

MICROWAVE PATH STUDY REPORT

ROSSLYN - INDEPENDENT HILL

Prepared for
OVERSEAS TELECOMMUNICATIONS, INC.
ALEXANDRIA, VIRGINIA

COMSEARCH, INC.
SYSTEMS ENGINEERING DIVISION
1307 GLENVILLE DRIVE
RICHARDSON, TEXAS 75081

JANUARY 1986

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SITE IDENTIFICATION: INDEPENDENT HILL, VIRGINIA
TERRESTRIAL PATH DAMASCUS - GERMANTOWN
AZIMUTH FROM EARTH STATION: 17.1 DEGREES
DISTANCE FROM EARTH STATION: 0.86 MILES
HEIGHT OF OBSTACLE: 30 FEET
(above ground)

FIGURE: 1 PATH SURVEY PHOTOGRAPHS



SITE IDENTIFICATION: INDEPENDENT HILL, VIRGINIA
TERRESTRIAL PATH: DAMASCUS - GERMANTOWN
AZIMUTH FROM EARTH STATION: 17.1 DEGREES
DISTANCE FROM EARTH STATION: 0.36 MILES
HEIGHT OF OBSTACLE: 40 FEET
(above ground)

FIGURE: 2 PATH SURVEY PHOTOGRAPHS

PATHLOSS CALCULATION

27 INDEPENDENDAMASCUS 38 37 34 77 27 23 39 20 48 77 10 18
 (6000.00 MHZ)

	<u>SITE 1</u>		<u>SITE 2</u>	
ANTENNA CENTER AGL.....	32.00 FT	9.75 M	320.00 FT	97.54 M
SITE ELEVATION AMSL.....	400.00 FT	121.92 M	880.00 FT	268.22 M
ANTENNA CENTER AMSL.....	432.00 FT	131.67 M	1200.00 FT	365.76 M
EFFECTIVE ANTENNA HT....	33.56 FT	10.23 M	783.88 FT	238.93 M
HORIZON DISTANCE.....	0.85 MI	1.37 KM	37.15 MI	59.79 KM
HORIZON ELEVATION AMSL..	439.17 FT	133.86 M	450.00 FT	137.16 M
HORIZON ANGLE.....	0.09 DG	1.52 MR	-0.42 DG	-7.34 MR
RAY CROSSOVER ANGLE.....	0.23 DG	4.03 MR		
TERRAIN DELTA HT.....	211.46 FT	64.45 M		
PATHLENGTH.....	52.01 MI	83.71 KM		
FREQUENCY.....	6000.00 MHZ			
FREE SPACE PATH LOSS....	146.49 DB			
K FACTOR (INPUT).....	1.33 (K)			
RADIO CLIMATIC ZONE.....	ONE 6 CONTINENTAL TEMPERATE			
TYPE OF PATH.....	DIFFRACTION OVER TWO ISOLATED OBSTACLES			

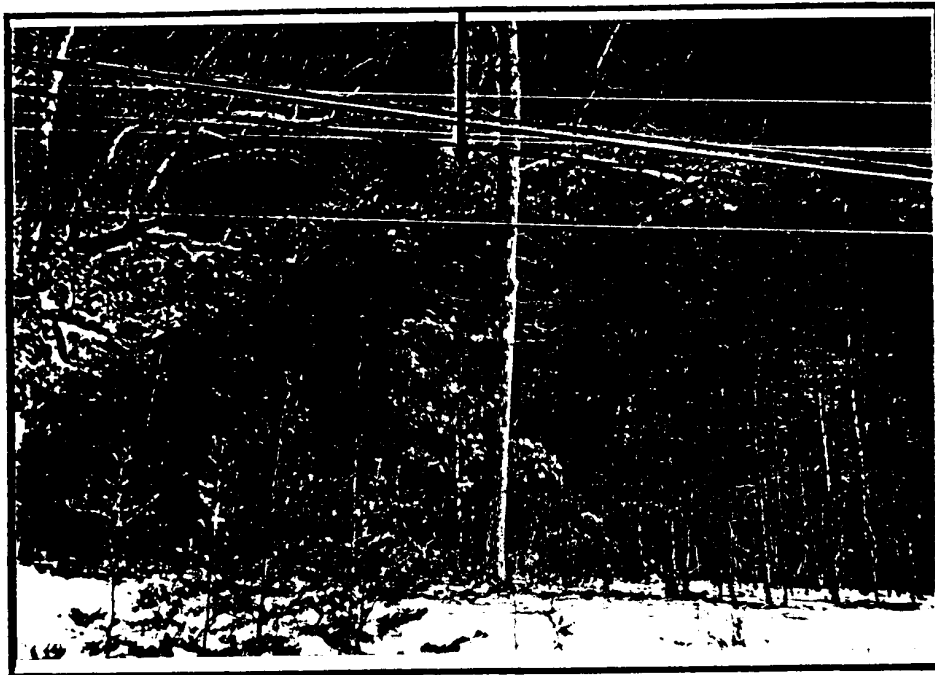
<u>LOSSES</u>	<u>L-FSPL</u>	<u>SIGMA</u>	<u>CONTROLLING PROPOGATION MODE</u>		
168.49 DB	22.00 DB	3.61 DB	20.	%	DIFFRACTION
162.02 DB	15.53 DB	3.89 DB	1.	%	DIFFRACTION
160.13 DB	13.64 DB	4.13 DB	.1	%	DIFFRACTION
158.82 DB	12.34 DB	4.31 DB	.01	%	DIFFRACTION
157.35 DB	10.87 DB	4.54 DB	.0025	%	DIFFRACTION
156.81 DB	10.33 DB	4.63 DB	.001	%	DIFFRACTION

K=INF. K=1.33					K=INF. K=1.33				
<u>DIST</u>	<u>ELEV</u>	<u>OBST</u>	<u>CLRNC</u>	<u>CLRNC</u>	<u>DIST</u>	<u>ELEV</u>	<u>OBST</u>	<u>CLRNC</u>	<u>CLRNC</u>
<u>(MI)</u>	<u>(FT)</u>	<u>(FT)</u>	<u>(FT)</u>	<u>(FT)</u>	<u>(MI)</u>	<u>(FT)</u>	<u>(FT)</u>	<u>(FT)</u>	<u>(FT)</u>
0.00	400.	32.	0.	0.	21.24	400.	0.	346.	19.
0.05	400.	0.	33.	31.	21.28	400.	0.	346.	19.
0.27	390.	0.	46.	39.	23.31	399.	0.	377.	43.
0.36	390.	40.	7.	-2.	23.51	367.	0.	412.	77.
0.42	400.	0.	38.	27.	24.71	315.	0.	482.	145.
0.43	410.	0.	28.	17.	26.83	349.	0.	479.	141.
0.50	410.	0.	29.	17.	27.53	397.	0.	441.	104.
0.86	410.	30.	5.	-17.	27.90	348.	0.	496.	160.
0.90	415.	0.	30.	7.	29.23	295.	0.	569.	236.
1.00	390.	0.	57.	31.	31.21	290.	0.	603.	278.
1.12	380.	30.	39.	10.	32.24	299.	0.	609.	290.
1.68	400.	0.	57.	15.	32.62	309.	0.	605.	288.
1.86	400.	0.	60.	13.	34.56	390.	0.	552.	251.
2.28	390.	0.	76.	19.	34.93	398.	0.	550.	251.
3.00	380.	0.	96.	23.	35.93	400.	0.	562.	273.
3.39	349.	0.	133.	51.	37.62	399.	0.	588.	318.
3.75	325.	0.	162.	72.	38.90	398.	0.	608.	353.
4.51	249.	0.	250.	142.	39.40	450.	0.	564.	315.
6.71	249.	0.	282.	130.	41.26	486.	0.	555.	333.
7.82	299.	0.	249.	76.	42.29	600.	0.	456.	251.
7.87	291.	0.	257.	84.	42.42	553.	0.	505.	302.
10.06	291.	0.	290.	79.	44.61	588.	0.	503.	338.
10.35	299.	0.	286.	70.	45.73	651.	0.	456.	312.
11.84	304.	0.	303.	65.	46.64	749.	0.	372.	246.
13.41	356.	0.	274.	15.	47.80	800.	0.	338.	237.
14.53	406.	0.	241.	-32.	48.08	800.	0.	342.	248.
14.86	450.	0.	201.	-75.	50.19	714.	0.	459.	413.
16.77	449.	0.	231.	-65.	51.06	762.	0.	424.	400.
17.64	449.	0.	243.	-60.	51.81	849.	0.	348.	343.
18.88	449.	0.	262.	-51.	52.01	880.	320.	-0.	-0.
19.25	399.	0.	317.	2.					



