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Method of Moments Analysis  
of the  
Effect of the Existing KKRT-AM Tower  
on the  
Directional Operation of KPQ-AM

Wenatchee, Washington

Prepared for  
MCC Radio, LLC

June 2015

This Engineering Report has been prepared on behalf of Adapt Engineering. It contains a method of moments analysis of the potential effect of the existing KKRT-AM tower (ASR# 1031821) on the directional operation of nearby AM station KPQ, as required by §1.30002(b) of the rules of the Federal Communications Commission. This report has been completed in order to satisfy Special Operating Condition #5 of Construction Permit BNPFT-20130805ACF. This condition requires a partial proof of performance be conducted on KPQ both before and after construction of the facilities authorized by the above listed Construction Permit. Since KPQ was licensed via a method of moments proof of performance, a traditional measurement based partial proof, as specified in §73.154, is not possible, as there are no measurement points to duplicate.

A model of the KPQ directional antenna array has been made using Expert Mininec Broadcast Professional Ver 14.0, assuming a lossless environment. The tower heights, spacing and orientation of the towers in the KPQ array contained in the CDBS (the FCC broadcast database) were used in the model. The bases of the KPQ towers were then driven in the model with voltages chosen such that the current moments for the towers calculated by the model are related to each other by the same ratio and phase as the theoretical field parameters of the KPQ antenna listed in the CDBS.

Based on the geographic coordinates for KPQ and KKRT obtained from FCCs ASR database, the KKRT tower is located 2.48 km (1667.7 electrical degrees) from the center of the KPQ array, at a bearing of 292.8°, and is 50.85 electrical degrees in height at KPQ's frequency (560 kHz). The KKRT tower was added to the Mininec model at this location. The model was then used to calculate the field strength of KPQ at a distance of 1 km in all directions, both with and without the affects of the KKRT tower<sup>1</sup>. These values are tabulated in columns 2 and 3 of the chart titled "KPQ-AM KKRT Tower MOM Analysis". The ratio of these two values is then multiplied by the FCC Theoretical IDF (Inverse Distance Field) for each radial under study. As these values do not exceed the IDF values of the FCC Augmented Standard pattern, (the values in the column labeled "Margin" are all positive), it is therefore determined that the KKRT tower does not negatively affect the operation of KPQ.

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<sup>1</sup>The base of the KKRT tower was loaded with an inductive reactance of 88 ohms (25μH), the value of the isolation coil obtained from the manufacturer.

## Mininec Model - KPQ

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KPQ

### GEOMETRY

Wire coordinates in degrees; other dimensions in meters

Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.29	19
		0	0	61.4		
2	none	90.	149.	0	.29	19
		90.	149.	61.4		
3	none	1,667.7	292.8	0	.58	19
		1,667.7	292.8	50.85		

Number of wires = 3  
current nodes = 57

	minimum	maximum
Individual wires	wire value	wire value
segment length	3 2.67632	1 3.23158
radius	1 .29	3 .58

### ELECTRICAL DESCRIPTION

Frequencies (KHz)

no.	frequency	step	no. of steps	segment length (wavelengths)
	lowest			minimum maximum
1	560.	0	1	7.43E-03 8.98E-03

### Sources

source	node	sector	magnitude	phase	type
1	1	1	3,065.58	277.9	voltage
2	20	1	3,235.47	30.	voltage

### Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	40	0	88.	0	0	0

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### IMPEDANCE

normalization = 50.

freq (KHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 1, sector 1							
560.	15.536	-133.93	134.83	276.6	26.582	-.65382	-8.5461
source = 2; node 20, sector 1							
560.	4.0549	-146.81	146.87	271.6	118.71	-.14634	-14.797

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Parallel combination of all sources.

