NORTHERN ARIZONA UNIVERSITY

LPFM Allocation Study

Northern Arizona University ("NAU") desires to mount a Channel 296 Shively 6812B four bay LPFM antenna on a 17.8 meter overall height structure created by mounting a tower on an existing building. Figure A is a picture[1] of the site.

Figure B of this document is an LPFM Allocation Spacing Study from the proposed site. The NAU facility is short spaced to one second adjacent facility, KSED, Facility ID 55402, Channel 298C0, in Sedona, AZ. The NAU facility must not cause interference to this second adjacent facility. NAU proposes to use a four bay Shively 6812B low power antenna with 0.7039 wavelength bay spacing to eliminate downward radiation. The effective radiated power ("ERP") will be 100 watts. Figure C and Figure C(a) show the 86.0 dbμ contour (yellow) of the KSED License (BLH-19940826KB) crossing the LPFM proposed site. Second adjacent channels are protected to a value 40 dbμ higher than the coverage contour. Therefore, it would require a signal level of 126.0 dbμ to interfere with KSED. The NAU facility will not interfere with this facility if the 126 dbμ signal of the proposed LPFM does not reach any occupied area around the proposed site.

Figures D through G define the design of the proposed Shively antenna[2]. The antenna is mounted at the top of the tower. The center of radiation ("COR") of the antenna is 4.64 meters above the roof of the building or 14.64 meters above ground. The main roof of the building is 10 meters above the ground. Figure H shows the level of the NAU signal at 4.64 meters below the COR. The maximum radiation of 124.93 dbμ occurs at a slant distance of 9.3 m at a 30 degree down tilt from the antenna center. Occupied portions of this building receive less than the interfering signal level even without taking material and other building losses into account. The 126 dbu level occurs at 35.5 meters from the antenna in the main lobe. Figure I demonstrates this radius about the site. The main lobe is 14.64 meters above ground. There are no buildings or occupied structures at this height anywhere within this 35.5 meter radius. The roof of the building and elevator equipment room is unoccupied on a general basis. Therefore, this proposal causes no interference to any second adjacent facility within their protected service contour. All occupied buildings, residences, roadways, highways and vehicles are protected from second adjacent channel interference to KSED.

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[1] Picture obtained from Google Earth.

[2] This design spreadsheet was obtained from Shively Laboratories. The calculations of field strength are based on the free space formula. The field strength spreadsheet was derived by Ellis Engineering using data from the Shively Laboratories output and additions from Clarence Beverage with Communications Technologies, Inc.
The antenna design has been checked and approved by Shively Laboratories.

NAU meets all co-channel, first adjacent, and third adjacent spacing requirements. NAU respectfully requests a waiver of the second adjacent spacing requirements due to the fact that this proposed facility will cause no interference to any second adjacent channel shortspaced facility. Northern Arizona University will perform any test or measurements required should the Commission grant a Construction Permit with conditions requiring tests or measurements.

Google earth

feet 1000

meters 400

Figure A

Northern Arizona University

Proposed LPFM Site

Figure B

Northern Arizona University
Channel 296 Spacing Study

Client: NEW-LP
FM Study for Proposed Site: 35-11-29.9400, 111-39-16.7800
Desired Class: L1
Channel: 296 Frequency: 107.1 MHz

