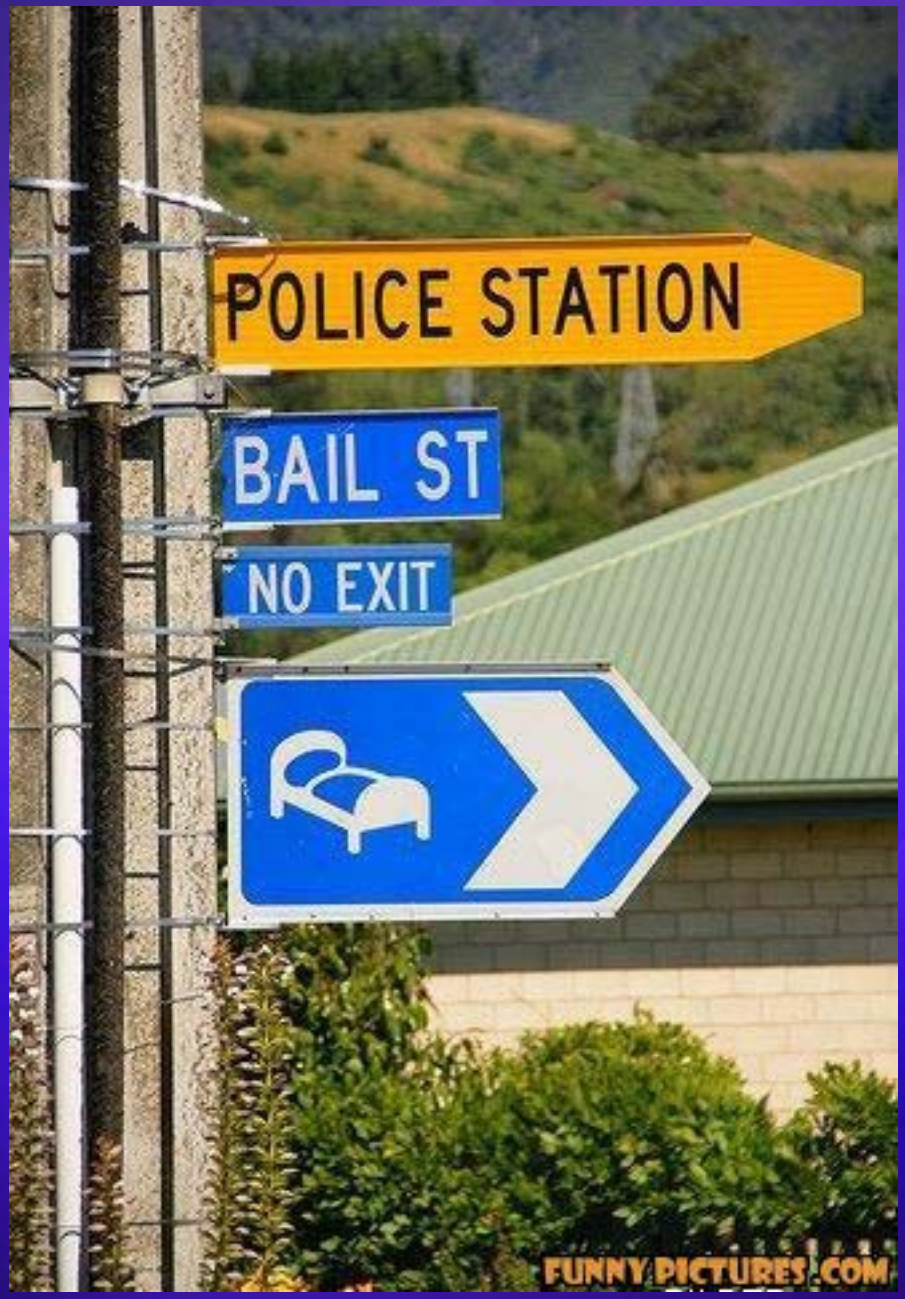
Engineering FM Translators for AM Stations

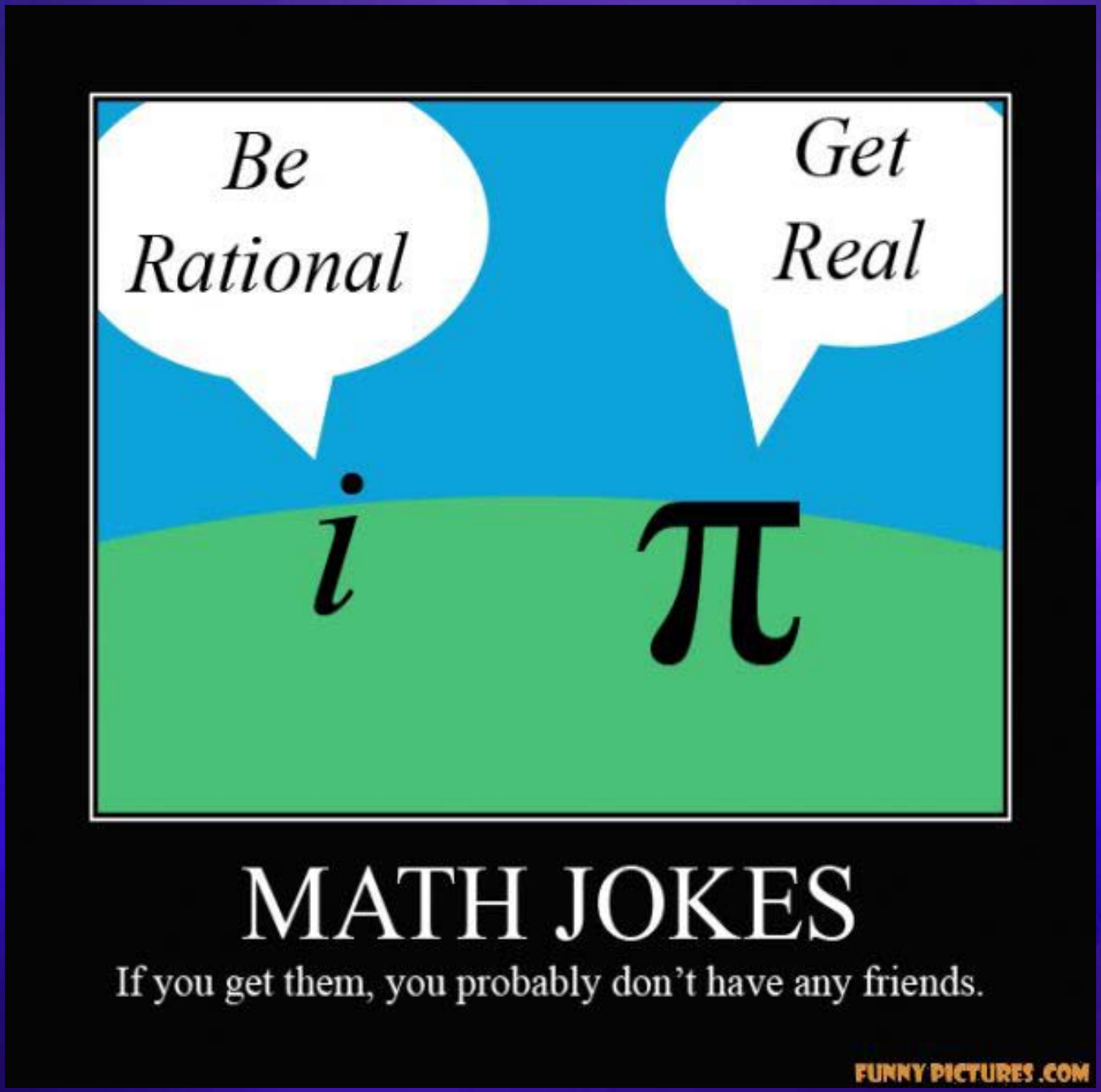
Jeremy D. Ruck, PE
D.L. Markley & Associates, Inc.
Peoria, Illinois
jdr@dlmarkley.com