560,000. 5.16194 -70.1728 70.3624 274.2 28.834 -.60272 -8.8746

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CURRENT rms

Frequency = 560 KHz

Input power = 4,999.88 watts

Efficiency = 100. %

coordinates in degrees

current				mag	phase	real	imaginary
no.	X	Y	Z	(amps)	(deg)	(amps)	(amps)
GND	0	0	0	16.0778	1.3	16.0737	.364692
2	0	0	3.23158	15.2639	1.	15.2617	.257096
3	0	0	6.46316	14.655	.7	14.6538	.188488
4	0	0	9.69474	14.0539	.5	14.0533	.131463
5	0	0	12.9263	13.4366	.4	13.4363	.0826474
6	0	0	16.1579	12.7932	.2	12.7931	.0405782
7	0	0	19.3895	12.1194	0.0	12.1194	4.52E-03
8	0	0	22.6211	11.4131	359.9	11.4131	-.0259655
9	0	0	25.8526	10.6735	359.7	10.6734	-.0511474
10	0	0	29.0842	9.90032	359.6	9.90006	-.0712212
11	0	0	32.3158	9.09395	359.5	9.09353	-.0863307
12	0	0	35.5474	8.25484	359.3	8.25427	-.0965873
13	0	0	38.779	7.38318	359.2	7.38248	-.102079
14	0	0	42.0105	6.47931	359.1	6.47849	-.10287
15	0	0	45.2421	5.54267	359.	5.54179	-.0989992
16	0	0	48.4737	4.57175	358.9	4.57085	-.0904616
17	0	0	51.7053	3.56269	358.8	3.56185	-.0771772
18	0	0	54.9368	2.50635	358.7	2.50566	-.0588958
19	0	0	58.1684	1.3799	358.5	1.37946	-.0349454
END	0	0	61.4	0	0	0	0
GND	-77.1451	-46.3534	0	15.5774	118.4	-7.40631	13.7041
21	-77.1451	-46.3534	3.23158	14.7169	118.3	-6.97719	12.9578
22	-77.1451	-46.3534	6.46316	14.0823	118.2	-6.66297	12.4063
23	-77.1451	-46.3534	9.69474	13.4642	118.2	-6.35888	11.8679
24	-77.1451	-46.3534	12.9263	12.8371	118.1	-6.05228	11.3209
25	-77.1451	-46.3534	16.1579	12.1906	118.1	-5.73793	10.7558
26	-77.1451	-46.3534	19.3895	11.52	118.	-5.41345	10.1688
27	-77.1451	-46.3534	22.6211	10.8229	118.	-5.07774	9.55782
28	-77.1451	-46.3534	25.8526	10.0984	117.9	-4.73033	8.92199
29	-77.1451	-46.3534	29.0842	9.34634	117.9	-4.37112	8.2612
30	-77.1451	-46.3534	32.3158	8.56681	117.8	-4.00022	7.57552
31	-77.1451	-46.3534	35.5474	7.76015	117.8	-3.61784	6.86522
32	-77.1451	-46.3534	38.779	6.92676	117.7	-3.22418	6.13064
33	-77.1451	-46.3534	42.0105	6.06675	117.7	-2.81936	5.37184
34	-77.1451	-46.3534	45.2421	5.17973	117.6	-2.40325	4.58846
35	-77.1451	-46.3534	48.4737	4.26428	117.6	-1.97529	3.7792
36	-77.1451	-46.3534	51.7053	3.31688	117.5	-1.5339	2.94089
37	-77.1451	-46.3534	54.9368	2.32912	117.5	-1.0753	2.06605
38	-77.1451	-46.3534	58.1684	1.27994	117.4	-.589893	1.1359
END	-77.1451	-46.3534	61.4	0	0	0	0

GND	646.26	1,537.39	0	.168622	145.2	-.138503	.0961785
40	646.26	1,537.39	2.67632	.169854	145.2	-.139515	.0968814
41	646.26	1,537.39	5.35263	.163717	145.2	-.134473	.0933812
42	646.26	1,537.39	8.02895	.158636	145.2	-.1303	.0904842
43	646.26	1,537.39	10.7053	.153236	145.2	-.125864	.0874048
44	646.26	1,537.39	13.3816	.147415	145.2	-.121081	.0840856
45	646.26	1,537.39	16.0579	.14111	145.2	-.115903	.0804907
46	646.26	1,537.39	18.7342	.134292	145.2	-.110301	.076603
47	646.26	1,537.39	21.4105	.126942	145.2	-.104263	.072412
48	646.26	1,537.39	24.0868	.119048	145.2	-.097778	.0679112
49	646.26	1,537.39	26.7632	.110602	145.2	-.0908392	.0630951
50	646.26	1,537.39	29.4395	.101594	145.2	-.0834393	.0579583
51	646.26	1,537.39	32.1158	.0920122	145.2	-.0755685	.0524943
52	646.26	1,537.39	34.7921	.0818397	145.2	-.0672125	.0466927
53	646.26	1,537.39	37.4684	.0710479	145.2	-.0583481	.0405376
54	646.26	1,537.39	40.1447	.0595889	145.2	-.0489362	.0340013
55	646.26	1,537.39	42.8211	.0473763	145.2	-.0389057	.0270345
56	646.26	1,537.39	45.4974	.0342294	145.2	-.0281085	.0195337
57	646.26	1,537.39	48.1737	.0198486	145.2	-.0162987	.0113278
END	646.26	1,537.39	50.85	0	0	0	0

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CURRENT MOMENTS(amp-degrees) rms

Frequency = 560 KHz

Input power = 5,000. watts

wire	magnitude	phase (deg)	vertical current moment	
			magnitude	phase (deg)
1	1,162.92	360.	1,162.92	360.
2	1,104.79	118.	1,104.79	118.
3	11.3511	145.2	11.3511	145.2

Medium wave array vertical current moment (amps-degrees) rms

(Calculation assumes tower wires are grouped together.

The first wire of each group must contain the source.)

