

ENGINEERING EXHIBITS FOR APPLICATION FOR CONSTRUCTION PERMIT  
FOR NONCOMMERCIAL EDUCATIONAL BROADCAST STATION WUSO

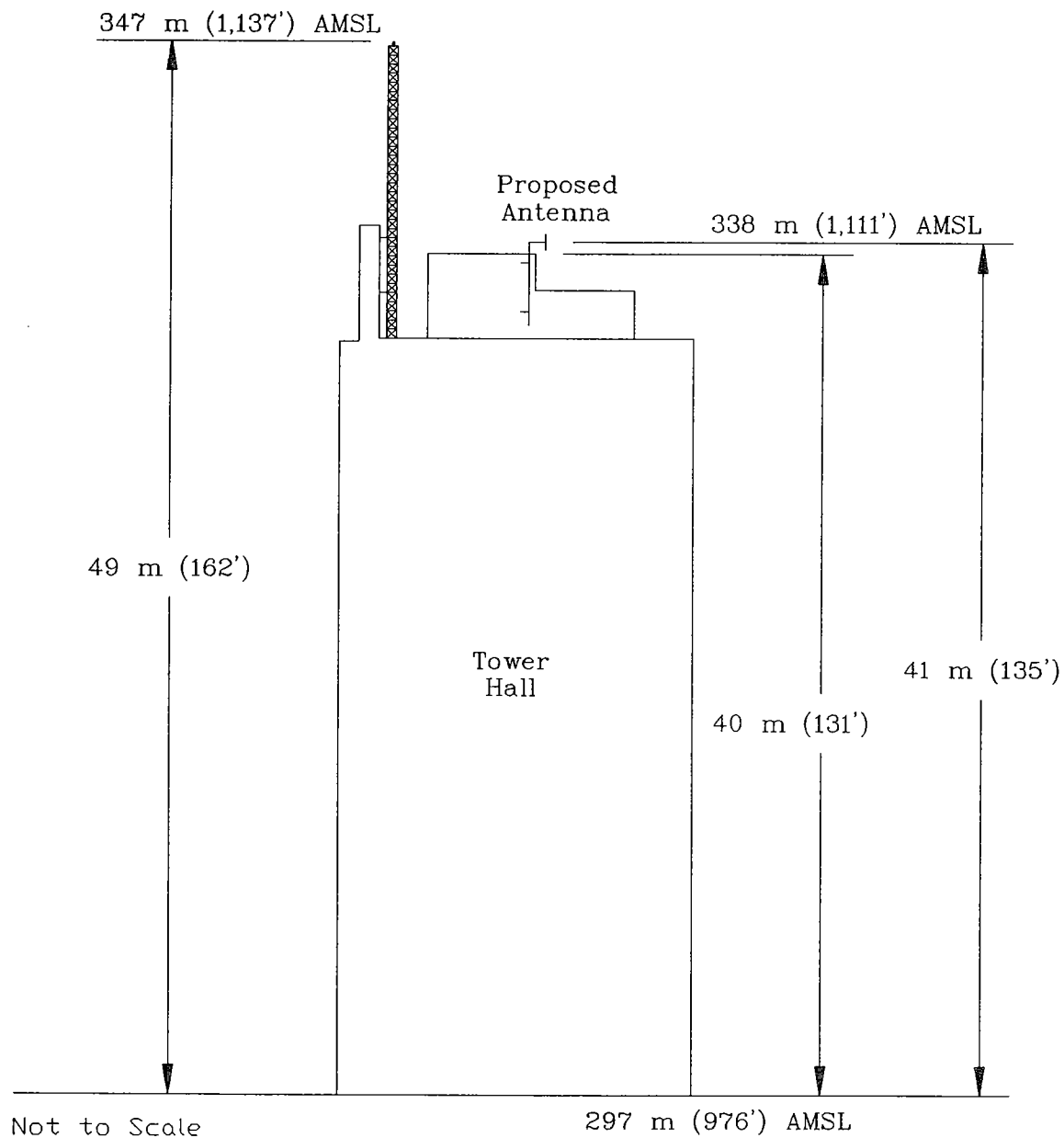
THE BOARD OF DIRECTORS OF WITTENBERG UNIVERSITY  
SPRINGFIELD, OHIO

MAY 1998

LIST OF EXHIBITS

- Exhibit 001 - Supporting Structure Sketch
- Exhibit 002 - Interference Analysis
- Exhibit 003 - Proposed WUSO Location (USGS Map)
- Exhibit 004 - Predicted 60 dBu Contours and Terrain Profiles
- Exhibit 005 - Present and Proposed 60 dBu Contours
- Exhibit 006 - Canada-U.S. Working Agreement Compliance
- Exhibit 007 - Allocation Study
- Exhibit 008 - I.F. Separation Study
- Exhibit 009 - TV Channel 6 Study
- Exhibit 010 - Radiofrequency Radiation (RFR) Analysis
- Exhibit 011 - Certification

Engineering Exhibit 001  
PROPOSED WUSO  
VERTICAL PLAN SKETCH OF ANTENNA SYSTEM  
Wittenberg University  
Springfield, Ohio  
Channel 206 0.100 kW ERP 26 m AAT



Louis A. Williams, Jr. and Associates  
May 1998

## ENGINEERING EXHIBIT 002 - INTERFERENCE ANALYSIS

The nearest AM broadcast station is on 1,340 kHz in Springfield at a distance of 2.16 km. The nearest FM station is on channel 275 (102.9 MHz) at a distance of 5.25 km. The nearest TV station is UHF channel 26 at a distance of 5.10 km. Several two-way radio stations are located within 10 km of the proposed WUSO site.

Because of the low power of the proposed WUSO and the insignificant change in antenna height for the proposed one-bay antenna as compared with the existing two-bay antenna, no impact is anticipated on any broadcast station within 10 km of the proposed WUSO.

The proposed WUSO 115 dBu blanketing contour is calculated in accordance with 47 C.F.R. 73.318 and is 0.12 km. There are no known commercial or government receiving stations or cable head-end facilities within the proposed blanketing contour. The area within the blanketing contour is primarily urban.

A case-by-case resolution is proposed for any complaints which are received. Station personnel will investigate such complaints and provide assistance in eliminating fundamental frequency overload problems. Traps, down lead replacement, and similar remedies are expected to be sufficient. Difficult cases will be referred to a qualified technical consultant.

The applicant intends for no one to be denied normal reception of broadcast, business, or other communications due to the operation of the proposed facilities. The applicant accepts full responsibility for the elimination of any objectionable interference, including that caused by receiver-induced or other types of modulation, to facilities in existence or authorized or to radio receivers in use prior to grant of this application.

## ENGINEERING EXHIBIT 003 - PROPOSED LOCATION

No change in site is proposed. The NAD27 coordinates to the nearest second for the site are 39° 56' 09" North Latitude, 83° 48' 41" West Longitude. These coordinates are plotted on the 7.5 minute quadrangle map which is located at the end of these exhibits.

These coordinates are based on a recent survey and differ by two seconds in longitude from the coordinates of record for WUSO. The current survey was performed by Mr. Terry Hoppes, P.S., Hoppes Engineering, 1533 Moorefield Road, Springfield, Ohio on March 18, 1998 and is believed to be more accurate than the previous coordinates of record. The old coordinates are listed in Item 9 of Section V-B.

ENGINEERING EXHIBIT 004 - PREDICTED 60 dBu CONTOURS  
AND TERRAIN PROFILES

Figure 1 of this exhibit is a computer-generated map using the Ohio State Plane, South projection converted to metric units. In Figure 1 the proposed WUSO 60 dBu contour is developed using the NGDC 30 second data base to generate the height above average terrain every one degree in azimuth and the FCC computer code CURVES to calculate the contour distance.

The legal boundaries for Springfield, Ohio are taken from the Bureau of the Census TIGER/Line Census Files, 1990 for Ohio.

Only the eight cardinal radials are shown in Figure 1 for the profiles. These cardinal radial profiles are given as Figures 2 through 9 below. As noted, radials have been calculated every one degree for the purposes of contour calculations.