SLOW
5MPH
CHILDREN
NO
HUNTING
www.freeuniverse4all.com


www.freeuniverse4all.com


POLICE STATION
BAIL ST
NO EXIT
FUNNY PICTURES .COM


HELP WANTED
WE MEAN, CUSTOMERS
PLEASE. BUY SOMETHING!!
FUNNYPICTURES.COM


Be Rational
Get Real
i
π
MATH JOKES
If you get them, you probably don't have any friends.
FUNNY PICTURES .COM

Engineering FM Translators for AM Stations

Jeremy D. Ruck, PE
D.L. Markley & Associates, Inc.
Peoria, Illinois
jdr@dlmarkley.com

History:

- 1970 – FM Translator Service Created.
- 1990 – Major Revision to the Rules.
- 1997 – U.S. – Canada FM Agreement Change.
- 2003 – ~13,000 Translator Applications Filed.
- 2009 – AM Translators Authorized.

Terms:

- Commercial Translator.
- Non-Commercial Translator.
- Primary Station.
- Translator Coverage Contour.
- Fill-In Translator.
- Secondary Service.

Translator Coverage Contour:

- Coverage contour varies with primary station.
- 54 dBu (0.5 mV/m) for Class B Commercial.
- 57 dBu (0.7 mV/m) for Class B1 Commercial.
- 60 dBu (1.0 mV/m) for all other FM classes.
- 60 dBu (1.0 mV/m) for AM primary stations.
- Within 2 mV/m Daytime Groundwave Contour.
- Within 25 mile radius of AM transmitter site.

Secondary Service:

- Translators are protected from each other.
- Spacing protection from LPFM.
- NO protection from FM and NCE FM.
- NO interference to FM stations regardless of that station's signal level.
- Subject to displacement.
- Secondary nature affords some flexibility in allocation.

AM Translators:

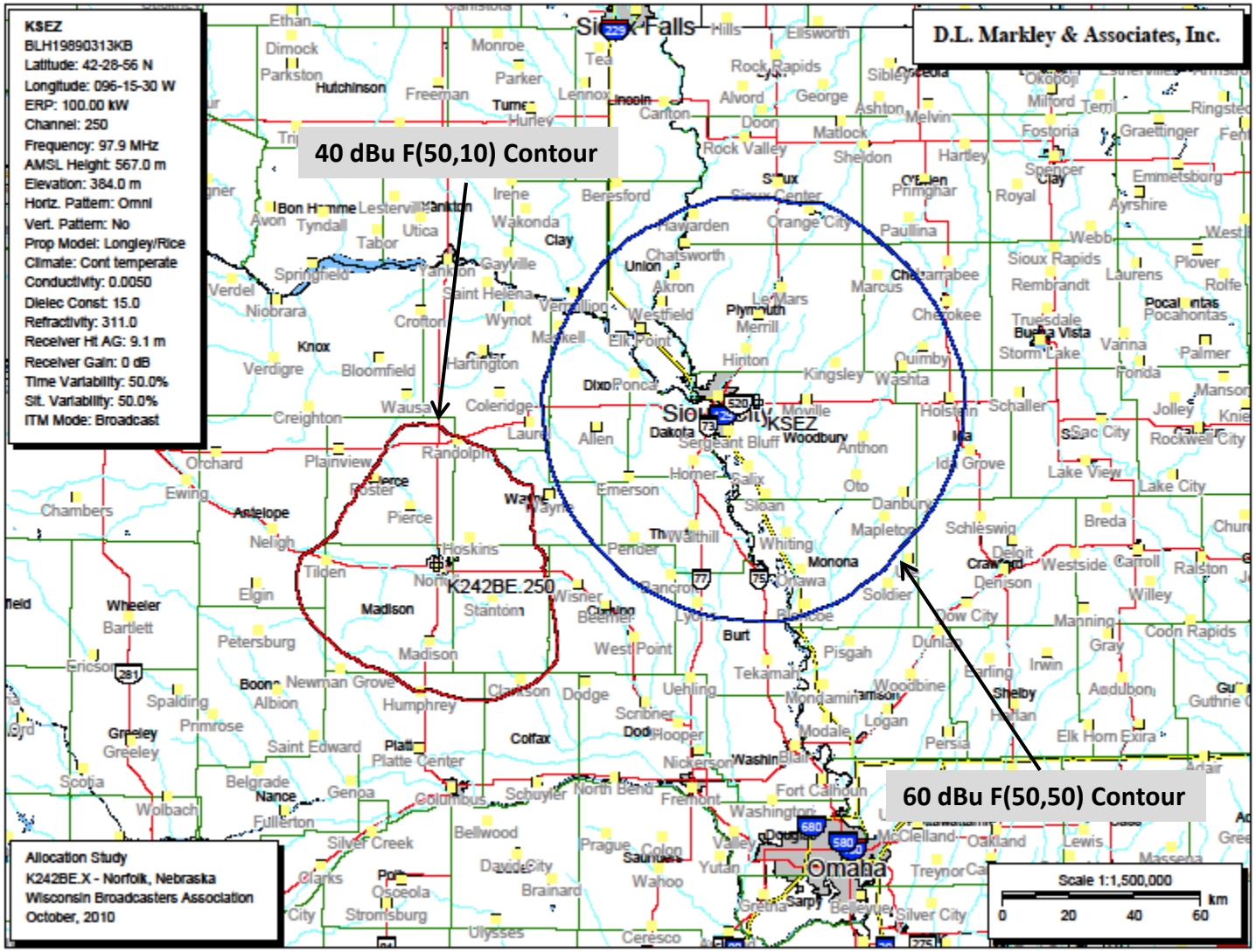
- All AM translators considered “Fill-In”.
- Maximum ERP is 250 Watts.
- No restriction on COR HAAT.
- Channel of Operation based on license type.
- May operate when Class D primary is off.
- Support and ownership rules apply.
- Translator authorized before May 1, 2009.

