Effects of the Ameren High Voltage Power Line on the WMMC Transmitting Facility

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WMMC Issues with the Ameren 345 kV Transmission Line

Introduction

Figure 1 demonstrates the situation with regard to the proposed construction of an Ameren 345 kV power line adjacent to the WMMC tower. The green line is the path of the proposed power line. The red line is the existing path of the WMMC studio to transmitter link 950 MHz microwave link. The white lines represent the guy wire locations of the existing tower.

The construction of the power line may cause problems to WMMC in four areas: (1) the physical location of the WMMC tower to the proposed power line may cause outages of both WMMC transmissions and the Ameren electrical distribution system should either fail ; (2) the possibility of high voltage issues causing interference to the WMMC transmission system; (3) possible interference to the microwave system by the construction of the support towers for the power line system; and (4) induced currents into the tower structure may cause arcing and deterioration of that structure.

Location Issues

The tower is 500 feet tall. The base of the tower is approximately 220 feet from the center of the proposed power line. The nearest guy anchor is only 70 feet from the center of the line.[1] If these measurements are correct, the WMMC guy anchor extends into the Ameren right of way for this power line. The possibility of failure of the tower structure due to severe weather or other issues might cause the tower to fall toward the power line. This would be disastrous. The tower would destroy the power lines and cause complete failure of the power line transmission system. In addition to the damage caused to the power line structures, there exist the possibility of injuries to nearby buildings and personnel. The construction of a high voltage power line this close to an existing tower structure is an unwise decision.

Interference to Sensitive Electronic Equipment

The WMMC transmitter building houses very sensitive electronics that includes microwave receivers, FM transmitters containing both low power and high power sections, and audio equipment. This equipment is susceptible to many types of interference. Any radio frequency radiation from corona discharge or arcing will likely cause noise to this sensitive equipment. It is probable that this noise

[1] Measurements obtained from Ameren Transmission Company of Illinois Response to JDL Broadcasting Data Requests Docket Nos. 12-0598, 1/24/2013.

would be transmitted on the FM signal to the general public and cause the loss of both listeners and revenue to WMMC.

Microwave Path Issues

At this point in time the locations of the support towers for the proposed high tension line are unknown. It is possible that a support tower would be constructed at the point where the WMMC microwave path crosses the power line path. There is the potential for path blockage of the WMMC microwave Studio-Transmitter Link. That should not occur and it would be difficult to remedy should it happen. This issue must be considered and a remedy found should construction of the power line continue.

Possible Effects of 345 kV Line Electric Field

The following chart is taken from EPRI AC Transmission Line Reference Book—200 kV and Above, Third Edition Chapter 7, Pages 7-14, 15 and gives the electric field at ground level of a 525 kV line with flat configuration, 10-m phase spacing, 10.6-m height above ground, regular 3-conductor bundles, 3.3-cm diameter, 45-cm spacing.

Electric Field vs. Distance from Center of Line

The electric field is proportional to the voltage[2], therefore at 21 meters from the center of the proposed 345 kV line the electric field would be 2630 V/m. At the tower base the field would be approximately 85 V/m. In an ordinary household living room, the electric field due to house wiring, appliances, lights and other electrical devices varies from about 0.5 to 8 V/m [3]. This normal level is significantly lower than the expected fields from the power line at the WMMC site.