tower	magnitude	phase (deg)
1	1,162.92	360.
2	1,114.9	118.3

**KPQ-AM KKRT Tower MOM Analysis**

Azimuth	Mininec KPQ IDF W/O KKRT Tower (mv/m@1km)	Mininec KPQ IDF WITH KKRT Tower (mv/m@1km)	Ratio W to W/O	FCC KPQ Theo IDF (mv/m@1km)	FCC KPQ Std Pat (mv/m@1km)	KPQ Theo x Ratio (mv/m@1km)	Margin Aug Std - Theo x Ratio	If Theo x Ratio < Aug Std then Pass
0	1057.46	1060.97	1.003	1010.02	1060.78	1013.37	47.41	Pass
1	1054.61	1059.76	1.005	1007.30	1057.92	1012.22	45.71	Pass
2	1051.63	1057.27	1.005	1004.45	1054.93	1009.83	45.10	Pass
3	1048.50	1053.35	1.005	1001.46	1051.80	1006.10	45.70	Pass
4	1045.24	1048.17	1.003	998.34	1048.52	1001.14	47.38	Pass
5	1041.82	1042.13	1.000	995.08	1045.10	995.38	49.72	Pass
6	1038.25	1035.86	0.998	991.68	1041.52	989.39	52.13	Pass
7	1034.53	1029.99	0.996	988.12	1037.79	983.78	54.01	Pass
8	1030.65	1025.05	0.995	984.41	1033.90	979.07	54.84	Pass
9	1026.61	1021.33	0.995	980.55	1029.85	975.51	54.34	Pass
10	1022.40	1018.75	0.996	976.53	1025.63	973.05	52.58	Pass
11	1018.03	1016.92	0.999	972.35	1021.24	971.29	49.95	Pass
12	1013.48	1015.20	1.002	968.01	1016.68	969.65	47.03	Pass
13	1008.76	1012.87	1.004	963.50	1011.95	967.42	44.52	Pass
14	1003.85	1009.33	1.005	958.82	1007.03	964.05	42.98	Pass
15	998.77	1004.21	1.005	953.96	1001.93	959.16	42.78	Pass
16	993.50	997.51	1.004	948.93	996.65	952.75	43.90	Pass
17	988.05	989.58	1.002	943.72	991.18	945.18	46.00	Pass
18	982.40	981.05	0.999	938.33	985.52	937.04	48.49	Pass
19	976.57	972.68	0.996	932.75	979.67	929.04	50.64	Pass
20	970.54	965.12	0.994	926.99	973.63	921.82	51.81	Pass
21	964.31	958.79	0.994	921.05	967.38	915.77	51.61	Pass
22	957.88	953.71	0.996	914.91	960.94	910.93	50.01	Pass
23	951.26	949.53	0.998	908.58	954.30	906.93	47.36	Pass
24	944.43	945.60	1.001	902.06	947.45	903.17	44.28	Pass
25	937.40	941.14	1.004	895.34	940.40	898.92	41.48	Pass
26	930.16	935.49	1.006	888.43	933.14	893.52	39.62	Pass
27	922.71	928.24	1.006	881.32	925.68	886.60	39.08	Pass
28	915.07	919.34	1.005	874.01	918.01	878.09	39.92	Pass
29	907.21	909.11	1.002	866.51	910.14	868.32	41.81	Pass
30	899.14	898.17	0.999	858.80	902.05	857.88	44.17	Pass
31	890.87	887.28	0.996	850.90	893.76	847.47	46.28	Pass
32	882.39	877.10	0.994	842.80	885.25	837.75	47.50	Pass
33	873.70	868.09	0.994	834.50	876.54	829.14	47.40	Pass
34	864.80	860.30	0.995	826.01	867.62	821.71	45.92	Pass
35	855.70	853.45	0.997	817.31	858.50	815.16	43.33	Pass
36	846.39	846.95	1.001	808.42	849.17	808.95	40.21	Pass
37	836.88	840.08	1.004	799.34	839.63	802.39	37.24	Pass
38	827.17	832.20	1.006	790.06	829.89	794.86	35.03	Pass
39	817.25	822.87	1.007	780.59	819.95	785.95	34.00	Pass
40	807.14	811.96	1.006	770.93	809.81	775.53	34.28	Pass
41	796.83	799.70	1.004	761.08	799.48	763.82	35.66	Pass
42	786.32	786.55	1.000	751.04	788.94	751.26	37.68	Pass
43	775.62	773.16	0.997	740.83	778.22	738.48	39.75	Pass
44	764.74	760.17	0.994	730.43	767.31	726.06	41.25	Pass
45	753.67	748.05	0.993	719.86	756.21	714.49	41.72	Pass
46	742.42	737.05	0.993	709.11	744.94	703.98	40.96	Pass
47	730.99	727.07	0.995	698.19	733.48	694.45	39.03	Pass
48	719.39	717.77	0.998	687.11	721.85	685.56	36.29	Pass
49	707.62	708.62	1.001	675.87	710.05	676.83	33.22	Pass
50	695.68	699.07	1.005	664.47	698.09	667.70	30.38	Pass
51	683.58	688.61	1.007	652.91	686.06	657.72	28.35	Pass
52	671.33	676.94	1.008	641.21	674.09	646.57	27.52	Pass
53	658.93	663.97	1.008	629.37	662.15	634.18	27.97	Pass
54	646.38	649.86	1.005	617.38	650.23	620.70	29.53	Pass
55	633.70	634.93	1.002	605.27	638.29	606.45	31.84	Pass
56	620.88	619.65	0.998	593.02	626.28	591.85	34.43	Pass
57	607.93	604.48	0.994	580.66	614.14	577.36	36.77	Pass
58	594.86	589.84	0.992	568.17	601.82	563.38	38.44	Pass
59	581.68	576.00	0.990	555.58	589.26	550.16	39.10	Pass
60	568.39	563.05	0.991	542.89	576.42	537.79	38.63	Pass
61	555.00	550.91	0.993	530.10	563.27	526.19	37.08	Pass
62	541.51	539.33	0.996	517.22	549.78	515.13	34.65	Pass
63	527.94	527.98	1.000	504.25	535.96	504.29	31.67	Pass
64	514.28	516.50	1.004	491.21	521.81	493.32	28.49	Pass