40

N0°E

○

N315°E

N45°E

Proposed  
F(50,50)  
60 dBu

SPRINGFIELD  
CITY

Proposed WUSO

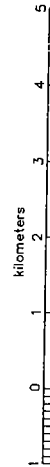
N270°E

N90°E

N225°E

N135°E

N180°E



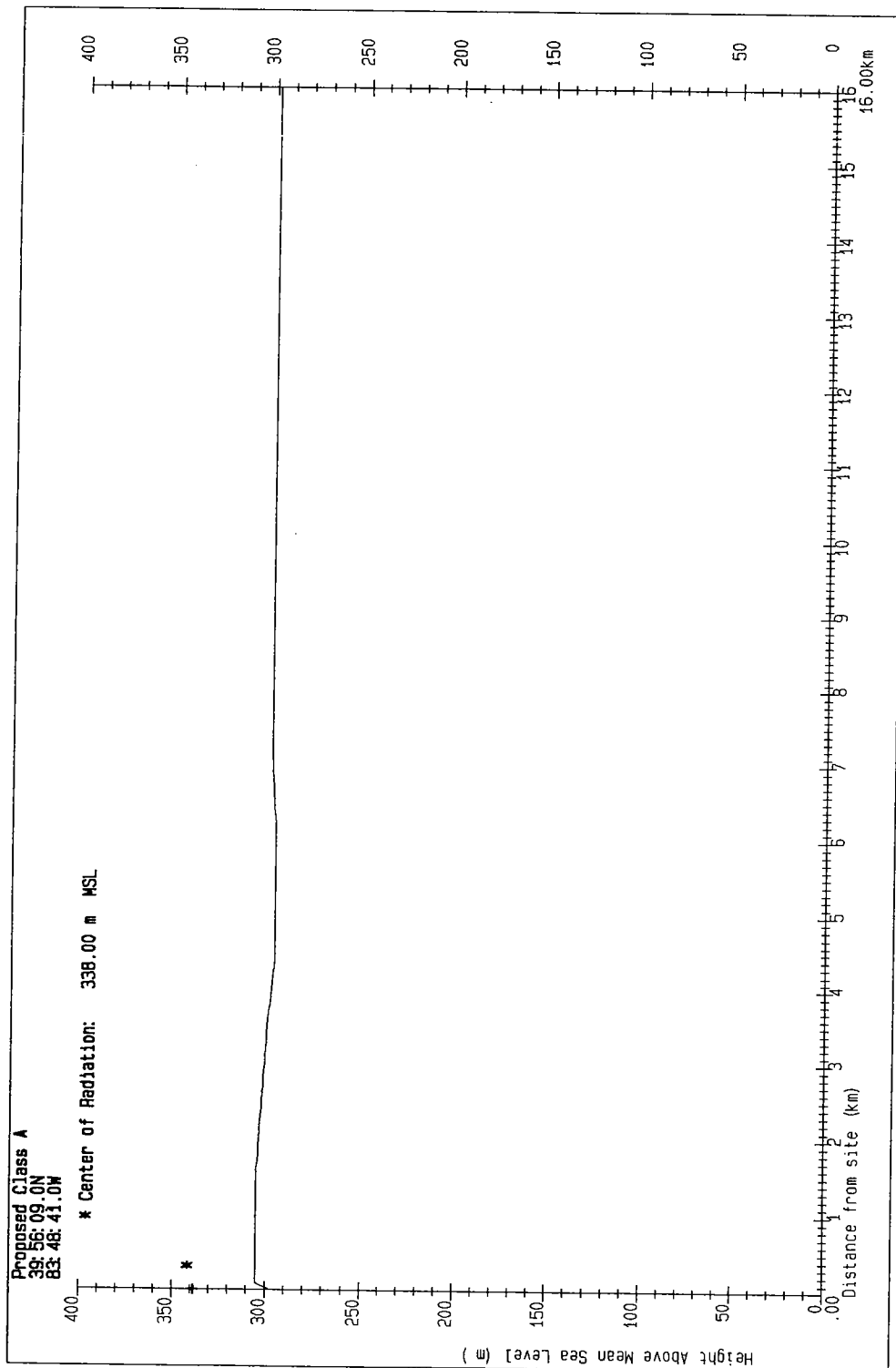
ENGINEERING EXHIBIT 004

FIGURE 1

PREDICTED WUSO  
60 dBu CONTOURS  
and TERRAIN PROFILES

Louis A. Williams, Jr. and Associates  
May 1998

EXHIBIT 004  
FIGURE 2

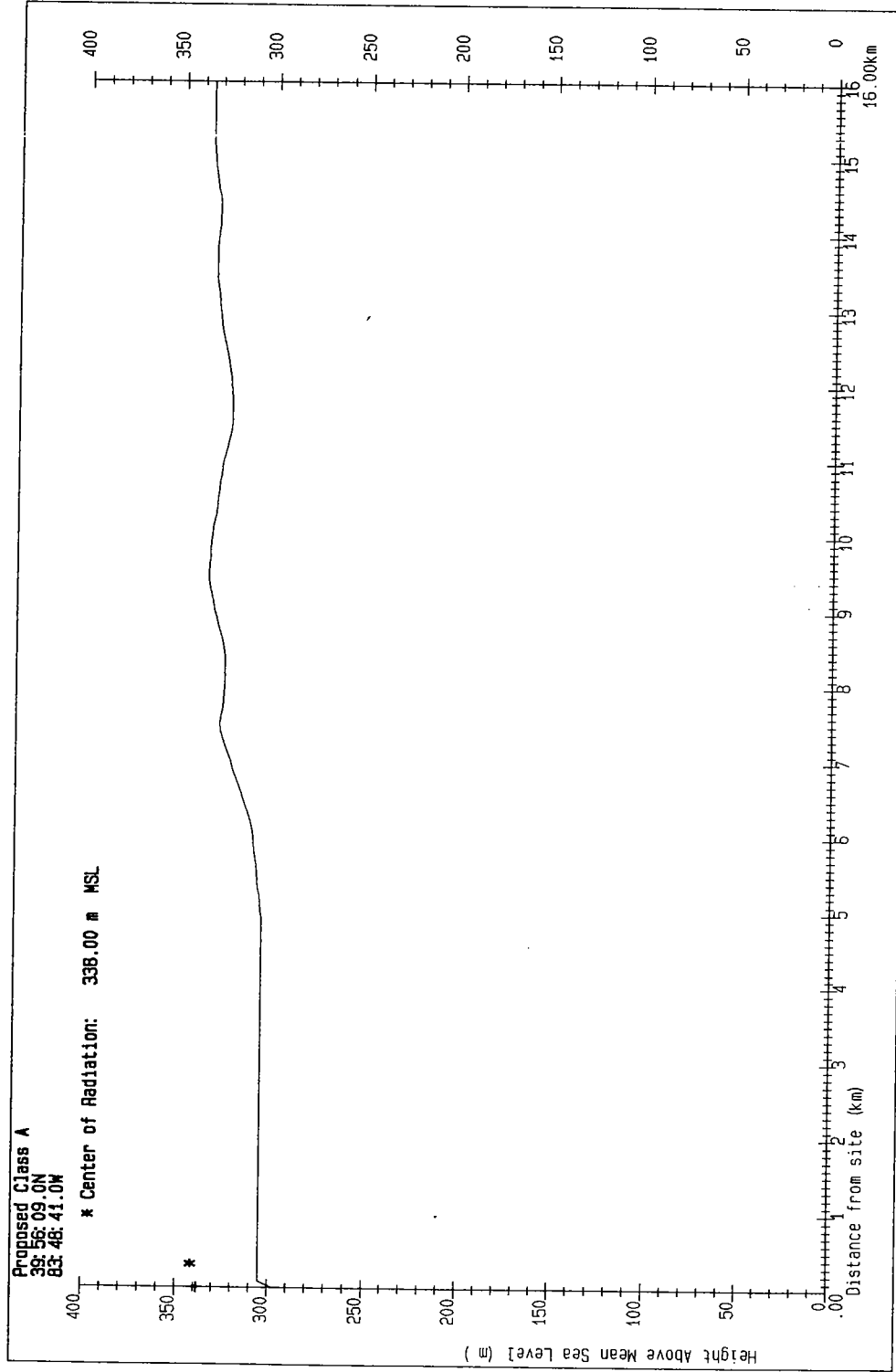


Elevation values from:  
30-second elevation data

Louis A. Williams, Jr.  
and Associates  
Cincinnati, Ohio  
May 1998

TERRAIN PROFILE GRAPH  
Azimuth 45.0

EXHIBIT 004  
FIGURE 3



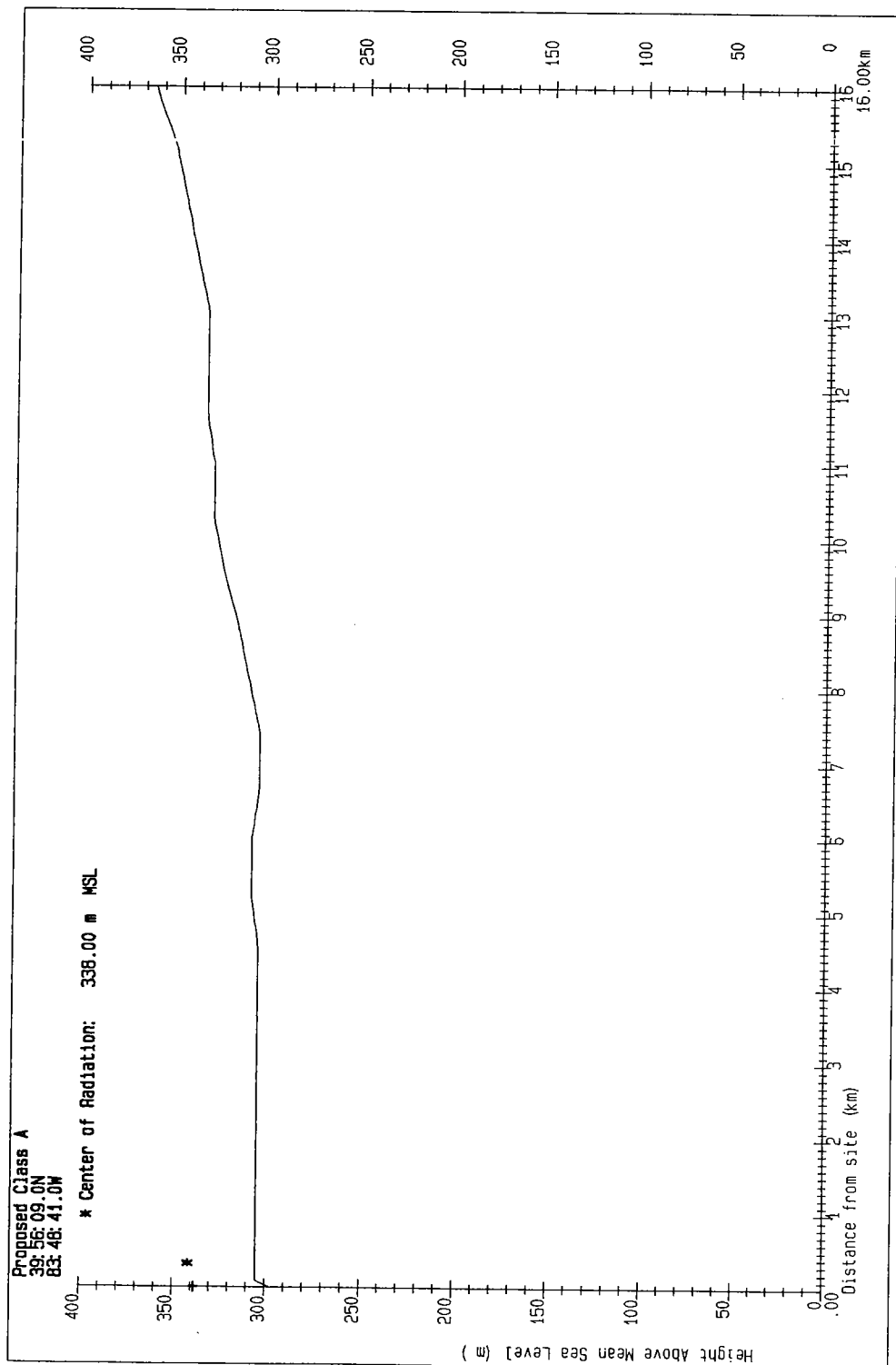
Elevation values from:  
30-second elevation data