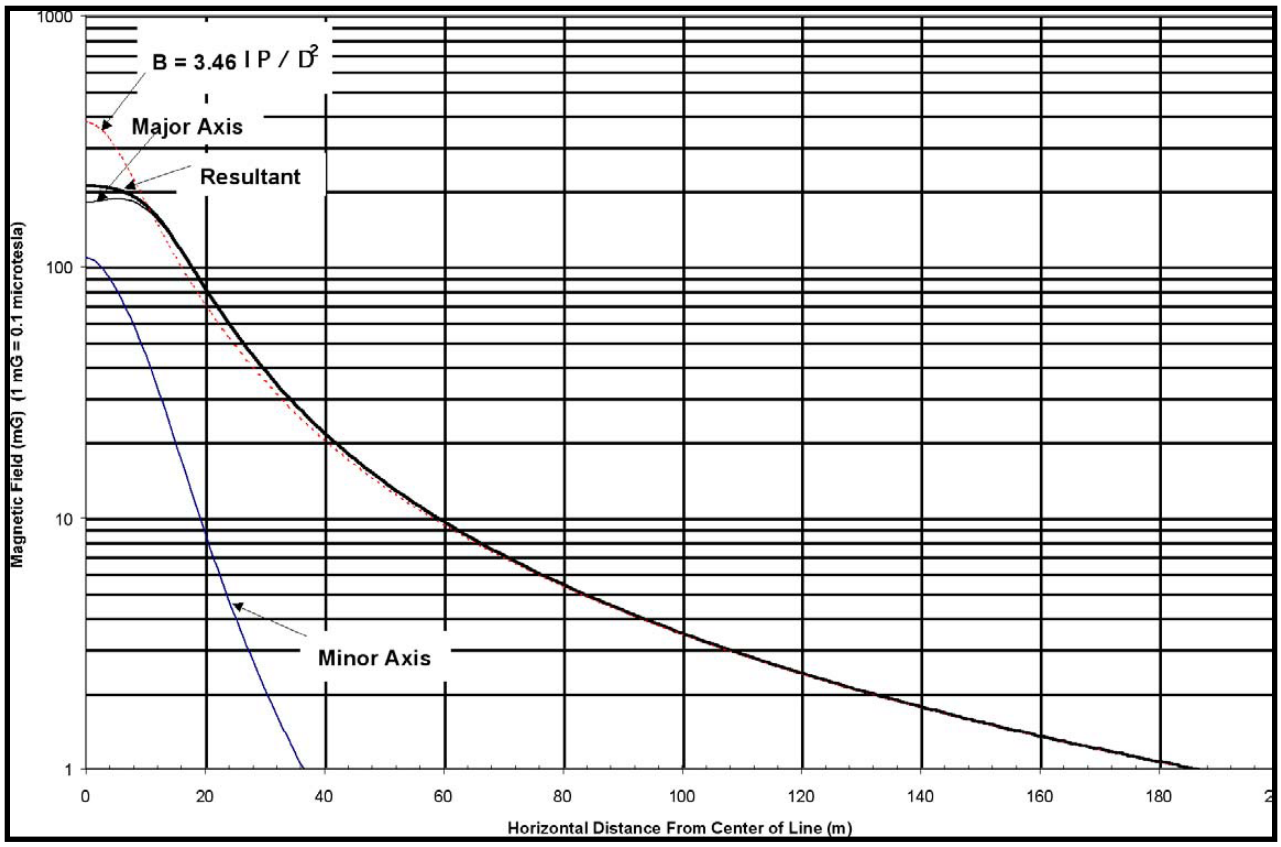
It is not known at this time the exact heights and configuration of the proposed Ameren 345 kV line and it is therefore impossible to calculate the effects of these fields. What is known is that due to the construction and operation of this power line it is possible and likely that very high electric fields will be created about the tower, guy wires, and equipment building. These varying alternating current electric fields can induce voltages and currents in the tower structure, guy wires, and any conductive surfaces on and within the WMMC transmitter building.

[2] EPRI AC Transmission Line Reference Book—200 kV and Above, Third Edition Chapter 7-17, *Effect of Voltage*
[3] EPRI AC Transmission Line Reference Book—200 kV and Above, Third Edition Chapter 7-33, Table 7.7-2 *Electric and magnetic Field levels in Common Environments*

Possible Effects of 345 kV Line Magnetic Field

The following chart is taken from EPRI AC Transmission Line Reference Book—200 kV and Above, Third Edition Chapter 7, Page 7-21 and gives the magnetic field calculated at 1 m above ground for a three-phase line of flat configuration with 1000 A, phase spacing P = 10 m and height above ground of 10.6 m.

Magnetic Field vs. Distance from Center of Line



At 21 meters, the location of the closest guy anchor, the field is 78 mG. At the tower the field is 7.6 mG. The average for all rooms in a normal home is about 0.6 mG[4]. Changing magnetic fields cause current to flow around conductive loops. Such loops are formed by the tower, guy wires and ground and even by such structures as the gutters around buildings. The main concern is the possible arcing and deterioration of the tower, FM coax, and fittings caused by 60 Hz currents and their harmonics induced

[4] EPRI AC Transmission Line Reference Book—200 kV and Above, Third Edition Chapter 7-33, Table 7.7-2 *Electric and magnetic Field levels in Common Environments*

into the tower structure, guy wires, and coax. Typically the 1-7/8" diameter coax used for Class A FM facilities is bonded to the tower at the antenna, at approximately the midpoint of the tower and at the base of the tower. The coax is usually covered by a non-conductive sheath. The high magnetic field surrounding the tower caused by the proposed 345 kV power line will induce currents that may cause burning, arcing, and general deterioration of the WMMC transmission facility on the tower over time. In addition, tower crews may find that metal tools used on the tower, coax, and guy wire structures often arc when used on the WMMC tower. In general, a deterioration of the tower structure over time may occur.