65	500.55	504.57	1.008	478.10	507.39	481.93	25.47	Pass
66	486.76	491.94	1.011	464.92	492.75	469.87	22.88	Pass
67	472.90	478.50	1.012	451.69	477.96	457.03	20.93	Pass
68	459.00	464.23	1.011	438.41	463.11	443.40	19.71	Pass
69	445.05	449.22	1.009	425.08	448.29	429.07	19.22	Pass
70	431.07	433.65	1.006	411.73	433.58	414.20	19.38	Pass
71	417.05	417.76	1.002	398.34	419.08	399.02	20.07	Pass
72	403.02	401.78	0.997	384.94	404.87	383.76	21.11	Pass
73	388.97	385.96	0.992	371.52	390.81	368.65	22.16	Pass
74	374.92	370.50	0.988	358.10	376.74	353.88	22.86	Pass
75	360.88	355.54	0.985	344.69	362.68	339.58	23.10	Pass
76	346.84	341.14	0.984	331.28	348.64	325.84	22.80	Pass
77	332.83	327.33	0.983	317.90	334.62	312.65	21.97	Pass
78	318.84	314.05	0.985	304.54	320.62	299.96	20.66	Pass
79	304.89	301.21	0.988	291.21	306.67	287.70	18.97	Pass
80	290.98	288.69	0.992	277.93	292.77	275.74	17.03	Pass
81	277.13	276.36	0.997	264.69	278.92	263.96	14.96	Pass
82	263.33	264.09	1.003	251.52	265.14	252.24	12.89	Pass
83	249.61	251.79	1.009	238.41	251.43	240.49	10.94	Pass
84	235.96	239.37	1.014	225.37	237.81	228.63	9.18	Pass
85	222.40	226.78	1.020	212.42	224.28	216.61	7.67	Pass
86	208.94	214.01	1.024	199.56	210.85	204.41	6.45	Pass
87	195.58	201.05	1.028	186.80	197.54	192.03	5.52	Pass
88	182.34	187.92	1.031	174.16	184.36	179.49	4.87	Pass
89	169.22	174.68	1.032	161.63	171.33	166.84	4.48	Pass
90	156.24	161.37	1.033	149.23	158.44	154.13	4.32	Pass
91	143.42	148.04	1.032	136.98	145.74	141.40	4.33	Pass
92	130.76	134.78	1.031	124.90	133.23	128.73	4.49	Pass
93	118.30	121.64	1.028	112.99	120.94	116.18	4.75	Pass
94	106.04	108.70	1.025	101.28	108.91	103.82	5.09	Pass
95	94.04	96.03	1.021	89.82	97.19	91.72	5.46	Pass
96	82.33	83.73	1.017	78.64	85.84	79.98	5.87	Pass
97	71.00	71.93	1.013	67.82	74.98	68.70	6.28	Pass
98	60.17	60.79	1.010	57.47	65.39	58.06	7.33	Pass
99	50.04	50.60	1.011	47.80	61.40	48.33	13.07	Pass
100	41.02	41.87	1.021	39.18	62.78	40.00	22.79	Pass
101	33.82	35.43	1.048	32.30	66.31	33.84	32.46	Pass
102	29.57	32.39	1.095	28.24	76.15	30.94	45.21	Pass
103	29.38	33.41	1.137	28.06	92.47	31.91	60.56	Pass
104	33.13	37.95	1.145	31.64	107.63	36.25	71.39	Pass
105	39.56	44.77	1.132	37.78	117.56	42.76	74.80	Pass
106	47.45	52.84	1.113	45.33	120.70	50.47	70.23	Pass
107	56.09	61.56	1.097	53.57	117.79	58.80	58.99	Pass
108	65.07	70.58	1.085	62.15	111.13	67.41	43.72	Pass
109	74.19	79.71	1.074	70.86	102.84	76.13	26.71	Pass
110	83.31	88.85	1.066	79.57	98.69	84.86	13.83	Pass
111	92.37	97.92	1.060	88.23	104.19	93.53	10.66	Pass
112	101.33	106.88	1.055	96.78	115.00	102.09	12.91	Pass
113	110.14	115.71	1.051	105.19	125.46	110.52	14.95	Pass
114	118.78	124.37	1.047	113.45	135.48	118.79	16.69	Pass
115	127.24	132.86	1.044	121.54	144.98	126.90	18.08	Pass
116	135.51	141.16	1.042	129.43	153.91	134.83	19.08	Pass
117	143.58	149.26	1.040	137.14	162.23	142.56	19.66	Pass
118	151.44	157.14	1.038	144.64	169.93	150.09	19.84	Pass
119	159.08	164.79	1.036	151.94	177.03	157.40	19.63	Pass
120	166.49	172.20	1.034	159.02	183.55	164.48	19.07	Pass
121	173.68	179.36	1.033	165.89	189.53	171.32	18.21	Pass
122	180.64	186.26	1.031	172.54	195.03	177.90	17.13	Pass
123	187.37	192.88	1.029	178.96	200.11	184.22	15.89	Pass
124	193.85	199.20	1.028	185.16	204.85	190.27	14.58	Pass
125	200.10	205.22	1.026	191.12	209.32	196.01	13.30	Pass
126	206.11	210.92	1.023	196.86	213.60	201.46	12.14	Pass
127	211.87	216.29	1.021	202.36	217.76	206.58	11.18	Pass
128	217.38	221.31	1.018	207.63	221.88	211.39	10.50	Pass
129	222.65	225.99	1.015	212.66	226.01	215.85	10.16	Pass
130	227.66	230.32	1.012	217.45	230.19	219.98	10.21	Pass
131	232.43	234.29	1.008	222.00	234.45	223.78	10.67	Pass
132	236.95	237.92	1.004	226.32	238.79	227.25	11.54	Pass
133	241.21	241.23	1.000	230.39	243.04	230.41	12.63	Pass
134	245.22	244.24	0.996	234.21	247.04	233.28	13.76	Pass
135	248.97	246.98	0.992	237.80	250.79	235.90	14.89	Pass
136	252.46	249.49	0.988	241.14	254.28	238.30	15.98	Pass
137	255.71	251.83	0.985	244.23	257.52	240.53	16.99	Pass

