FB
KDM243	154.25000	Outagamie, County of	1/30/2015	90.20a	N5155 Hample Rd	Binghamton	Outagamie	WI	249	44	25	27.9	88	28	30.4	0.0	Tower	85.0	110.0	150.0	FB
KGP796	154.25000	Grand Chute, Town of	6/22/2011	90.21A	502 W Northland Ave	Appleton	Outagamie	WI	250	44	17	15.0	88	24	54.4	0.0		12.0	40.0	152.0	FB
KNIF845	154.25000	Oneida, Town of	7/6/2011	90.21A	2431 Hwy H	Oneida	Outagamie	WI	232	44	28	40.0	88	15	3.4	0.0		15.0	50.0	177.0	FB
KNJX254	154.25000	Seymour, City of	7/13/2014	90.21	328 N Main St	Seymour	Outagamie	WI	239	44	30	52.0	88	19	46.4	0.0		12.0	110.0	400.0	FB
KTH969	154.25000	Shiocton Bovina Fire Dept	9/10/2015	90.21A	131 Pine St	Shiocton	Outagamie	WI	233	44	26	36.9	88	34	41.4	0.0		13.0	40.0	65.0	FB
KZZ943	154.25000	Hortonville Fire Department	8/31/2013	90	Fire Dept S Nash St	Hortonville	Outagamie	WI	253	44	20	9.9	88	38	36.4	0.0		15.0	35.0	101.0	FB
WPNV319	154.25000	Outagamie, County of	7/1/2014	90.2	W8279 Grand View Rd	Hortonville	Outagamie	WI	285	44	20	41.9	88	36	24.4	81.0	Tower	67.0	250.0	465.0	FB
WPUL317	154.25000	Dale, Town of	3/26/2012	90.20(A)	W9641 Hwy 10	Dale	Outagamie	WI	251	44	16	23.9	88	40	49.4	24.3	Tower	24.3	40.0	90.0	FB
KMD400	154.29500	Calumet, County of	3/11/2012	90.20a1ii	206 Court St	Chilton	Calumet	WI	278	44	1	49.0	88	10	7.4	82.0	Tower	82.0	110.0	230.0	FB
KNIF845	154.29500	Oneida, Town of	7/6/2011	90.21A	2431 Hwy H	Oneida	Outagamie	WI	232	44	28	40.0	88	15	3.4	0.0		15.0	50.0	177.0	FB
KNO707	154.29500	Morrison Volunteer Fire Department	8/10/2014	90.21A	Fire House Hwy 32	Morrison	Brown	WI	274	44	17	52.0	87	59	13.4	0.0		21.0	50.0	141.0	FB
KVQ637	154.29500	Howard, Village of	5/1/2012	90.20(A)	2456 Glendale Ave	Green Bay	Brown	WI	180	44	33	46.0	88	4	40.4	30.0		37.0	110.0	230.0	FB
KVQ637	154.29500	Howard, Village of	5/1/2012	90.20(A)	4165 Shawano Ave	Green Bay	Brown	WI	229	44	34	33.0	88	8	38.4	30.0		37.0	110.0	230.0	FB
WNBH795	154.29500	Pulaski Tricounty Fire Department Inc	2/14/2015	90.21A	600 E Glenbrook Dr	Pulaski	Brown	WI	244	44	39	50.0	88	13	39.4	24.0	Tower	30.0	50.0	154.0	FB
KFZ899	154.32500	Winnebago, County of	5/8/2015	90.2	3009 W Fairview Rd	Neenah	Winnebago	WI	275.2	44	12	50.0	88	32	58.0	30.4	Tower	28.0	100.0	263.0	FB
KFZ899	154.32500	Winnebago, County of	5/8/2015	90.2	3009 W Fairview Rd	Neenah	Winnebago	WI	275.2	44	12	50.0	88	32	58.0	30.4	Tower	30.4	100.0	263.0	FB
KNJN850	154.32500	Winnebago, County of	8/23/2015	90.2	1080 Breezewood Ln	Neenah	Winnebago	WI	232	44	9	21.9	88	29	40.4	12.0	BTwr	21.0	25.0	30.0	FB
KNJN850	154.32500	Winnebago, County of	8/23/2015	90.2	1000 Valley Rd	Menasha	Winnebago	WI	238	44	14	15.0	88	25	55.4	12.0	BTwr	19.0	40.0	88.0	FB
KNJN850	154.32500	Winnebago, County of	8/23/2015	90.2	1326 Cold Spring Rd	Neenah	Winnebago	WI	235	44	12	42.9	88	29	14.4	12.0	BTwr	25.0	40.0	88.0	FB
KNJN850	154.32500	Winnebago, County of	8/23/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	12.0	88	26	53.4	49.0	Tower	27.0	25.0	30.0	FB
KNJN850	154.32500	Winnebago, County of	8/23/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	12.0	88	26	53.4	49.0	Tower	27.0	60.0	76.0	FB
KNJN850	154.32500	Winnebago, County of	8/23/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	12.0	88	26	53.4	49.0	Tower	37.0	25.0	30.0	FB
KNJN850	154.32500	Winnebago, County of	8/23/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	12.0	88	26	53.4	49.0	Tower	37.0	60.0	76.0	FB
KNJN850	154.32500	Winnebago, County of	8/23/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	12.0	88	26	53.4	49.0	Tower	17.0	25.0	30.0	FB
KNJN850	154.32500	Winnebago, County of	8/23/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	12.0	88	26	53.4	49.0	Tower	17.0	60.0	76.0	FB
KNJN850	154.32500	Winnebago, County of	8/23/2015	90.2	901 Airport Rd	Menasha	Winnebago	WI	233	44	13	24.0	88	25	34.4	12.0	BTwr	21.0	25.0	30.0	FB
KNJN850	154.32500	Winnebago, County of	8/23/2015	90.2	125 E Columbian Ave	Menasha	Winnebago	WI	230	44	11	3.9	88	27	44.4	12.0	BTwr	20.0	25.0	30.0	FB
KNJN850	154.32500	Winnebago, County of	8/23/2015	90.2	125 E Columbian Ave	Menasha	Winnebago	WI	230	44	11	3.9	88	27	44.4	12.0	BTwr	21.0	25.0	30.0	FB
KVQ637	154.34000	Howard, Village of	5/1/2012	90.20(A)	4165 Shawano Ave	Green Bay	Brown	WI	229	44	34	33.0	88	8	38.4	30.0		37.0	110.0	230.0	FB
KVQ637	154.34000	Howard, Village of	5/1/2012	90.20(A)	2456 Glendale Ave	Green Bay	Brown	WI	180	44	33	46.0	88	4	40.4	30.0		37.0	110.0	230.0	FB

VHF FREQUENCIES

Callsign	Frequency	Entity	Expiration Date	Eligibility Rule	Location				Ground Elevation	N. Latitude			W. Longitude			overall_height_of_structure	Structure Type	Height to tip	Power		Station Class
					Address	City	County	State		Deg	Min	Sec	Deg	Min	Sec				Output	ERP	
KNHP909	154.37000	Denmark Volunteer Fire Dept	10/26/2013	90.20a2i	300 County Highway R	Denmark	Brown	WI	274	44	20	41.7	87	49	58.2	46.6	Tank	46.6	50.0	115.0	FB
KNHP909	154.37000	Denmark Volunteer Fire Dept	10/26/2013	90.20a2i	451 N Wall St	Denmark	Brown	WI	261	44	21	14.0	87	49	37.7	10.6	Bant	10.6	50.0	86.0	FB
KNO707	154.37000	Morrison Volunteer Fire Department	5/10/2014	90.21A	Fire House Hwy 32	Morrison	Brown	WI	274	44	17	52.0	87	59	13.4	0.0		21.0	50.0	141.0	FB
KUQ884	154.37000	De Pere, City of	5/11/2013	90	1180 Grant	De Pere	Brown	WI	186	44	25	44.0	88	5	23.4	0.0		29.0	25.0	50.0	FB
KUQ885	154.37000	De Pere, City of	5/11/2013	90	307 S Broadway St	De Pere	Brown	WI	189	44	26	35.0	88	3	40.4	0.0		24.0	25.0	50.0	FB
KVQ637	154.37000	Howard, Village of	5/1/2012	90.20(A)	2456 Glendale Ave	Green Bay	Brown	WI	180	44	33	46.0	88	4	40.4	30.0		37.0	110.0	230.0	FB
KVQ637	154.37000	Howard, Village of	5/1/2012	90.20(A)	4165 Shawano Ave	Green Bay	Brown	WI	229	44	34	33.0	88	8	38.4	30.0		37.0	110.0	230.0	FB