It is imperative that Ameren study these issues before construction and bear full responsibility for any problems caused by this power line installation over the full life of the WMMC facility.

Allocation Process for FM Facilities

The Federal Communications Commission ("FCC") governs the allocation and placement of FM facilities in the United States. The Code of Federal Regulations Parts 73.201 through 73.333 govern the technical specifications and allotment of FM facilities. There are spacing requirements, power requirements, height of antenna requirements, city of license coverage requirements, and a host of other criteria that make locating an FM facility a difficult task. This does not account for Federal Aviation Administration ("FAA") issues regarding tower structures and radio frequency ("RF") issues.

Recently, the FCC has required that any new tower structure[5] must go through an exhaustive process of clearing the construction with the FAA, Indian Tribes, and the Fish and Wildlife Service and local historical authorities. In addition, archeological studies must be performed and bird flyways investigated. It is getting increasingly more difficult to build towers of any type in the US, especially a five hundred foot tower as required by the WMMC facility.

Specific allocation issues for WMMC

Should WMMC try to move its facility away from the power line, it is assumed that the existing frequency will remain and that the facility will continue to use a non-directional antenna. Based on these usual assumptions an FCC Spacing analysis was completed. Table 1 and Figure 2 demonstrate the

[5] For example, to ensure safe air navigation FCC rules require the registration of towers or other structures that support antennas, such as water towers or buildings, that are more than 200 feet in height or located near an airport runway. The FCC administers these requirements through the Antenna Structure Registration (ASR) system. The FCC also administers rules to ensure the construction of communications towers complies with environmental and historic preservation laws, including the National Environmental Policy Act and National Historic Preservation Act. (Taken from FCC http://www.fcc.gov/topic/tower)

present WMMC allocation situation. WMMC is presently shortspaced to WGKC in Mahomet, IL on Channel 290, the same channel as WMMC. This shortspacing occurred when both stations agreed to accept interference when moving from the old Class A power of 3 kW maximum to the presently allowed power of 6 kW maximum. The FCC allowed for this type of agreement in these cases. Figure 2 demonstrates the spacing arcs for the WMMC City Grade Coverage, and the WGKC, WOKZ and WWVR spacing requirements. WMMC must cover the city of license, Marshall, IL with a city grade signal. The white circle represents the area within which the tower should be located in order to achieve this coverage. The black arcs represent minimum distances to other facilities. WMMC must remain outside those black arcs but within the white circle. As Figure 2 demonstrates, WMMC cannot move it facilities. There is no "Usable Area" that meets all allocation criteria.

Conclusion

There are five issues that require detailed study before Ameren constructs the 345 kV line very near the WMMC transmitting site.

1. A structural failure of the tower or power line may cause loss of power over a wide area and significant damage to both the proposed line and the WMMC facility.
2. It is likely that there will be interference to delicate receiving and low power equipment at the WMMC transmitting facility due to corona discharge and other electrical effects.
3. It is possible that the WMMC microwave path will be obstructed by a support tower for the 345 kV line.
4. There will be induced 60 Hz voltages and currents in the WMMC tower and surrounding structures that may cause deterioration of the tower and other WMMC structures.[6]
5. It may be impossible to move WMMC should it become impossible to correct problems cause by the power line.

The only real solution is to move the power line away from the WMMC transmitting installation.