Channel	Facility/Application ID	City	State	Callsign	Licensee	Facility Status	Class	Service	Latitude	Longitude	Distance Between Facilities	Direction True North	Required Distance	Spacing Status	Separation Distance
293	191514	LEUPP	AZ	KLFZ	ALEX MEDIA, INC.	CP	C1	FM	35-23-42.000000	110-52-52.000000	73.8929	72.2232	73	OK	0.8929
293	191514	LEUPP	AZ	KLFZ	ALEX MEDIA, INC.	USE	C1	FA	35-37-0.000000	111-8-0.000000	66.8292	45.1234	73	****SHORT****	-6.1708
294	53414	PRESCOTT VALLEY	AZ	KPPV	PRESCOTT VALLEY BROADCASTING CO. INC	LIC	C2	FM	34-29-25.000000	112-32-0.000000	111.8617	225.9282	53	OK	58.8617
294	20655	PAYSON	AZ	K294AN	FAMILY LIFE BROADCASTING, INC.	LIC	D	FX	34-17-17.000000	111-11-32.000000	108.8171	157.0966	6	OK	102.8171
294	53414	PRESCOTT VALLEY	AZ	KPPV	PRESCOTT VALLEY BROADCASTING CO. INC	USE	C2	FA	34-29-25.000000	112-32-0.000000	111.8617	225.9282	53	OK	58.8617
294	190350	PRESCOTT VALLEY	AZ	KPPV-FM2	PRESCOTT VALLEY BROADCASTING	LIC	D	FB	34-42-2.200000	112-7-4.400000	68.9788	217.8403	6	OK	62.9788
294	190350	PRESCOTT VALLEY	AZ	KPPV-FM2	PRESCOTT VALLEY BROADCASTING	CP	D	FB	34-41-13.800000	112-7-2.400000	70.134	217.0623	6	OK	64.134
295	152108	PEACH SPRINGS	AZ	K295CC	DONALD F. HENDREN	CP	D	FX	35-19-40.000000	112-52-29.000000	112.0491	277.7461	13	OK	99.0491
296	156453	NOTHING	AZ	K296GN	DONALD F. HENDREN	CP	D	FX	34-29-24.000000	112-31-59.000000	111.865	225.9078	24	OK	87.865
298	55402	SEDONA	AZ	KSED	GRENAX BROADCASTING II, LLC	LIC	C0	FM	34-58-7.000000	111-30-24.000000	28.1856	151.3883	84	****SHORT****	-55.8144
298	94487	SEDONA	AZ			USE	C0	FA	34-53-3.000000	111-44-37.000000	35.064	193.3841	84	****SHORT****	-48.936