SITE IDENTIFICATION: INDEPENDENT HILL, VIRGINIA
TERRESTRIAL PATH: FT. BELVOIR #2 - QUANTICO
ANDREWS AFB - FT. BELVOIR
AZIMUTH FROM EARTH STATION: 67.3
66.9 DEGREES
DISTANCE FROM EARTH STATION: 1.1 MILES
HEIGHT OF OBSTACLE: 35 FEET
(above ground)

FIGURE: 3 PATH SURVEY PHOTOGRAPHS



SITE IDENTIFICATION: INDEPENDENT HILL, VIRGINIA
TERRESTRIAL PATH: FT. BELVOIR #2 - QUANTICO
ANDREWS AFB - FT. BELVOIR
AZIMUTH FROM EARTH STATION: 67.3 DEGREES
66.9
DISTANCE FROM EARTH STATION: 1.2 MILES
HEIGHT OF OBSTACLE: 35 FEET
(above ground)

FIGURE: 4 PATH SURVEY PHOTOGRAPHS

PATHLOSS CALCULATION

17 INDEPENDENT BELVOIR 2 38 37 34 77 27 23 38 43 39 77 8 44
 (6000.00 MHZ)

	<u>SITE 1</u>		<u>SITE 2</u>	
ANTENNA CENTER AGL.....	32.00 FT	9.75 M	270.00 FT	82.30 M
SITE ELEVATION AMSL.....	400.00 FT	121.92 M	130.00 FT	39.62 M
ANTENNA CENTER AMSL.....	432.00 FT	131.67 M	400.00 FT	121.92 M
EFFECTIVE ANTENNA HT....	35.65 FT	10.87 M	270.00 FT	82.30 M
HORIZON DISTANCE.....	1.15 MI	1.85 KM	17.10 MI	27.52 KM
HORIZON ELEVATION AMSL..	432.67 FT	131.88 M	433.34 FT	132.08 M
HORIZON ANGLE.....	0.00 DG	0.00 MR	-0.07 DG	-1.25 MR
RAY CROSSOVER ANGLE.....	0.13 DG	2.20 MR		
TERRAIN DELTA HT.....	70.60 FT	21.52 M		
PATHLENGTH.....	18.20 MI	29.30 KM		
FREQUENCY.....	6000.00 MHZ			
FREE SPACE PATH LOSS....	137.37 DB			
K FACTOR (INPUT).....	1.33 (K)			
RADIO CLIMATIC ZONE.....	ONE 6 CONTINENTAL TEMPERATE			
TYPE OF PATH.....	KNIFE EDGE DIFFRACTION (SINGLE OBSTACLE)			

<u>LOSSES</u>	<u>L-FSPL</u>	<u>SIGMA</u>	<u>CONTROLLING PROPOGATION MODE</u>		
142.98 DB	5.62 DB	3.58 DB	20.	%	DIFFRACTION
139.30 DB	1.93 DB	3.68 DB	1.	%	DIFFRACTION
138.28 DB	0.91 DB	3.77 DB	.1	%	DIFFRACTION
137.58 DB	0.21 DB	3.84 DB	.01	%	DIFFRACTION
136.79 DB	-0.58 DB	3.93 DB	.0025	%	DIFFRACTION
136.50 DB	-0.87 DB	3.96 DB	.001	%	DIFFRACTION

K=INF. K=1.33					K=INF. K=1.33				
<u>DIST</u>	<u>ELEV</u>	<u>OBST</u>	<u>CLRNC</u>	<u>CLRNC</u>	<u>DIST</u>	<u>ELEV</u>	<u>OBST</u>	<u>CLRNC</u>	<u>CLRNC</u>
<u>(MI)</u>	<u>(FT)</u>	<u>(FT)</u>	<u>(FT)</u>	<u>(FT)</u>	<u>(MI)</u>	<u>(FT)</u>	<u>(FT)</u>	<u>(FT)</u>	<u>(FT)</u>
0.00	400.	32.	0.	0.	8.67	249.	0.	168.	126.
0.04	400.	0.	32.	32.	9.40	249.	0.	166.	125.
0.85	359.	0.	71.	64.	9.49	215.	0.	200.	159.
1.11	400.	35.	-5.	-14.	10.26	218.	0.	196.	155.
1.28	390.	35.	5.	-6.	10.38	250.	0.	164.	123.
1.41	380.	0.	50.	38.	10.94	250.	0.	163.	123.
1.94	395.	0.	34.	18.	11.45	200.	0.	212.	173.
2.01	360.	0.	68.	52.	11.97	200.	0.	211.	174.
2.18	345.	0.	83.	66.	12.26	200.	0.	210.	174.
2.99	331.	0.	96.	73.	12.73	199.	0.	211.	176.
3.42	349.	0.	77.	52.	12.86	165.	0.	244.	210.
3.59	350.	0.	76.	49.	13.55	124.	0.	284.	253.
4.00	370.	0.	55.	27.	13.72	101.	0.	307.	276.
4.10	380.	0.	45.	16.	14.53	49.	0.	357.	331.
4.23	380.	0.	45.	15.	14.96	87.	0.	319.	294.
4.53	350.	0.	74.	43.	15.38	149.	0.	256.	234.
4.79	350.	0.	74.	41.	15.43	150.	0.	255.	233.
5.56	349.	0.	73.	38.	15.90	70.	0.	334.	316.
5.60	329.	0.	93.	58.	16.41	49.	0.	354.	339.
6.15	321.	0.	100.	63.	17.05	99.	0.	303.	293.
6.84	299.	0.	121.	82.	17.39	150.	0.	251.	244.
7.18	349.	0.	70.	31.	17.91	132.	0.	269.	266.
7.48	349.	0.	70.	30.	18.03	123.	0.	277.	276.
7.78	299.	0.	119.	79.	18.20	130.	270.	-0.	-0.
8.55	249.	0.	168.	127.					

PATHLOSS CALCULATION

1 INDEPENDENANDREWS AFB 38 37 34 77 27 23 38 48 50 76 53 18
 (6000.00 MHZ)

	<u>SITE 1</u>		<u>SITE 2</u>	
ANTENNA CENTER AGL.....	32.00 FT	9.75 M	159.00 FT	48.46 M
SITE ELEVATION AMSL.....	400.00 FT	121.92 M	263.00 FT	80.16 M
ANTENNA CENTER AMSL.....	432.00 FT	131.67 M	422.00 FT	128.63 M
EFFECTIVE ANTENNA HT....	43.85 FT	13.37 M	159.00 FT	48.46 M
HORIZON DISTANCE.....	1.10 MI	1.77 KM	32.10 MI	51.66 KM
HORIZON ELEVATION AMSL..	435.00 FT	132.59 M	435.00 FT	132.59 M
HORIZON ANGLE.....	0.02 DG	0.41 MR	-0.17 DG	-2.96 MR
RAY CROSSOVER ANGLE.....	0.22 DG	3.76 MR		
TERRAIN DELTA HT.....	151.58 FT	46.20 M		
PATHLENGTH.....	33.32 MI	53.62 KM		
FREQUENCY.....	6000.00 MHZ			
FREE SPACE PATH LOSS....	142.62 DB			
K FACTOR (INPUT).....	1.33 (K)			
RADIO CLIMATIC ZONE.....	ONE 6 CONTINENTAL TEMPERATE			
TYPE OF PATH.....	DIFFRACTION OVER A SINGLE ROUNDED OBSTACLE			

<u>LOSSES</u>	<u>L-FSPL</u>	<u>SIGMA</u>	<u>CONTROLLING PROPOGATION MODE</u>	
152.08 DB	9.46 DB	3.61 DB	20. %	DIFFRACTION
145.60 DB	2.99 DB	3.89 DB	1. %	DIFFRACTION
143.72 DB	1.10 DB	4.13 DB	.1 %	DIFFRACTION
142.41 DB	-0.20 DB	4.31 DB	.01 %	DIFFRACTION
140.94 DB	-1.67 DB	4.54 DB	.0025 %	DIFFRACTION
140.40 DB	-2.22 DB	4.63 DB	.001 %	DIFFRACTION

K=INF. K=1.33					K=INF. K=1.33				
DIST	ELEV	OBST	CLRNC	CLRNC	DIST	ELEV	OBST	CLRNC	CLRNC
(MI)	(FT)	(FT)	(FT)	(FT)	(MI)	(FT)	(FT)	(FT)	(FT)
0.00	400.	32.	0.	0.	15.26	149.	0.	278.	141.
0.04	400.	0.	32.	31.	15.39	135.	0.	292.	154.
0.09	387.	0.	45.	44.	16.80	59.	0.	368.	229.
1.10	400.	35.	-3.	-21.	17.44	150.	0.	277.	138.
1.22	400.	35.	-3.	-23.	17.87	146.	0.	281.	143.
1.46	399.	0.	33.	9.	18.30	116.	0.	311.	173.
1.83	380.	0.	51.	23.	19.29	48.	0.	378.	243.
1.94	400.	0.	31.	1.	19.80	36.	0.	390.	256.
2.06	365.	0.	66.	34.	21.17	47.	0.	379.	250.
2.96	323.	0.	108.	63.	21.77	47.	0.	378.	253.
3.69	349.	0.	82.	27.	22.63	60.	0.	365.	244.
3.94	350.	0.	81.	23.	22.97	175.	0.	250.	131.
4.10	380.	0.	51.	-9.	23.87	100.	0.	325.	212.
4.25	370.	0.	61.	-1.	24.64	0.	0.	425.	318.
4.80	350.	0.	81.	12.	25.54	99.	0.	325.	226.
5.57	349.	0.	81.	4.	26.27	150.	0.	274.	182.
6.21	349.	0.	81.	-3.	26.66	150.	0.	274.	185.
7.29	350.	0.	80.	-15.	27.04	100.	0.	324.	239.
7.41	350.	0.	80.	-16.	28.20	100.	0.	324.	251.
8.10	253.	0.	177.	74.	28.76	183.	0.	240.	175.
9.47	249.	0.	180.	67.	29.49	200.	0.	223.	167.
9.56	219.	0.	210.	97.	30.18	250.	0.	173.	126.
10.89	250.	0.	179.	57.	30.74	249.	0.	174.	134.
11.70	202.	0.	226.	100.	31.69	250.	0.	172.	147.
11.83	202.	0.	226.	99.	32.54	250.	0.	172.	160.
12.99	199.	0.	229.	97.	33.28	248.	0.	174.	173.
13.46	150.	0.	278.	144.	33.32	263.	159.	-0.	-0.
14.61	51.	0.	377.	240.					