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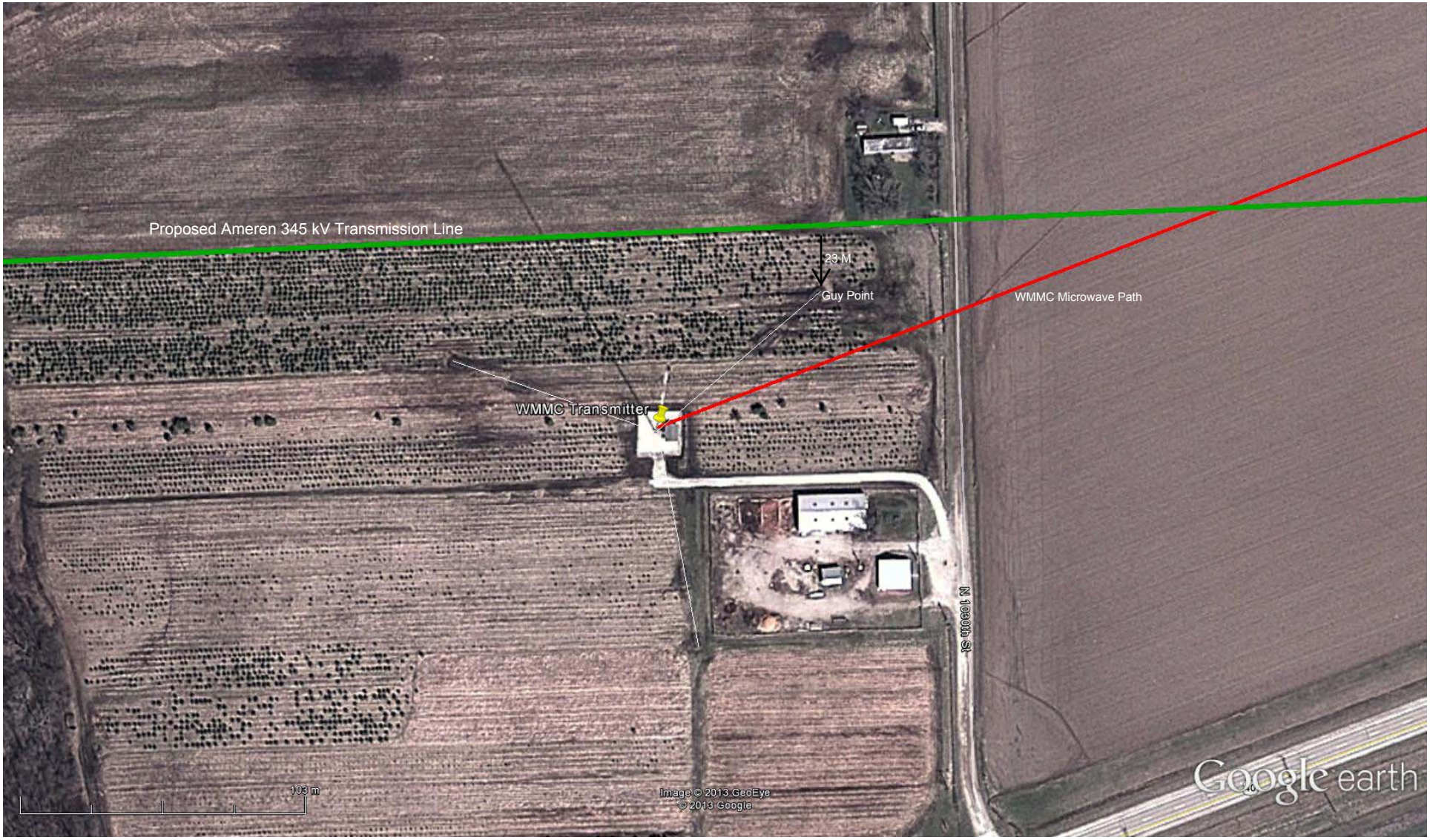
[6] David K. Davies, Structural Consulting Partner, Consolidated Engineering Inc, "North American Tower Failures Causes and Cures"