Louis A. Williams, Jr.  
and Associates  
Cincinnati, Ohio  
May 1998



TERRAIN PROFILE GRAPH  
AZIMUTH 90.0

EXHIBIT 004  
FIGURE 4

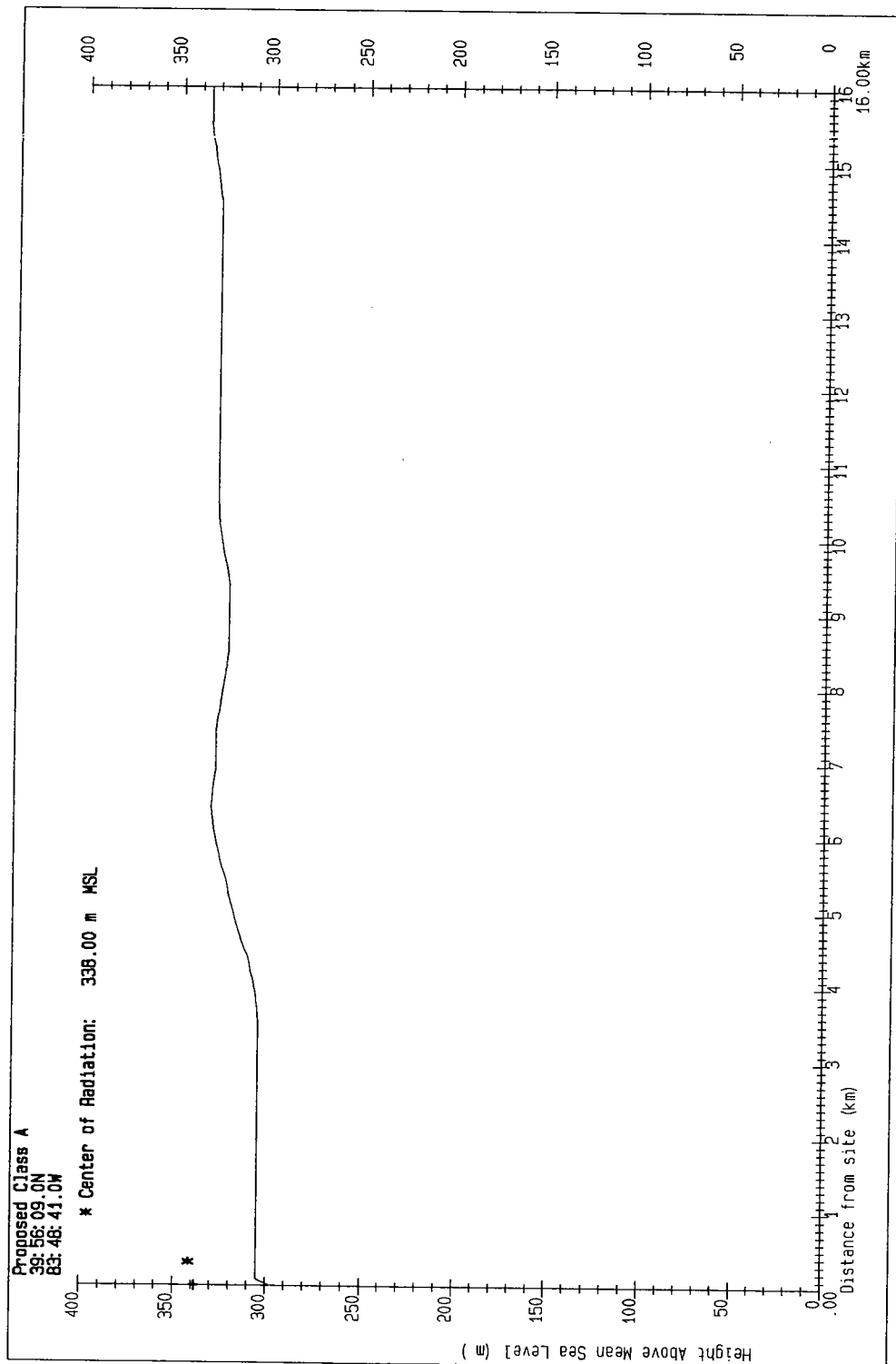


Elevation values from:  
30-second elevation data

Louis A. Williams, Jr.  
and Associates  
Cincinnati, Ohio  
May 1998

**EXHIBIT 004  
FIGURE 5**

**TERRAIN PROFILE GRAPH**  
Azimuth 135.0

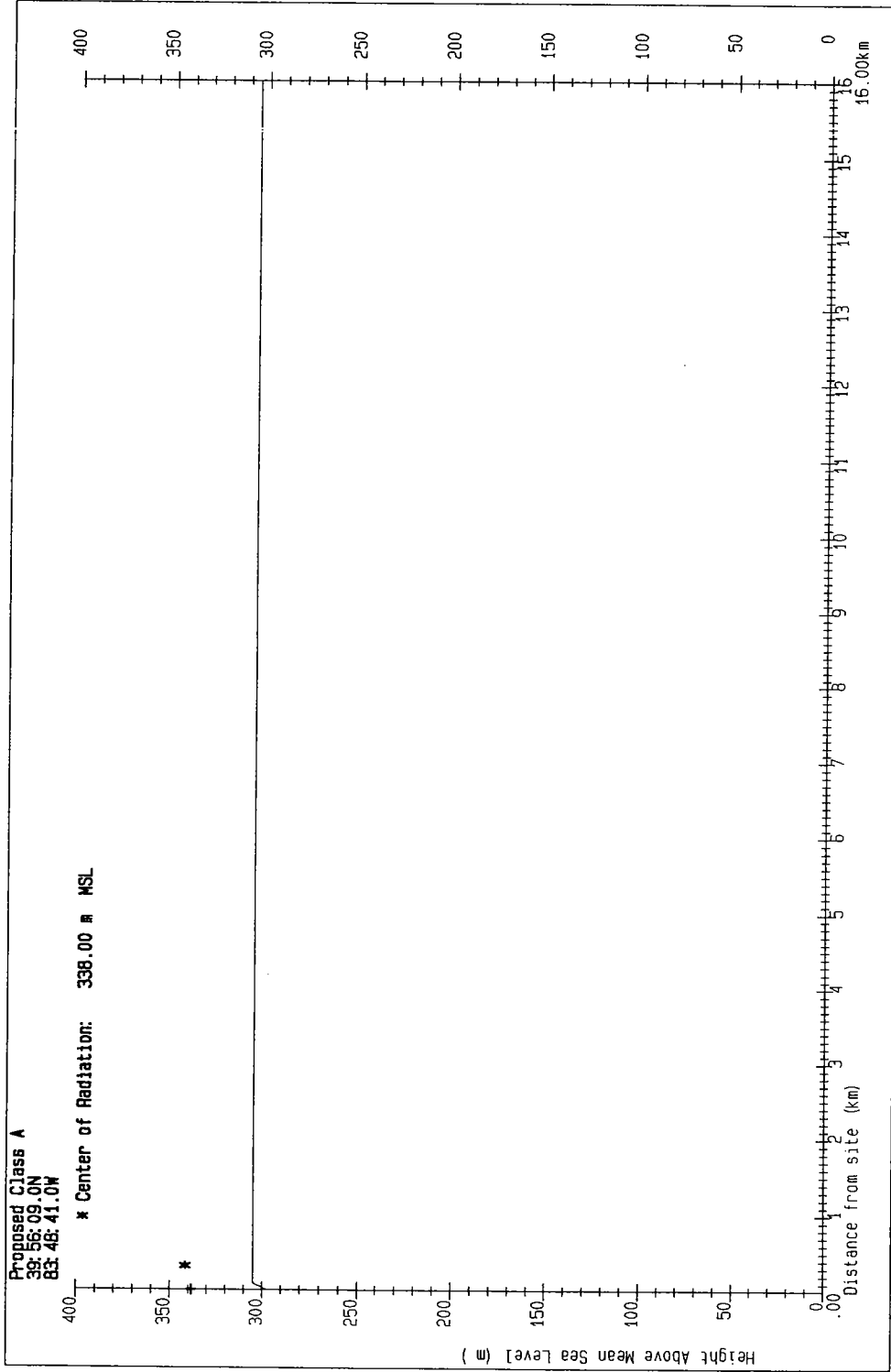


Elevation values from  
30-second elevation data

Louis A. Williams, Jr.  
and Associates  
Cincinnati, Ohio  
May 1998

TERRAIN PROFILE GRAPH  
Azimuth 180.0

EXHIBIT 004  
FIGURE 6

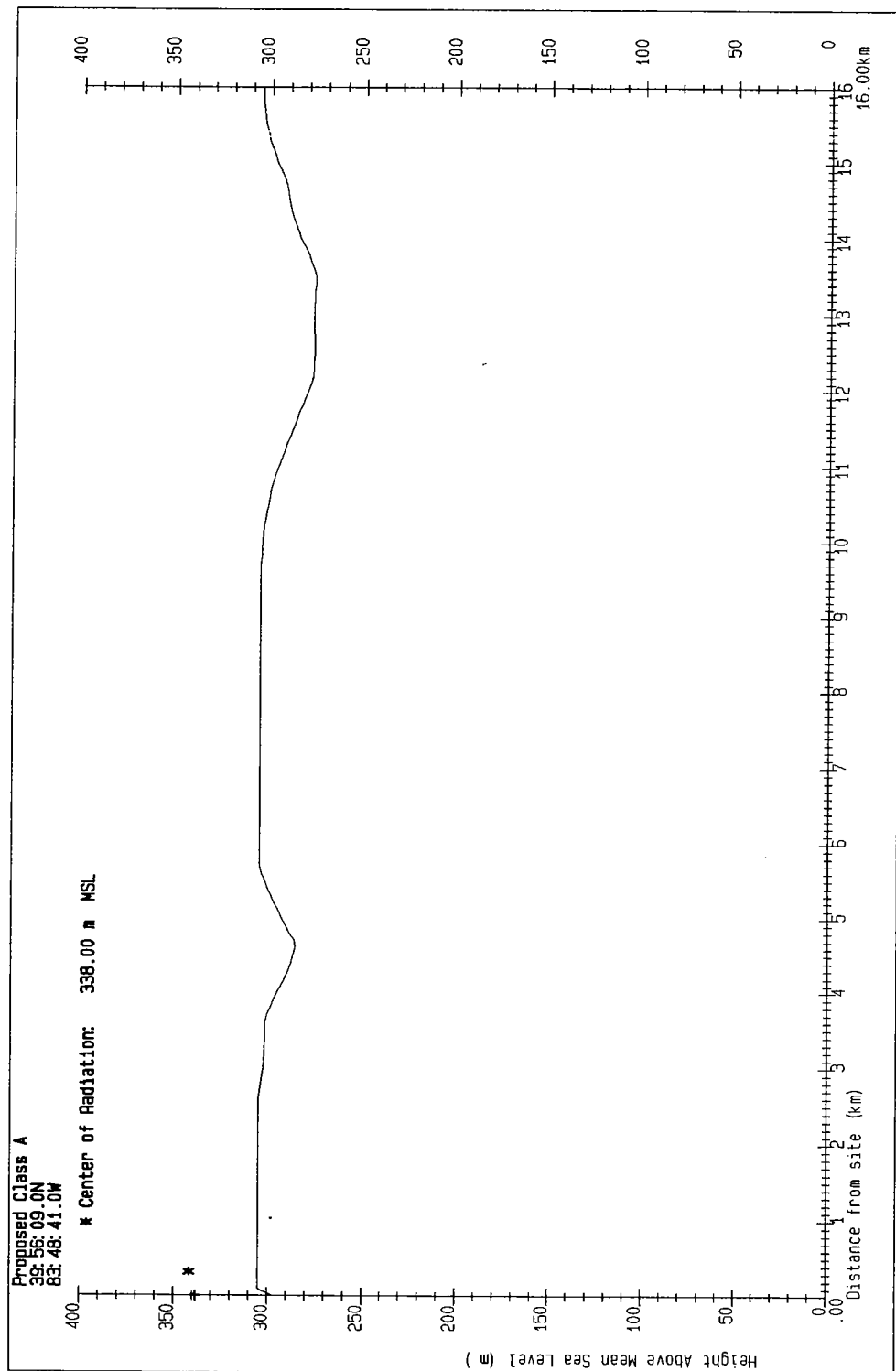


Elevation values from  
30-second elevation data

Louis A. Williams, Jr.  
and Associates  
Cincinnati, Ohio  
May 1998

EXHIBIT 004  
FIGURE 7

TERRAIN PROFILE GRAPH  
Azimuth 225.0

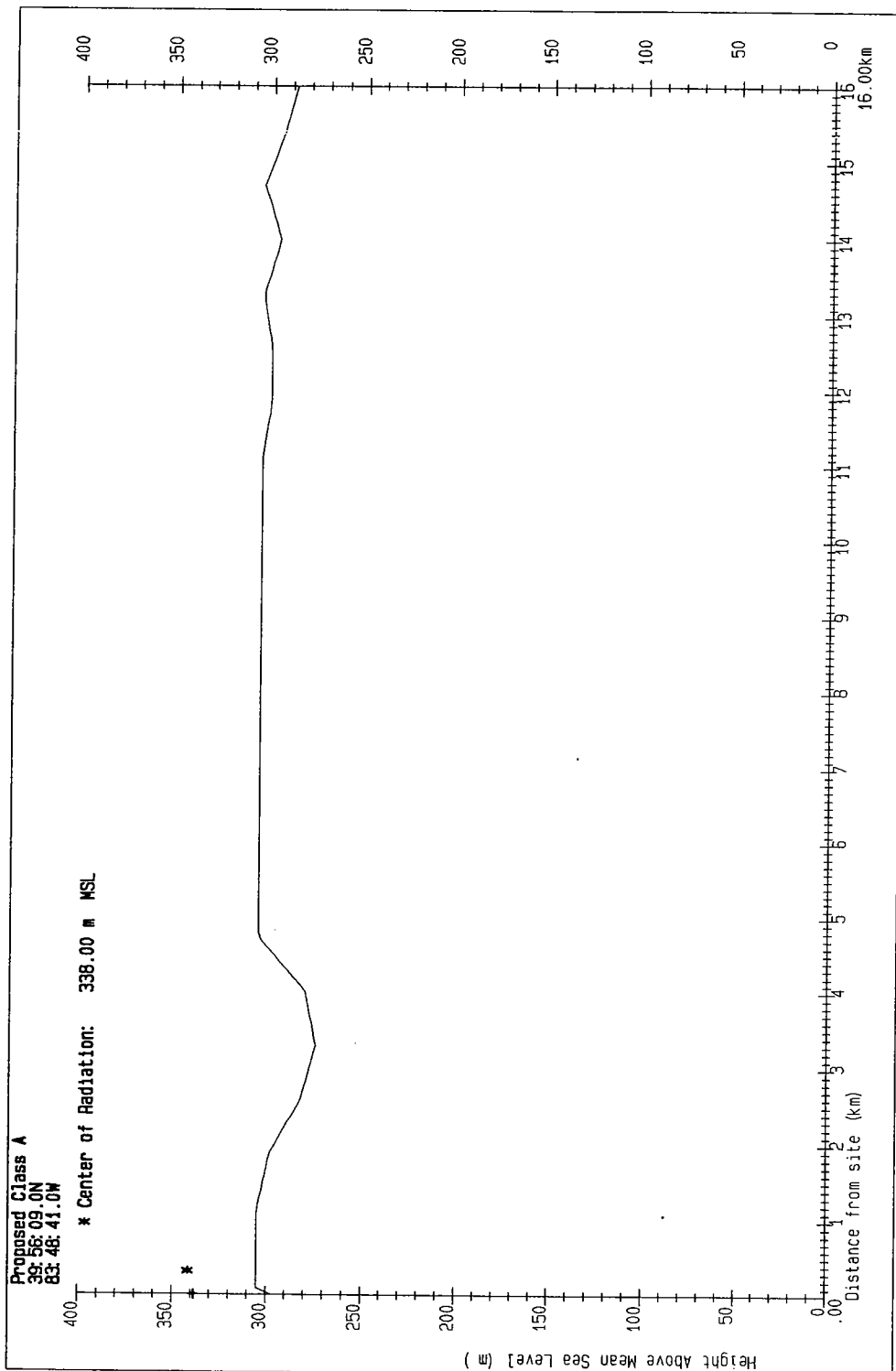


Elevation values from  
30-second elevation data

Louis A. Williams, Jr.  
and Associates  
Cincinnati, Ohio  
May 1998

TERRAIN PROFILE GRAPH  
Azimuth 270.0

EXHIBIT 004  
FIGURE 8

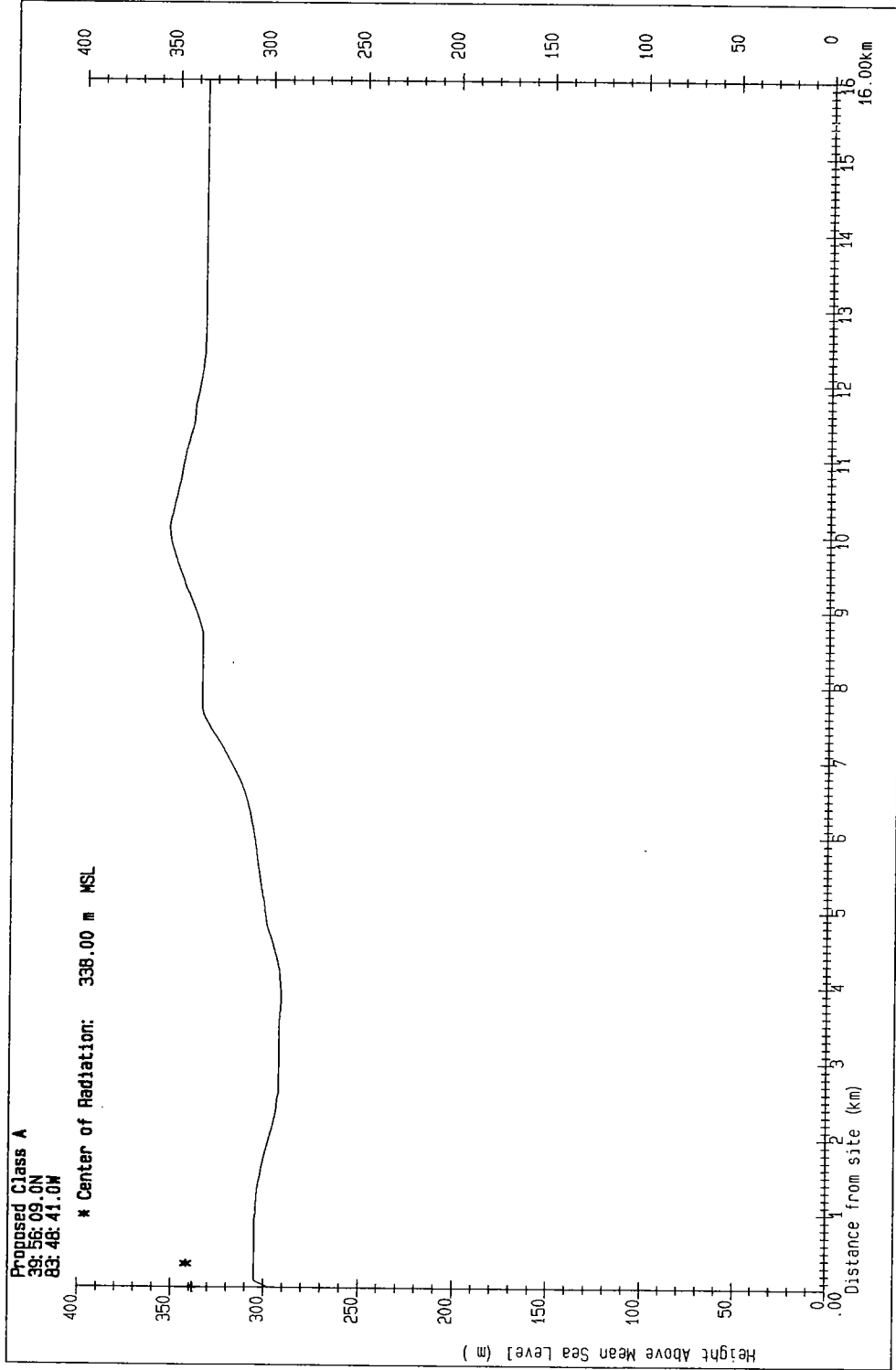


Elevation values from:  
30-second elevation data

Louis A. Williams, Jr.  
and Associates  
Cincinnati, Ohio  
May 1998

TERRAIN PROFILE GRAPH  
Azimuth 315.0

EXHIBIT 004  
FIGURE 9



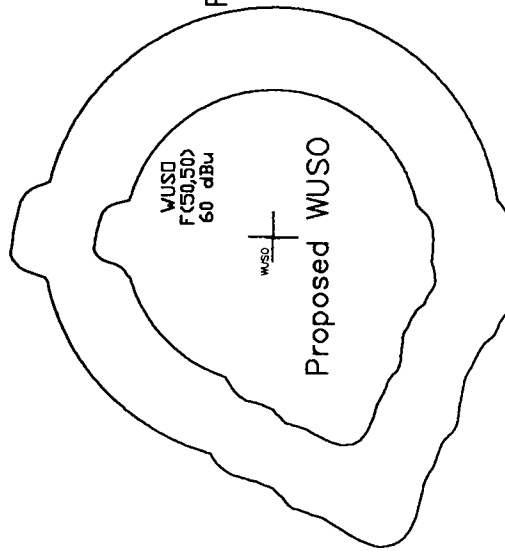
Elevation values from:  
30-second elevation data

Louis A. Williams, Jr.  
and Associates  