KZZ222	154.37000	Brown, County of	8/14/2011	90.2	2198 Glendale Ave	Green Bay	Brown	WI	179.8	44	33	49.9	88	4	12.3	98.5	Tower	61.0	110.0	230.0	FB
KZZ222	154.37000	Brown, County of	8/14/2011	90.2	229 Williams St	Pulaski	Brown	WI	243.2	44	40	13.0	88	14	13.0	55.4	Tower	40.0	110.0	180.0	FB
KZZ222	154.37000	Brown, County of	8/14/2011	90.2	4070 County X	De Pere	Brown	WI	277.3	44	24	32.0	88	0	12.0	82.2	Tower	61.0	110.0	230.0	FB
KZZ222	154.37000	Brown, County of	8/14/2011	90.2	239 Green Bay Rd	Denmark	Brown	WI	260	44	20	52.0	87	49	54.0	30.4	Tank	30.4	110.0	220.0	FB
KZZ222	154.37000	Brown, County of	8/14/2011	90.2	235 W Pulaski St	Pulaski	Brown	WI	241	44	40	21.0	88	13	57.4	6.0	Bant	6.0	35.0	35.0	FX1
WNBH795	154.37000	Pulaski Tricounty Fire Department Inc	2/14/2015	90.21A	600 E Glenbrook Dr	Pulaski	Brown	WI	244	44	39	50.0	88	13	39.4	24.0	Tower	30.0	50.0	154.0	FB
WNZJ311	154.37000	Greenleaf Volunteer Fire Dept Inc	5/31/2012	90.21A	1657 Day St	Greenleaf	Brown	WI	219	44	18	47.0	88	5	38.4	21.0		27.0	60.0	135.0	FB
KNFE839	154.40000	De Pere, City of	6/10/2014	90.20A1	400 Lewis St	De Pere	Brown	WI	186	44	30	2.0	88	0	44.4	15.0	Tank	15.0	28.0	28.0	FB2
KSD759	154.43000	Appleton, City of	3/31/2013	90.20A	700 N Drew St	Appleton	Outagamie	WI	237	44	16	8.0	88	24	1.4	22.0	BTwr	22.0	100.0	150.0	FB
KSD759	154.43000	Appleton, City of	3/31/2013	90.20A	801 W Grove St	Appleton	Outagamie	WI	237	44	14	35.0	88	25	2.4	15.0	Tower	15.0	45.0	65.0	FB
KSD759	154.43000	Appleton, City of	3/31/2013	90.20A	724 E Greenfield St	Appleton	Outagamie	WI	237	44	17	9.0	88	23	47.4	15.0	Tower	15.0	45.0	65.0	FB
KSD759	154.43000	Appleton, City of	3/31/2013	90.20A	1801 S Matthias St	Appleton	Outagamie	WI	237	44	14	47.0	88	22	15.4	15.0	Tower	15.0	45.0	65.0	FB
KSD759	154.43000	Appleton, City of	3/31/2013	90.20A	1701 W Brewster St	Appleton	Outagamie	WI	246	44	16	32.0	88	23	54.4	15.0	Tower	15.0	45.0	65.0	FB
KNJN850	154.44500	Winnebago, County of	8/23/2015	90.2	1080 Breezewood Ln	Neenah	Winnebago	WI	232	44	9	21.9	88	29	40.4	12.0	BTwr	21.0	25.0	30.0	FB
KNJN850	154.44500	Winnebago, County of	8/23/2015	90.2	1000 Valley Rd	Menasha	Winnebago	WI	238	44	14	15.0	88	25	55.4	12.0	BTwr	19.0	40.0	88.0	FB
KNJN850	154.44500	Winnebago, County of	8/23/2015	90.2	1326 Cold Spring Rd	Neenah	Winnebago	WI	235	44	12	42.9	88	29	14.4	12.0	BTwr	25.0	40.0	88.0	FB
KNJN850	154.44500	Winnebago, County of	8/23/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	12.0	88	26	53.4	49.0	Tower	27.0	60.0	84.0	FB
KNJN850	154.44500	Winnebago, County of	8/23/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	12.0	88	26	53.4	49.0	Tower	27.0	25.0	30.0	FB
KNJN850	154.44500	Winnebago, County of	8/23/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	12.0	88	26	53.4	49.0	Tower	37.0	60.0	84.0	FB
KNJN850	154.44500	Winnebago, County of	8/23/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	12.0	88	26	53.4	49.0	Tower	37.0	25.0	30.0	FB
KNJN850	154.44500	Winnebago, County of	8/23/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	12.0	88	26	53.4	49.0	Tower	17.0	60.0	84.0	FB
KNJN850	154.44500	Winnebago, County of	8/23/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	12.0	88	26	53.4	49.0	Tower	17.0	25.0	30.0	FB
KNJN850	154.44500	Winnebago, County of	8/23/2015	90.2	901 Airport Rd	Menasha	Winnebago	WI	233	44	13	24.0	88	25	34.4	12.0	BTwr	21.0	25.0	30.0	FB
KNJN850	154.44500	Winnebago, County of	8/23/2015	90.2	125 E Columbian Ave	Menasha	Winnebago	WI	230	44	11	3.9	88	27	44.4	12.0	BTwr	20.0	25.0	30.0	FB
KNJN850	154.44500	Winnebago, County of	8/23/2015	90.2	125 E Columbian Ave	Menasha	Winnebago	WI	230	44	11	3.9	88	27	44.4	12.0	BTwr	21.0	25.0	30.0	FB
KRO245	154.44500	Oshkosh, City of	3/14/2011	90.20(A)	2050 Knapp St	Oshkosh	Winnebago	WI	239	43	59	50.9	88	33	53.4	6.0	B	6.0	25.0	35.0	FB
KBB201	154.74000	Brown, County of	9/20/2015	90.2	4070 County X	De Pere	Brown	WI	274	44	24	36.0	88	0	38.4	61.0	Tower	30.0	90.0	270.0	FB2
KBB201	154.74000	Brown, County of	9/20/2015	90.2	4070 County X	De Pere	Brown	WI	274	44	24	36.0	88	0	38.4	61.0	Tower	58.0	90.0	270.0	FB2
KBB201	154.74000	Brown, County of	9/20/2015	90.2	4070 County X	De Pere	Brown	WI	274	44	24	36.0	88	0	38.4	61.0	Tower	15.0	90.0	270.0	FB2
KBB201	154.74000	Brown, County of	9/20/2015	90.2	4070 County X	De Pere	Brown	WI	274	44	24	36.0	88	0	38.4	61.0	Tower	23.0	90.0	270.0	FB2
KBB201	154.74000	Brown, County of	9/20/2015	90.2	2198 Glendale Ave	Howard	Brown	WI	180	44	33	55.0	88	4	12.4	91.0		91.0	100.0	300.0	FB2
KNIG886	154.80000	Oshkosh, City of	11/10/2014	90.2	725 Butler Ave	Oshkosh	Winnebago	WI	234	44	4	40.9	88	31	38.4	38.0	Tank	38.0	100.0	112.0	FB2
KNIG886	154.80000	Oshkosh, City of	11/10/2014	90.2	3843 Sandpit Rd	Omro	Winnebago	WI	259	44	1	50.9	88	39	15.4	73.0	Tower	70.0	100.0	126.0	FB2
KNIG886	154.80000	Oshkosh, City of	11/10/2014	90.2	4311 Jackson Dr	Oshkosh	Winnebago	WI	233	44	4	51.9	88	32	53.4	58.0	Tower	44.4	100.0	240.0	FB2
KNIG886	154.80000	Oshkosh, City of	11/10/2014	90.2	215 Church St	Oshkosh	Winnebago	WI	235	44	1	16.9	88	32	35.4	43.0	BTwr	43.0	100.0	159.0	FB2
WPKG720	154.81500	Calumet, County of	2/15/2012	90.2	206 Court St	Chilton	Calumet	WI	278	44	1	49.0	88	10	7.4	15.0	B	12.0	25.0	27.0	FB2
KNBR753	154.83000	Ashwaubenon, Village of	7/28/2014	90.2	2155 Holgren Way	Ashwaubenon	Brown	WI	186	44	29	30.0	88	3	35.4	9.0	B	9.0	25.0	25.0	FX1
KNBR753	154.83000	Ashwaubenon, Village of	7/28/2014	90.2	2155 Holgren Way	Ashwaubenon	Brown	WI	186	44	29	30.0	88	3	35.4	9.0	B	9.0	25.0	25.0	FX1
KNCE275	154.84500	Pulaski, City of	11/9/2014	90.19A	421 Augustine St	Pulaski	Brown	WI	206	44	40	14.0	88	14	15.4	0.0		11.0	60.0	50.0	FB
WZH623	154.84500	Omro, City of	8/2/2014	90.20(A)	921 Tower Ln	Omro	Winnebago	WI	246	44	1	56.0	88	44	35.0	44.4	Tank	44.4	10.0	10.0	FB2