Google earth

feet 1000

meters 300

Figure 1

WMMC Site Characteristics

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Table 1

Client: WMMC

FM Study for Proposed Site: 39-21-9, 87-49-19

Channel 290 Frequency 105.9 MHz

Channel	City	State	Callsign	Facility Status	Class	Service	Latitude	Longitude	Distance Between Facilities	Direction True North	Required Distance	Spacing Status	Separation Distance
288	BEDFORD	IN	WQRK	LIC	A	FM	38-54-29.000000	86-28-28.000000	126.53	112.95	31	OK	95.53
288	MONTICELLO	IL	WCZQ	USE	A	FA	40-2-52.000000	88-34-22.000000	100.53	320.16	31	OK	69.53
288	BEDFORD	IN	WQRK	USE	A	FA	38-54-29.000000	86-28-28.000000	126.53	112.95	31	OK	95.53
288	WEST TERRE HAUTE	IN	WWVR	USE	A	FA	39-27-15.000000	87-28-18.000000	32.21	69.49	31	OK	1.21
288	WEST TERRE HAUTE	IN	WWVR	LIC	A	FM	39-27-13.000000	87-28-15.000000	32.26	69.64	31	OK	1.26
288	ALTAMONT	IL		VAC	A	FA	39-1-44.000000	88-48-22.000000	92.31	247.09	31	OK	61.31
288	MONTICELLO	IL	WCZQ	LIC	A	FM	40-2-54.000000	88-34-25.000000	100.62	320.16	31	OK	69.62
289	BICKNELL	IN	WUZR	LIC	A	FM	38-43-47.000000	87-24-44.000000	77.71	152.84	72	OK	5.71
289	BICKNELL	IN	WUZR	USE	A	FA	38-43-47.000000	87-24-44.000000	77.71	152.84	72	OK	5.71
289	PEORIA	IL	WIXO	USE	B	FA	40-38-34.000000	89-32-28.000000	205.13	314.3	113	OK	92.13
289	INDIANAPOLIS	IN	WYXB	USE	B	FA	39-48-1.000000	86-4-39.000000	157.91	71.65	113	OK	44.91
289	TELL CITY	IN	960823ME	USE	A	FA	37-50-49.000000	86-43-27.000000	192.55	150.22	72	OK	120.55
289	INDIANAPOLIS	IN	WYXB	LIC	B	FM	39-46-3.000000	86-0-12.000000	162.94	73.57	113	OK	49.94
289	INDIANAPOLIS	IN	WYXB	LIC	B	FS	39-46-3.000000	86-0-12.000000	162.94	73.57	113	OK	49.94
289	CANNELTON	IN		RSV	A	FA	37-48-13.000000	86-48-57.000000	193	152.98	72	OK	121
289	PEORIA	IL	WIXO	LIC	B	FS	40-43-25.000000	89-29-4.000000	208.11	317.01	113	OK	95.11
289	CANNELTON	IN	WTCJ-FM	LIC	A	FM	37-47-44.000000	86-50-58.000000	192.49	153.88	72	OK	120.49
289	CANNELTON	IN	WTCJ-FM	LIC	A	FS	37-47-44.000000	86-50-58.000000	192.49	153.88	72	OK	120.49
289	COLLINSVILLE	IL	KPNT	USE	C1	FA	38-23-25.000000	90-21-23.000000	244.52	244.1	133	OK	111.52
289	PEORIA	IL	WIXO	LIC	B	FM	40-43-25.000000	89-29-4.000000	208.11	317.01	113	OK	95.11
289	COLLINSVILLE	IL	KPNT	CP MOD	C1	FM	38-34-27.700000	90-19-31.500000	233.55	248.29	133	OK	100.55
290	WABASH	IN	WJOT-FM	LIC	A	FM	40-49-54.000000	85-48-36.000000	237.52	46.25	115	OK	122.52
290	NEW LONDON	MO	KZZK	LIC	C3	FM	39-43-48.000000	91-24-19.000000	310.88	277.75	142	OK	168.88
290	FAIRFIELD	IL	WOKZ	LIC	A	FM	38-22-46.000000	88-19-33.000000	116.54	202.04	115	OK	1.54
290	MAHOMET	IL	870910MT	USE	A	FA	40-13-54.000000	88-21-31.000000	107.89	334.78	115	****SHORT****	-7.11
290	MARSHALL	IL	WMMC	USE	A	FA	39-22-0.000000	87-46-8.000000	4.84	71.02	115	****SHORT****	-110.16
290	WABASH	IN	880725MM	USE	A	FA	40-47-52.000000	85-49-14.000000	234.3	46.77	115	OK	119.3