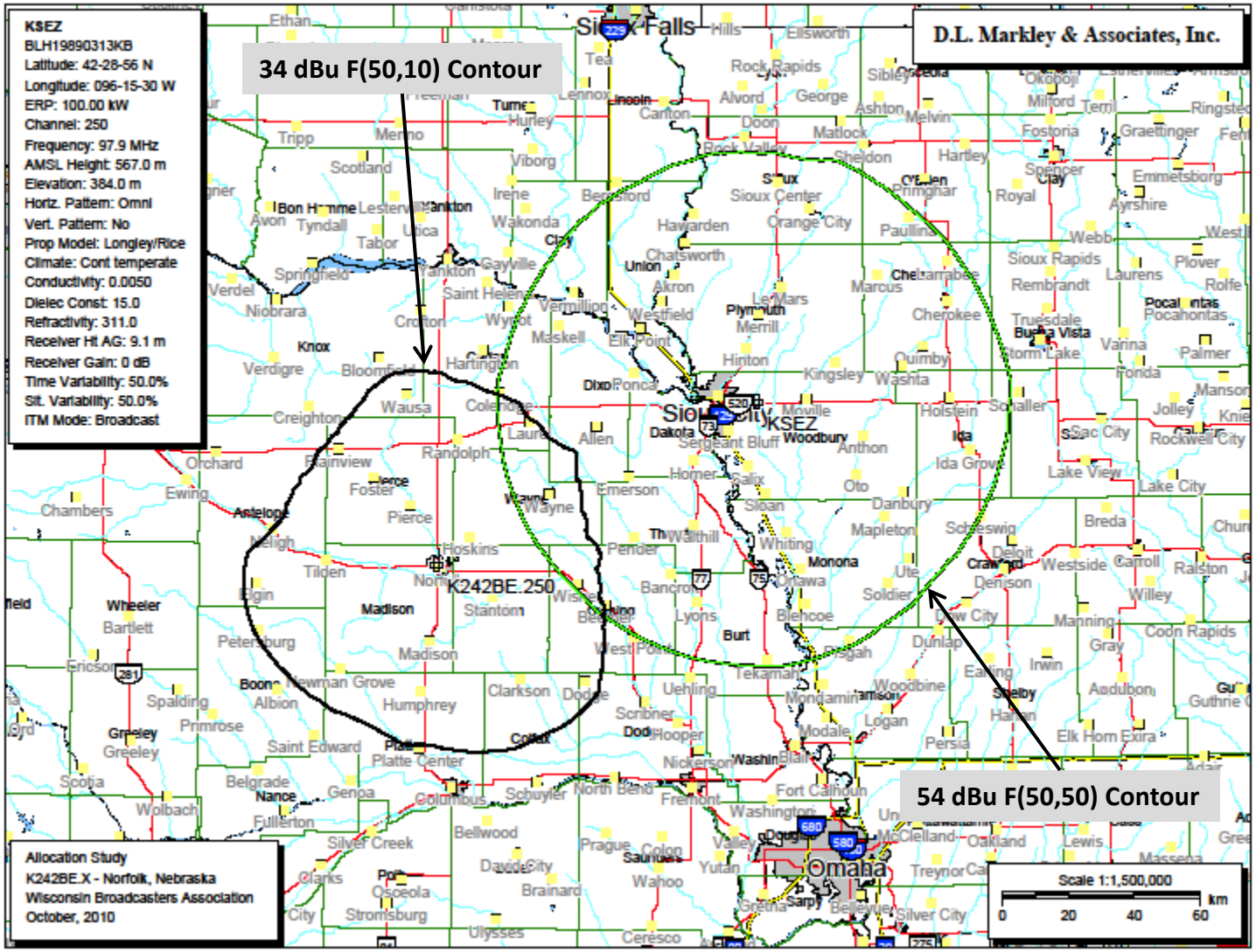
Allocation Considerations:

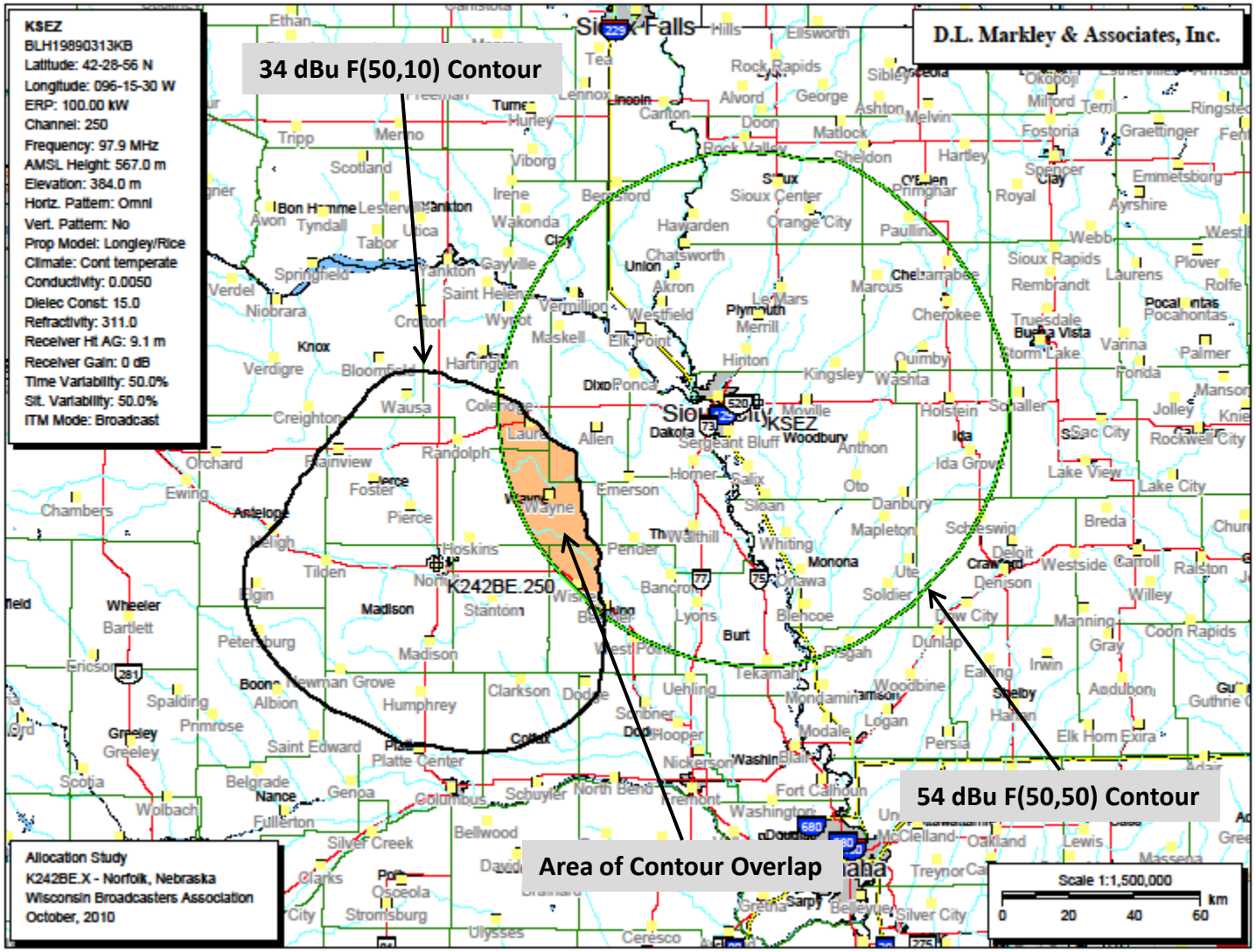
- Facilities separated by 10.7 MHz (+/- 53 and 54 channels) considered.
- Spacings as a class A facility must be maintained if the ERP is 100 Watts or greater.
- No wiggle room on this provision.