138	258.69	254.05	0.982	247.08	260.50	242.65	17.85	Pass
139	261.41	256.20	0.980	249.69	263.22	244.71	18.51	Pass
140	263.88	258.35	0.979	252.04	265.69	246.76	18.92	Pass
141	266.09	260.54	0.979	254.15	267.89	248.85	19.04	Pass
142	268.04	262.80	0.980	256.02	269.84	251.01	18.83	Pass
143	269.73	265.14	0.983	257.63	271.53	253.25	18.28	Pass
144	271.16	267.56	0.987	259.00	272.96	255.55	17.41	Pass
145	272.33	269.99	0.991	260.12	274.13	257.88	16.25	Pass
146	273.25	272.38	0.997	260.99	275.04	260.16	14.88	Pass
147	273.90	274.62	1.003	261.61	275.69	262.30	13.39	Pass
148	274.29	276.57	1.008	261.98	276.08	264.17	11.91	Pass
149	274.42	278.12	1.013	262.11	276.21	265.64	10.57	Pass
150	274.29	279.11	1.018	261.98	276.08	266.58	9.50	Pass
151	273.90	279.42	1.020	261.61	275.69	266.88	8.81	Pass
152	273.25	278.95	1.021	260.99	275.04	266.44	8.60	Pass
153	272.33	277.66	1.020	260.12	274.13	265.20	8.93	Pass
154	271.16	275.54	1.016	259.00	272.96	263.18	9.78	Pass
155	269.73	272.66	1.011	257.63	271.53	260.43	11.10	Pass
156	268.04	269.16	1.004	256.02	269.84	257.09	12.75	Pass
157	266.09	265.24	0.997	254.15	267.89	253.34	14.55	Pass
158	263.88	261.13	0.990	252.04	265.69	249.41	16.27	Pass
159	261.41	257.09	0.983	249.69	263.22	245.56	17.66	Pass
160	258.69	253.37	0.979	247.08	260.50	242.00	18.49	Pass
161	255.71	250.14	0.978	244.23	257.52	238.92	18.60	Pass
162	252.46	247.48	0.980	241.14	254.28	236.38	17.90	Pass
163	248.97	245.33	0.985	237.80	250.79	234.33	16.46	Pass
164	245.22	243.52	0.993	234.21	249.19	232.59	16.60	Pass
165	241.21	241.74	1.002	230.39	251.08	230.90	20.19	Pass
166	236.95	239.66	1.011	226.32	254.89	228.91	25.98	Pass
167	232.43	236.91	1.019	222.00	258.48	226.28	32.20	Pass
168	227.66	233.19	1.024	217.45	259.83	222.72	37.11	Pass
169	222.65	228.30	1.025	212.66	257.50	218.05	39.45	Pass
170	217.38	222.19	1.022	207.63	250.82	212.22	38.60	Pass
171	211.87	214.98	1.015	202.36	240.04	205.34	34.71	Pass
172	206.11	206.94	1.004	196.86	226.33	197.66	28.67	Pass
173	200.10	198.48	0.992	191.12	211.65	189.58	22.08	Pass
174	193.85	190.07	0.980	185.16	198.53	181.54	16.98	Pass
175	187.37	182.16	0.972	178.96	189.37	173.99	15.38	Pass
176	180.64	175.08	0.969	172.54	182.68	167.23	15.45	Pass
177	173.68	168.94	0.973	165.89	175.76	161.36	14.40	Pass
178	166.49	163.59	0.983	159.02	168.62	156.25	12.37	Pass
179	159.08	158.64	0.997	151.94	161.26	151.52	9.73	Pass
180	151.44	153.57	1.014	144.64	153.68	146.68	7.00	Pass
181	143.58	147.84	1.030	137.14	145.90	141.21	4.69	Pass
182	135.51	141.02	1.041	129.43	137.92	134.69	3.23	Pass
183	127.24	132.86	1.044	121.54	130.03	126.90	3.13	Pass
184	118.78	123.35	1.038	113.45	123.90	117.82	6.09	Pass
185	110.14	112.71	1.023	105.19	119.66	107.66	12.00	Pass
186	101.33	101.37	1.000	96.78	116.61	96.82	19.79	Pass
187	92.37	89.88	0.973	88.23	113.76	85.85	27.91	Pass
188	83.31	78.81	0.946	79.57	110.05	75.28	34.77	Pass
189	74.19	68.67	0.926	70.86	104.61	65.59	39.02	Pass
190	65.07	59.73	0.918	62.15	96.89	57.05	39.84	Pass
191	56.09	52.00	0.927	53.57	87.21	49.66	37.55	Pass
192	47.45	45.25	0.954	45.33	78.97	43.22	35.76	Pass
193	39.56	39.32	0.994	37.78	73.42	37.55	35.86	Pass
194	33.13	34.45	1.040	31.64	70.44	32.90	37.53	Pass
195	29.38	31.66	1.077	28.06	69.30	30.24	39.06	Pass
196	29.57	32.45	1.097	28.24	69.07	30.99	38.08	Pass
197	33.82	37.41	1.106	32.30	67.07	35.73	31.34	Pass
198	41.02	45.56	1.111	39.18	64.29	43.51	20.78	Pass
199	50.04	55.39	1.107	47.80	63.52	52.90	10.62	Pass
200	60.17	65.73	1.093	57.47	67.59	62.78	4.81	Pass
201	71.00	75.88	1.069	67.82	76.72	72.47	4.25	Pass
202	82.33	85.53	1.039	78.64	86.95	81.69	5.26	Pass
203	94.04	94.78	1.008	89.82	97.71	90.53	7.18	Pass
204	106.04	104.08	0.981	101.28	109.04	99.41	9.63	Pass
205	118.30	114.02	0.964	112.99	120.94	108.90	12.03	Pass
206	130.76	125.19	0.957	124.90	133.23	119.57	13.65	Pass
207	143.42	137.94	0.962	136.98	145.74	131.75	13.99	Pass
208	156.24	152.22	0.974	149.23	158.44	145.39	13.05	Pass
209	169.22	167.65	0.991	161.63	171.33	160.13	11.20	Pass
210	182.34	183.57	1.007	174.16	184.36	175.34	9.03	Pass