PATHLOSS CALCULATION

1 INDEPENDENANDREWS AFB 38 37 34 77 27 23 38 48 50 76 53 18
 (6000.00 MHZ)

SITE 1

SITE 2

ANTENNA CENTER AGL.....	32.00 FT	9.75 M	159.00 FT	48.46 M
SITE ELEVATION AMSL.....	400.00 FT	121.92 M	263.00 FT	80.16 M
ANTENNA CENTER AMSL.....	432.00 FT	131.67 M	422.00 FT	128.63 M
EFFECTIVE ANTENNA HT....	43.85 FT	13.37 M	159.00 FT	48.46 M
HORIZON DISTANCE.....	1.10 MI	1.77 KM	32.10 MI	51.66 KM
HORIZON ELEVATION AMSL..	435.00 FT	132.59 M	435.00 FT	132.59 M
HORIZON ANGLE.....	0.02 DG	0.41 MR	-0.17 DG	-2.96 MR
RAY CROSSOVER ANGLE.....	0.22 DG	3.76 MR		
TERRAIN DELTA HT.....	151.58 FT	46.20 M		
PATHLENGTH.....	33.32 MI	53.62 KM		
FREQUENCY.....	6000.00 MHZ			
FREE SPACE PATH LOSS....	142.62 DB			
K FACTOR (INPUT).....	1.33 (K)			
RADIO CLIMATIC ZONE.....	ONE 6 CONTINENTAL TEMPERATE			
TYPE OF PATH.....	DIFFRACTION OVER A SINGLE ROUNDED OBSTACLE			

<u>LOSSES</u>	<u>L-FSPL</u>	<u>SIGMA</u>	<u>CONTROLLING PROPOGATION MODE</u>		
152.08 DB	9.46 DB	3.61 DB	20.	%	DIFFRACTION
145.60 DB	2.99 DB	3.89 DB	1.	%	DIFFRACTION
143.72 DB	1.10 DB	4.13 DB	.1	%	DIFFRACTION
142.41 DB	-0.20 DB	4.31 DB	.01	%	DIFFRACTION
140.94 DB	-1.67 DB	4.54 DB	.0025	%	DIFFRACTION
140.40 DB	-2.22 DB	4.63 DB	.001	%	DIFFRACTION

K=INF. K=1.33

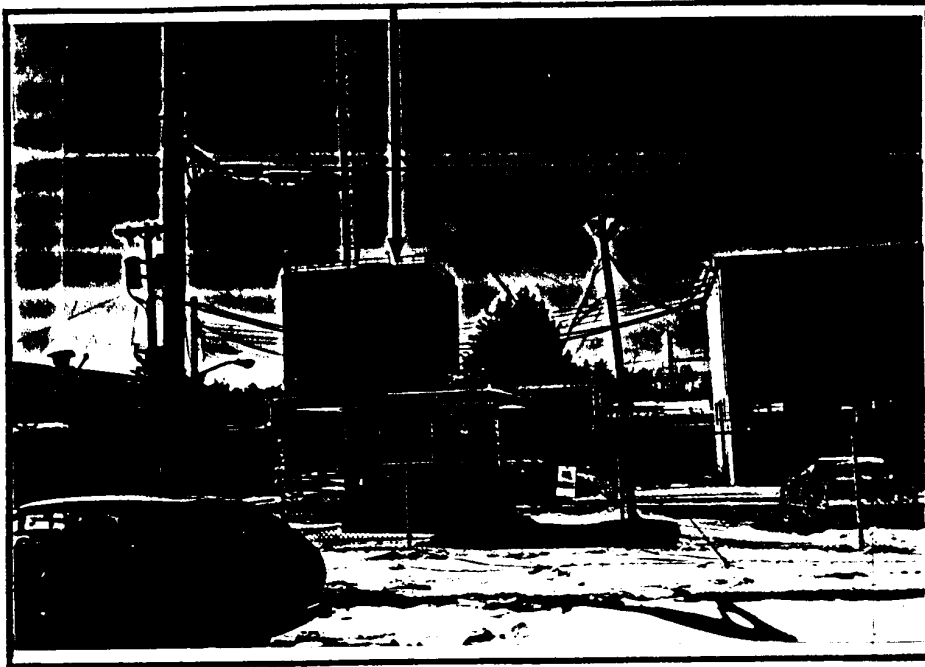
K=INF. K=1.33

DIST	ELEV	OBST	CLRNCE	CLRNCE	DIST	ELEV	OBST	CLRNCE	CLRNCE
(MI)	(FT)	(FT)	(FT)	(FT)	(MI)	(FT)	(FT)	(FT)	(FT)
0.00	400.	32.	0.	0.	15.26	149.	0.	278.	141.
0.04	400.	0.	32.	31.	15.39	135.	0.	292.	154.
0.09	387.	0.	45.	44.	16.80	59.	0.	368.	229.
1.10	400.	35.	-3.	-21.	17.44	150.	0.	277.	138.
1.22	400.	35.	-3.	-23.	17.87	146.	0.	281.	143.
1.46	399.	0.	33.	9.	18.30	116.	0.	311.	173.
1.83	380.	0.	51.	23.	19.29	48.	0.	378.	243.
1.94	400.	0.	31.	1.	19.80	36.	0.	390.	256.
2.06	365.	0.	66.	34.	21.17	47.	0.	379.	250.
2.96	323.	0.	108.	63.	21.77	47.	0.	378.	253.
3.69	349.	0.	82.	27.	22.63	60.	0.	365.	244.
3.94	350.	0.	81.	23.	22.97	175.	0.	250.	131.
4.10	380.	0.	51.	-9.	23.87	100.	0.	325.	212.
4.25	370.	0.	61.	-1.	24.64	0.	0.	425.	318.
4.80	350.	0.	81.	12.	25.54	99.	0.	325.	226.
5.57	349.	0.	81.	4.	26.27	150.	0.	274.	182.
6.21	349.	0.	81.	-3.	26.66	150.	0.	274.	185.
7.29	350.	0.	80.	-15.	27.04	100.	0.	324.	239.
7.41	350.	0.	80.	-16.	28.20	100.	0.	324.	251.
8.10	253.	0.	177.	74.	28.76	183.	0.	240.	175.
9.47	249.	0.	180.	67.	29.49	200.	0.	223.	167.
9.56	219.	0.	210.	97.	30.18	250.	0.	173.	126.
10.89	250.	0.	179.	57.	30.74	249.	0.	174.	134.
11.70	202.	0.	226.	100.	31.69	250.	0.	172.	147.
11.83	202.	0.	226.	99.	32.54	250.	0.	172.	160.
12.99	199.	0.	229.	97.	33.28	248.	0.	174.	173.
13.46	150.	0.	278.	144.	33.32	263.	159.	-0.	-0.
14.61	51.	0.	377.	240.					



SITE IDENTIFICATION: INDEPENDENT HILL, VIRGINIA
TERRESTRIAL PATH: ACCOKEEK - HOADLY
AZIMUTH FROM EARTH STATION: 83.0 DEGREES
DISTANCE FROM EARTH STATION: 1.0 MILES
HEIGHT OF OBSTACLE: 25 FEET
(above ground)

FIGURE: 5 PATH SURVEY PHOTOGRAPHS



SITE IDENTIFICATION: INDEPENDENT HILL, VIRGINIA
TERRESTRIAL PATH: ACCOKEEK - HOADLY
AZIMUTH FROM EARTH STATION: 83.0 DEGREES
DISTANCE FROM EARTH STATION: 1.07 MILES
HEIGHT OF OBSTACLE: 40 FEET
(above ground)

FIGURE: 6 PATH SURVEY PHOTOGRAPHS

PATHLOSS CALCULATION

29 INDEPENDENACCOKEEK 38 37 34 77 27 23 38 40 10 76 59 43
 (6000.00 MHZ)

	<u>SITE 1</u>		<u>SITE 2</u>	
ANTENNA CENTER AGL.....	32.00 FT	9.75 M	155.00 FT	47.24 M
SITE ELEVATION AMSL.....	400.00 FT	121.92 M	205.00 FT	62.48 M
ANTENNA CENTER AMSL.....	432.00 FT	131.67 M	360.00 FT	109.73 M
EFFECTIVE ANTENNA HT.....	32.00 FT	9.75 M	155.00 FT	47.24 M
HORIZON DISTANCE.....	1.00 MI	1.61 KM	24.10 MI	38.79 KM
HORIZON ELEVATION AMSL..	440.00 FT	134.11 M	435.57 FT	132.76 M
HORIZON ANGLE.....	0.08 DG	1.42 MR	-0.10 DG	-1.69 MR
RAY CROSSOVER ANGLE.....	0.26 DG	4.49 MR		
TERRAIN DELTA HT.....	171.21 FT	52.19 M		
PATHLENGTH.....	25.12 MI	40.43 KM		
FREQUENCY.....	6000.00 MHZ			
FREE SPACE PATH LOSS....	140.16 DB			
K FACTOR (INPUT).....	1.33 (K)			
RADIO CLIMATIC ZONE.....	ONE 6 CONTINENTAL TEMPERATE			
TYPE OF PATH.....	DIFFRACTION OVER TWO ISOLATED OBSTACLES			

<u>LOSSES</u>	<u>L-FSPL</u>	<u>SIGMA</u>	<u>CONTROLLING PROPOGATION MODE</u>	
164.95 DB	24.79 DB	3.59 DB	20. %	DIFFRACTION
159.79 DB	19.62 DB	3.78 DB	1. %	DIFFRACTION
158.31 DB	18.15 DB	3.94 DB	.1 %	DIFFRACTION
157.29 DB	17.13 DB	4.07 DB	.01 %	DIFFRACTION
156.14 DB	15.98 DB	4.23 DB	.0025 %	DIFFRACTION
155.72 DB	15.56 DB	4.29 DB	.001 %	DIFFRACTION