Cincinnati, Ohio  
May 1998

CHAMPAIGN

CLAF

40°

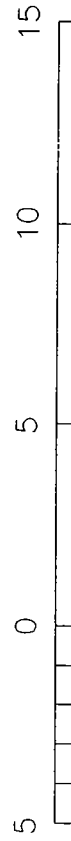


Proposed  
F(50,50)  
60 dBu

WUSO

Proposed WUSO

kilometers



Percent Change:

$$\frac{63.9 + 0.0}{49.9} \times 100 = 128\%$$

ENGINEERING EXHIBIT 005

PRESENT and PROPOSED WUSO  
60 dBu CONTOURS

Louis A. Williams, Jr. and Associates  
May 1998

ENGINEERING EXHIBIT 006 -  
CANADA-U.S. WORKING AGREEMENT COMPLIANCE

The proposed WUSO site is 215 km from the U.S./Canadian border. Because of this distance and the low power of the proposed WUSO, no relevant Canadian stations were discovered in interference contour searches of two different data bases. The proposed WUSO therefore complies with the Working Agreement for Allocation of FM Broadcasting Stations on Channels 201-300 under the Canada-United States FM Agreement of 1947.



## ENGINEERING EXHIBIT 007 - ALLOCATION STUDY

A search of the FM data base shows that detailed analysis is needed for four stations: (1) a new co-channel application in Urbana, Ohio on channel 206, (2) first-adjacent WCSU-FM in Wilberforce, Ohio on channel 205, (3) second-adjacent WDPR/WDPS (share time and facilities) in Dayton, Ohio on channel 208, and (4) third-adjacent WOSU-FM in Columbus, Ohio on channel 209.