211	195.58	199.29	1.019	186.80	197.54	190.35	7.19	Pass
212	208.94	214.20	1.025	199.56	210.85	204.59	6.26	Pass
213	222.40	227.92	1.025	212.42	224.28	217.69	6.58	Pass
214	235.96	240.38	1.019	225.37	237.81	229.59	8.21	Pass
215	249.61	251.82	1.009	238.41	251.43	240.53	10.90	Pass
216	263.33	262.78	0.998	251.52	265.14	250.99	14.14	Pass
217	277.13	273.93	0.988	264.69	278.92	261.64	17.28	Pass
218	290.98	285.91	0.983	277.93	292.77	273.08	19.68	Pass
219	304.89	299.19	0.981	291.21	306.67	285.76	20.91	Pass
220	318.84	313.89	0.984	304.54	320.62	299.81	20.81	Pass
221	332.83	329.81	0.991	317.90	334.62	315.01	19.60	Pass
222	346.84	346.45	0.999	331.28	348.64	330.90	17.73	Pass
223	360.88	363.16	1.006	344.69	362.68	346.87	15.82	Pass
224	374.92	379.33	1.012	358.10	376.74	362.31	14.43	Pass
225	388.97	394.48	1.014	371.52	390.81	376.78	14.03	Pass
226	403.02	408.37	1.013	384.94	404.87	390.05	14.81	Pass
227	417.05	421.07	1.010	398.34	418.92	402.18	16.74	Pass
228	431.07	432.86	1.004	411.73	432.95	413.44	19.51	Pass
229	445.05	444.24	0.998	425.08	446.95	424.31	22.65	Pass
230	459.00	455.75	0.993	438.41	460.92	435.30	25.62	Pass
231	472.90	467.91	0.989	451.69	474.85	446.92	27.93	Pass
232	486.76	481.07	0.988	464.92	488.73	459.48	29.25	Pass
233	500.55	495.32	0.990	478.10	502.55	473.10	29.45	Pass
234	514.28	510.55	0.993	491.21	516.30	487.65	28.66	Pass
235	527.94	526.41	0.997	504.25	529.98	502.80	27.19	Pass
236	541.51	542.45	1.002	517.22	543.59	518.11	25.47	Pass
237	555.00	558.18	1.006	530.10	557.10	533.14	23.96	Pass
238	568.39	573.21	1.008	542.89	570.52	547.49	23.03	Pass
239	581.68	587.25	1.010	555.58	583.84	560.90	22.93	Pass
240	594.86	600.20	1.009	568.17	597.05	573.28	23.77	Pass
241	607.93	612.14	1.007	580.66	610.14	584.67	25.47	Pass
242	620.88	623.26	1.004	593.02	623.12	595.30	27.82	Pass
243	633.70	633.88	1.000	605.27	635.96	605.44	30.52	Pass
244	646.38	644.36	0.997	617.38	648.68	615.45	33.22	Pass
245	658.93	655.04	0.994	629.37	661.25	625.65	35.60	Pass
246	671.33	666.16	0.992	641.21	673.68	636.28	37.40	Pass
247	683.58	677.90	0.992	652.91	685.96	647.49	38.47	Pass
248	695.68	690.29	0.992	664.47	698.09	659.32	38.77	Pass
249	707.62	703.23	0.994	675.87	710.05	671.68	38.37	Pass
250	719.39	716.56	0.996	687.11	721.85	684.41	37.44	Pass
251	730.99	730.05	0.999	698.19	733.48	697.29	36.19	Pass
252	742.42	743.43	1.001	709.11	744.94	710.08	34.86	Pass
253	753.67	756.48	1.004	719.86	756.21	722.54	33.68	Pass
254	764.74	768.99	1.006	730.43	767.31	734.49	32.82	Pass
255	775.62	780.83	1.007	740.83	778.22	745.80	32.42	Pass
256	786.32	791.93	1.007	751.04	788.94	756.40	32.55	Pass
257	796.83	802.27	1.007	761.08	799.48	766.28	33.20	Pass
258	807.14	811.92	1.006	770.93	809.81	775.49	34.32	Pass
259	817.25	820.95	1.005	780.59	819.95	784.12	35.83	Pass
260	827.17	829.50	1.003	790.06	829.89	792.28	37.61	Pass
261	836.88	837.68	1.001	799.34	839.63	800.10	39.53	Pass
262	846.39	845.64	0.999	808.42	849.17	807.70	41.46	Pass
263	855.70	853.49	0.997	817.31	858.50	815.20	43.30	Pass
264	864.80	861.32	0.996	826.01	867.62	822.68	44.94	Pass
265	873.70	869.21	0.995	834.50	876.54	830.21	46.33	Pass
266	882.39	877.19	0.994	842.80	885.25	837.84	47.41	Pass
267	890.87	885.29	0.994	850.90	893.76	845.57	48.18	Pass
268	899.14	893.48	0.994	858.80	902.05	853.40	48.65	Pass
269	907.21	901.75	0.994	866.51	910.14	861.30	48.84	Pass
270	915.07	910.06	0.995	874.01	918.01	869.23	48.79	Pass
271	922.71	918.35	0.995	881.32	925.68	877.15	48.53	Pass
272	930.16	926.58	0.996	888.43	933.14	885.01	48.14	Pass
273	937.39	934.69	0.997	895.34	940.40	892.76	47.64	Pass
274	944.43	942.66	0.998	902.06	947.45	900.36	47.09	Pass
275	951.26	950.42	0.999	908.58	954.30	907.78	46.52	Pass
276	957.88	957.96	1.000	914.91	960.94	914.98	45.96	Pass
277	964.31	965.24	1.001	921.05	967.38	921.94	45.44	Pass
278	970.54	972.26	1.002	926.99	973.63	928.64	44.98	Pass
279	976.57	979.00	1.002	932.75	979.67	935.08	44.59	Pass
280	982.40	985.47	1.003	938.33	985.52	941.25	44.27	Pass
281	988.05	991.65	1.004	943.72	991.18	947.16	44.03	Pass
282	993.50	997.55	1.004	948.93	996.65	952.80	43.85	Pass
283	998.77	1003.19	1.004	953.96	1001.93	958.18	43.75	Pass