K=INF. K=1.33					K=INF. K=1.33				
<u>DIST</u>	<u>ELEV</u>	<u>OBST</u>	<u>CLRNCE</u>	<u>CLRNCE</u>	<u>DIST</u>	<u>ELEV</u>	<u>OBST</u>	<u>CLRNCE</u>	<u>CLRNCE</u>
<u>(MI)</u>	<u>(FT)</u>	<u>(FT)</u>	<u>(FT)</u>	<u>(FT)</u>	<u>(MI)</u>	<u>(FT)</u>	<u>(FT)</u>	<u>(FT)</u>	<u>(FT)</u>
0.00	400.	32.	0.	0.	12.17	0.	0.	397.	318.
0.10	400.	0.	32.	30.	12.69	0.	0.	396.	317.
0.80	357.	0.	73.	63.	12.89	0.	0.	395.	316.
1.00	400.	40.	-11.	-23.	13.73	-1.	0.	394.	315.
1.07	400.	25.	4.	-9.	14.24	-1.	0.	392.	315.
1.34	390.	0.	38.	22.	14.76	0.	0.	390.	313.
1.83	349.	0.	78.	56.	15.28	3.	0.	385.	310.
2.20	370.	0.	56.	30.	15.71	33.	0.	354.	280.
2.35	349.	0.	76.	50.	15.83	29.	0.	358.	284.
2.60	360.	0.	65.	35.	16.35	21.	0.	364.	292.
2.82	349.	0.	75.	43.	17.35	0.	0.	382.	315.
2.90	325.	0.	99.	66.	17.86	0.	0.	381.	316.
3.90	300.	0.	121.	79.	18.38	0.	0.	379.	317.
4.26	301.	0.	119.	74.	18.90	0.	0.	378.	319.
4.93	299.	0.	119.	69.	19.33	13.	0.	364.	308.
5.33	299.	0.	118.	65.	19.93	7.	0.	368.	316.
5.85	299.	0.	116.	60.	20.45	20.	0.	353.	306.
6.01	269.	0.	146.	88.	20.97	38.	0.	334.	290.
7.00	277.	0.	135.	71.	21.44	150.	0.	221.	181.
7.04	277.	0.	135.	71.	21.52	150.	0.	220.	182.
8.00	227.	0.	182.	114.	22.40	149.	0.	219.	188.
8.55	247.	0.	160.	90.	22.56	150.	0.	217.	188.
8.59	241.	0.	166.	95.	23.55	155.	0.	209.	191.
9.27	199.	0.	206.	133.	24.07	194.	0.	169.	156.
9.95	150.	0.	253.	178.	24.59	198.	0.	164.	157.
10.14	106.	0.	297.	221.	24.71	200.	0.	161.	156.
10.66	58.	0.	343.	266.	25.12	205.	155.	-0.	-0.
11.18	24.	0.	376.	298.					



MICROWAVE PATH STUDY REPORT

ROSSLYN - INDEPENDENT HILL

Prepared for
OVERSEAS TELECOMMUNICATIONS, INC.
ALEXANDRIA, VIRGINIA

COMSEARCH, INC.
SYSTEMS ENGINEERING DIVISION
1307 GLENVILLE DRIVE
RICHARDSON, TEXAS 75081

JANUARY 1986



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ONE PATH AT 23GHZ WITH A LANDLINE (SECTION 2)
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I. INTRODUCTION

This report presents the results of map studies together with field verified location data for the proposed Overseas Telecommunications, Inc.(OTI) microwave system connecting Rosslyn, Virginia facilities with Independent Hill, Virginia facilities. Feasible paths have been evaluated using 7.5 minute topographic mapping of the Virginia area.

Section II of the report includes a summary of results for the three (3) possible system routings. Conclusions are presented in Section III. Supporting Documentation is presented in Section IV.



II. SUMMARY OF RESULTS

This part of the report summarizes the results of map studies and field verification of existing site/tower locations. It has been divided into separate sections that identify the paths that would be needed to achieve a workable system based on the number of repeaters and frequency band to be used.

At this stage of the project, no detailed frequency interference analysis has been performed. Reference to frequency bands of operation in the following paragraphs refers to path profile presentations only, including associated path clearances.

Direct Path: Independent Hill - Rosslyn

The field study confirms that a single path from Independent Hill to Rosslyn cannot physically be achieved because of taller buildings around the Rosslyn site. Therefore, several other possibilities have been studied and listed below.

One Intermediate Repeater Possibilities (Section 1)

Two possible repeaters have been determined: WETA (#9) and WAVA (#10). With reference to Exhibit 1 in Section IV, Support Documentation, the longer paths, approximately 25 miles, between Independent Hill and the intermediate site area if operated in the 11 GHz band could seriously degrade overall system reliability because of excessive propagation outages due to rain. If these paths were operable at 6 GHz, then a frequency tradeoff study would be required to determine compatibility with the proposed "C" band Independent Hill earth station.

The two routes that appear feasible from map studies are:

Route #1

Rossllyn - WETA (#9)	Path No. 1	11 GHz
WETA (#9) - Independent Hill	Path No. 2	11 GHz

Route #2

Rossllyn - WAVA (#10)	Path No. 13	11 GHz
WAVA (#10) - Independent Hill	-	

Two Intermediate Repeaters: Two Paths Common Carrier, One Path at 23 Ghz With Optional Land Line (Section 2)

Five routes have been determined using two intermediate repeaters. Each of these routes consists of two paths in the



common carrier band and one path at 23 GHz with optional landline. Refer to Exhibit #2 (Support Documentation)
The routes are as follows:

Route #1	Rosslyn - WETA (#9)	Path No. 1	11 GHz
	WETA (#9) - Prince William Co. Ind. Hill (#59)	Path No. 3	6 GHz
	Prince William Co. Ind. Hill (#59) - Independent Hill	Path No. 4	23 GHz
Route #2	Rosslyn - 13 North 17th St (#1)	Path No. 5	23 GHz
	13 North 17th St. (#1) - WVT (#58)	Path No. 6	6 GHz
	WVT (#58) - Independent Hill	-	23 GHz or landline
Route #3	Rosslyn - 13 North 17th St. (#1)	Path No. 5	23 GHz
	13 North 17th (#1) - Butts Corner (#52)	Path No. 7	11 GHz
	Butts Corner - Independent Hill	Path No. 8	11 GHz
Route #4	Rosslyn - Oak Lawn (#24)	Path No. 9	11 GHz
	Oak Lawn (#24) - WVT (#58)	Path No. 10	6 GHz
	WVT (#58) - Independent Hill	-	23 GHz or landline
Route #5	Rosslyn - Oak Tree E. (#20)	Path No. 11	11 GHz
	Oak Tree E. (#20) - WVT (#58)	Path No. 12	6 GHz
	WVT (#58) - Independent Hill	-	23 GHz or landline

Two Intermediate Repeaters: Three Paths Common Carrier
(Section 3)

This section shows routes consisting of three paths common carrier, and two intermediate repeaters. Refer to Exhibit #3 (Support Documentation).

Eight routes have been determined and they are as follows:

Route #1	Rosslyn - WAVA (#10)	Path No 13	11 GHz
	WAVA (#10) - Sandy Run (#48)	Path No 14	11 GHz
	Sandy Run (#48) - Independent Hill	Path No 15	11 GHz



Route #2

Rossllyn - WETA(#9)	Path No 1	11 GHz
WETA(#9) - Elgin Corner(#51)	Path No 16	11 GHz
Elgin Corner - Independent Hill	Path No 17	11 GHz

Route #3

Rossllyn - Silver Hill(#62)	Path No 18	11 GHz
Silver Hill(#62) - Bethel (#47)	Path No 19	6 GHz
Bethel(#47) - Independent Hill	Path No 20	11 GHz

Route #4

Rossllyn - Silver Hill(#62)	Path No 18	11 GHz
Silver Hill(#62) - Lorfax(#61)	Path No 21	6 GHz
Lorfax(#61) - Independent Hill	Path No 28	11 GHz

Route #5

Rossllyn - Oak Tree E.(#20)	Path No 11	11 GHz
Oak Tree(#20) - Lorton(#45)	Path No 23	11 GHz
Lorton(#45) - Independent Hill	Path No 24	11 GHz

Route #6

Rossllyn - Oak Tree E.(#20)	Path No 11	11 GHz
Oak Tree E.(#20) - Gunston Heights (#46)	Path No 25	11 GHz
Gunston Heights(#46) - - Independent Hill	Path No 26	11 GHz

Route #7

Rossllyn - Oaklawn(#24)	Path No 9	11 GHz
Oaklawn(#24) - Lorfax(#61)	Path No 27	11 GHz
Lorfax(#61) - Independent Hill	Path No 28	11 GHz

Route #8

Rossllyn - Oaklawn(#24)	Path No 9	11 GHz
Oaklawn(#24) - Gunston Heights(#46)	Path No 29	11 GHz
Gunston Heights(#46) - Independent Hill	Path No 26	11 GHz



III CONCLUSIONS

- The Rosslyn location is located such that a direct path between Independent Hill is not possible.
- Taller buildings surrounding the customer locations in Rosslyn limits the establishment of microwave paths between 150 degrees through 260 degrees referenced to true north.
- Three (3) different system routings are proposed in this report. Each routing proposes the use of repeater location between Rosslyn and Independent Hill.
- It may be necessary to utilize the 11GHz common carrier band because of existing Earth Station uplinking facilities between Rosslyn and Independent Hill which could adversely effect 6GHz band operation. The 11GHz path lengths between repeaters should be kept to a distance of 10 miles. Paths lengths longer than 10 miles in the 11GHz band will be subject to long outages due to rain which will affect the overall system reliability.
- Based on the above two (2) or three (3) microwave repeaters will be required if 11GHz is employed. One (1) repeater will be required if 6GHz is employed.