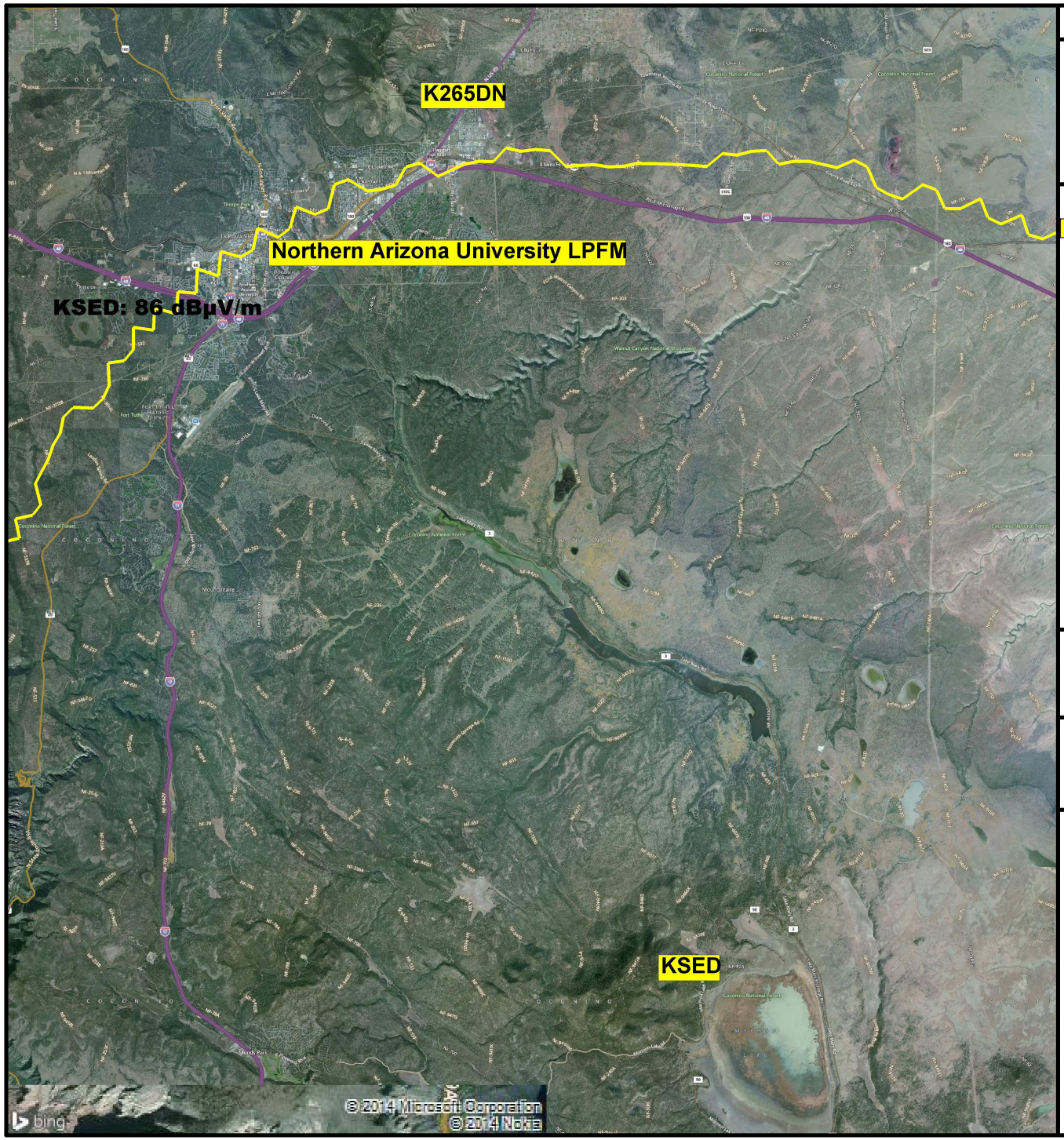

Figure C KSED 86.0 dBu Contour

Prop. model 1: FCC
Time: 50.0% Loc.: 50.0%
Prediction Confidence Margin: 0.0dB
Climate: Continental Temperate
Land use (clutter): USGS
Atmospheric Abs.: none
K Factor: 1.333

Field strength at remote

= 86.0 dBuV/m

Sites

Site: K265DN
N35°14'27.00" W111°35'49.00" 2815.0 m
K265DN Tx.Ht.AGL: 12.0 m Total ERPd: 0.010 kW
Model: 1 Isotropic-horizontal/0.0° 10 6.7000 MHz

Site: KSED
N34°58'07.00" W111°30'24.00" 2580.0 m
KSED Tx.Ht.AGL: 45.0 m Total ERPd: 100.00 kW
Model: 1 Isotropic-horizontal/0.0° 10 7.5000 MHz

Site: Northern Arizona University LPFM
N35°11'29.94" W111°39'16.78" 2106.0 m
NAU Tx.Ht.AGL: 14.6 m Total ERPd: 0.10 kW
Model: 1 Isotropic-horizontal/0.0° 10 7.1000 MHz