KNGT950	154.87500	Combined Locks, Village of	6/4/2013	90	405 Wallace St	Combined Locks	Outagamie	WI	219	44	15	54.0	88	18	38.4	0.0		6.0	45.0	0.0	FB
KNJG268	154.87500	Seymour, City of	4/28/2014	90.2	328 N Main St	Seymour	Outagamie	WI	239	44	30	52.0	88	19	46.4	24.0	Tower	18.0	45.0	65.0	FB
KNJG268	154.87500	Seymour, City of	4/28/2014	90.2	328 N Main St	Seymour	Outagamie	WI	239	44	30	52.0	88	19	46.4	24.0	Tower	18.0	110.0	100.0	FB
WQDH931	154.96500	Green Bay, City of	8/31/2015	90.20a	885 Shawano Ave	Green Bay	Brown	WI	199.6	44	31	16.0	88	1	54.4	45.1	Tower	45.1	100.0	75.0	FB2
WQDH931	154.96500	Green Bay, City of	8/31/2015	90.20a	885 Shawano Ave	Green Bay	Brown	WI	199.6	44	31	16.0	88	1	54.4	45.1	Tower	45.1	100.0	75.0	FB2
WPPD237	154.98000	Pulaski, Village of	10/28/2014	90.2	229 Williams St	Pulaski	Brown	WI	242	44	39	59.0	88	14	35.4	20.0	Tank	11.0	50.0	90.0	FB
KNEZ945	155.01000	De Pere, City of	2/26/2013	90	315 N Ninth St	De Pere	Brown	WI	184	44	27	15.0	88	4	53.4	0.0		31.0	60.0	0.0	FB2

VHF FREQUENCIES

Callsign	Frequency	Entity	Expiration Date	Elegibility Rule	Location				Ground Elevation	N. Latitude			W. Longitude			overall_height_of_structure	Structure Type	Height to tip	Power		Station Class
					Address	City	County	State		Deg	Min	Sec	Deg	Min	Sec				Output	ERP	
WPVI776	155.02500	Clayton, Town of	6/24/2012	90.2	6358 Hwy T	Larsen	Winnebago	WI	242	44	11	37.0	88	37	27.0	12.5	Bant	12.5	25.0	35.0	FB
WZH623	155.02500	Omro, City of	8/2/2014	90.20(A)	205 S Webster Ave	Omro	Winnebago	WI	232	44	2	17.9	88	44	42.4	12.0	Bant	12.0	20.0	40.0	FB
KGL593	155.04000	Calumet, County of	3/10/2012	90.20A	206 Court St	Chilton	Calumet	WI	281	44	1	55.7	88	10	12.1	82.3	Tower	68.0	250.0	208.0	FB2
KGL593	155.04000	Calumet, County of	3/10/2012	90.20A	206 Court St	Chilton	Calumet	WI	281	44	1	55.7	88	10	12.1	82.3	Tower	82.3	250.0	208.0	FB2
KGL593	155.04000	Calumet, County of	3/10/2012	90.20A	206 Court St	Chilton	Calumet	WI	281	44	1	55.7	88	10	12.1	82.3	Tower	27.4	250.0	208.0	FB2
KGL593	155.04000	Calumet, County of	3/10/2012	90.20A	Hwy Garage 1/8 MI N Hwy 114 & 55	Sherwood	Calumet	WI	297	44	9	57.0	88	15	51.4	43.0	Tower	43.0	100.0	148.0	FB2S
KGL593	155.04000	Calumet, County of	3/10/2012	90.20A	800 E Lake St	Stockbridge	Calumet	WI	256	44	4	18.8	88	17	49.8	48.7	Tower	36.5	110.0	280.0	FB2
KXC545	155.04000	Brillion, City of	6/16/2015	90.2	130 Calumet St	Brillion	Calumet	WI	253	44	10	40.0	88	3	45.4	25.0	Tower	24.0	45.0	57.0	FB
KVQ637	155.05500	Howard, Village of	5/1/2012	90.20(A)	3343 Evergreen	Green Bay	Brown	WI	228	44	34	32.8	88	6	43.6	34.1	Tank	34.1	10.0	20.0	FB2
KB90882	155.08500	Stockbridge, Town of	5/14/2012	90.17A			Calumet	WI	0	44	4	19.0	88	17	57.4	0.0		0.0	40.0	0.0	MO
KXC545	155.08500	Brillion, City of	6/16/2015	90.2	130 Calumet St	Brillion	Calumet	WI	253	44	10	40.0	88	3	45.4	25.0	Tower	24.0	45.0	57.0	FB
WNNF292	155.08500	Hilbert, Village of	12/20/2013	90.17A	26 N 6th St	Hilbert	Calumet	WI	255	44	8	23.0	88	9	40.4	0.0		12.0	45.0	30.0	FB
KDG828	155.10000	Oshkosh, City of	12/16/2012	90.17A	639 Witzel Ave	Oshkosh	Winnebago	WI	232	44	2	45.9	88	32	23.4	20.0		26.0	100.0	302.0	FB2
KNAB465	155.10000	Brown, County of	1/21/2012	90.20a	2077 Airport Dr	Green Bay	Brown	WI	212	44	29	31.0	88	7	36.4	31.0		14.0	100.0	214.0	FB2
KNAB465	155.10000	Brown, County of	1/21/2012	90.20a	2077 Airport Dr	Green Bay	Brown	WI	212	44	29	31.0	88	7	36.4	31.0		11.7	100.0	214.0	FB2
KNAB465	155.10000	Brown, County of	1/21/2012	90.20a	2077 Airport Dr	Green Bay	Brown	WI	212	44	29	31.0	88	7	36.4	31.0		14.0	100.0	214.0	FB2
KNAB465	155.10000	Brown, County of	1/21/2012	90.20a	2077 Airport Dr	Green Bay	Brown	WI	212	44	29	31.0	88	7	36.4	31.0		11.7	100.0	214.0	FB2
KNCG848	155.11500	Outagamie, County of	6/10/2012	90.2	N5155 Hample Rd	Binghamton	Outagamie	WI	249	44	25	27.9	88	28	30.4	66.0	Tower	30.0	40.0	90.0	FB
KNCG848	155.11500	Outagamie, County of	6/10/2012	90.2	N5155 Hample Rd	Binghamton	Outagamie	WI	249	44	25	27.9	88	28	30.4	66.0	Tower	43.0	40.0	90.0	FB
KNCG848	155.11500	Outagamie, County of	6/10/2012	90.2	N5155 Hample Rd	Binghamton	Outagamie	WI	249	44	25	27.9	88	28	30.4	66.0	Tower	73.0	40.0	90.0	FB
KNCG848	155.11500	Outagamie, County of	6/10/2012	90.2	N5155 Hample Rd	Binghamton	Outagamie	WI	249	44	25	27.9	88	28	30.4	66.0	Tower	85.0	40.0	90.0	FB
WNIJ845	155.11500	Outagamie, County of	3/30/2013	90.2	1419 Holland Rd	Appleton	Outagamie	WI	226	44	17	15.0	88	21	30.4	13.0	B	13.0	40.0	35.0	FB
WPSP510	155.11500	New Holstein City of	7/3/2011	90.20A1II	2110 Washington Street	New Holstein	Calumet	WI	300	43	57	5.0	88	5	41.0	39.9	Tower	18.0	25.0	25.0	FB
WPSP510	155.11500	New Holstein City of	7/3/2011	90.20A1II	2110 Washington Street	New Holstein	Calumet	WI	300	43	57	5.0	88	5	41.0	39.9	Tower	18.0	25.0	25.0	FB
WPSP510	155.11500	New Holstein City of	7/3/2011	90.20A1II	2110 Washington Street	New Holstein	Calumet	WI	300	43	57	5.0	88	5	41.0	39.9	Tower	9.0	25.0	25.0	FB
WPSP510	155.11500	New Holstein City of	7/3/2011	90.20A1II	2110 Washington Street	New Holstein	Calumet	WI	300	43	57	5.0	88	5	41.0	39.9	Tower	9.0	25.0	25.0	FB
KBB201	155.13000	Brown, County of	9/20/2015	90.2	307 S Adams St	Green Bay	Brown	WI	180	44	30	28.0	88	0	58.4	56.0	Pole	10.0	100.0	200.0	FB2
KBB201	155.13000	Brown, County of	9/20/2015	90.2	307 S Adams St	Green Bay	Brown	WI	180	44	30	28.0	88	0	58.4	56.0	Pole	47.0	100.0	200.0	FB2
KRZ398	155.14500	Sanitary District No 4	12/6/2013	90.20A1	Chain Dr	Neenah	Winnebago	WI	237	44	6	31.0	88	42	14.0	41.0	Tower	41.0	40.0	20.0	FB2
KRZ398	155.14500	Sanitary District No 4	12/6/2013	90.20A1	919 Shady Ln	Neenah	Winnebago	WI	245	44	13	44.0	88	28	48.0	24.0	Tower	24.0	25.0	50.0	FB
KRZ398	155.14500	Sanitary District No 4	12/6/2013	90.20A1	Chain Dr	Neenah	Winnebago	WI	237	44	6	31.0	88	42	14.0	41.0	Tower	41.0	40.0	20.0	FB2