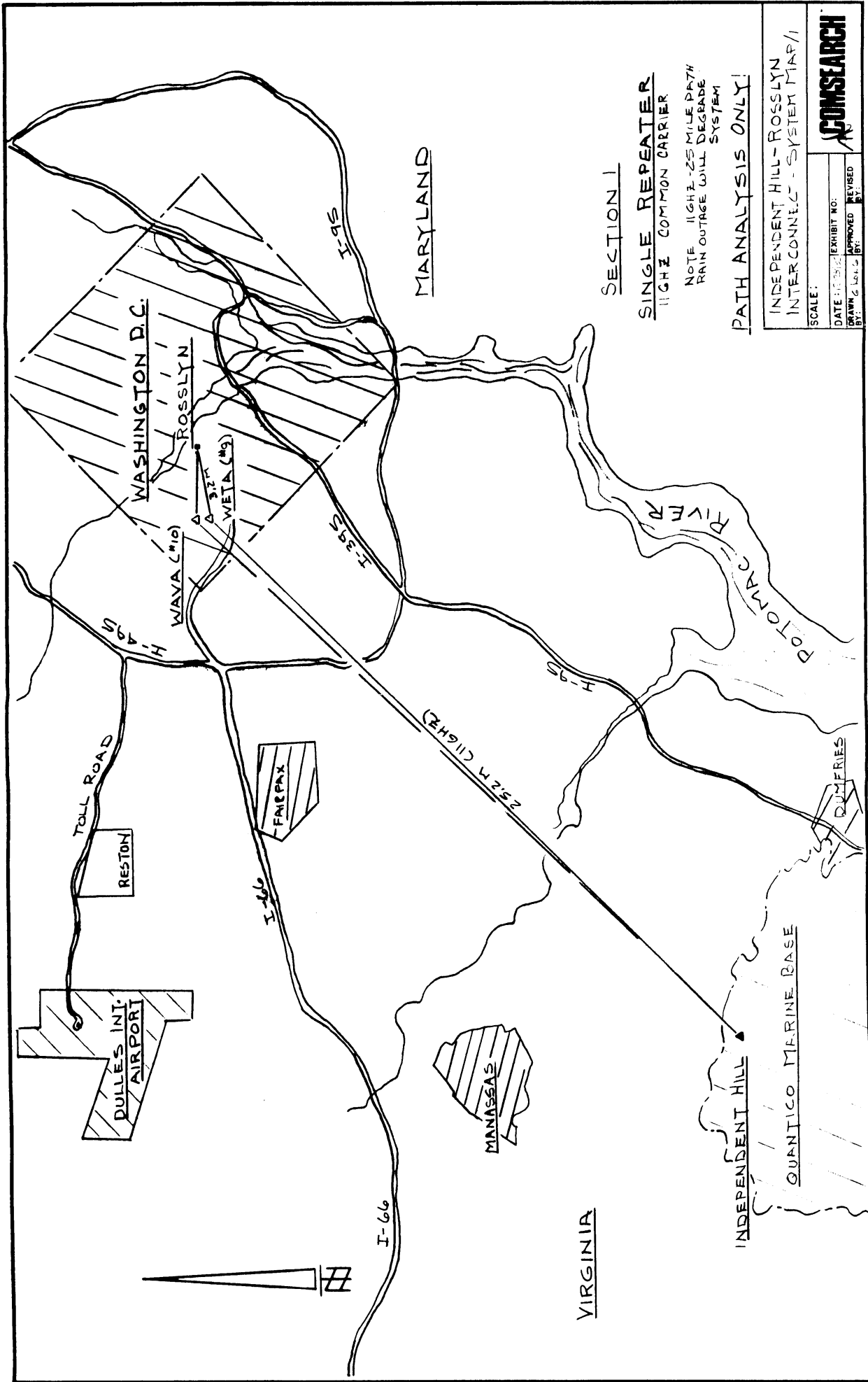


IV. SUPPORTING DOCUMENTATION

- A. SYSTEM MAPS
- B. AREA MAP
- C. SYSTEM DESIGN
- D. SITE TOPOGRAPHIC MAPS
- E. SITE LOCATION MAPS
- F. SITE PHOTOGRAPHS
- G. PATH PROFILES
- H. MICROWAVE PATH PROFILE DATA SHEETS

IV. SUPPORTING DOCUMENTATION

A. SYSTEM MAPS



MARYLAND

VIRGINIA

SECTION 1

SINGLE REPEATER
HIGH COMMON CARRIER

NOTE: HIGH-FREQUENCY REPEATER
 RAIN OUTAGE WILL DEGRADE
 SYSTEM

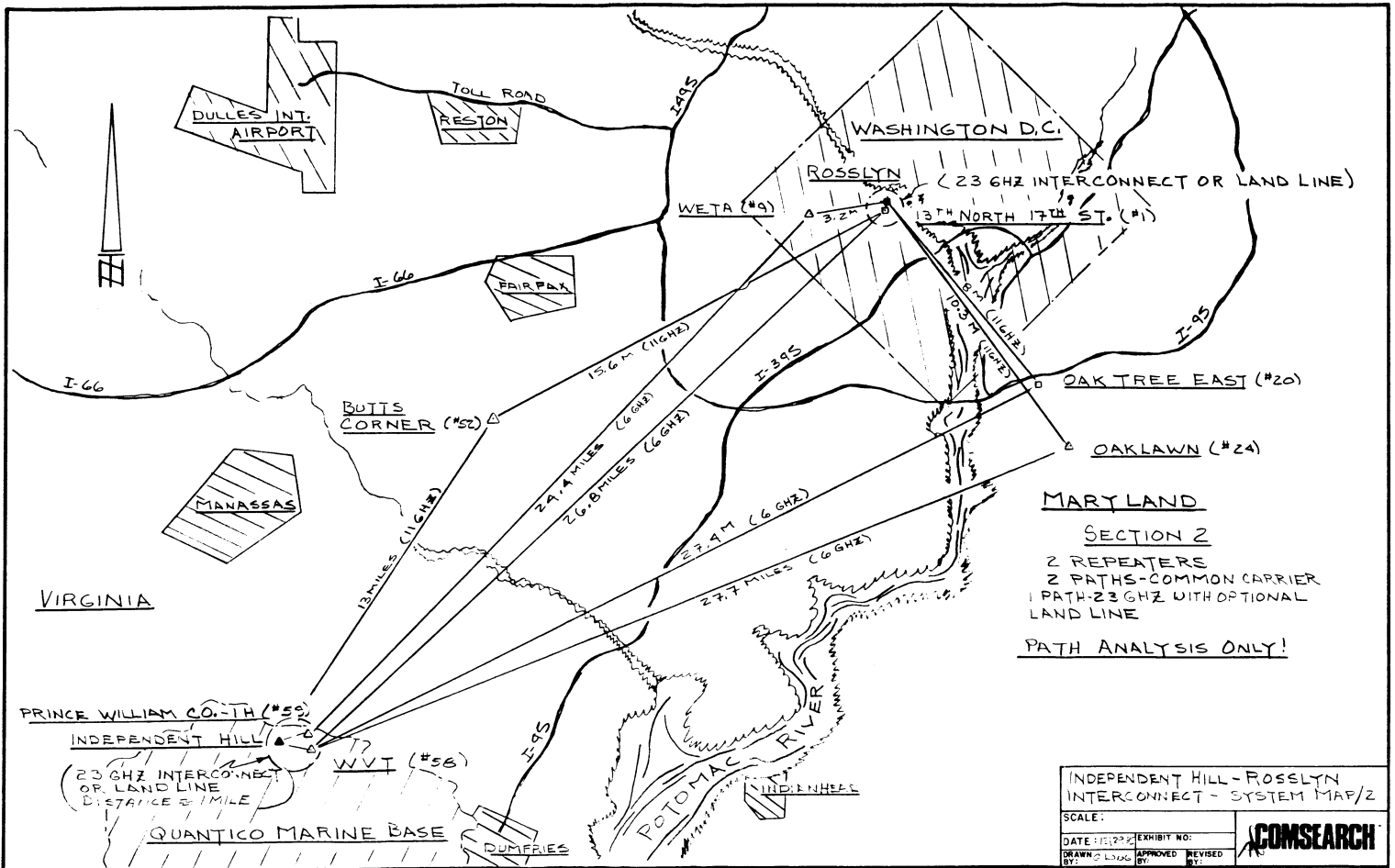
PATH ANALYSIS ONLY!

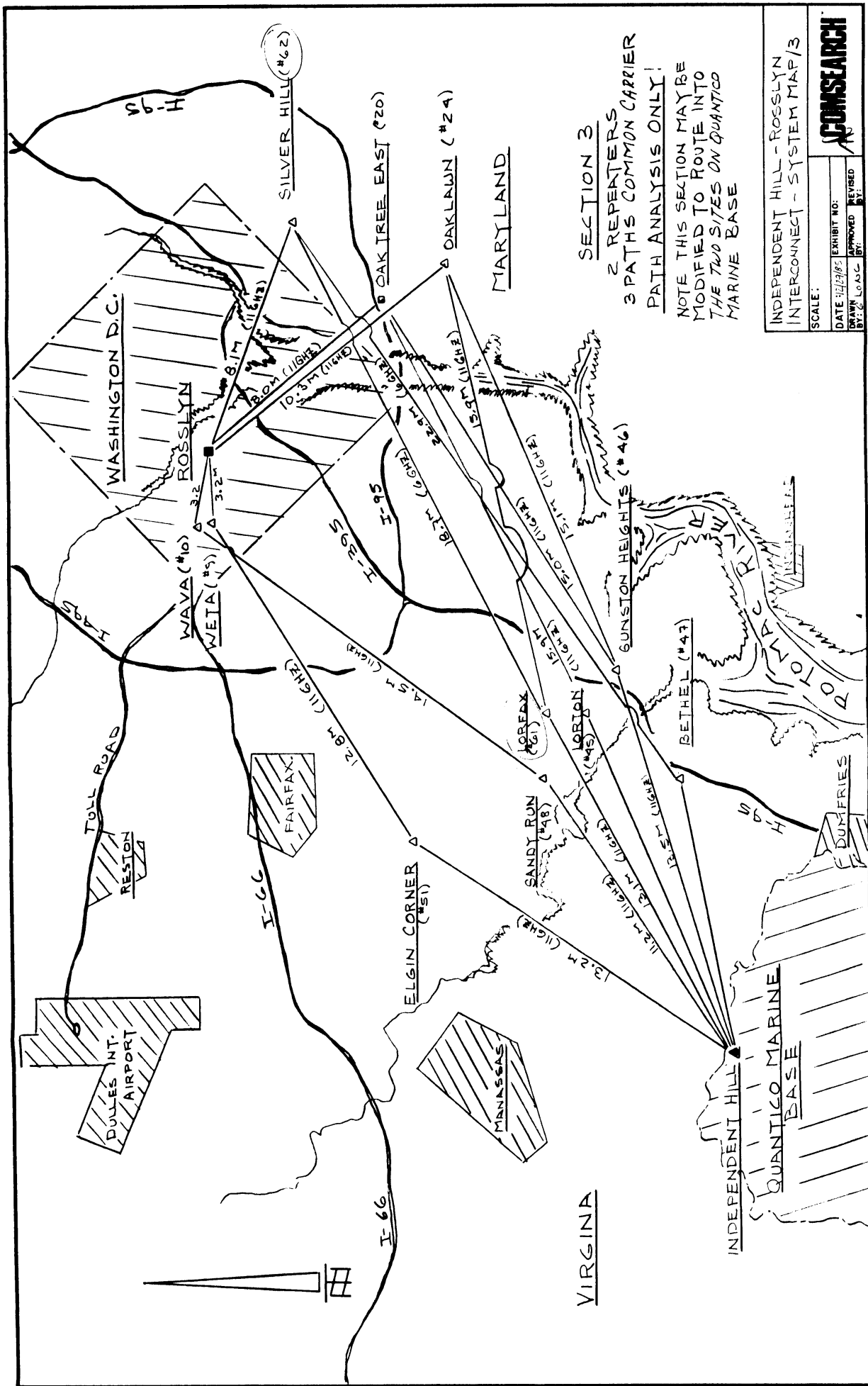
INDEPENDENT HILL - ROSSLYN
 INTERCONNECT - SYSTEM MAP/1

SCALE:

DATE: 11/15/62	EXHIBIT NO.:
DRAWN BY: G. L. S. / J. B. S.	APPROVED BY:
	REVISED BY:







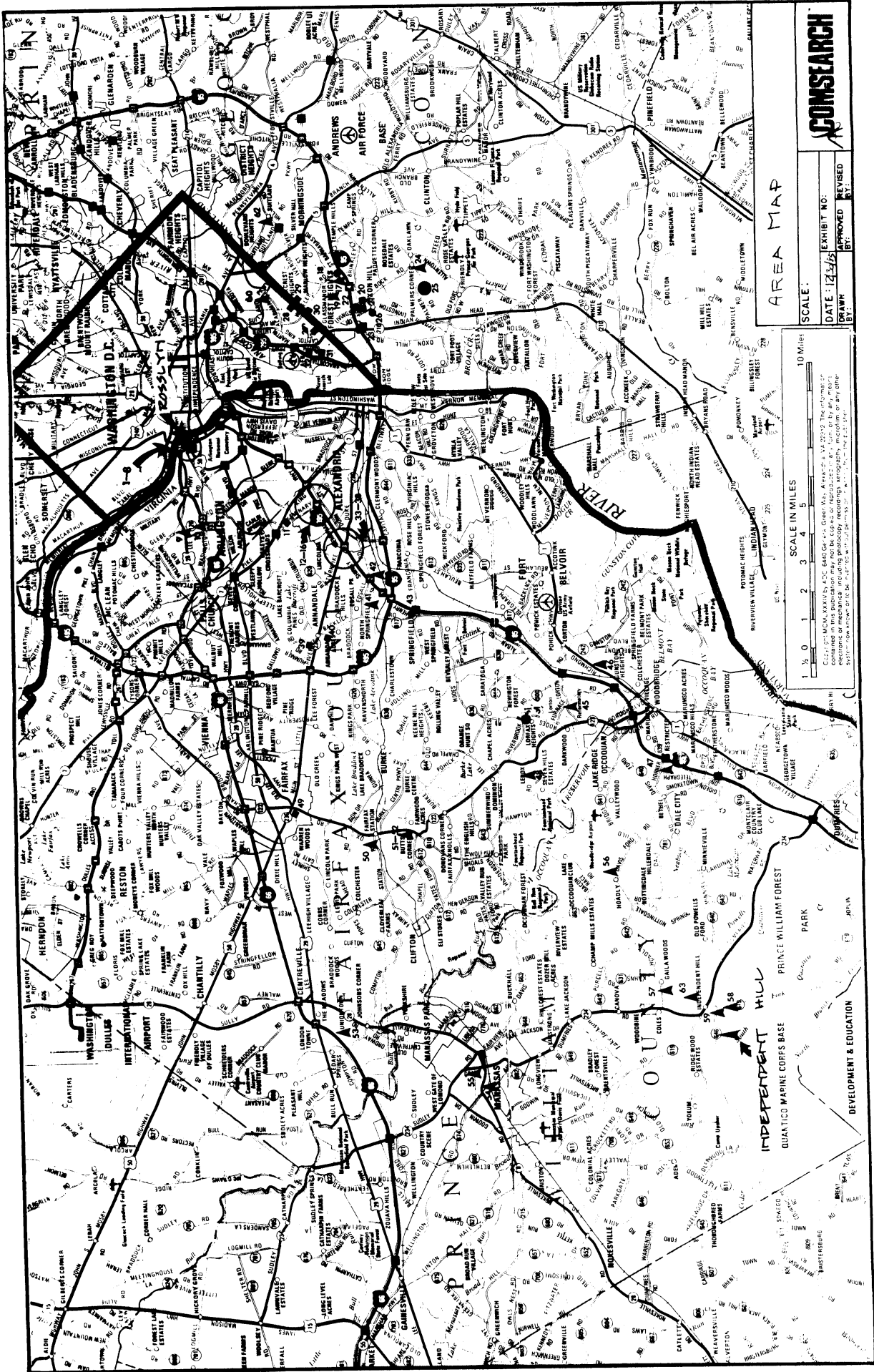
INDEPENDENT HILL - ROSSLYN
 INTERCONNECT - SYSTEM MAP/3

SCALE:

DATE: 1/1/78	EXHIBIT NO.:
DRAWN: G.P.S.	APPROVED:
BY: G.P.S.	REVISED:
	BY:

COMSEARCH

IV. SUPPORTING DOCUMENTATION
B. AREA MAP



AREA MAP

SCALE:

DATE:	EXHIBIT NO.:
12/3/68	
DRAWN BY:	REVISED BY:

10 Miles

SCALE IN MILES

1 2 3 4 5

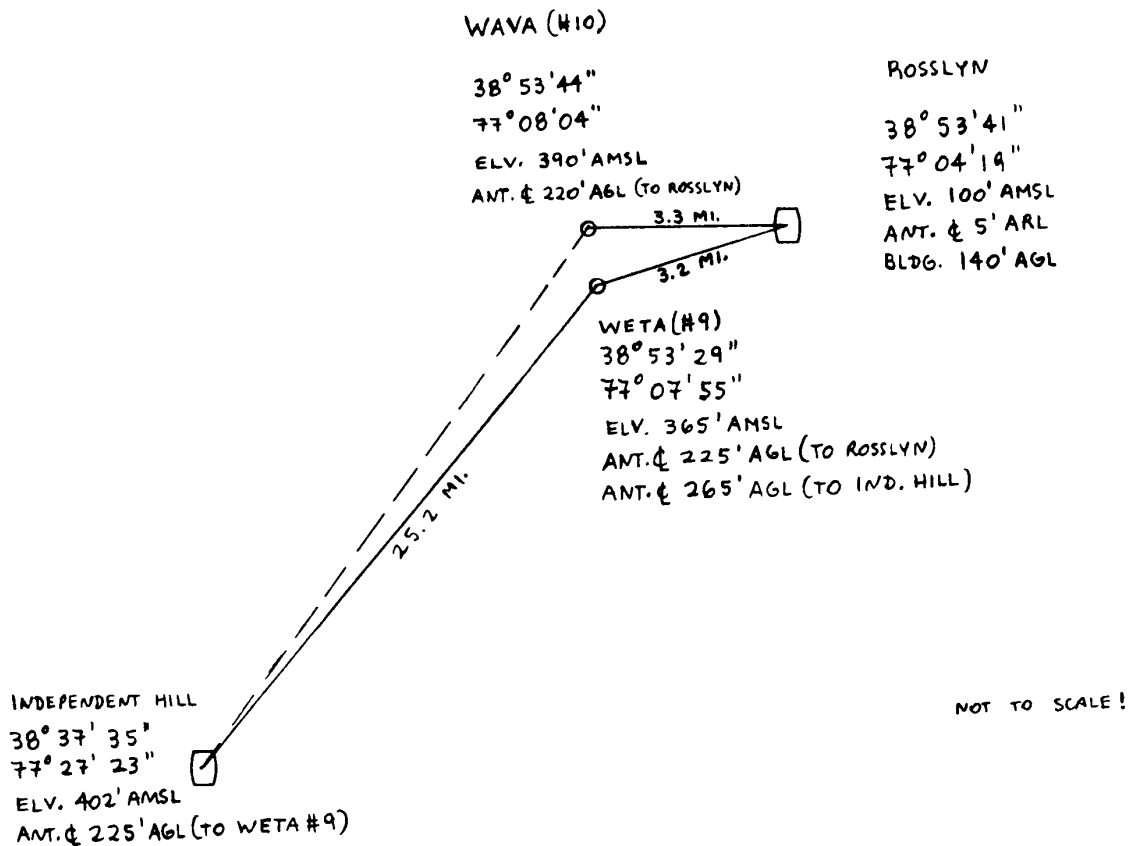
COMSEARCH

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IV. SUPPORTING DOCUMENTATION