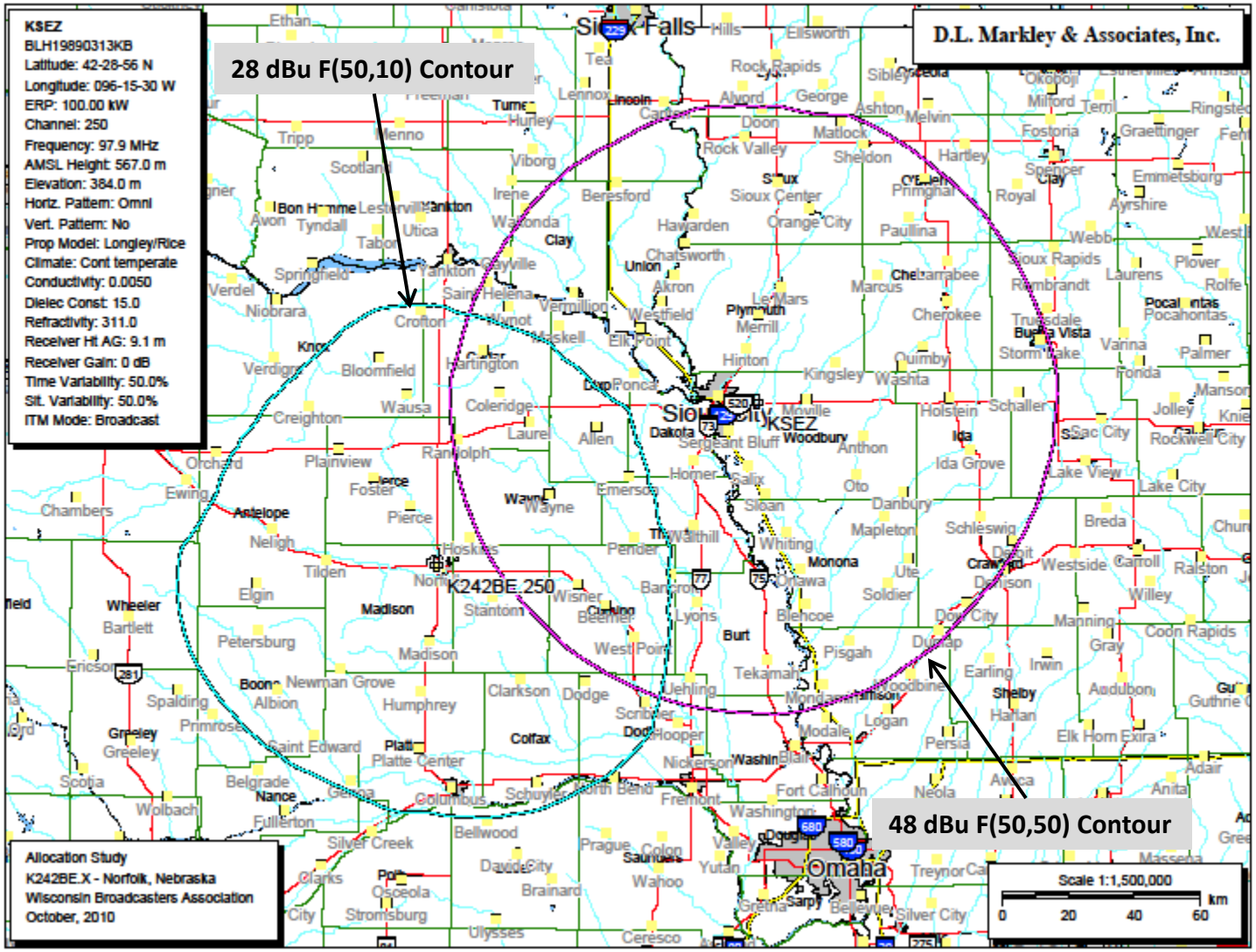
Allocation Considerations:

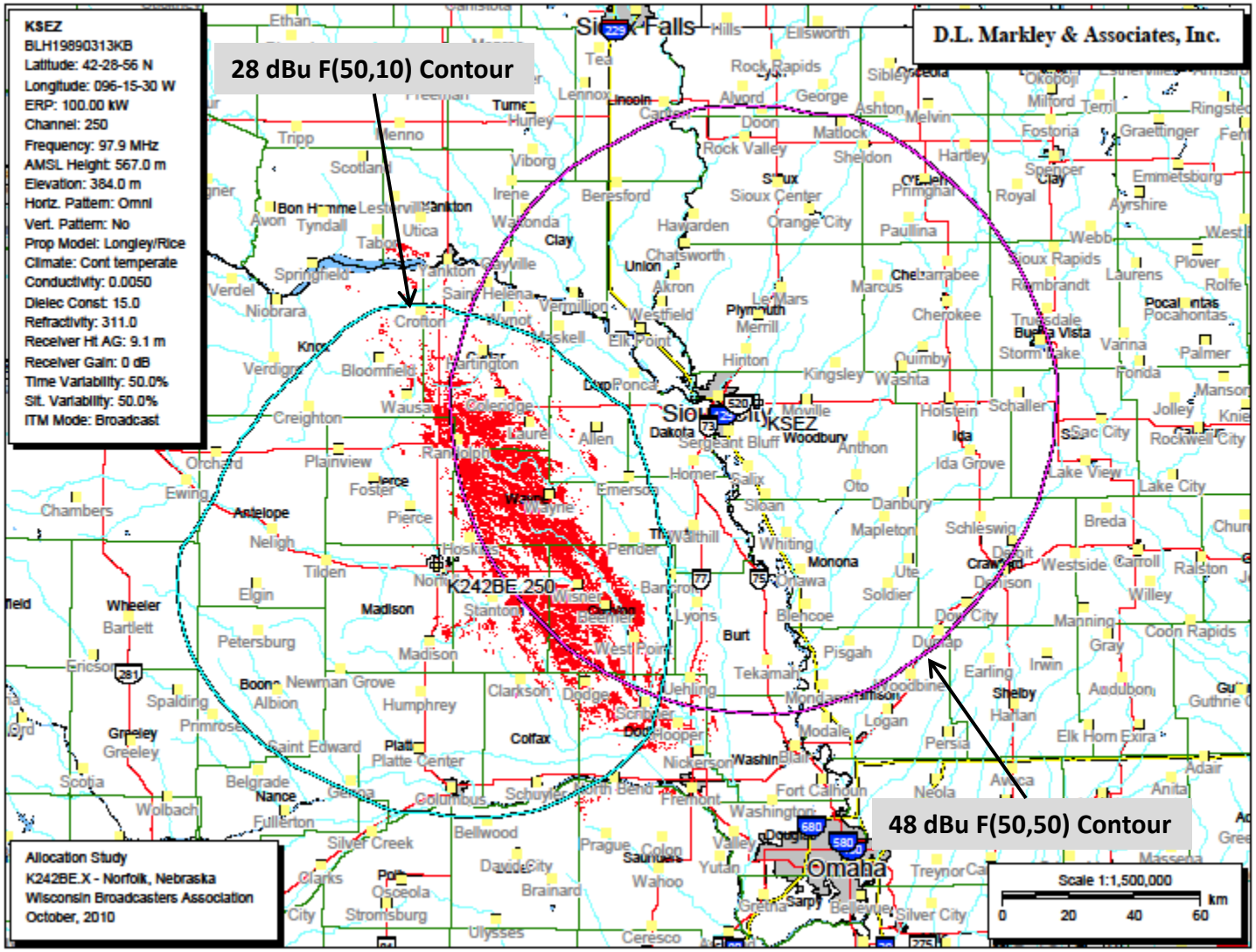
- Facilities within 600 kHz (+/- 3) considered.
- Contour methodology used.
- Standard protection ratios apply.
- U/D Ratio of -20 dB for co-channel.
- U/D Ratio of -6 dB for 1st adjacent.
- U/D Ratio of +40 dB for 2nd and 3rd adjacent.
- Lack of contour overlap is not an all-clear.
- The reverse is also true.