284	1003.85	1008.58	1.005	958.82	1007.03	963.33	43.70	Pass
285	1008.76	1013.72	1.005	963.50	1011.95	968.23	43.71	Pass
286	1013.48	1018.63	1.005	968.01	1016.68	972.93	43.75	Pass
287	1018.03	1023.31	1.005	972.35	1021.24	977.40	43.84	Pass
288	1022.40	1027.79	1.005	976.53	1025.63	981.68	43.95	Pass
289	1026.61	1032.07	1.005	980.55	1029.85	985.77	44.08	Pass
290	1030.65	1036.17	1.005	984.41	1033.90	989.69	44.21	Pass
291	1034.53	1040.08	1.005	988.12	1037.79	993.42	44.37	Pass
292	1038.25	1043.82	1.005	991.68	1041.52	997.00	44.53	Pass
293	1041.82	1047.40	1.005	995.08	1045.10	1000.41	44.69	Pass
294	1045.24	1050.82	1.005	998.34	1048.52	1003.67	44.85	Pass
295	1048.50	1054.08	1.005	1001.46	1051.80	1006.79	45.01	Pass
296	1051.63	1057.18	1.005	1004.45	1054.93	1009.75	45.18	Pass
297	1054.61	1060.14	1.005	1007.30	1057.92	1012.58	45.34	Pass
298	1057.46	1062.94	1.005	1010.02	1060.78	1015.25	45.53	Pass
299	1060.17	1065.59	1.005	1012.61	1063.50	1017.78	45.71	Pass
300	1062.75	1068.08	1.005	1015.07	1066.08	1020.16	45.92	Pass
301	1065.21	1070.42	1.005	1017.42	1068.55	1022.39	46.15	Pass
302	1067.54	1072.58	1.005	1019.65	1070.89	1024.46	46.43	Pass
303	1069.76	1074.58	1.005	1021.76	1073.11	1026.37	46.74	Pass
304	1071.85	1076.40	1.004	1023.77	1075.21	1028.11	47.10	Pass
305	1073.84	1078.04	1.004	1025.66	1077.20	1029.68	47.53	Pass
306	1075.72	1079.49	1.004	1027.46	1079.09	1031.06	48.03	Pass
307	1077.49	1080.75	1.003	1029.15	1080.86	1032.26	48.60	Pass
308	1079.16	1081.83	1.002	1030.74	1082.54	1033.29	49.24	Pass
309	1080.73	1082.72	1.002	1032.24	1084.11	1034.14	49.97	Pass
310	1082.20	1083.42	1.001	1033.65	1085.59	1034.81	50.77	Pass
311	1083.58	1083.97	1.000	1034.97	1086.97	1035.34	51.63	Pass
312	1084.87	1084.36	1.000	1036.20	1088.26	1035.71	52.55	Pass
313	1086.07	1084.63	0.999	1037.34	1089.46	1035.97	53.50	Pass
314	1087.18	1084.80	0.998	1038.40	1090.58	1036.13	54.45	Pass
315	1088.21	1084.93	0.997	1039.39	1091.61	1036.26	55.35	Pass
316	1089.16	1085.06	0.996	1040.29	1092.56	1036.38	56.18	Pass
317	1090.03	1085.24	0.996	1041.13	1093.43	1036.55	56.88	Pass
318	1090.82	1085.51	0.995	1041.88	1094.23	1036.81	57.42	Pass
319	1091.54	1085.94	0.995	1042.57	1094.95	1037.22	57.73	Pass
320	1092.18	1086.57	0.995	1043.18	1095.59	1037.82	57.77	Pass
321	1092.75	1087.43	0.995	1043.73	1096.17	1038.65	57.52	Pass
322	1093.26	1088.53	0.996	1044.21	1096.67	1039.69	56.98	Pass
323	1093.69	1089.87	0.997	1044.62	1097.10	1040.97	56.13	Pass
324	1094.05	1091.43	0.998	1044.97	1097.47	1042.46	55.00	Pass
325	1094.35	1093.13	0.999	1045.25	1097.76	1044.08	53.68	Pass