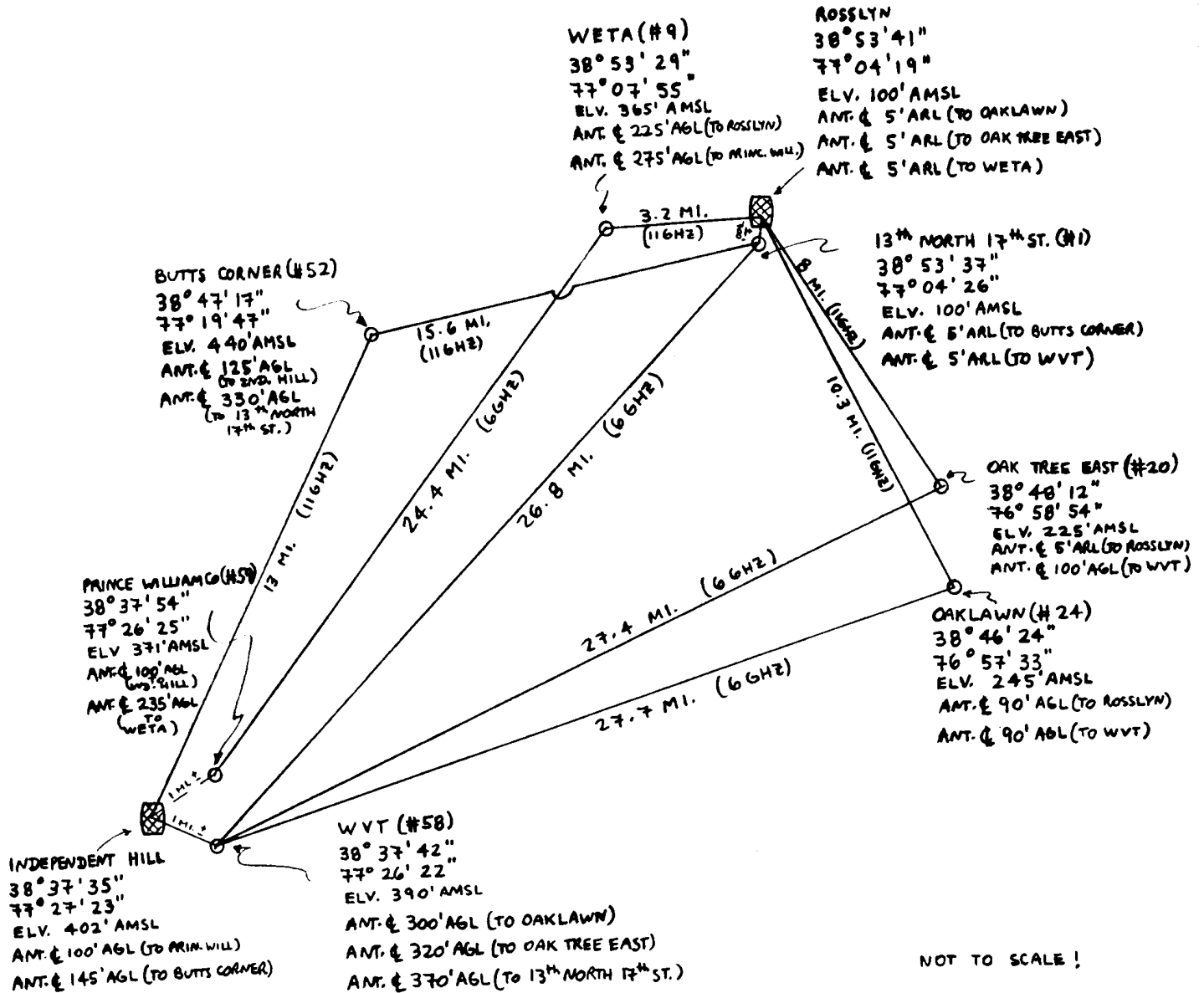
C. SYSTEM DESIGN

EXHIBIT #1



NOTES:

- THERE ARE ONLY TWO POSSIBLE REPEATERS THAT WILL WORK FROM A PATH STANDPOINT: WETA (#9) AND WAVA (#10). HOWEVER BECAUSE OF FREQUENCY (11GHZ) AND PATH LENGTHS, RELIABILITY WILL BE DEGRADED.
- INDEPENDENT HILL SITE IS AN L-SHAPED (APPROX. 400' x 300' x 600') CLEARED GRASSY AREA ENCLOSED BY A FENCE LINK FENCE AND BOUNDED ON ALL SIDES BY DECIDUOUS TREES. THE SITE IS AN ABANDONED COMMUNICATIONS FACILITY WITH A 80' x 30' CONCRETE BLOCK BUILDING. THE AREA SURROUNDING THE BUILDING IS FAIRLY LEVEL WITH A GENTLE DOWNWARD SLOPE TO THE NORTH. THE AREA IS SURROUNDED BY QUANTICO MARINE CORPS BASE.
- PATH BETWEEN ROSSLYN AND WETA MAY WORK IN 23 GHZ BAND.
- ALL BUILDING, TOWER HEIGHTS, GEODETIC COORDINATES, AND GROUND ELEVATIONS ARE PRELIMINARY AND SUBJECT TO CHANGE.



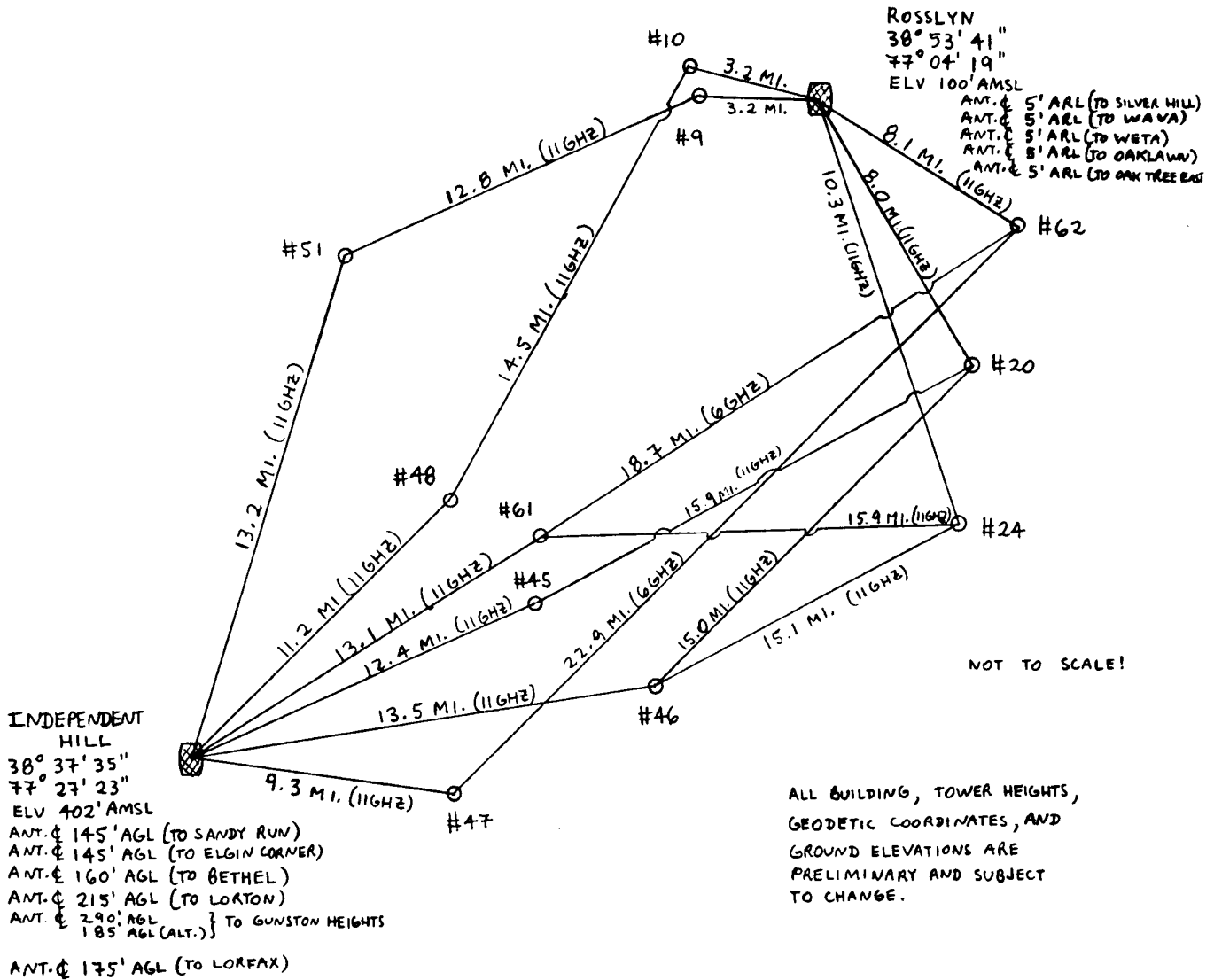
NOT TO SCALE !

NOTES:

- THERE ARE EIGHT POSSIBLE LOCAL BUILDINGS LOCATED NEAR 1200 WILSON BLVD. THAT MIGHT LEAD THEMSELVES VIABLE TO THE SYSTEM DESIGN.
- THERE ARE TWO SITES LOCATED NEAR INDEPENDENT HILL SITE THAT ARE ON GOVERNMENT LAND AND WITHIN ONE MILE. ANOTHER SITE IS WITHIN 1.5 MILES WHILE THE OTHER IS WITHIN 2.5 MILES
- ALL BUILDING, TOWER HEIGHTS, GEODETIC COORDINATES, AND GROUND ELEVATIONS ARE PRELIMINARY AND SUBJECT TO CHANGE.