290	VALLEY STATION	KY	881130MA	USE	A	FA	38-6-40.000000	85-52-13.000000	218.61	129.08	115	OK	103.61
290	ELMWOOD PARK	IL	WCFS-FM	USE	B	FA	41-52-44.000000	87-38-10.000000	280.98	3.21	178	OK	102.98
290	MIDDLETOWN	OH	WNKN	USE	B	FA	39-30-57.000000	84-21-5.000000	299.35	86.53	178	OK	121.35
290	NEW LONDON	MO	KZZK	USE	C3	FA	39-41-44.000000	91-20-10.000000	304.56	277.18	142	OK	162.56
290	FAIRFIELD	IL	WOKZ	USE	A	FA	38-24-21.000000	88-23-54.000000	116.39	205.45	115	OK	1.39
290	ELMWOOD PARK	IL	WCFS-FM	LIC	B	FM	41-52-44.000000	87-38-8.000000	280.99	3.22	178	OK	102.99
290	MARSHALL	IL	WMMC	LIC	A	FM	39-21-9.000000	87-49-19.000000	0	0	115	****SHORT****	-115
290	MAHOMET	IL	WGKC	LIC	A	FM	40-13-27.000000	88-17-56.000000	105.05	337.11	115	****SHORT****	-9.95
290	ELMWOOD PARK	IL	WCFS-FM	LIC	B	FS	41-56-17.000000	87-45-4.000000	287.18	1.2	178	OK	109.18
290	MIDDLETOWN	OH	WNKN	LIC	B	FM	39-30-57.000000	84-21-5.000000	299.35	86.53	178	OK	121.35
290	VALLEY STATION	KY	WSYI	LIC	A	FM	38-10-24.700000	85-54-50.100000	211.26	128.28	115	OK	96.26
290	VALLEY STATION	KY	WSYI	CP	A	FS	38-10-25.000000	85-54-50.000000	211.26	128.28	115	OK	96.26
290	VALLEY STATION	KY	WSYI	LIC	A	FS	38-10-25.000000	85-54-50.000000	211.26	128.28	115	OK	96.26
291	LITCHFIELD	IL	WSMI-FM	LIC	B	FM	39-15-21.000000	89-36-48.000000	154.89	266.03	113	OK	41.89
291	NORTH VERNON	IN	WWWY	LIC	B	FM	39-4-2.000000	85-42-10.000000	185.76	99.82	113	OK	72.76
291	LITCHFIELD	IL	WSMI-FM	LIC	B	FS	39-10-21.000000	89-34-14.000000	152.24	262.46	113	OK	39.24
291	STREATOR	IL	900516MJ	USE	A	FA	41-7-30.000000	88-49-48.000000	214.7	336.45	72	OK	142.7
291	NEWBURGH	IN	WDKS	USE	A	FA	37-57-16.000000	87-25-7.000000	159.12	167.25	72	OK	87.12
291	LITCHFIELD	IL	WSMI-FM	USE	B	FA	39-15-21.000000	89-36-48.000000	154.89	266.03	113	OK	41.89
291	NORTH VERNON	IN	WWWY	USE	B	FA	39-4-2.000000	85-42-10.000000	185.76	99.82	113	OK	72.76
291	FOWLER	IN		USE	A	FA	40-38-5.000000	87-18-46.000000	148.86	16.98	72	OK	76.86
291	STREATOR	IL	WYYS	LIC	A	FM	41-16-30.000000	88-57-56.000000	234.56	335.52	72	OK	162.56
291	NEWBURGH	IN	WDKS	LIC	A	FM	37-52-57.000000	87-32-28.000000	165	171.48	72	OK	93
291	FOWLER	IN	WTGB	CP	A	FM	40-34-18.000000	87-27-14.000000	138.97	13.08	72	OK	66.97
292	GIBSON CITY	IL	WGCY	LIC	A	FM	40-33-57.000000	88-20-48.000000	141.98	341.59	31	OK	110.98
292	GIBSON CITY	IL	WGCY	USE	A	FA	40-34-1.000000	88-20-41.000000	142.05	341.67	31	OK	111.05
292	CRAWFORDSVILLE	IN	WCDQ	USE	A	FA	40-2-19.000000	86-54-22.000000	109.42	45.88	31	OK	78.42
292	CRAWFORDSVILLE	IN	WCDQ	LIC	A	FM	40-3-19.000000	86-55-57.000000	109.12	44.35	31	OK	78.12
293	WASHINGTON	IN	WWBL	LIC	B	FM	38-39-4.000000	87-9-55.000000	96.43	143.85	69	OK	27.43
293	WASHINGTON	IN	WWBL	USE	B	FA	38-39-4.000000	87-9-55.000000	96.43	143.85	69	OK	27.43
237	SULLIVAN	IN	WNDI-FM	USE	A	FA	39-5-36.000000	87-26-38.000000	43.52	131.39	10	OK	33.52
237	SULLIVAN	IN	WNDI-FM	LIC	A	FM	39-9-36.000000	87-32-32.000000	32.24	131.51	10	OK	22.24