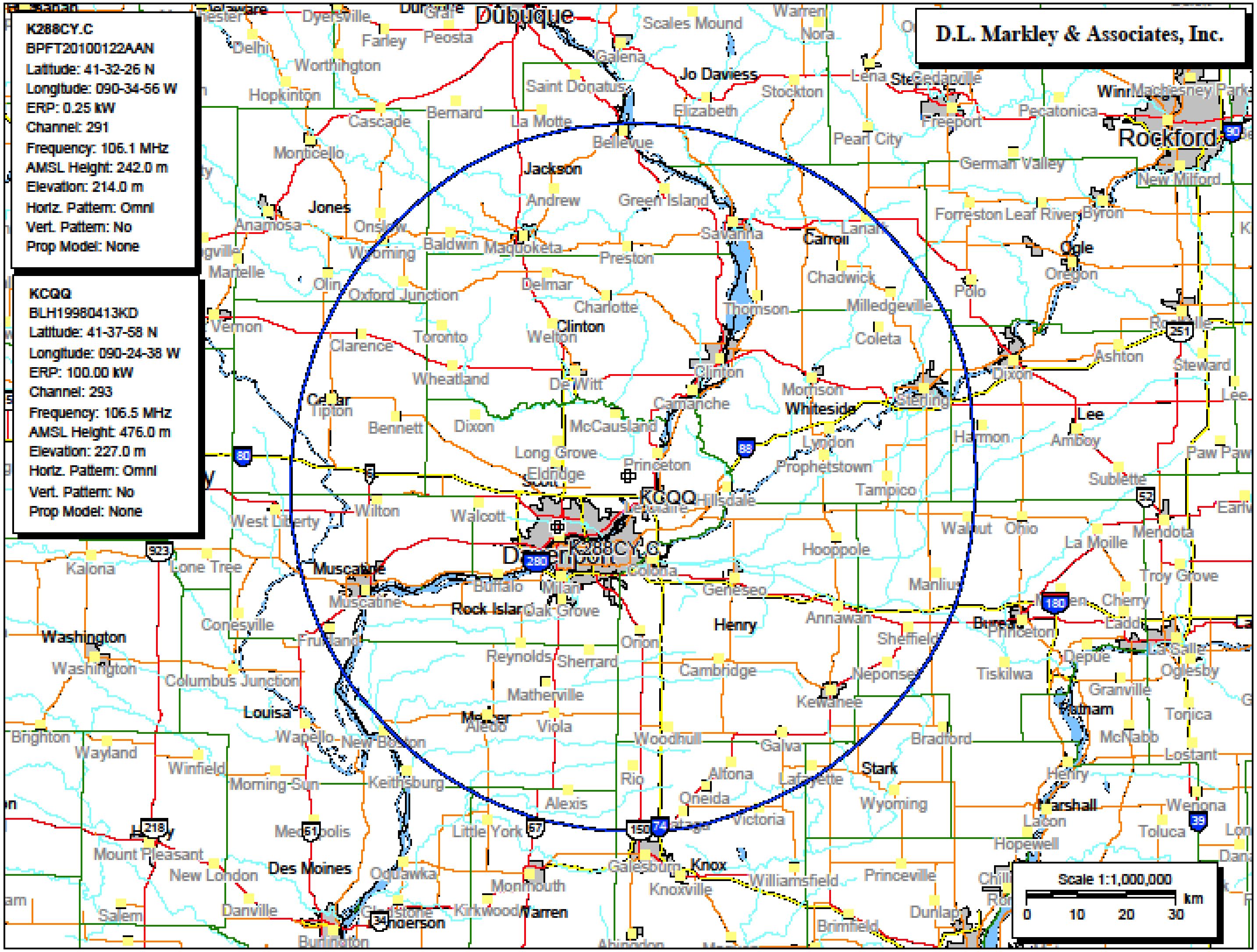

KSEZ
BLH19890313KB
Latitude: 42-28-56 N
Longitude: 096-15-30 W
ERP: 100.00 kW
Channel: 250
Frequency: 97.9 MHz
AMSL Height: 567.0 m
Elevation: 384.0 m
Horiz. Pattern: Omni
Vert. Pattern: No
Prop Model: Longley/Rice
Climate: Cont temperate
Conductivity: 0.0050
Dielec Const: 15.0
Refractivity: 311.0
Receiver Ht AG: 9.1 m
Receiver Gain: 0 dB
Time Variability: 50.0%
Sit. Variability: 50.0%
ITM Mode: Broadcast
D.L. Markley & Associates, Inc.
40 dBu F(50,10) Contour
60 dBu F(50,50) Contour
K242BE.250
KSEZ
Allocation Study
K242BE.X - Norfolk, Nebraska
Wisconsin Broadcasters Association
October, 2010
Scale 1:1,500,000
0 20 40 60 km


KSEZ
BLH19890313KB
Latitude: 42-28-56 N
Longitude: 096-15-30 W
ERP: 100.00 kW
Channel: 250
Frequency: 97.9 MHz
AMSL Height: 567.0 m
Elevation: 384.0 m
Horiz. Pattern: Omni
Vert. Pattern: No
Prop Model: Longley/Rice
Climate: Cont temperate
Conductivity: 0.0050
Dielec Const: 15.0
Refractivity: 311.0
Receiver Ht AG: 9.1 m
Receiver Gain: 0 dB
Time Variability: 50.0%
Sit. Variability: 50.0%
ITM Mode: Broadcast
34 dBu F(50,10) Contour
D.L. Markley & Associates, Inc.
KSEZ
K242BE 250
54 dBu F(50,50) Contour
Allocation Study
K242BE.X - Norfolk, Nebraska
Wisconsin Broadcasters Association
October, 2010
Scale 1:1,500,000
km
0
20
40
60