KRZ398	155.14500	Sanitary District No 4	12/6/2013	90.20A1	919 Shady Ln	Neenah	Winnebago	WI	245	44	13	44.0	88	28	48.0	24.0	Tower	24.0	25.0	50.0	FB
WPGS829	155.14500	Public Works Department	3/10/2015	90.17A			Winnebago	WI	0	44	6	39.9	88	42	35.4	0.0		0.0	45.0	0.0	MO
KNAI231	155.17500	Winneconne Community School District	3/4/2011	90.35A	233 S Third Ave	Winneconne	Winnebago	WI	261	44	6	27.9	88	42	18.4	0.0		17.0	25.0	65.0	FB
KNHS530	155.17500	County Rescue Service Inc.	6/25/2014	90.20A2	1765 Allouez Ave	Green Bay	Brown	WI	177	44	28	16.0	87	59	41.4	30.0	Tower	30.0	100.0	225.0	FB
KFZ899	155.19000	Winnebago, County of	5/8/2015	90.2	4311 Jackson Dr	Oshkosh	Winnebago	WI	233	44	4	51.9	88	32	53.4	58.0	Tower	6.0	25.0	47.0	FB2
KFZ899	155.19000	Winnebago, County of	5/8/2015	90.2	4311 Jackson Dr	Oshkosh	Winnebago	WI	233	44	4	51.9	88	32	53.4	58.0	Tower	58.0	25.0	47.0	FB2
WNMI470	155.31000	Little Chute, Village of	10/3/2011	90.19A	200 W Mc Kinley Ave	Little Chute	Outagamie	WI	219	44	16	58.0	88	19	4.4	24.0	Tower	24.0	100.0	145.0	FB2
WPWE601	155.32500	Seymour Fire and Rescue	10/29/2012	90.20(A)	501 Bronson Rd	Seymour	Outagamie	WI	243	44	31	21.0	88	19	27.7	53.7	Tank	53.7	10.0	10.0	FB2
KBB201	155.37000	Brown, County of	9/20/2015	90.2	4070 County X	De Pere	Brown	WI	274	44	24	36.0	88	0	38.4	61.0	Tower	58.0	50.0	150.0	FB
KBB201	155.37000	Brown, County of	9/20/2015	90.2	4070 County X	De Pere	Brown	WI	274	44	24	36.0	88	0	38.4	61.0	Tower	30.0	50.0	150.0	FB
KBB201	155.37000	Brown, County of	9/20/2015	90.2	4070 County X	De Pere	Brown	WI	274	44	24	36.0	88	0	38.4	61.0	Tower	23.0	50.0	150.0	FB
KBB201	155.37000	Brown, County of	9/20/2015	90.2	4070 County X	De Pere	Brown	WI	274	44	24	36.0	88	0	38.4	61.0	Tower	15.0	50.0	150.0	FB
KNEZ944	155.37000	De Pere, City of	2/26/2013	90	325 S Broadway St	De Pere	Brown	WI	189	44	26	35.0	88	4	40.4	0.0		3.0	45.0	0.0	FB
KNIF646	155.37000	Winnebago, County of	8/23/2015	90.2	4311 Jackson Dr	Oshkosh	Winnebago	WI	233	44	4	51.9	88	32	53.4	58.0	Tower	58.0	100.0	230.0	FB
KNIF646	155.37000	Winnebago, County of	8/23/2015	90.2	4311 Jackson Dr	Oshkosh	Winnebago	WI	233	44	4	51.9	88	32	53.4	58.0	Tower	51.8	100.0	230.0	FB
KSB450	155.37000	Calumet, County of	4/7/2012	90.19A	206 Court St	Chilton	Calumet	WI	278	44	1	49.0	88	10	7.4	82.0	Tower	52.0	120.0	260.0	FB
KSB450	155.37000	Calumet, County of	4/7/2012	90.19A	2110 Washington St	New Holstein	Calumet	WI	300	43	57	5.0	88	5	41.4	40.0	Tower	21.0	45.0	90.0	FB
KSQ802	155.37000	Little Chute, Village of	5/31/2014	90.19A	200 W Mc Kinley Ave	Little Chute	Outagamie	WI	219	44	16	58.0	88	19	4.4	0.0		24.0	110.0	320.0	FB
WPFU249	155.37000	Brillion, City of	10/14/2014	90.19A	130 Calumet St	Brillion	Calumet	WI	250	44	10	40.0	88	3	45.4	15.0	Tower	22.0	45.0	57.0	FB
WPUH780	155.38500	New Franken Volunteer Fire Dpt	3/7/2012	90.20(A)	2620 Scott Tower Dr	Green Bay	Brown	WI	229.8	44	32	21.0	87	52	59.0	47.8	Tank	47.8	50.0	42.0	FB2
KJF229	155.41500	Outagamie, County of	10/29/2014	90.2	1451 Tower Dr	Kaukauna	Outagamie	WI	207	44	17	31.0	88	15	46.4	46.0	Tank	46.0	100.0	160.0	FB2

VHF FREQUENCIES

Callsign	Frequency	Entity	Expiration Date	Elegibility Rule	Location				Ground Elevation	N. Latitude			W. Longitude			overall_height_of_structure	Structure Type	Height to tip	Power		Station Class
					Address	City	County	State		Deg	Min	Sec	Deg	Min	Sec				Output	ERP	
WNCH483	155.43000	University of Wisconsin	4/2/2015	90.2	Nursing Education Bldg 845 Algoma Blvd	Oshkosh	Winnebago	WI	236	44	1	33.9	88	33	15.4	40.0	B	40.0	20.0	10.0	FB2
WNCH483	155.43000	University of Wisconsin	4/2/2015	90.2	Nursing Education Bldg 845 Algoma Blvd	Oshkosh	Winnebago	WI	236	44	1	33.9	88	33	15.4	40.0	B	38.0	20.0	10.0	FB2
KBB201	155.47500	Brown, County of	9/20/2015	90.2	4070 County X	De Pere	Brown	WI	274	44	24	36.0	88	0	38.4	61.0	Tower	30.0	100.0	210.0	FB
KBB201	155.47500	Brown, County of	9/20/2015	90.2	4070 County X	De Pere	Brown	WI	274	44	24	36.0	88	0	38.4	61.0	Tower	23.0	100.0	210.0	FB
KBB201	155.47500	Brown, County of	9/20/2015	90.2	4070 County X	De Pere	Brown	WI	274	44	24	36.0	88	0	38.4	61.0	Tower	58.0	100.0	210.0	FB
KBB201	155.47500	Brown, County of	9/20/2015	90.2	4070 County X	De Pere	Brown	WI	274	44	24	36.0	88	0	38.4	61.0	Tower	15.0	100.0	210.0	FB
KNIF646	155.47500	Winnebago, County of	8/23/2015	90.2	4311 Jackson Dr	Oshkosh	Winnebago	WI	233	44	4	51.9	88	32	53.4	58.0	Tower	58.0	100.0	230.0	FB
KNIF646	155.47500	Winnebago, County of	8/23/2015	90.2	4311 Jackson Dr	Oshkosh	Winnebago	WI	233	44	4	51.9	88	32	53.4	58.0	Tower	51.8	100.0	230.0	FB
KTI669	155.55000	Kaukauna, City of	11/4/2011	90.19A	City's Side Water Twr Ann St & Parkwood St	Kaukauna	Outagamie	WI	229	44	15	59.0	88	15	46.4	47.0	Tank	47.0	60.0	45.0	FB2
KZV876	155.58750	Winnebago, County of	4/7/2015	90.20A1	725 Butler Ave	Oshkosh	Winnebago	WI	235	44	4	32.4	88	31	32.6	10.9	Bant	10.9	45.0	25.1	FB2
KNBR753	155.59500	Ashwaubenon, Village of	7/28/2014	90.2	Marvelle Ln & Ridge Rd	Ashwaubenon	Brown	WI	202	44	29	30.0	88	4	18.4	52.0	Tank	52.0	40.0	25.0	FB2
KNBR753	155.59500	Ashwaubenon, Village of	7/28/2014	90.2	Marvelle Ln & Ridge Rd	Ashwaubenon	Brown	WI	202	44	29	30.0	88	4	18.4	52.0	Tank	52.0	40.0	25.0	FB2
KNIF646	155.61000	Winnebago, County of	8/23/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	29.0	88	26	30.4	49.0	Tower	30.0	100.0	46.0	FB2
KNIF646	155.61000	Winnebago, County of	8/23/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	29.0	88	26	30.4	49.0	Tower	46.0	100.0	46.0	FB2
KNIF646	155.61000	Winnebago, County of	8/23/2015	90.2	2111 Marathon St	Neenah	Winnebago	WI	229	44	9	47.9	88	28	15.4	37.0	Pole	37.0	100.0	195.0	FB2
KNIF646	155.61000	Winnebago, County of	8/23/2015	90.2	3009 W Fairview Rd	Neenah	Winnebago	WI	275.2	44	12	50.0	88	32	58.0	30.4	Tower	30.4	100.0	263.0	FB2