## MUTUALLY EXCLUSIVE APPLICATION

Contours for the application by American Family Radio for a new co-channel station in Urbana, Ohio on channel 206 are shown in detail in Figure 1. For both the proposed Urbana station and the proposed WUSO the terrain elevation was calculated using the NGDC 30-second data base in one degree azimuthal steps. The effective antenna height in the direction of the radial was calculated by taking the radiation center above mean sea level (RCMSL) and subtracting the average terrain elevation for that radial.

The distance to the appropriate contour was calculated using the FCC computer code CURVES. The map projection used was the Ohio State Plane, South, converted to metric units.

Figure 1 shows that the proposed Urbana station's F(50,10) 40 dBu contour and the proposed WUSO F(50,50) 60 dBu contour overlap. Figure 1 also shows that the proposed WUSO F(50,10) 40 dBu contour and the proposed Urbana F(50,50) 60 dBu contour overlap. The overlap is quite significant in both cases and the two applications are mutually exclusive.

## REMAINING CONTOURS

Figure 2 shows the contours for WCSU-FM versus the proposed WUSO. In Figure 2 only the proposed WUSO contours were calculated using the more accurate USGS 30-m data base because of the close spacing of the contours. Figure 2 shows that the proposed WUSO F(50,10) 54 dBu contour does not overlap the WCSU-FM F(50,50) 60 dBu contour. Figure 2 also

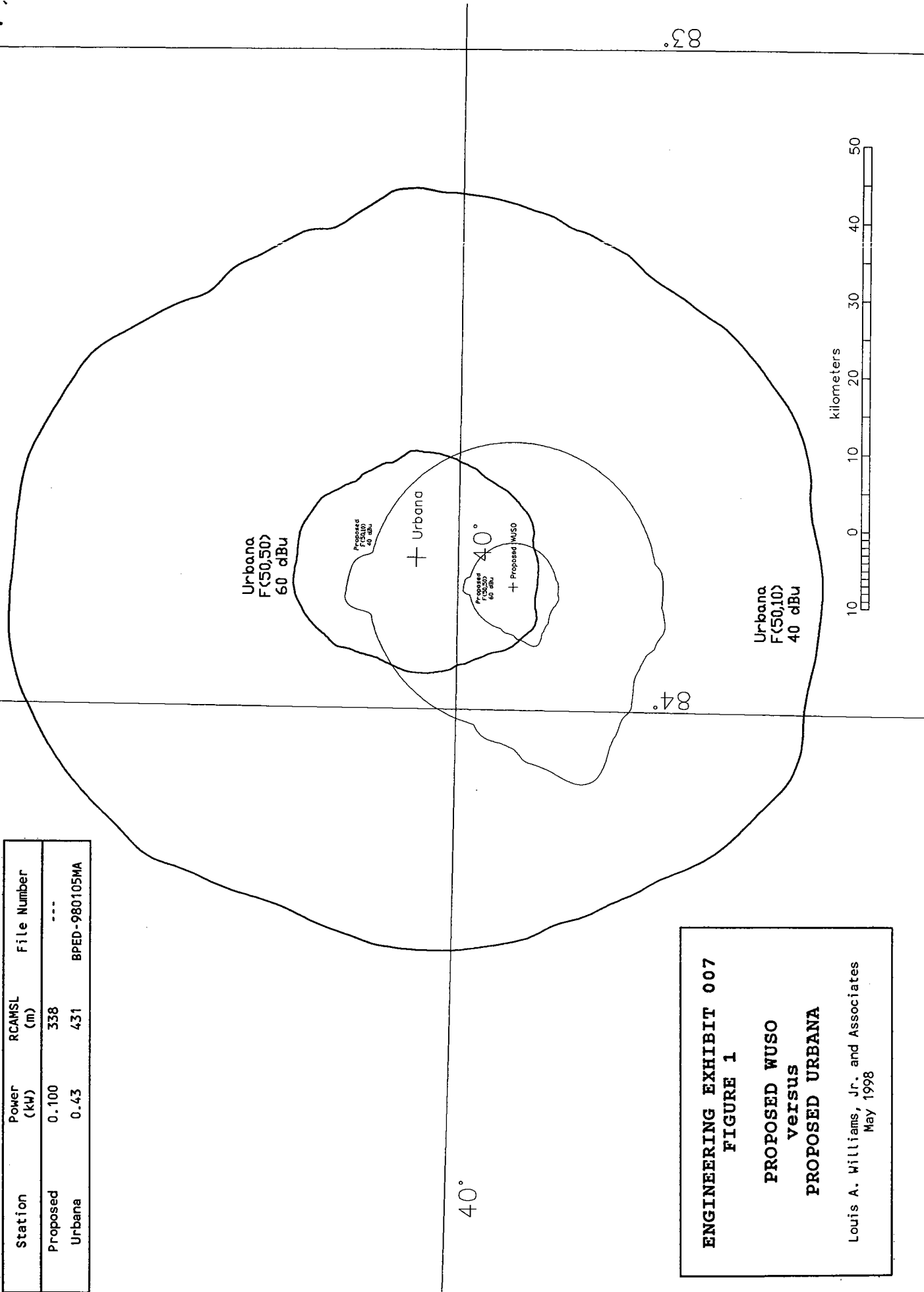
shows that the proposed WUSO F(50,50) 60 dBu contour does not overlap the WCSU-FM F(50,10) 54 dBu contour.