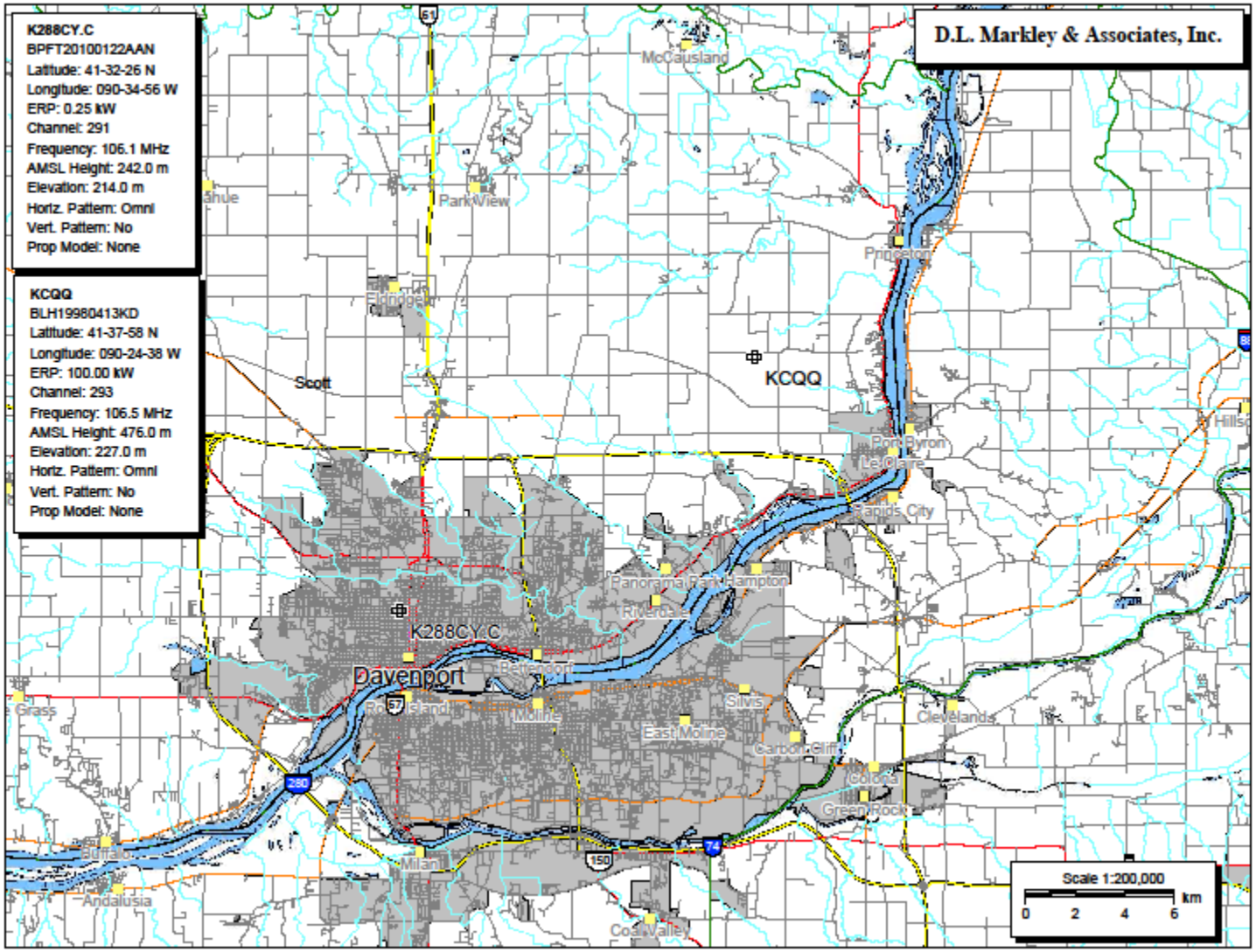

KSEZ
BLH19890313KB
Latitude: 42-28-56 N
Longitude: 096-15-30 W
ERP: 100.00 kW
Channel: 250
Frequency: 97.9 MHz
AMSL Height: 567.0 m
Elevation: 384.0 m
Horiz. Pattern: Omni
Vert. Pattern: No
Prop Model: Longley/Rice
Climate: Cont temperate
Conductivity: 0.0050
Dielec Const: 15.0
Refractivity: 311.0
Receiver Ht AG: 9.1 m
Receiver Gain: 0 dB
Time Variability: 50.0%
Sit. Variability: 50.0%
ITM Mode: Broadcast
34 dBu F(50,10) Contour
D.L. Markley & Associates, Inc.
KSEZ
K242BE 250
54 dBu F(50,50) Contour
Area of Contour Overlap
Allocation Study
K242BE.X - Norfolk, Nebraska
Wisconsin Broadcasters Association
October, 2010
Scale 1:1,500,000
km
0
20
40
60

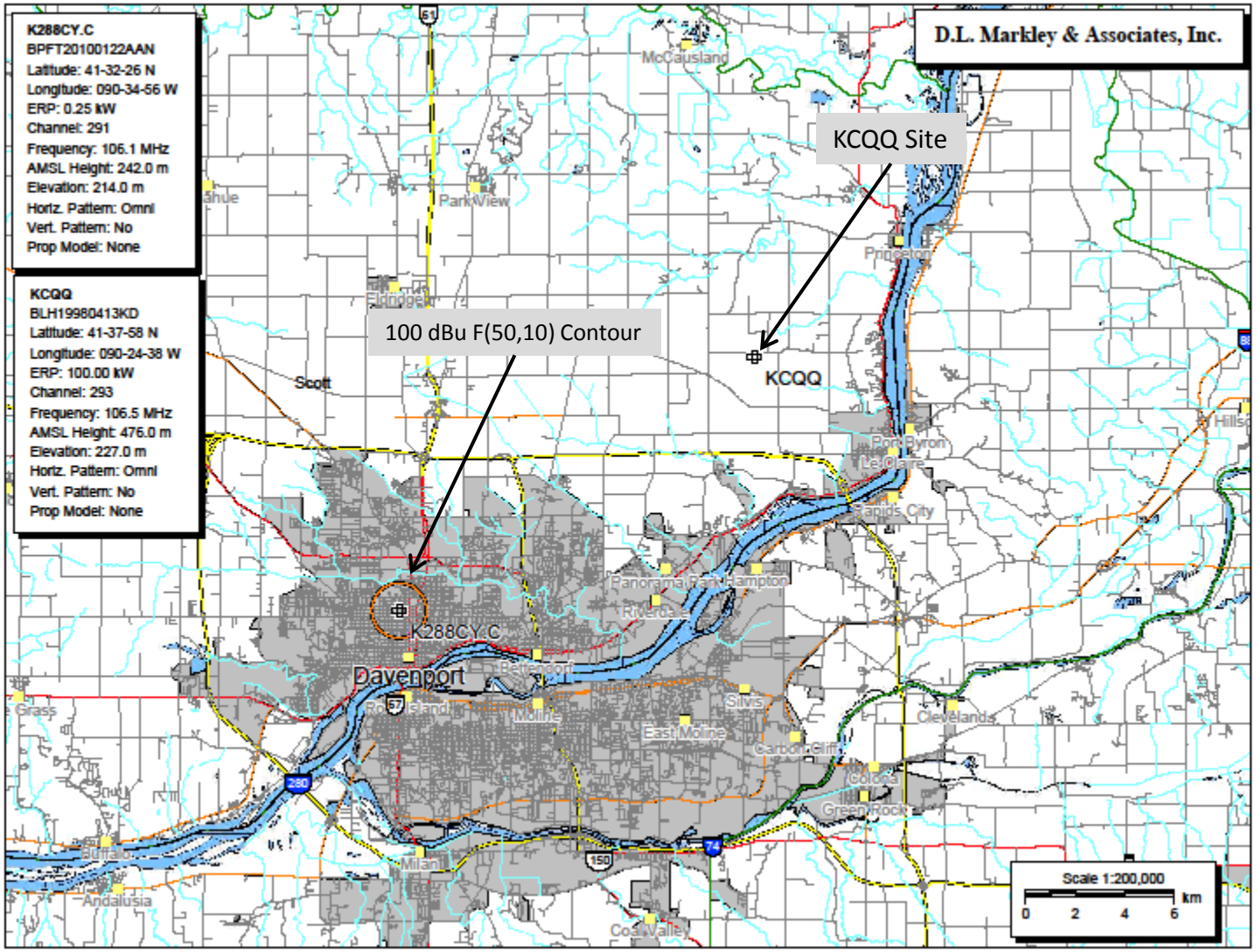

KSEZ
BLH19890313KB
Latitude: 42-28-56 N
Longitude: 096-15-30 W
ERP: 100.00 kW
Channel: 250
Frequency: 97.9 MHz
AMSL Height: 567.0 m
Elevation: 384.0 m
Horiz. Pattern: Omni
Vert. Pattern: No
Prop Model: Longley/Rice
Climate: Cont temperate
Conductivity: 0.0050
Dielec Const: 15.0
Refractivity: 311.0
Receiver Ht AG: 9.1 m
Receiver Gain: 0 dB
Time Variability: 50.0%
Sit. Variability: 50.0%
ITM Mode: Broadcast
28 dBu F(50,10) Contour
D.L. Markley & Associates, Inc.
KSEZ
K242BE 250
48 dBu F(50,50) Contour
Allocation Study
K242BE.X - Norfolk, Nebraska
Wisconsin Broadcasters Association
October, 2010
Scale 1:1,500,000
km
0
20
40
60