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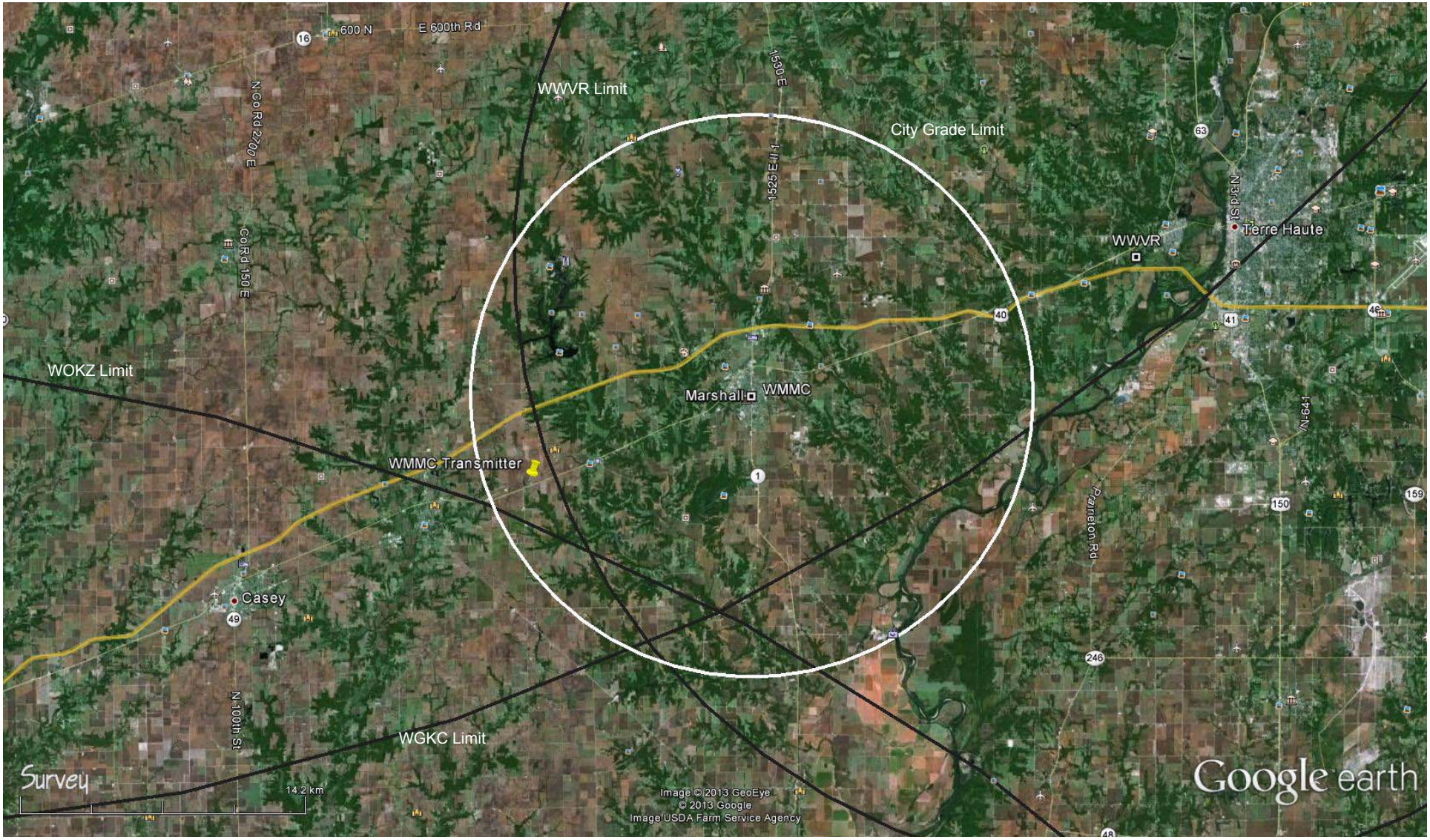

Figure 2

Allocation Map

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