KILOMETERS

-5 0 5

Northern Arizona University

KSED 86 dbu Contour

Figure C Thu Oct 02 13:23:53 2014

Figure C

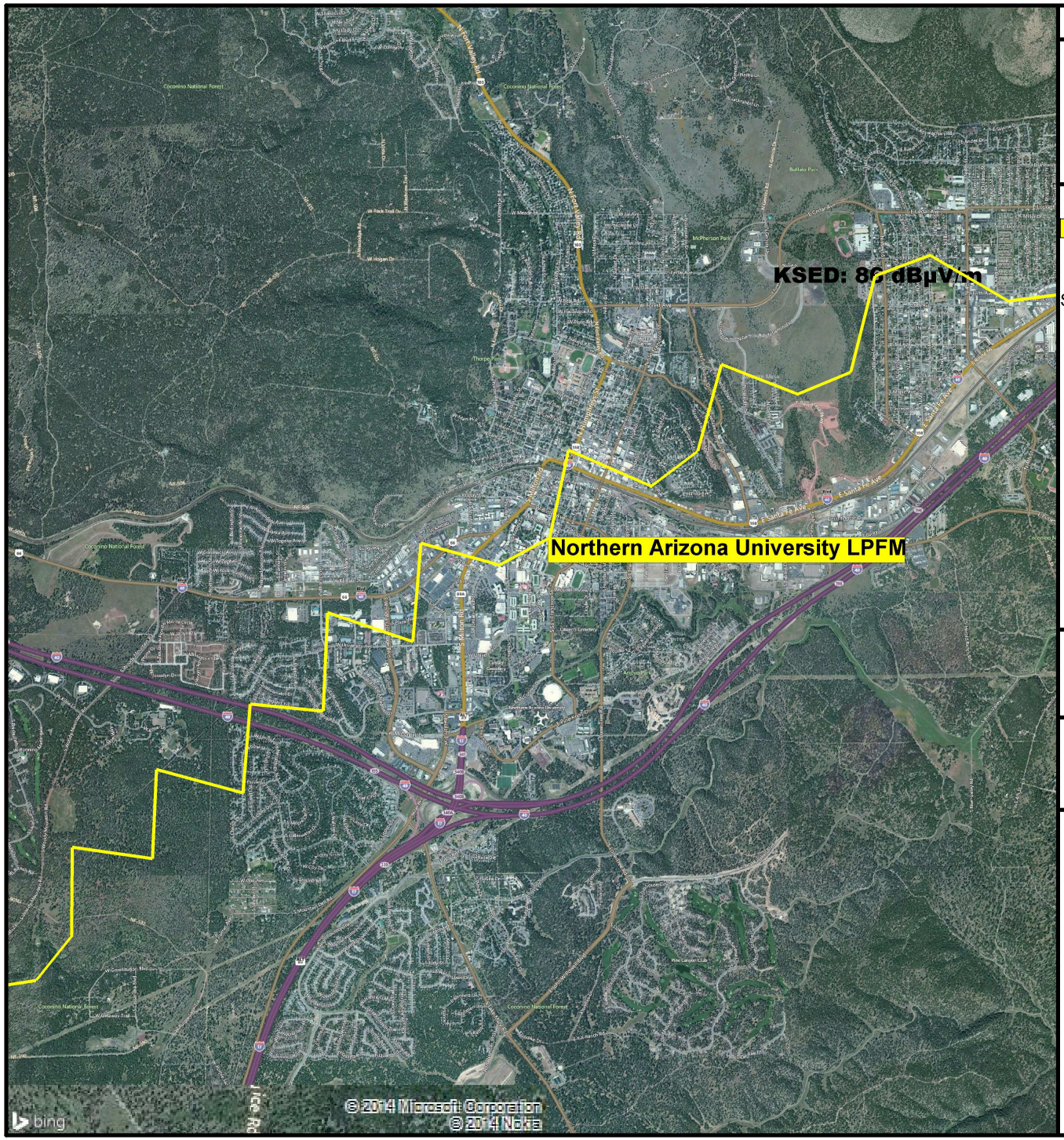

Figure C(a) KSED 86.0 dBu Contour Detail

Prop. model 1: FCC
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Prediction Confidence Margin: 0.0dB
Climate: Continental Temperate
Land use (clutter): USGS
Atmospheric Abs.: none
K Factor: 1.333

Field strength at remote

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KILOMETERS

-1 0 1

Northern Arizona University

KSED 86 dbu Contour

Figure C(a) Thu Oct 02 13:29:37 2014

Figure C(a)

KSED Contour Detail
About Proposed LPFM Site

Figure D
NAU LPFM Antenna Design Parameters

User specified data is entered only in yellow highlighted cells

Antenna Manufacturer	Shively Labs
Antenna Type	6812B
Station	NEW-LP
Frequency (MHz)	107.1
Channel #	296
Wavelength (in)	110.2
Number of Bays	4
Bay Spacing (in)	77.57
Beam Tilt Angle (Deg)	0
Center (1) or End (0) Fed	1
End Bay Line Length Delta (in)	0
Tee Offset Length for Center Fed (in)	0
Computed (0) or Custom (1) Excitation	0
Figure	FIGURE D
Total Gain	1.781
Azimuth Gain	1
Computed Elevation Gain	1.781

Computed Array Excitation			Custom Excitation			
Bay #	Bay Amp.	Bay Phase (Deg)	Bay Amp.	Bay Phase (Deg)	Phase for Null Fill	Phase for Beam Tilt
1	1	0.00	1		0.00	0.00
2	1	0.00	1		0.00	0.00
3	1	0.00	1		0.00	0.00
4	1	0.00	1		0.00	0.00
			1			

Figure E

Antenna Mfg.:	**Shively Labs**			**Date: 10/2/2014**
Antenna Type:	**6812B**			
Station:	**NEW-LP**	**Beam Tilt**	**0**	
Frequency:	**107.1**	**Gain (Max)**	**1.781**	**2.506 dB**
Channel #:	**296**	**Gain (Horizon)**	**1.781**	**2.506 dB**
Figure:	**FIGURE E**			