KNIF646	155.61000	Winnebago, County of	8/23/2015	90.2	3009 W Fairview Rd	Neenah	Winnebago	WI	275.2	44	12	50.0	88	32	58.0	30.4	Tower	24.3	100.0	263.0	FB2
WQAZ833	155.67000	Hortonville, Village of	9/2/2014	90.20a1		Hortonville	Outagamie	WI	0	44	20	4.9	88	38	19.2	0.0		0.0	50.0	50.0	MO
KJB874	155.68500	Appleton, City of	7/16/2014	90.20A1	Hwy 00 & French Rd	Grand Chute	Outagamie	WI	222	44	17	18.0	88	20	56.4	128.0	Tower	52.0	25.0	60.0	FB2
KJF229	155.70000	Outagamie, County of	10/29/2014	90.2	W8279 Grand View Rd	Hortonville	Outagamie	WI	285	44	20	41.9	88	36	24.4	81.0	Tower	67.0	100.0	104.0	FB2
KJF229	155.70000	Outagamie, County of	10/29/2014	90.2	501 E Bronson Rd	Seymour	Outagamie	WI	241	44	31	30.0	88	19	30.4	55.0	Tank	55.0	100.0	168.0	FB2
KJF229	155.70000	Outagamie, County of	10/29/2014	90.2	1451 Tower Dr	Kaukauna	Outagamie	WI	207	44	17	31.0	88	15	46.4	46.0	Tank	46.0	100.0	160.0	FB2
KJF229	155.70000	Outagamie, County of	10/29/2014	90.2	N5155 Hample Rd	Binghamton	Outagamie	WI	249	44	25	27.9	88	28	30.4	91.0	Tower	79.0	100.0	150.0	FB2
KJF229	155.70000	Outagamie, County of	10/29/2014	90.2	412 W Willow St	Bear Creek	Outagamie	WI	262	44	31	53.9	88	43	58.4	49.0	Tank	45.0	100.0	110.0	FB2
WPDC664	155.70000	Outagamie, County of	9/13/2013	90.19A	207 Misty Ln	Grand Chute	Outagamie	WI	240	44	15	29.9	88	28	58.4	58.0		58.0	100.0	168.0	FB
KNJT308	155.71500	Kimberly, Village of	6/28/2014	90.17A	SW Corner of RR & First St	Kimberly	Outagamie	WI	230	44	16	20.0	88	20	5.4	0.0		15.0	40.0	125.0	FB
WPMZ607	155.71500	Freedom, Town of	4/13/2014	90.2	W2004 County Hwy S	Kaukauna	Outagamie	WI	226	44	22	6.0	88	18	33.4	8.0	Bant	8.0	40.0	60.0	FB
WPMH677	155.74500	Wrightstown, Village of	7/29/2013	90.2	101 N Washington St	Wrightstown	Brown	WI	189	44	19	37.0	88	9	39.4	15.0	BTwr	15.0	25.0	40.0	FB
WPMH677	155.74500	Wrightstown, Village of	7/29/2013	90.2	529 Main St	Wrightstown	Brown	WI	194	44	19	32.0	88	9	37.4	16.0	BTwr	16.0	25.0	25.0	FB
KNIA835	155.76000	Denmark, Village of	12/8/2013	90.17A	118 Main St	Denmark	Brown	WI	279	44	20	54.0	87	49	58.3	0.0		41.0	30.0	15.0	FB2
WPSP510	155.77500	New Holstein, City of	7/3/2011	90.20A1II	2110 Washington Street	New Holstein	Calumet	WI	300	43	57	5.0	88	5	41.0	39.9	Tower	18.0	40.0	130.0	FB
WPSP510	155.77500	New Holstein, City of	7/3/2011	90.20A1II	2110 Washington Street	New Holstein	Calumet	WI	300	43	57	5.0	88	5	41.0	39.9	Tower	18.0	40.0	130.0	FB
WPSP510	155.77500	New Holstein, City of	7/3/2011	90.20A1II	2110 Washington Street	New Holstein	Calumet	WI	300	43	57	5.0	88	5	41.0	39.9	Tower	18.0	40.0	130.0	FB
WPSP510	155.77500	New Holstein, City of	7/3/2011	90.20A1II	2110 Washington Street	New Holstein	Calumet	WI	300	43	57	5.0	88	5	41.0	39.9	Tower	9.0	40.0	130.0	FB
WPSP510	155.77500	New Holstein, City of	7/3/2011	90.20A1II	2110 Washington Street	New Holstein	Calumet	WI	300	43	57	5.0	88	5	41.0	39.9	Tower	9.0	40.0	130.0	FB
WPSP510	155.77500	New Holstein, City of	7/3/2011	90.20A1II	2110 Washington Street	New Holstein	Calumet	WI	300	43	57	5.0	88	5	41.0	39.9	Tower	9.0	40.0	130.0	FB
KJB874	155.79000	Appleton, City of	7/16/2014	90.20A1	222 W College Ave	Appleton	Outagamie	WI	239	44	15	42.9	88	24	30.3	57.9	Bant	57.9	100.0	128.0	FB2
KNCG848	155.82000	Outagamie, County of	6/10/2012	90.2	N5155 Hample Rd	Binghamton	Outagamie	WI	249	44	25	27.9	88	28	30.4	66.0	Tower	30.0	100.0	150.0	FB2
KNCG848	155.82000	Outagamie, County of	6/10/2012	90.2	N5155 Hample Rd	Binghamton	Outagamie	WI	249	44	25	27.9	88	28	30.4	66.0	Tower	43.0	100.0	150.0	FB2
KNCG848	155.82000	Outagamie, County of	6/10/2012	90.2	N5155 Hample Rd	Binghamton	Outagamie	WI	249	44	25	27.9	88	28	30.4	66.0	Tower	73.0	100.0	150.0	FB2
KNCG848	155.82000	Outagamie, County of	6/10/2012	90.2	N5155 Hample Rd	Binghamton	Outagamie	WI	249	44	25	27.9	88	28	30.4	66.0	Tower	85.0	100.0	150.0	FB2
KNCG848	155.82000	Outagamie, County of	6/10/2012	90.2	207 Misty Ln	Grand Chute	Outagamie	WI	240	44	15	30.0	88	28	38.4	58.0	Tank	58.0	100.0	204.0	FB2
KNJX262	155.83500	Little Chute, Village of	7/17/2014	90.17	200 W Mc Kinley Ave	Little Chute	Outagamie	WI	219	44	16	58.0	88	19	4.4	0.0		24.0	110.0	320.0	FB
KNEZ944	155.85000	De Pere, City of	2/26/2013	90	325 S Broadway St	De Pere	Brown	WI	189	44	26	35.0	88	4	40.4	0.0		3.0	45.0	0.0	FX1
KEM598	155.88000	De Pere, City of	3/30/2014	90.17A	City Water Treatment Merril St	De Pere	Brown	WI	198	44	26	10.0	88	3	20.4	30.0		32.0	60.0	59.0	FB2
WNGI436	155.92500	Oneida, Town of	11/22/2011	90.17A	N6631 Hwy H	Oneida	Outagamie	WI	229	44	28	40.0	88	15	3.4	11.0	BPIPE	11.0	50.0	96.0	FB
KLL469	155.95500	Brown, County of	3/4/2011	90.20(A)	Humbolt Rd & Mount Mary Dr	Green Bay	Brown	WI	229	44	30	44.0	87	56	11.4	49.0	Tower	49.0	110.0	240.0	FB2
KBB201	156.03000	Brown, County of	9/20/2015	90.2	307 S Broadway St	Green Bay	Brown	WI	189	44	26	35.0	88	4	40.4	2.0		3.0	30.0	30.0	FX1
KBB201	156.03000	Brown, County of	9/20/2015	90.2	421 Augustine St	Pulaski	Brown	WI	206	44	40	14.0	88	14	15.4	17.0		11.0	30.0	30.0	FX1
KNBR753	156.03000	Ashwaubenon, Village of	7/28/2014	90.2	2155 Holgren Way	Ashwaubenon	Brown	WI	186	44	29	30.0	88	3	35.4	9.0	B	9.0	25.0	25.0	FX1
KNBR753	156.03000	Ashwaubenon, Village of	7/28/2014	90.2	2155 Holgren Way	Ashwaubenon	Brown	WI	186	44	29	30.0	88	3	35.4	9.0	B	9.0	25.0	25.0	FX1
KGS85	156.04500	Winnebago, County of	11/17/2014	90.20a	4311 Jackson Dr	Oshkosh	Winnebago	WI	233	44	4	51.9	88	32	53.4	58.0	Tower	11.2	40.0	35.0	FX1
WQGS313	156.24000	Bellevue, Village of	4/3/2017	90.20a	2828 Allouez Ave	Bellevue	Brown	WI	221	44	27	30.0	87	56	30.4	9.0	Bant	9.0	25.0	20.0	FB
WQGS313	156.24000	Bellevue, Village of	4/3/2017	90.20a	2828 Allouez Ave	Bellevue	Brown	WI	221	44	27	29.0	87	56	30.0	44.8	Tank	44.8	25.0	21.0	FB2