Figure 3 shows that the proposed WUSO F(50,10) 80 dBu contour does not overlap the WDPR/WDPS F(50,50) 60 dBu contour. Figure 3 also shows that the proposed WUSO F(50,50) 60 dBu contour does not overlap the WDPR/WDPS F(50,10) 80 dBu contour.

Figure 4 shows that the proposed WUSO F(50,10) 100 dBu contour does not overlap the WOSU-FM F(50,50) 60 dBu contour. Figure 4 also shows that the proposed WUSO F(50,50) 60 dBu contour does not overlap the WOSU-FM F(50,10) 100 dBu contour.

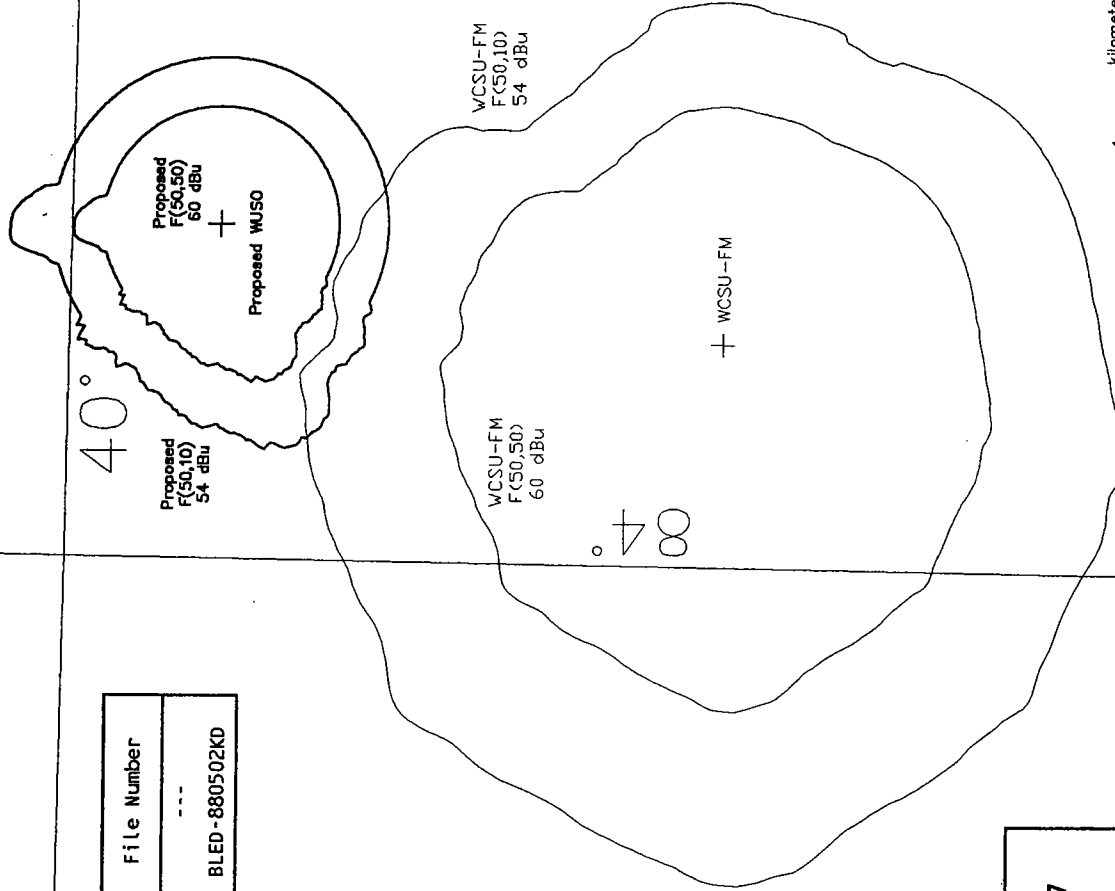
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Station	Power (kW)	RCAMSL (m)	File Number
Proposed	0.100	338	---
Urbana	0.43	431	BPED-980105MA



ENGINEERING EXHIBIT 007  
 FIGURE 1  
 PROPOSED WUSO  
 versus  
 PROPOSED URBANA  
 Louis A. Williams, Jr. and Associates  
 May 1998

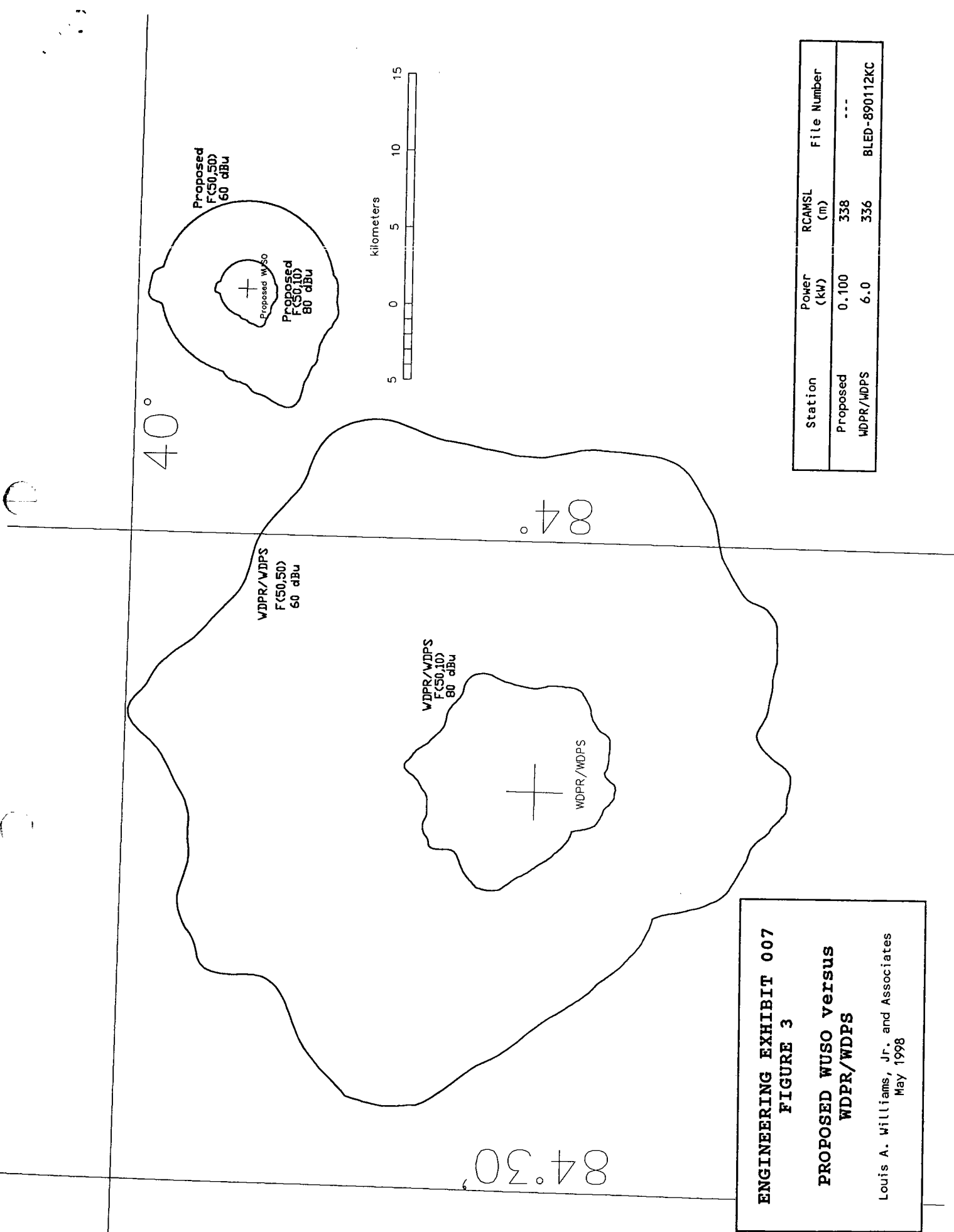
Station	Power (kW)	RCAMSL (m)	File Number
Proposed	0.100	338	---
WCSU-FM	1.00	350	BLED-880502KD