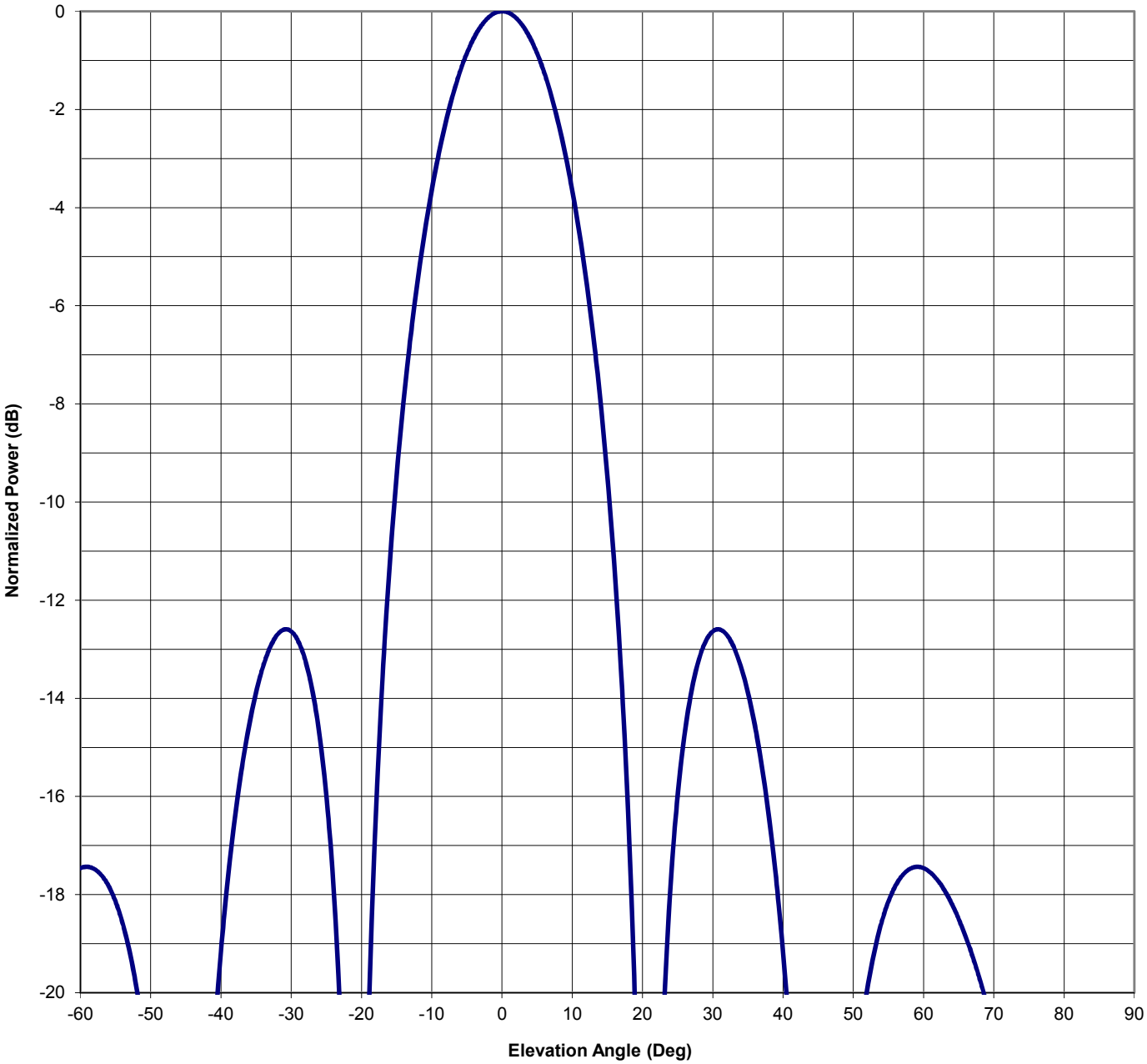


Figure F

Antenna Mfg.: Shively Labs
Antenna Type: 6812B
Station: NEW-LP
Frequency: 107.1
Channel #: 296
Figure: FIGURE F