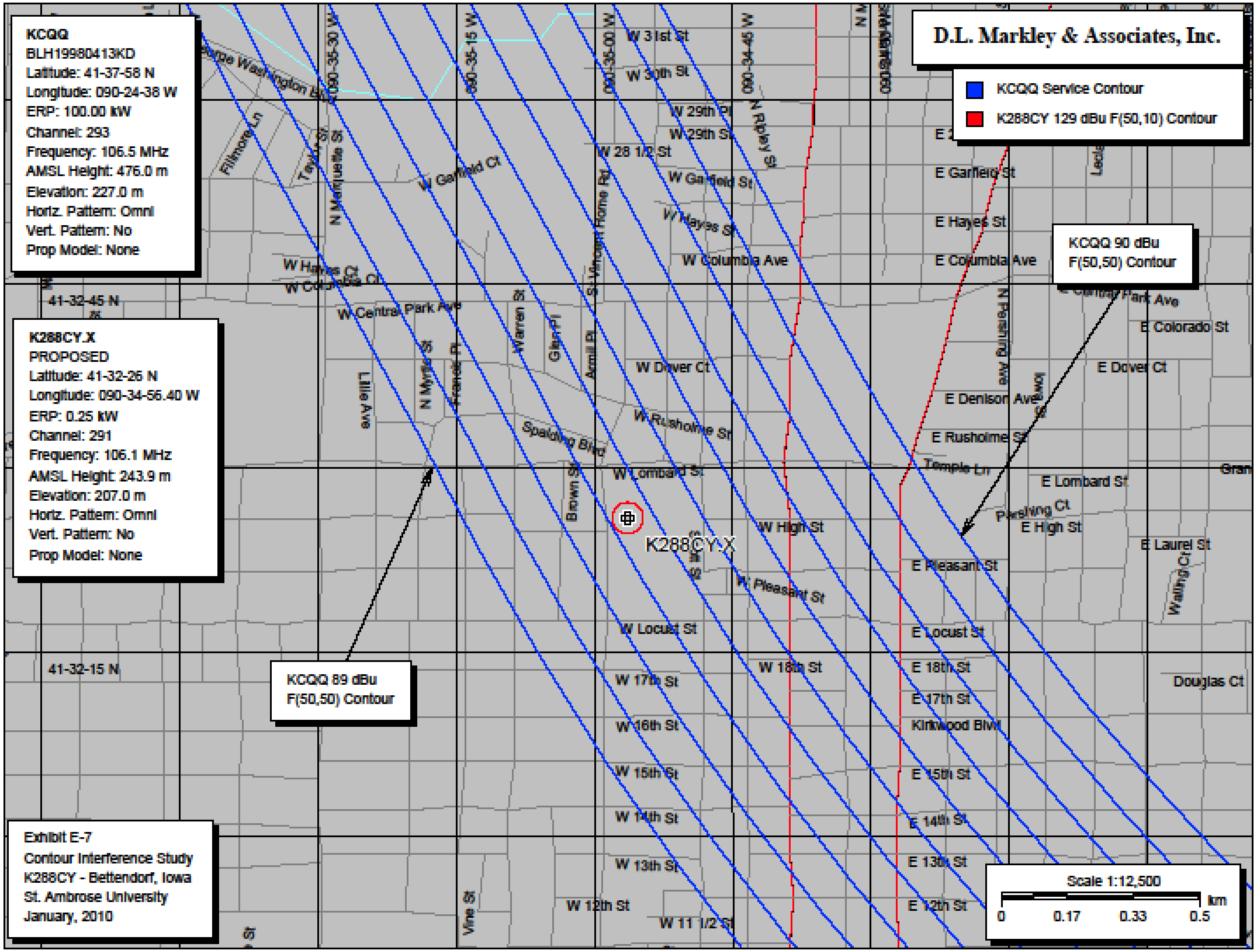

KSEZ
BLH19890313KB
Latitude: 42-28-56 N
Longitude: 096-15-30 W
ERP: 100.00 kW
Channel: 250
Frequency: 97.9 MHz
AMSL Height: 567.0 m
Elevation: 384.0 m
Horiz. Pattern: Omni
Vert. Pattern: No
Prop Model: Longley/Rice
Climate: Cont temperate
Conductivity: 0.0050
Dielec Const: 15.0
Refractivity: 311.0
Receiver Ht AG: 9.1 m
Receiver Gain: 0 dB
Time Variability: 50.0%
Sit. Variability: 50.0%
ITM Mode: Broadcast
28 dBu F(50,10) Contour
D.L. Markley & Associates, Inc.
KSEZ
K242BE 250
48 dBu F(50,50) Contour
Allocation Study
K242BE.X - Norfolk, Nebraska
Wisconsin Broadcasters Association
October, 2010
Scale 1:1,500,000
km
0
20
40
60



D.L. Markley & Associates, Inc.
K288CY.C
BPFT20100122AAN
Latitude: 41-32-26 N
Longitude: 090-34-56 W
ERP: 0.25 kW
Channel: 291
Frequency: 106.1 MHz
AMSL Height: 242.0 m
Elevation: 214.0 m
Horiz. Pattern: Omni
Vert. Pattern: No
Prop Model: None
KCQQ
BLH19980413KD
Latitude: 41-37-58 N
Longitude: 090-24-38 W
ERP: 100.00 kW
Channel: 293
Frequency: 106.5 MHz
AMSL Height: 476.0 m
Elevation: 227.0 m
Horiz. Pattern: Omni
Vert. Pattern: No
Prop Model: None
Scale 1:1,000,000
km
0 10 20 30
Dubuque
Rockford
Davenport
K288CY.C
KCQQ
Clinton
Maquoketa
Muscatine
Rock Island
Moline
Galesburg
Kewanee
Sterling
Dixon
Freeport
Washington
Burlington
Monmouth
Galena
Savanna
Geneseo
Princeton


K288CY.C
BPFT20100122AAN
Latitude: 41-32-26 N
Longitude: 090-34-56 W
ERP: 0.25 kW
Channel: 291
Frequency: 106.1 MHz
AMSL Height: 242.0 m
Elevation: 214.0 m
Horiz. Pattern: Omni
Vert. Pattern: No
Prop Model: None
KCQQ
BLH19980413KD
Latitude: 41-37-58 N
Longitude: 090-24-38 W
ERP: 100.00 kW
Channel: 293
Frequency: 106.5 MHz
AMSL Height: 476.0 m
Elevation: 227.0 m
Horiz. Pattern: Omni
Vert. Pattern: No
Prop Model: None
D.L. Markley & Associates, Inc.
McCausland
Park View
Princeton
Eldridge
Scott
KCQQ
Port Byron
LeClaire
Rapids City
Panorama Park
Hampton
Riverdale
K288CY.C
Davenport
Bettendorf
Rock Island
Moline
Silvis
East Moline
Carbon Cliff
Clevelands
Colona
Green Rock
Buffalo
Milan
Andalusia
Coal Valley
Scale 1:200,000
km
0
2
4
6


K288CY.C
BPFT20100122AAN
Latitude: 41-32-26 N
Longitude: 090-34-56 W
ERP: 0.25 kW
Channel: 291
Frequency: 106.1 MHz
AMSL Height: 242.0 m
Elevation: 214.0 m
Horiz. Pattern: Omni
Vert. Pattern: No
Prop Model: None
KCQQ
BLH19980413KD
Latitude: 41-37-58 N
Longitude: 090-24-38 W
ERP: 100.00 kW
Channel: 293
Frequency: 106.5 MHz
AMSL Height: 476.0 m
Elevation: 227.0 m
Horiz. Pattern: Omni
Vert. Pattern: No
Prop Model: None
D.L. Markley & Associates, Inc.
KCQQ Site
100 dBu F(50,10) Contour
KCQQ
K288CY.C
Davenport
Bettendorf
Moline
East Moline
Silvis
Riverdale
Panorama Park
Hampton
Port Byron
LeClaire
Rapids City
Cleveland
Carbon Cliff
Colona
Green Rock
Milan
Buffalo
Andalusia
Scott
McCausland
Park View
Princeton
Eldridge
Scale 1:200,000
km
0
2
4
6


D.L. Markley & Associates, Inc.
KCQQ Service Contour
K288CY 129 dBu F(50,10) Contour
KCQQ
BLH19980413KD
Latitude: 41-37-58 N
Longitude: 090-24-38 W
ERP: 100.00 kW
Channel: 293
Frequency: 106.5 MHz
AMSL Height: 476.0 m
Elevation: 227.0 m
Horiz. Pattern: Omni
Vert. Pattern: No
Prop Model: None
K288CY.X
PROPOSED
Latitude: 41-32-26 N
Longitude: 090-34-56.40 W
ERP: 0.25 kW
Channel: 291
Frequency: 106.1 MHz
AMSL Height: 243.9 m
Elevation: 207.0 m
Horiz. Pattern: Omni
Vert. Pattern: No
Prop Model: None
KCQQ 90 dBu
F(50,50) Contour
KCQQ 89 dBu
F(50,50) Contour
K288CY.X
41-32-45 N
41-32-15 N
090-35-30 W
090-35-15 W
090-35-00 W
090-34-45 W
Exhibit E-7
Contour Interference Study
K288CY - Bettendorf, Iowa
St. Ambrose University
January, 2010
Scale 1:12,500
0
0.17
0.33
0.5
km