**ENGINEERING EXHIBIT 007  
FIGURE 2**

**PROPOSED WUSO VERSUS  
WCSU-FM**

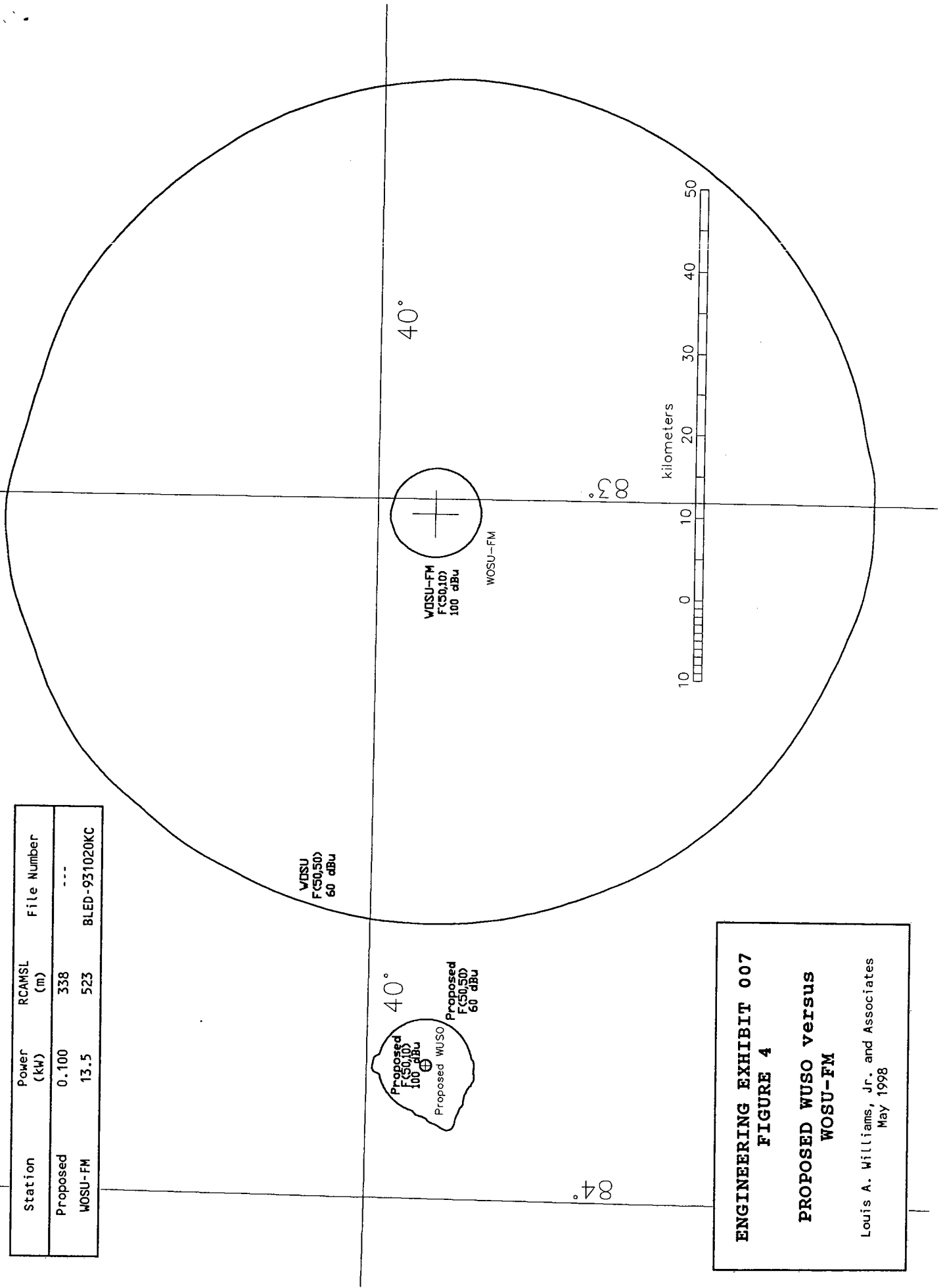
Louis A. Williams, Jr. and Associates  
January 2003



Station	Power (kW)	RCAMSL (m)	File Number
Proposed	0.100	338	---
WDPR/WDPS	6.0	336	BLD-890112KC

**ENGINEERING EXHIBIT 007**  
**FIGURE 3**  
**PROPOSED WUSO versus**  
**WDPR/WDPS**  
 Louis A. Williams, Jr. and Associates  
 May 1998

Station	Power (kW)	RCAMSL (m)	File Number
Proposed	0.100	338	---
WOSU-FM	13.5	523	BLED-931020KC



ENGINEERING EXHIBIT 007  
FIGURE 4

PROPOSED WUSO versus  
WOSU-FM

Louis A. Williams, Jr. and Associates  
May 1998

## ENGINEERING EXHIBIT 008 - I.F. SEPARATION STUDY

The relevant stations separated by 53 or 54 channels are given below with the required information. As can be seen, both stations are further than the minimum distance specified in 47 C.F.R. 73.207.

Call City of	Auth Licensee name License	St FCC File no.	Chan ERP-kW Freq EAH-m	Latitude Longitude	Br-to -from	Dist. (km)	Req. (km)
WBZX Columbus	LIC North American Broadcast OH BLH-881128KA		259B 20.1 99.7 239	39-58-16 83-01-40	86.4 67.08 266.9 52.08	15 CLEAR	
LQT Kettering	LIC Citicasters Company OH BLH-640101		260B 50 99.9 152	39-44-07 84-10-10	234.0 37.88 53.8 22.88	15 CLEAR	



## ENGINEERING EXHIBIT 009 - TV CHANNEL 6 STUDY

In accordance with 47 C.F.R. 73.525(a)(1) the radius of TV Channel 6 protection for NCE-FM Channel 206 is a distance of 211 km. The relevant stations are WSYX in Columbus, Ohio and WRTV in Indianapolis, Indiana.

Figure 1 of this exhibit is a map showing the WRTV F(50,50) 47 dBu contour, the WSYX F(50,50) 47 and 68 dBu contours, and the proposed WUSO F(50,10) horizontally-equivalent 63.5 dBu contour. Since Springfield is a city of over 50,000 persons and the proposed WUSO uses vertical-only polarization, a factor of 10 is used to relate vertically-polarized radiation to horizontally-equivalent radiation in accordance with 47 C.F.R. 73.525(e)(4)(i).

This map was generated using the NGDC 30-second data base in one degree azimuthal steps. The effective antenna height in the direction of the radial was calculated by taking the radiation center above mean sea level (RCAMSL) and subtracting the average terrain elevation for that radial. The distance to the contour was calculated using the FCC computer code CURVES. The map projection used was the Ohio State Plane, South, converted to metric units.

As can be seen in the Figure, the WRTV 47 dBu contour and the proposed WUSO horizontally-equivalent 63.5 dBu contour do not overlap. Since there is no overlap of these contours, there is no interference population, and the proposed WUSO is in compliance with 47 C.F.R. 73.525 with regard to WRTV.

Figure 1 also shows that the proposed WUSO horizontally equivalent 63.5 dBu contour is inside the Columbus, Ohio TV Channel 6 WSYX Grade B contour but outside the WSYX Grade A contour. WSYX has no objection to the proposed WUSO construction. A written agreement between WSYX and WUSO is given in Attachment 1.

# ENGINEERING EXHIBIT 009

## FIGURE 1

### CONTOURS FOR TV CHANNEL 6 INTERFERENCE STUDY

Louis A. Williams, Jr. and Associates  
May 1998

WSYX  
F(50,50)  
47 dBu

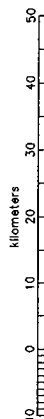
WRTV  
F(50,50)  
47 dBu

WSYX  
F(50,50)  
68 dBu

Horizontally  
Equivalent  
F(50,10)  
63.5 dBu  
+  
Proposed WUSO

WSYX

+ WRTV



Station	Power (kW)	RCAMSL (m)	File Number
Proposed	0.100	338	---
WRTV	100	551	BMLCT-880712KE
WSYX	100	523	BLCT-931022KE

39°

39°

40°

40°

83°

83°

84°

84°

84°

83°

ENGINEERING EXHIBIT 009  
ATTACHMENT 1

LETTER AGREEMENT  
BETWEEN  
PROPOSED WUSO  
AND  
TV CHANNEL 6 WSYX



Wittenburg University  
P.O. Box 720  
Springfield, Ohio 45501-720

May 14, 1998


Dear Mr. Gell:

I am in receipt of a letter from your engineering consultant, Louis A. Williams, Jr. in which he described a proposed improvement in the facilities of WUSO (FM), which is licensed to the Board of Directors of Wittenburg University. Specifically, it is proposed that WUSO change from Class D to Class A and increase power to 100 watts, vertically polarized at 26 meters above average terrain, continuing to operated on 89.1 MHZ.

Please be advised that WSYX does not object to this proposal, provided that the parameters remain as outlined by Mr. Williams.

I would appreciate it if you would provide me with copies of any submissions you may make to the FCC in this regard.

Yours truly,

  
Richard M. Sweeney  
Chief Engineer  
WSYX

Cc: Mr. Neil Smith  
Mr. Louis A. Williams, Jr.  
John Wells King Esq.

ENGINEERING EXHIBIT 010 -  
RADIOFREQUENCY RADIATION (RFR) ANALYSIS

The Board of Directors of Wittenberg University, in coordination with other users of the WUSO transmitter site, agree that WUSO will reduce power or cease operation as necessary to protect persons having access to the rooftop or antenna from radiofrequency radiation in excess of FCC guidelines.

The Tower Hall rooftop is a posted, restricted area with controlled access. An RFR notice sign will be posted at the entry to the rooftop. The area on the Tower Hall roof at the base and to the north of the WUSO antenna as shown in the Tower Hall Plan View below will be restricted to five minutes or less occupancy. The Tower Hall penthouse roof will be completely restricted from occupancy except when all radiators including WUSO are off. These conditions may be modified based on actual radiation hazard measurements of sufficient duration to allow for the duty cycles of the paging transmitters.

The impact of the proposed WUSO on the exposure of humans to radiofrequency radiation is considered in this exhibit. Based on these results the proposed WUSO is excluded from environmental processing.

The environmental impact of the proposed station has been evaluated under 47 C.F.R. 1.1306 and 1.1307. Use of an existing building is an environmentally desirable alternative to the construction of a new tower and is encouraged.

Compliance with FCC-specified guidelines for human exposure to radiofrequency radiation is evaluated in accordance with 47 C.F.R. 1.1310 and OET Bulletin No. 65 (August 1997). Since the proposed operation constitutes a multiple-use site, the fraction of the recommended limit incurred within each frequency interval is determined and the fractional contributions are summed.

The WUSO rooftop is well above the level of the surrounding terrain. Since the rooftop is a posted, controlled area the maximum permissible exposure limits for occupational/controlled

## EXHIBIT 010, PAGE 2

exposure apply. This analysis is based on data supplied by Wittenberg University and not on a site inspection or actual measurements.