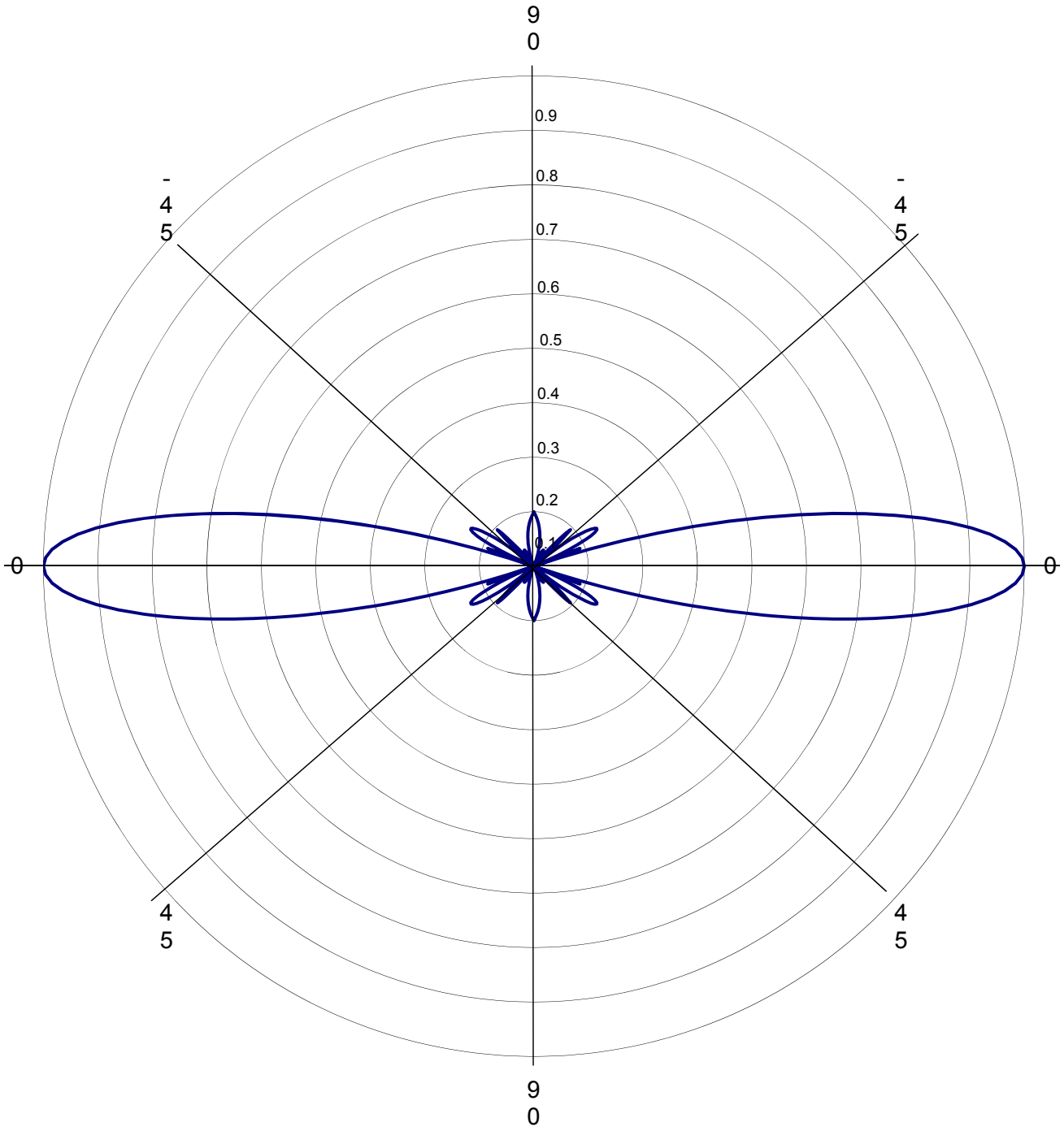
Date: 10/2/2014

Beam Tilt	**0**	
Gain (Max)	**1.781**	**2.506 dB**
Gain (Horizon)	**1.781**	**2.506 dB**