326	1094.58	1094.89	1.000	1045.47	1097.99	1045.77	52.23	Pass
327	1094.74	1096.61	1.002	1045.63	1098.16	1047.41	50.75	Pass
328	1094.84	1098.15	1.003	1045.72	1098.26	1048.88	49.38	Pass
329	1094.87	1099.37	1.004	1045.75	1098.29	1050.05	48.24	Pass
330	1094.84	1100.16	1.005	1045.72	1098.26	1050.80	47.46	Pass
331	1094.74	1100.39	1.005	1045.63	1098.16	1051.02	47.14	Pass
332	1094.58	1100.01	1.005	1045.47	1097.99	1050.66	47.34	Pass
333	1094.35	1099.00	1.004	1045.25	1097.76	1049.69	48.07	Pass
334	1094.05	1097.41	1.003	1044.97	1097.47	1048.18	49.29	Pass
335	1093.69	1095.34	1.002	1044.62	1097.10	1046.20	50.91	Pass
336	1093.25	1092.98	1.000	1044.21	1096.67	1043.95	52.72	Pass
337	1092.75	1090.54	0.998	1043.73	1096.17	1041.62	54.55	Pass
338	1092.18	1088.29	0.996	1043.18	1095.59	1039.47	56.13	Pass
339	1091.54	1086.44	0.995	1042.57	1094.95	1037.70	57.25	Pass
340	1090.82	1085.19	0.995	1041.88	1094.23	1036.50	57.72	Pass
341	1090.03	1084.66	0.995	1041.13	1093.43	1036.00	57.44	Pass
342	1089.16	1084.83	0.996	1040.29	1092.56	1036.16	56.40	Pass
343	1088.21	1085.59	0.998	1039.39	1091.61	1036.89	54.72	Pass
344	1087.18	1086.70	1.000	1038.40	1090.58	1037.95	52.63	Pass
345	1086.07	1087.83	1.002	1037.34	1089.46	1039.02	50.44	Pass
346	1084.87	1088.61	1.003	1036.20	1088.26	1039.77	48.49	Pass
347	1083.58	1088.71	1.005	1034.97	1086.97	1039.86	47.10	Pass
348	1082.20	1087.85	1.005	1033.65	1085.59	1039.04	46.54	Pass
349	1080.73	1085.92	1.005	1032.24	1084.11	1037.20	46.91	Pass
350	1079.16	1082.96	1.004	1030.74	1082.54	1034.37	48.16	Pass
351	1077.49	1079.18	1.002	1029.15	1080.86	1030.76	50.10	Pass
352	1075.72	1074.95	0.999	1027.46	1079.09	1026.72	52.36	Pass
353	1073.84	1070.75	0.997	1025.66	1077.20	1022.71	54.49	Pass
354	1071.85	1067.02	0.995	1023.77	1075.21	1019.15	56.06	Pass
355	1069.76	1064.13	0.995	1021.76	1073.11	1016.38	56.72	Pass
356	1067.54	1062.28	0.995	1019.65	1070.89	1014.62	56.26	Pass

357	1065.21	1061.42	0.996	1017.42	1068.55	1013.80	54.75	Pass
358	1062.75	1061.25	0.999	1015.07	1066.08	1013.64	52.44	Pass
359	1060.17	1061.29	1.001	1012.61	1063.50	1013.67	49.82	Pass

## Certification

This Engineering Report has been prepared personally by the undersigned or under my immediate supervision, and all representations are true and correct to the best of my knowledge. I am an experienced radio engineer whose qualifications are a matter of record with the Federal Communications Commission. I am an engineer in the firm of Hatfield & Dawson Consulting Engineers, LLC, and I am Registered as a Professional Engineer in the States of Washington and Oregon.

June 16, 2015



Thomas S. Gorton P.E.