Table 1 shows the stations which must be considered in an RFR analysis and their relationship to the proposed WUSO:

TABLE 1 - PERTINENT STATIONS						
STATION	PLAN ID	DISTANCE FROM WUSO (ft)	BEARING FROM WUSO (Deg T)	FREQUENCY (MHz)	RCAMSL (ft)	ERP (w)
Proposed	1	0	0	89.1	1,111	100
Uniden Paging	3	8	100	151.655	1,115	250
Motorola Paging	4	17	60	929.3125	1,115	600
Motorola Paging	5	17	60	959.85625	1,116	600
Motorola Security	6	18	5	151.895	1,116	250
UHF Paging	8	22	35	454.45	1,116	500

The rooftop elevation is 332.6 m AMSL and a 2 m person standing on the roof at the base of the WUSO tower is used as an example in Table 2. Table 2 shows the percent of the MPE at a head height of 334.6 m AMSL for the person for each station considered based on the following formula:

A far-field prediction based on pages 19-23 of OET No. 65 gives a worst case upper limit for the near field for each station:

$$S = \frac{(2.56)(1.64)(F^2)(ERP)(1000 \text{ mW/W})}{4\pi R^2}$$

where R is the slant range from the center of radiation. Table 2 shows the controlled and uncontrolled total exposure for all the stations in Table 1. Directly below the proposed WUSO antenna the calculated exposure is 104 percent of MPE(C), the allowed occupational/controlled exposure.

Base on similar calculations to Table 2, the main roof area below the proposed WUSO antenna where the calculated exposure is

WUSO RFR

TABLE 2

May 1998

STATION: PROP WUSO  
 DATE: 01-May-98  
 SITE ELEV (M AMSL): 297.4  
 BEARING FROM WUSO (DEG): 0  
 DISTANCE FROM WUSO (M): 0  
 ROOF ELEV (M): 35.2  
 PERSON HEIGHT (M): 2

STATION	FREQ (MHZ)	CHANNEL	HERP(AUR) (kW)	VERP(AUR) (kW)	RCAMSL (M)	DISTANCE FROM WUSO (KM)	BEARING FROM WUSO (Deg)	SLANT R (M)	DEPRESSION ANGLE (Deg)	REL FIELD	PD (mW/cm2)	MPE(C) (mW/cm2)	% OF MPE(C)	MPE(U) (mW/cm2)	% OF MPE(U)
FM (LESS THAN 300 MHZ):															
Prop WUSO	89.1	206	0	0.1	338	0.0000	0	3.40	90.0	1.000	0.28901	1.00	28.90	0.20	144.51
Uniden Paging	151.855		0	0.25	339.9	0.0024	100	5.82	85.6	1.000	0.24675	1.00	24.67	0.20	123.37
Motorola Security	151.895		0	0.25	340.2	0.0055	5	7.85	45.5	1.000	0.13557	1.00	13.56	0.20	67.78
FM (MORE THAN 300 MHZ):															
UHF Paging	454.45		0	0.5	340.2	0.0067	35	8.73	39.9	1.000	0.21908	1.51	14.46	0.30	72.31
Motorola Paging	929.3125		0	0.6	339.9	0.0052	60	7.42	45.5	1.000	0.36361	3.10	11.74	0.62	58.69
Motorola Paging	959.8563		0	0.6	340.2	0.0052	80	7.64	47.1	1.000	0.34325	3.20	10.73	0.64	53.64

VHF TV:

None Known

UHF TV:

None Known

TOTALS: 104.06 520.31

## EXHIBIT 010, PAGE 4

over one hundred percent of MPE(C) has been calculated and is shown in Table 3 below and in Figure 1, Restricted Area, Tower Hall Plan View. This area is restricted from continuous occupancy but may be occupied intermittently for up to five minutes. The penthouse roof is restricted from occupancy because the estimated time required to climb to the roof, perform any reasonable task, and climb down from the roof is longer than the allowed exposure time.

Based on the above conditions, WUSO is in compliance with 47 C.F.R. 1.1310.

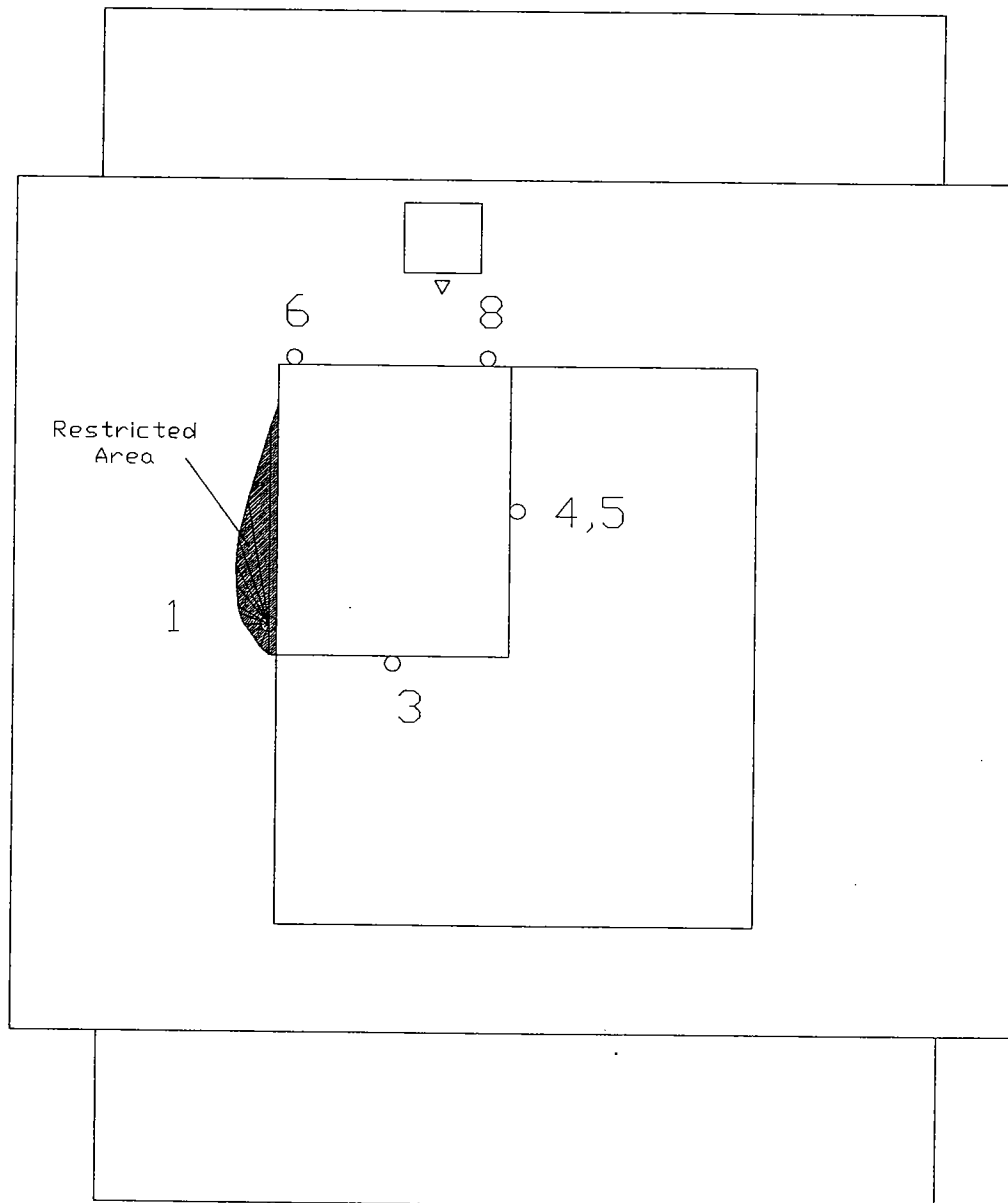
TABLE 3 - TOWER ROOF RESTRICTED AREA BOUNDARY	
BEARING FROM WUSO (T)	HORIZONTAL DISTANCE FROM WUSO (m/ft)
180	0.6/2.0
200	0.5/1.6
240	0.4/1.3
270	0.5/1.6
290	0.6/2.0
300	0.7/2.3
320	1.0/3.3
330	1.3/4.3
340	1.8/5.9
350	2.5/8.2
0	4.0/13



ENGINEERING EXHIBIT 010  
FIGURE 1

RESTRICTED AREA ON ROOF

Louis A. Williams, Jr. and Associates  
May 1998



Feet  
0 5 10 15 20

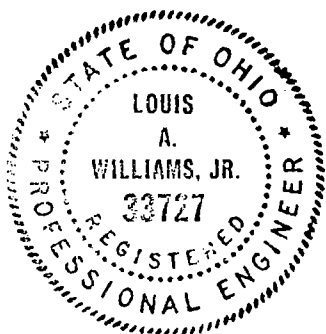
TOWER HALL  
PLAN VIEW

## ENGINEERING EXHIBIT 011 - CERTIFICATION

Louis A. Williams, Jr. certifies that he is a consulting engineer doing business since 1970 as Louis A. Williams, Jr. and Associates with offices at 2092 Arrowood Place, Cincinnati, Ohio 45231. He holds a degree of Bachelor of Science in Humanities and Engineering from the Massachusetts Institute of Technology. He is a licensed Professional Engineer in Ohio (#33727) and Kentucky (#7374) and holds a General Radiotelephone license (PG-19-19343).

He is a full member of the Association of Federal Communications Consulting Engineers, a member of IEEE/SCC28 (Standards Coordinating Committee 28, Safety Levels with respect to Human Exposure to Non-Ionizing Radiation), a member of Subcommittees 3 and 4 of IEEE/SCC28, an Associate Member of the Bioelectromagnetics Society, and a member of other technical and professional organizations.

The foregoing exhibits entitled "Engineering Exhibits for Application for Construction Permit for Noncommercial Educational Broadcast Station WUSO, The Board of Directors of Wittenberg University, Springfield, Ohio, May 1998" were prepared by him personally or under his supervision and are true and accurate to the best of his belief and knowledge.



A handwritten signature in cursive script that reads "Louis A. Williams, Jr.".

Louis A. Williams, Jr., P.E.

Date: May 19, 1998

Original stamped in purple.