Angle of Depression (Deg)	Relative Field	Angle of Depression (Deg)	Relative Field	Angle of Depression (Deg)	Relative Field	Angle of Depression (Deg)	Relative Field
-90	0.000	-44	0.025	0	1.000	46	0.014
-89	0.004	-43	0.046	1	0.996	47	0.032
-88	0.007	-42	0.067	2	0.985	48	0.049
-87	0.010	-41	0.089	3	0.966	49	0.064
-86	0.014	-40	0.110	4	0.939	50	0.078
-85	0.017	-39	0.131	5	0.906	51	0.090
-84	0.021	-38	0.151	6	0.867	52	0.101
-83	0.025	-37	0.170	7	0.821	53	0.110
-82	0.029	-36	0.187	8	0.771	54	0.118
-81	0.033	-35	0.202	9	0.716	55	0.124
-80	0.037	-34	0.215	10	0.657	56	0.129
-79	0.042	-33	0.225	11	0.596	57	0.132
-78	0.047	-32	0.232	12	0.532	58	0.134
-77	0.052	-31	0.235	13	0.467	59	0.134
-76	0.057	-30	0.233	14	0.401	60	0.134
-75	0.062	-29	0.228	15	0.336	61	0.133
-74	0.068	-28	0.218	16	0.272	62	0.130
-73	0.074	-27	0.203	17	0.210	63	0.127
-72	0.080	-26	0.184	18	0.150	64	0.123
-71	0.086	-25	0.159	19	0.093	65	0.119
-70	0.092	-24	0.129	20	0.040	66	0.114
-69	0.097	-23	0.094	21	0.009	67	0.109
-68	0.103	-22	0.054	22	0.054	68	0.103
-67	0.109	-21	0.009	23	0.094	69	0.097
-66	0.114	-20	0.040	24	0.129	70	0.092
-65	0.119	-19	0.093	25	0.159	71	0.086
-64	0.123	-18	0.150	26	0.184	72	0.080
-63	0.127	-17	0.210	27	0.203	73	0.074
-62	0.130	-16	0.272	28	0.218	74	0.068
-61	0.133	-15	0.336	29	0.228	75	0.062
-60	0.134	-14	0.401	30	0.233	76	0.057
-59	0.134	-13	0.467	31	0.235	77	0.052
-58	0.134	-12	0.532	32	0.232	78	0.047
-57	0.132	-11	0.596	33	0.225	79	0.042
-56	0.129	-10	0.657	34	0.215	80	0.037
-55	0.124	-9	0.716	35	0.202	81	0.033
-54	0.118	-8	0.771	36	0.187	82	0.029
-53	0.110	-7	0.821	37	0.170	83	0.025
-52	0.101	-6	0.867	38	0.151	84	0.021
-51	0.090	-5	0.906	39	0.131	85	0.017
-50	0.078	-4	0.939	40	0.110	86	0.014
-49	0.064	-3	0.966	41	0.089	87	0.010
-48	0.049	-2	0.985	42	0.067	88	0.007
-47	0.032	-1	0.996	43	0.046	89	0.004
-46	0.014	0	1.000	44	0.025	90	0.000
-45	0.005			45	0.005		

Figure G

ANTENNA ELEVATION PATTERN



Polar Plot

Antenna Mfg: Shively Labs
Antenna Type: 6812B
Station: NEW-LP
Frequecy: 107.1
Channel: 296
Figure: FIGURE G

Date: 10/2/2014

Beam Tilt	**0**	
Gain (Max)	**1.781**	**2.506 dB**
Gain (Horizon)	**1.781**	**2.506 dB**