VHF FREQUENCIES

Callsign	Frequency	Entity	Expiration Date	Eligibility Rule	Location				Ground Elevation	N. Latitude			W. Longitude			overall_height_of_structure	Structure Type	Height to tip	Power		Station Class
					Address	City	County	State		Deg	Min	Sec	Deg	Min	Sec				Output	ERP	
KNIF646	158.73000	Winnebago, County of	8/23/2015	90.2	3843 Sandpit Rd	Omro	Winnebago	WI	259.1	44	1	51.0	88	39	15.0	73.2	Tower	67.0	100.0	132.0	FB2
KNIF646	158.73000	Winnebago, County of	8/23/2015	90.2	415 Jackson St	Oshkosh	Winnebago	WI	234.1	44	1	17.0	88	32	35.0	45.7	Bant	45.7	100.0	240.0	FB2
KNIF646	158.73000	Winnebago, County of	8/23/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	29.0	88	26	30.4	49.0	Tower	30.0	100.0	144.0	FB2
KNIF646	158.73000	Winnebago, County of	8/23/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	29.0	88	26	30.4	49.0	Tower	46.0	100.0	144.0	FB2
KNIF646	158.73000	Winnebago, County of	8/23/2015	90.2	4311 Jackson Dr	Oshkosh	Winnebago	WI	233	44	4	51.9	88	32	53.4	58.0	Tower	58.0	100.0	230.0	FB2
KNIF646	158.73000	Winnebago, County of	8/23/2015	90.2	4311 Jackson Dr	Oshkosh	Winnebago	WI	233	44	4	51.9	88	32	53.4	58.0	Tower	51.8	100.0	230.0	FB2
KNIF646	158.73000	Winnebago, County of	8/23/2015	90.2	3009 W Fairview Rd	Neenah	Winnebago	WI	275.2	44	12	50.0	88	32	58.0	30.4	Tower	30.4	100.0	252.0	FB2
KNIF646	158.73000	Winnebago, County of	8/23/2015	90.2	3009 W Fairview Rd	Neenah	Winnebago	WI	275.2	44	12	50.0	88	32	58.0	30.4	Tower	24.3	100.0	252.0	FB2
KVQ571	158.74500	Howard, Village of	11/18/2014	90.2	1336 Cornell Rd	Howard	Brown	WI	179	44	34	47.0	88	4	1.4	48.0	Tower	27.0	45.0	45.0	FB2
KFZ899	158.77500	Winnebago, County of	5/8/2015	90.2	3843 Sand Pit Rd	Omro	Winnebago	WI	259	44	1	50.9	88	39	15.4	67.0	Tower	56.0	100.0	132.0	FB2
KFZ899	158.77500	Winnebago, County of	5/8/2015	90.2	3843 Sand Pit Rd	Omro	Winnebago	WI	259	44	1	50.9	88	39	15.4	67.0	Tower	67.0	100.0	132.0	FB2
KFZ899	158.77500	Winnebago, County of	5/8/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	11.8	88	26	53.1	49.0	Tower	20.0	100.0	44.0	FB2
KFZ899	158.77500	Winnebago, County of	5/8/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	11.8	88	26	53.1	49.0	Tower	37.0	100.0	44.0	FB2
KFZ899	158.77500	Winnebago, County of	5/8/2015	90.2	3009 W Fairview Rd	Neenah	Winnebago	WI	275.2	44	12	50.0	88	32	58.0	30.4	Tower	28.0	100.0	44.0	FB2
KFZ899	158.77500	Winnebago, County of	5/8/2015	90.2	3009 W Fairview Rd	Neenah	Winnebago	WI	275.2	44	12	50.0	88	32	58.0	30.4	Tower	30.4	100.0	44.0	FB2
KFZ899	158.77500	Winnebago, County of	5/8/2015	90.2	4311 Jackson Dr	Oshkosh	Winnebago	WI	233	44	4	51.9	88	32	53.4	58.0	Tower	6.0	100.0	219.0	FB
KFZ899	158.77500	Winnebago, County of	5/8/2015	90.2	4311 Jackson Dr	Oshkosh	Winnebago	WI	233	44	4	51.9	88	32	53.4	58.0	Tower	58.0	100.0	219.0	FB
KEQ222	158.82000	Green Bay, City of	10/23/2014	90.17A	City Hall 100 N Jefferson St	Green Bay	Brown	WI	189	44	30	48.0	88	0	45.4	24.0		46.0	60.0	200.0	FB2
WPQJ803	158.82000	Public Works Department	8/11/2015	90.2	309 5th Ave	Winneconne	Winnebago	WI	228	44	6	58.9	88	42	23.4	38.0	Tank	29.0	15.0	5.0	FB2
KGL593	158.86500	Calumet, County of	3/10/2012	90.20A	2110 Washington St	New Holstein	Calumet	WI	300	43	57	5.0	88	5	41.4	40.0	Tower	11.0	40.0	70.0	FX1
KXC545	158.86500	Brillion, City of	6/16/2015	90.2	130 Calumet St	Brillion	Calumet	WI	253	44	10	40.0	88	3	45.4	25.0	Tower	24.0	25.0	35.0	FX1
KFZ899	158.94000	Winnebago, County of	5/8/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	11.8	88	26	53.1	49.0	Tower	20.0	60.0	29.0	FB
KFZ899	158.94000	Winnebago, County of	5/8/2015	90.2	430 First St	Menasha	Winnebago	WI	232	44	12	11.8	88	26	53.1	49.0	Tower	37.0	60.0	29.0	FB
KUU390	159.07500	Calumet, County of	2/13/2013	90.23A	2110 Washington St	New Holstein	Calumet	WI	300	43	57	5.0	88	5	41.4	40.0	Tower	11.0	40.0	70.0	FX1
WNFJ765	159.12000	Denmark, Village of	1/2/2011	90.23A	118 Main St	Denmark	Brown	WI	268	44	20	50.0	87	49	42.3	0.0		15.0	40.0	75.0	FB
WPCE461	159.12000	Brown, County of	5/10/2013	90.23A			Brown	WI	0	44	30	0.0	88	0	0.4	0.0		0.0	40.0	0.0	MO
WPCE461	159.12000	Brown, County of	5/10/2013	90.23A			Brown	WI	0	44	30	0.0	88	0	0.4	0.0		0.0	5.0	0.0	MO
KGS85	159.18000	Winnebago, County of	11/17/2014	90.20a	3843 Sand Pit Rd	Oshkosh	Winnebago	WI	259	44	1	50.9	88	39	15.4	67.0	Tower	47.0	100.0	250.0	FB2
KGS85	159.18000	Winnebago, County of	11/17/2014	90.20a	3009 W Fairview Rd	Neenah	Winnebago	WI	275.2	44	12	50.0	88	32	58.0	30.4	Tower	30.4	100.0	252.0	FB2
KAG945	163.25000	ST Vincent Hospital Inc	11/12/2013	90.2	835 S Van Buren	Green Bay	Brown	WI	183	44	30	2.0	88	0	44.4	47.0	B	47.0	100.0	78.0	FB
WNPJ257	173.23750	Ashwaubenon, Village of	5/17/2014	90.17A	2070 ARGONNE St	Green Bay	Brown	WI	189	44	29	45.0	88	4	47.4	0.0		6.0	5.0	20.0	FXO
WNPJ257	173.23750	Ashwaubenon, Village of	5/17/2014	90.17A	2041 Airport Dr	Green Bay	Brown	WI	203	44	29	40.0	88	7	18.4	0.0		6.0	5.0	20.0	FXO
WNPW452	173.23750	Ashwaubenon, Village of	7/20/2014	90.17A	737 Cormier Rd	Green Bay	Brown	WI	185	44	29	37.0	88	3	33.4	0.0		6.0	7.0	20.0	FXO
WNPW452	173.23750	Ashwaubenon, Village of	7/20/2014	90.17A	461 Morris Ave	Green Bay	Brown	WI	183	44	29	37.0	88	2	32.4	0.0		6.0	5.0	20.0	FXO
WNPW452	173.23750	Ashwaubenon, Village of	7/20/2014	90.17A	2201 Ridge Rd	Green Bay	Brown	WI	201	44	29	40.0	88	4	7.4	0.0		6.0	5.0	20.0	FXO
WNPW452	173.23750	Ashwaubenon, Village of	7/20/2014	90.17A	2634 Babcock Rd	Green Bay	Brown	WI	204	44	29	37.0	88	6	1.4	0.0		6.0	5.0	20.0	FXO
WNPW452	173.23750	Ashwaubenon, Village of	7/20/2014	90.17A	2319 Shady LN	Green Bay	Brown	WI	192	44	29	42.0	88	5	34.4	0.0		6.0	5.0	20.0	FXO
WNPW452	173.23750	Ashwaubenon, Village of	7/20/2014	90.17A	2916 S Ridge Rd	Green Bay	Brown	WI	198	44	29	28.0	88	5	12.4	0.0		6.0	5.0	20.0	FXO