Allocation Considerations:

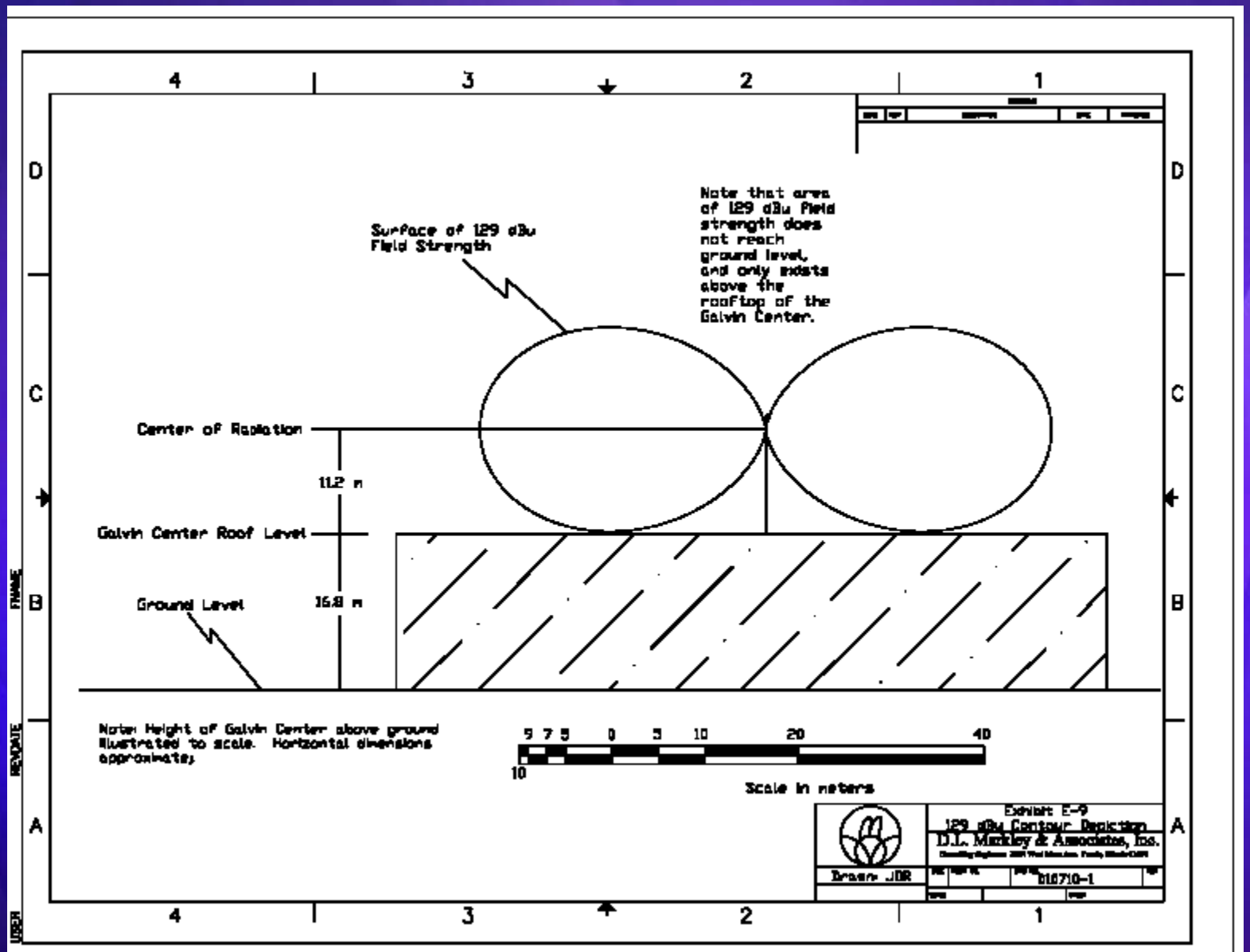
$$S = \frac{E^2}{Z_0}$$

$$S = \frac{P}{4\pi R^2}$$

$$R^2 = \frac{P}{4\pi S}$$

Allocation Considerations:

- Determined value of “R” becomes the radius at which field strength is met.
- Horizontal and vertical plane patterns are then utilized to create a “surface” where interference would exist.
- No population in surface means no interference.


Surface of 129 dBu Field Strength
Note that area of 129 dBu field strength does not reach ground level, and only exists above the rooftop of the Galvin Center.
Center of Radiation
11.2 m
Galvin Center Roof Level
16.8 m
Ground Level
Note: Height of Galvin Center above ground illustrated to scale. Horizontal dimensions approximate.
10 5 2.5 0 5 10 20 40
Scale in meters
Exhibit E-9
129 dBu Contour Depiction
D.L. Markley & Associates, Inc.
Drawn: JDR
016710-1

Your AM Translator:

- Authorization must pre-dates May 1, 2009.
- Translator coverage contour overlap between licensed and proposed is minor change.
- Channel changes of up to +/- 3 and +/- 53 or 54 are considered minor changes.
- If necessary, relocate or make changes.
- Within 2 mV/m Daytime/25 mile radius.
- International Considerations.

International Considerations:

- US-Canada FM agreement modified in 1997.
- Affects translators within 320 km of border.
- Maximum ERP of 250 Watts permitted.
- Previous limit of 50 Watts in border zone.
- 34 dBu contour distance 60 kilometers or less.
- Concurrence unnecessary for 34 dBu contours that do not cross border.

International Considerations:

- 34 dBu at 107 meters requires 220 Watts.
- 34 dBu at 32 meters requires 986 Watts.
- Maximum HAAT for 250 Watt ERP and 60 kilometer 34 dBu contour is 99 meters.
- 250 Watts at 99 meters HAAT yields a 60 dBu contour radius of 13 kilometers (8.1 miles).
- This meets requirements for many Class C AM.

Additional Considerations:

- Application processing time is running about 90 days now.
- This change is a result of “Ford Explorer” abuses to the service.
- Multiple hops, if necessary, will require additional time to complete as a result.
- The landscape is unsure due to LPFM interests.

Additional Considerations:

- AM translators are considered “fill-in”.
- Any terrestrial signal delivery method may be used.
- Aural intercity relay frequencies may be used on a secondary basis as well.
- Changes in primary station made via letter to FCC.
- Recommend Including contour illustration.

By the Numbers:

- Spectrum demand is increasing.
- 1,847 Boosters and Translators on 9/30/1990.
- 2,881 Translators on 12/31/1997.
- 3,818 Translators in March of 2003.
- 3,897 Translators in March of 2005.
- ~13,000 Applications filed in 2003.
- ~7,000 Application remain.

The Bottom Line:

- AM Translators are a welcome addition.
- Existing translators have increased in value.
- Re-purposing a translator for AM may take some time. Be patient if in process.
- AM stations with translators have more value.
- How many currently use a translator for AM?
- How many have plans to do so?

Thank You!

Jeremy D. Ruck, PE
D.L. Markley & Associates, Inc.
Peoria, Illinois
jdr@dlmarkley.com

Thank You!

Questions?

Jeremy D. Ruck, PE
D.L. Markley & Associates, Inc.
Peoria, Illinois
jdr@dlmarkley.com