Shively Labs

A Division of Howell Laboratories Bridgton, ME 207-647-3327

Figure H

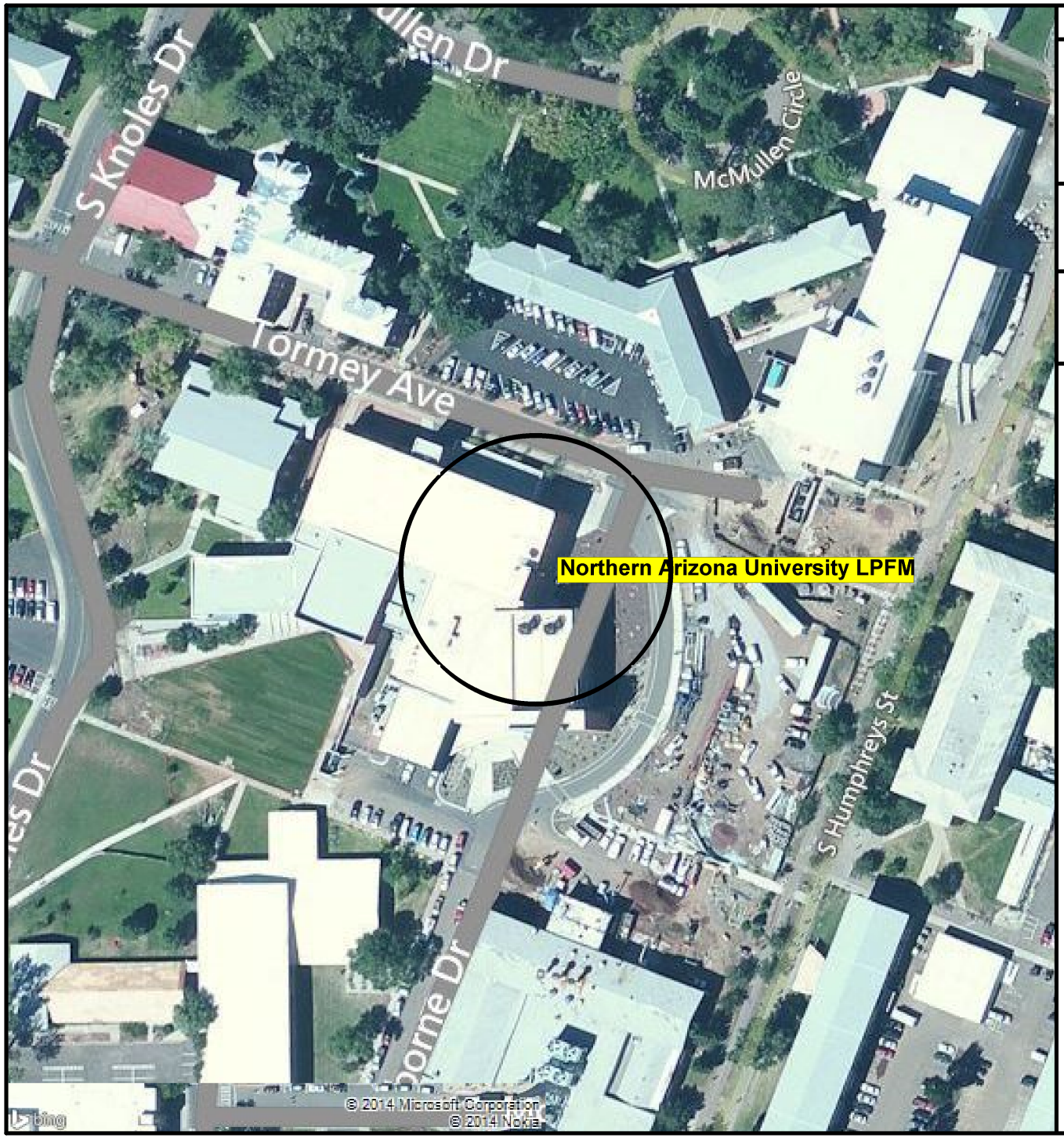
Analysis of Signal Levels At Roof Level

Antenna COR Above Roof	4.64	
LPFM ERP	100	
LPFM Channel	296	
LPFM HAAT	-93	
Interference Contour	126	
Highest signal at 4.64 M at roof level	124.93	**Adequate Choice**

Depression Angle, Degrees	Relative Field	ERP Watts	dBk	Kilometers	Free Space Signal
90	0.000	0.0000	-336.6	0.0046	-183.05
85	0.017	0.0294	-45.3	0.0047	108.24
80	0.037	0.1378	-38.6	0.0047	114.85
75	0.062	0.3892	-34.1	0.0048	119.19
70	0.092	0.8389	-30.8	0.0049	122.29
65	0.119	1.4139	-28.5	0.0051	124.24
60	0.134	1.7947	-27.5	0.0054	124.88
55	0.124	1.5345	-28.1	0.0057	123.72
50	0.078	0.6075	-32.2	0.0061	119.11
45	0.005	0.0026	-55.8	0.0066	94.81
40	0.110	1.2131	-29.2	0.0072	120.59
35	0.202	4.0928	-23.9	0.0081	124.88
30	0.233	5.4514	-22.6	0.0093	124.93
25	0.159	2.5242	-26.0	0.0110	120.13
20	0.040	0.1588	-38.0	0.0136	106.28
15	0.336	11.2976	-19.5	0.0179	122.38
10	0.657	43.1922	-13.6	0.0267	124.74
5	0.906	82.1107	-10.9	0.0532	121.54
4	0.939	88.2236	-10.5	0.0665	119.92
3	0.966	93.2286	-10.3	0.0887	117.66
2	0.985	96.9428	-10.1	0.1330	114.31
1	0.996	99.2284	-10.0	0.2659	108.39

Notes:

Antenna radiation center above roof (meters):		4.64
Antenna radiation center above ground (meters):		14.64
Maximum ERP (watts) at 0° Depression angle (Watts):		100
Distance to Int. Level at 0° Depression angle (meters):		35.5
Free Space Signal = 106.92 -20*log(distance in km) + dBk		



35.5 Meter Interference Disk about Proposed Site

Sites

Site: Northern Arizona University LPFM
N35°11'29.94" W111°39'16.78" 2106.0 m
NAU Tx.Ht.AGL: 14.6 m Total ERPd: 0.10 kW
Model: 1 Isotropic-horizontal/0.0° 10 7.1000 MHz

METERS

-25 0 50

Northern Arizona University

35.5 Meter Circle

Figure I Thu Oct 02 14:33:14 2014

Figure I