WPXW627	173.23750	Hortonville, Village of	6/23/2013	90.20a	Lakeview Ave .25 MI N of Hwy 45	Hortonville	Outagamie	WI	241	44	19	44.9	88	38	8.4	6.0	Pole	6.0	5.0	20.0	FXO
WPXW627	173.23750	Hortonville, Village of	6/23/2013	90.20a	Hwy 45 E of Hwy M	Hortonville	Outagamie	WI	242	44	20	6.9	88	37	49.4	6.0	Pole	6.0	5.0	20.0	FXO
WPXW627	173.23750	Hortonville, Village of	6/23/2013	90.20a	521 W Cedar St	Hortonville	Outagamie	WI	235	44	20	15.9	88	39	4.4	6.0	Bant	6.0	5.0	20.0	FXO
WPXW627	173.23750	Hortonville, Village of	6/23/2013	90.20a	Hwy M 200' N of Hwy MM	Hortonville	Outagamie	WI	247	44	20	35.9	88	38	8.4	6.0	Pole	6.0	5.0	20.0	FXO
WNVI382	173.33750	Howard, Village of	1/30/2011	90.17A	600 W of Packerland Dr & Parkside Ct	Green Bay	Brown	WI	185	44	32	35.0	88	5	30.4	0.0		15.0	7.0	20.0	FXO
WNVI382	173.33750	Howard, Village of	1/30/2011	90.17A	200 W of Glendale Ave & Hillcrest Heights	Green Bay	Brown	WI	202	44	33	56.0	88	5	59.4	0.0		15.0	7.0	20.0	FXO
WNVI387	173.33750	Howard, Village of	1/30/2011	90.17A	1336 Cornell Rd	Green Bay	Brown	WI	180	44	34	46.0	88	4	6.4	4.0		15.0	7.0	20.0	FXO
WNVI387	173.33750	Howard, Village of	1/30/2011	90.17A	605 Maywood Ave	Green Bay	Brown	WI	188	44	33	30.0	88	4	13.4	4.0		15.0	7.0	20.0	FXO
WNVI387	173.33750	Howard, Village of	1/30/2011	90.17A	3343 Evergreen Ave	Green Bay	Brown	WI	229	44	34	33.0	88	6	44.4	4.0		15.0	7.0	20.0	FXO
WNVI387	173.33750	Howard, Village of	1/30/2011	90.17A	1650 Cornell Rd	Green Bay	Brown	WI	181	44	35	9.0	88	4	8.4	4.0		15.0	7.0	20.0	FXO
WNVI387	173.33750	Howard, Village of	1/30/2011	90.17A	100 S of Woodale Ave & Lakeview Dr	Green Bay	Brown	WI	181	44	34	22.0	88	3	52.4	4.0		15.0	7.0	20.0	FXO
WNVI387	173.33750	Howard, Village of	1/30/2011	90.17A	400 E of Warble Dr & Downy St INT	Green Bay	Brown	WI	190	44	32	36.0	88	4	20.4	4.0		15.0	7.0	20.0	FXO
WNRR557	173.36250	Public Works Department	3/22/2015	90.17A	300 Washington St	Winneconne	Winnebago	WI	229	44	5	54.9	88	42	32.4	0.0		15.0	7.0	20.0	FXO
WNRR557	173.36250	Public Works Department	3/22/2015	90.17A	90 Tower Rd	Winneconne	Winnebago	WI	231	44	6	17.9	88	43	31.4	0.0		15.0	7.0	20.0	FXO
WNRR557	173.36250	Public Works Department	3/22/2015	90.17A	203 S Third St	Winneconne	Winnebago	WI	231	44	6	32.9	88	42	55.4	0.0		15.0	7.0	20.0	FXO
WNRR557	173.36250	Public Works Department	3/22/2015	90.17A	410 Meadow Ln	Winneconne	Winnebago	WI	231	44	6	35.9	88	42	14.4	0.0		15.0	7.0	20.0	FXO

VHF FREQUENCIES

Callsign	Frequency	Entity	Expiration Date	Eligibility Rule	Location				Ground Elevation	N. Latitude			W. Longitude			overall_height_of_structure	Structure Type	Height to tip	Power		Station Class
					Address	City	County	State		Deg	Min	Sec	Deg	Min	Sec				Output	ERP	
WNRR557	173.36250	Public Works Department	3/22/2015	90.17A	279 N 6th Ave	Winneconne	Winnebago	WI	229	44	7	-0.1	88	42	0.4	0.0		15.0	7.0	20.0	FXO
WNRR557	173.36250	Public Works Department	3/22/2015	90.17A	300 N 7th St	Winneconne	Winnebago	WI	229	44	6	49.9	88	43	18.4	0.0		15.0	7.0	20.0	FXO
WNRR558	173.36250	Public Works Department	3/22/2015	90.17A	790 S 5th Ave	Winneconne	Winnebago	WI	229	44	6	14.9	88	42	15.4	0.0		15.0	7.0	20.0	FXO
WPAI916	173.36250	Green Bay, City of	2/22/2014	90.2	702 Edgewood Dr	Green Bay	Brown	WI	213	44	29	16.0	87	57	31.4	6.0	B	6.0	20.0	40.0	FXO
WPAI916	173.36250	Green Bay, City of	2/22/2014	90.2	801 Lime Kiln Rd	Green Bay	Brown	WI	186	44	29	22.0	87	58	38.4	6.0	B	6.0	20.0	40.0	FXO
WPAI916	173.36250	Green Bay, City of	2/22/2014	90.2	802 John St	Green Bay	Brown	WI	177	44	29	46.0	87	59	43.4	6.0	B	6.0	20.0	40.0	FXO
WPAI916	173.36250	Green Bay, City of	2/22/2014	90.2	1810 S Point Rd	Green Bay	Brown	WI	232	44	30	50.0	88	6	39.4	6.0	B	6.0	20.0	40.0	FXO
WPAI916	173.36250	Green Bay, City of	2/22/2014	90.2	804 Abrams St	Green Bay	Brown	WI	179	44	29	31.0	87	59	7.4	6.0	B	6.0	20.0	40.0	FXO
WNQC854	173.39000	Neenah, City of	8/16/2014	90.2	2490 Towerview Dr	Neenah	Winnebago	WI	232.6	44	8	32.1	88	28	51.7	41.1	Tank	6.9	4.0	25.0	FXO
WNQC854	173.39000	Neenah, City of	8/16/2014	90.2	333 Cecil St	Neenah	Winnebago	WI	229	44	10	45.9	88	28	20.4	0.0		43.0	4.0	25.0	FXO
WPAI912	173.39625	Green Bay, City of	6/2/2012	90.17A	631 S Adams Rd	Green Bay	Brown	WI	183	44	30	25.0	88	1	7.4	15.0	Tower	15.0	20.0	50.0	FXO
WPAI912	173.39625	Green Bay, City of	6/2/2012	90.17A	3120 Sturgeon Bay Rd	Green Bay	Brown	WI	198	44	31	31.0	87	55	15.4	6.0	Tower	6.0	20.0	40.0	FXO
WPAI912	173.39625	Green Bay, City of	6/2/2012	90.17A	2240 Eastman Ave	Green Bay	Brown	WI	178	44	31	1.0	87	57	59.4	6.0	Tower	6.0	20.0	40.0	FXO
WPAI912	173.39625	Green Bay, City of	6/2/2012	90.17A	1817 Deckner Ave	Green Bay	Brown	WI	183	44	30	10.0	87	58	39.4	6.0	Tower	6.0	20.0	40.0	FXO
WPAI912	173.39625	Green Bay, City of	6/2/2012	90.17A	1451 Cass St	Green Bay	Brown	WI	177	44	27	59.0	87	59	53.4	6.0	Tower	6.0	20.0	40.0	FXO
WPAI912	173.39625	Green Bay, City of	6/2/2012	90.17A	2228 N Quincy St	Green Bay	Brown	WI	178	44	31	56.0	87	59	33.4	6.0	Tower	6.0	20.0	40.0	FXO
WPAI913	173.39625	Green Bay, City of	8/20/2012	90.17A	1569 Seventh St	Green Bay	Brown	WI	195	44	31	4.0	88	4	3.4	6.0	Tower	6.0	20.0	40.0	FXO
WPAI913	173.39625	Green Bay, City of	8/20/2012	90.17A	2115 SUGAR Maple Ct	Green Bay	Brown	WI	198	44	30	41.0	88	5	8.4	6.0	Tower	6.0	20.0	40.0	FXO
WPAI913	173.39625	Green Bay, City of	8/20/2012	90.17A	1649 Bond St	Green Bay	Brown	WI	183	44	32	15.0	88	3	32.4	6.0	Tower	6.0	20.0	40.0	FXO
WPAI913	173.39625	Green Bay, City of	8/20/2012	90.17A	1479 N Military Ave	Green Bay	Brown	WI	178	44	33	2.0	88	2	47.4	6.0	Tower	6.0	20.0	40.0	FXO
WPAI913	173.39625	Green Bay, City of	8/20/2012	90.17A	2880 St Anthony Dr	Green Bay	Brown	WI	195	44	31	7.0	87	56	18.4	6.0	Tower	6.0	20.0	40.0	FXO
WPAI913	173.39625	Green Bay, City of	8/20/2012	90.17A	UWGB Circle Dr	Green Bay	Brown	WI	196	44	32	19.0	87	54	57.4	6.0	Tower	6.0	20.0	40.0	FXO
WPAI914	173.39625	Green Bay, City of	8/20/2012	90.17A	649 Grand View Rd	Green Bay	Brown	WI	238	44	29	17.0	87	53	47.4	6.0		6.0	20.0	40.0	FXO
WPAI914	173.39625	Green Bay, City of	8/20/2012	90.17A	3595 Humbolt Rd	Green Bay	Brown	WI	235	44	30	48.0	87	54	10.4	6.0		6.0	20.0	40.0	FXO
WPAI914	173.39625	Green Bay, City of	8/20/2012	90.17A	3220 Sturgeon Bay Rd	Green Bay	Brown	WI	198	44	31	29.0	87	55	11.4	6.0		6.0	20.0	40.0	FXO
WPAI914	173.39625	Green Bay, City of	8/20/2012	90.17A	653 Alpine Dr	Green Bay	Brown	WI	219	44	29	19.0	87	56	49.4	6.0		6.0	20.0	40.0	FXO
WPAI914	173.39625	Green Bay, City of	8/20/2012	90.17A	643 Mount Mary Dr	Green Bay	Brown	WI	229	44	30	43.0	87	56	12.4	6.0		6.0	20.0	40.0	FXO
WPAI914	173.39625	Green Bay, City of	8/20/2012	90.17A	650 Bader St	Green Bay	Brown	WI	189	44	29	26.0	87	58	22.4	6.0		6.0	20.0	40.0	FXO
WPAI915	173.39625	Green Bay, City of	4/28/2012	90.17A	1417 Lawe St	Green Bay	Brown	WI	241	44	29	53.0	88	0	0.4	6.0	Tower	6.0	20.0	40.0	FXO
WPAI915	173.39625	Green Bay, City of	4/28/2012	90.17A	1334 Ninth St	Green Bay	Brown	WI	179	44	30	45.0	88	3	29.4	6.0	Tower	6.0	20.0	40.0	FXO
WPAI915	173.39625	Green Bay, City of	4/28/2012	90.17A	1741 Sparten Rd	Green Bay	Brown	WI	233	44	31	25.0	87	54	9.4	6.0	Tower	6.0	20.0	40.0	FXO
WPAI915	173.39625	Green Bay, City of	4/28/2012	90.17A	714 Ninth St	Green Bay	Brown	WI	180	44	30	15.0	88	2	6.4	6.0	Tower	6.0	20.0	40.0	FXO
WPAI915	173.39625	Green Bay, City of	4/28/2012	90.17A	720 Huron Rd	Green Bay	Brown	WI	237	44	29	15.0	87	55	7.4	6.0	Tower	6.0	20.0	40.0	FXO

800 MHz

Callsign	Frequency	Name	Expiration Date	Eligibility Rule	Location				Ground Elevation	N. Latitude			W. Longitude			overall_height_of_structure	Structure Type	Height to tip	Power		Station Class
					Address	City	County	State		Deg	Min	Sec	Deg	Min	Sec				Output	ERP	
WPST447	854.83750	Oneida Tribe of Indians of WI	7/30/2011	90.617	N Side of St Hwy 54 1/4 MI W of St Hwy 54 & County Rd U Intersection	Oneida	Outagamie	WI	226.8	44	30	13	88	11	55	40.8	Tank	40.8	75	123	FB2C
WPUK865	854.98750	Green Bay Metropolitan Sewage District	3/25/2012	90.2	2231 N Quincy St	Green Bay	Brown	WI	177	44	32	4.8	87	59	50.8	12.9	Bant	12.9	60	60	FB2
WNMI560	855.21250	Brown County Public Safety	8/3/2015	90.2	307 S Adams St	Green Bay	Brown	WI	180	44	30	28	88	0	58.4	0		56	125	170	FB2
WPLV518	855.46250	Outagamie, County of	9/21/2014	90.617	206 Court St	Chilton	Calumet	WI	278	44	1	49	88	10	7.4	82	Tower	82	100	500	FB
WPST447	855.51250	Oneida Tribe of Indians of WI	7/30/2011	90.617	N Side of St Hwy 54 1/4 MI W of St Hwy 54 & County Rd U Intersection	Oneida	Outagamie	WI	226.8	44	30	13	88	11	55	40.8	Tank	40.8	75	123	FB2C
WPST447	855.58750	Oneida Tribe of Indians of WI	7/30/2011	90.617	N Side of St Hwy 54 1/4 MI W of St Hwy 54 & County Rd U Intersection	Oneida	Outagamie	WI	226.8	44	30	13	88	11	55	40.8	Tank	40.8	75	123	FB2C
WPBJ369	855.71250	Winnebago, County of	1/8/2013	90.20A	3843 Sandpit Rd	Omro	Winnebago	WI	259	44	1	50.9	88	39	15.4	73		55	75	415	FB
WPHY856	855.73750	Green Bay, City of	8/24/2015	90.21A	3489 HUMBOldT Rd Fire STATION 7	Green Bay	Brown	WI	234	44	30	48	87	54	37.4	18	B	18	125	88	FB2
WPHY856	855.73750	Green Bay, City of	8/24/2015	90.21A	100 N Jefferson St	Green Bay	Brown	WI	180	44	30	49	88	0	46.4	35	B	35	125	88	FB2
WPHY856	855.73750	Green Bay, City of	8/24/2015	90.21A	1810 S Point Rd HE NIS RA PK	Green Bay	Brown	WI	226	44	30	49	88	6	40.4	24	Tank	24	125	88	FB2
WPST447	855.78750	Oneida Tribe of Indians of WI	7/30/2011	90.617	N Side of St Hwy 54 1/4 MI W of St Hwy 54 & County Rd U Intersection	Oneida	Outagamie	WI	226.8	44	30	13	88	11	55	40.8	Tank	40.8	75	123	FB2C
WPLV518	855.96250	Outagamie, County of	9/21/2014	90.617	Hwy & FRNCH Rd	Grand Chute	Outagamie	WI	222	44	17	18	88	20	56.4	128	Tower	122	100	500	FB
WPST447	857.83750	Oneida Tribe of Indians of WI	7/30/2011	90.617	N Side of St Hwy 54 1/4 MI W of St Hwy 54 & County Rd U Intersection	Oneida	Outagamie	WI	226.8	44	30	13	88	11	55	40.8	Tank	40.8	75	123	FB2C
WPST447	858.81250	Oneida Tribe of Indians of WI	7/30/2011	90.617	N Side of St Hwy 54 1/4 MI W of St Hwy 54 & County Rd U Intersection	Oneida	Outagamie	WI	226.8	44	30	13	88	11	55	40.8	Tank	40.8	75	123	FB2C
WPST447	858.83750	Oneida Tribe of Indians of WI	7/30/2011	90.617	N Side of St Hwy 54 1/4 MI W of St Hwy 54 & County Rd U Intersection	Oneida	Outagamie	WI	226.8	44	30	13	88	11	55	40.8	Tank	40.8	75	123	FB2C
WPLV518	859.26250	Outagamie, County of	9/21/2014	90.617	N5155 Hample Rd	Binghamton	Outagamie	WI	249	44	25	27.9	88	28	30.4	98	Tower	98	100	500	FB
WPST447	859.78750	Oneida Tribe of Indians of WI	7/30/2011	90.617	N Side of St Hwy 54 1/4 MI W of St Hwy 54 & County Rd U Intersection	Oneida	Outagamie	WI	226.8	44	30	13	88	11	55	40.8	Tank	40.8	75	123	FB2C
WPST447	859.86250	Oneida Tribe of Indians of WI	7/30/2011	90.617	N Side of St Hwy 54 1/4 MI W of St Hwy 54 & County Rd U Intersection	Oneida	Outagamie	WI	226.8	44	30	13	88	11	55	40.8	Tank	40.8	75	123	FB2C
WPBJ369	859.96250	Winnebago, County of	1/8/2013	90.20A	430 First St	Menasha	Winnebago	WI	232	44	12	29	88	26	30.4	49	Tower	46	75	110	FB
WQAP246	860.73750	Brown, County of	7/13/2014	90.2	4070 County X	De Pere	Brown	WI	277.3	44	24	32	88	0	12	82.2	Tower	67	100	240	FB
WQAP246	860.73750	Brown, County of	7/13/2014	90.2	2198 Glendale Ave	Green Bay	Brown	WI	179.8	44	33	49.9	88	4	12.3	98.5	Tower	67	100	240	FB
WPST447	860.78750	Oneida Tribe of Indians of WI	7/30/2011	90.617	N Side of St Hwy 54 1/4 MI W of St Hwy 54 & County Rd U Intersection	Oneida	Outagamie	WI	226.8	44	30	13	88	11	55	40.8	Tank	40.8	75	123	FB2C