EXHIBIT #3

PAGE 1 OF 2



ELGIN CORNER (#51)
 38° 47' 18"
 77° 19' 45"
 ELV 439' AMSL
 ANT. & 150' AGL (TO WETA)
 ANT. & 125' AGL (TO IND. HILL)

SANDY RUN (#48)
 38° 43' 26"
 77° 17' 21"
 ELV 310' AMSL
 ANT. & 170' AGL (TO WAVA)
 ANT. & 225' AGL (TO IND. HILL)

LORFAX (#61)
 38° 43' 15"
 77° 14' 45"
 ELV 295' AMSL
 ANT. & 135' AGL (TO SILVER HILL)
 ANT. & 115' AGL (TO OAKLAWN)
 ANT. & 110' AGL (TO IND. HILL)

LORTON (#45)
 38° 42' 01"
 77° 14' 47"
 ELV 230' AMSL
 ANT. & 180' (TO OAK TREE EAST)
 ANT. & 195' (TO IND. HILL)

GUNSTON HEIGHTS (#46)
 38° 41' 16"
 77° 13' 06"
 ELV 230' AMSL
 ANT. & 130' AGL (TO OAK TREE EAST)
 ANT. & 95' AGL } TO IND. HILL
 ANT. & 185' AGL (ALT.) }
 ANT. & 95' AGL (TO OAKLAWN)

BETHEL (#47)
 38° 39' 22"
 77° 17' 14"
 ELV 240' AMSL
 ANT. & 190' AGL (TO SILVER HILL)
 ANT. & 200' AGL (TO IND. HILL)

WAVA (#10)
 38° 53' 44"
 77° 08' 04"
 ELV 390' AMSL
 ANT. & 160' AGL (TO SANDY RUN)
 ANT. & 220' AGL (TO ROSSLYN)

WETA (#9)
 38° 53' 29"
 77° 07' 55"
 ELV 365' AMSL
 ANT. & 115' AGL (TO ELGIN CORNER)
 ANT. & 225' AGL (TO ROSSLYN)

SILVER HILL (#62)
 38° 50' 53"
 76° 59' 10"
 ELV 290' AMSL
 ANT. & 175' AGL (TO ROSSLYN)
 ANT. & 150' AGL (TO BETHEL)
 ANT. & 145' AGL (TO LORFAX)

OAK TREE EAST (#20)
 38° 48' 12"
 77° 58' 54"
 ELV 255' AMSL
 ANT. & 5' ARL (TO LORTON)
 ANT. & 105' AGL (TO GUNSTON HEIGHTS)
 ANT. & 5' ARL (TO ROSSLYN)

OAKLAWN (#24)
 38° 46' 24"
 76° 57' 33"
 ELV 245' AMSL
 ANT. & 95' AGL (TO LORFAX)
 ANT. & 95' AGL (TO GUNSTON HEIGHTS)
 ANT. & 90' AGL (TO ROSSLYN)

PAGE 2 OF 2

NOTES:

ROSSLYN (1200 WILSON BLVD., ROSSLYN)

THIS IS A TWELVE - STORY BUILDING WITH A SMALLER MECHANICAL LEVEL ON THE MAIN ROOF. THERE ARE SOME SMALL OMNI ANTENNAS, A PORTABLE MICROWAVE STATION, AND A SINGLE SMALL GRID ANTENNA ON THE MECHANICAL ROOF. THIS BUILDING IS SURROUNDED BY OTHER TALLER OFFICE BUILDINGS. THE ROSSLYN COMMUNITY IS ON THE EAST BANK OF THE POTOMAC RIVER AND HAS HILLS TO THE WEST AND SOUTH AND WASHINGTON D.C. TO THE NORTHEAST.

OPEN VIEW AREAS FROM THE ROOF ARE FROM APPROXIMATELY 265° TO 270°; 340° TO 00°; AND FROM 120° TO 145° THE OFFICE BUILDING TO THE SOUTH, 1701 FT. MEYER (#8) OBSTRUCTS APPROXIMATELY 60° OF THE VIEW ANGLE TO A BEARING OF ± 205° TRUE. THIS BUILDING IS ABOUT 40 FEET HIGHER THAN THE MAIN ROOF.

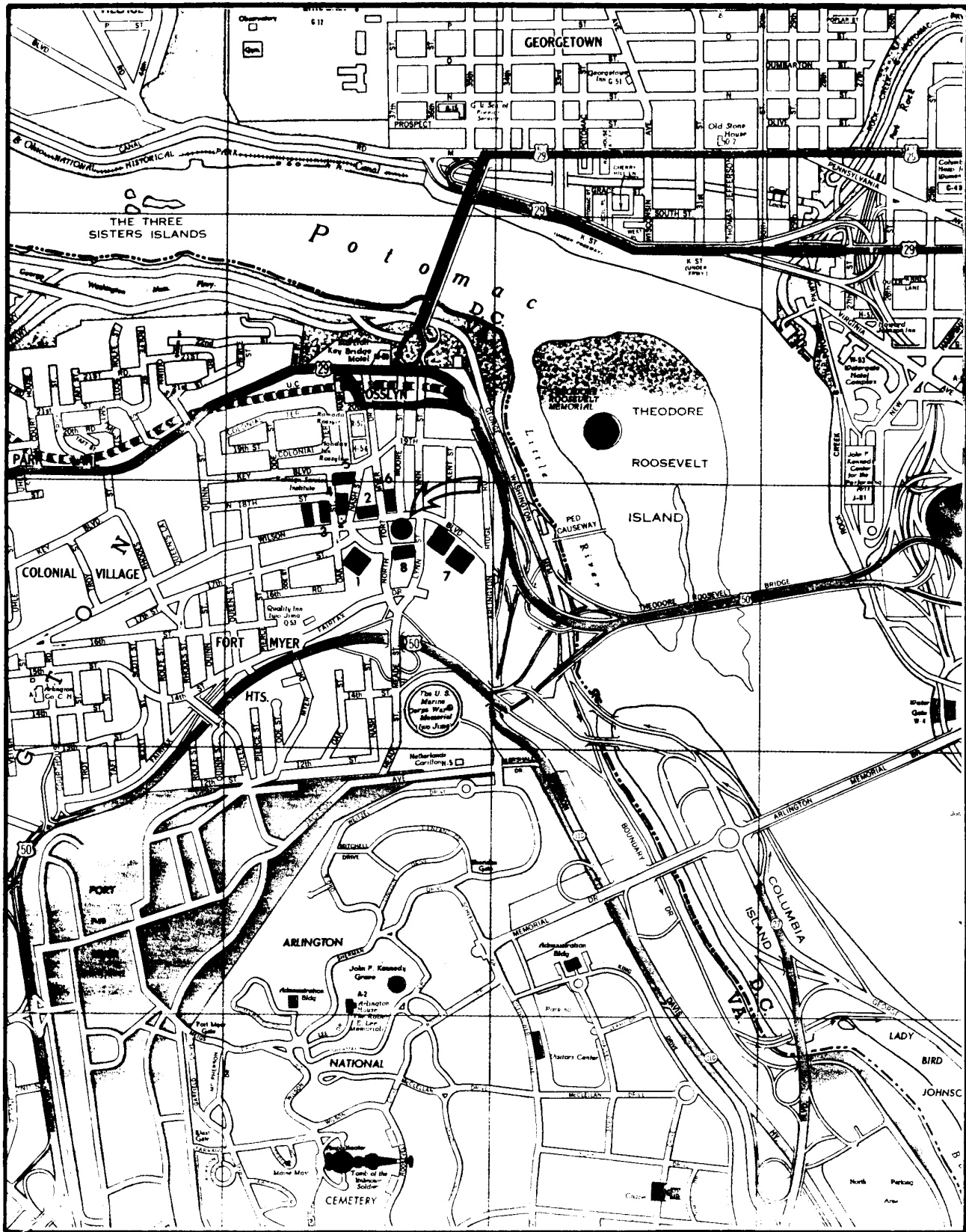
IV. SUPPORTING DOCUMENTATION
D. SITE TOPOGRAPHIC MAPS
E. SITE LOCATION MAPS



WASHINGTON WEST QUADRANGLE
 DISTRICT OF COLUMBIA-MARYLAND-VIRGINIA
 7.5 MINUTE SERIES

SITE TOPOGRAPHIC MAP
 # 1-8 & ROSSLYN

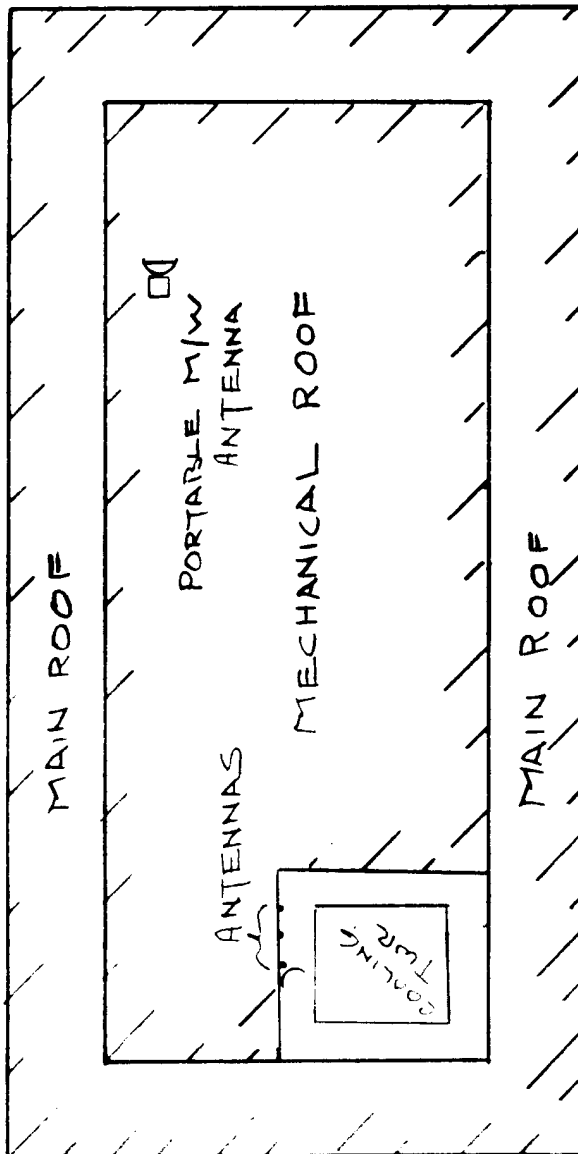




SITE LOCATION MAP
1-8 & ROSSLYN



CONSEARCH



NOT TO SCALE

ROSSLYN SITE SKETCH



FALLS CHURCH QUADRANGLE
 VIRGINIA-MARYLAND
 7.5 MINUTE SERIES (TOPOGRAPHIC)
 WASHINGTON WEST. D. C.-MD.-VA.
 38077-H1-TR 024

SITE TOPOGRAPHIC MAP
 #9 & 10

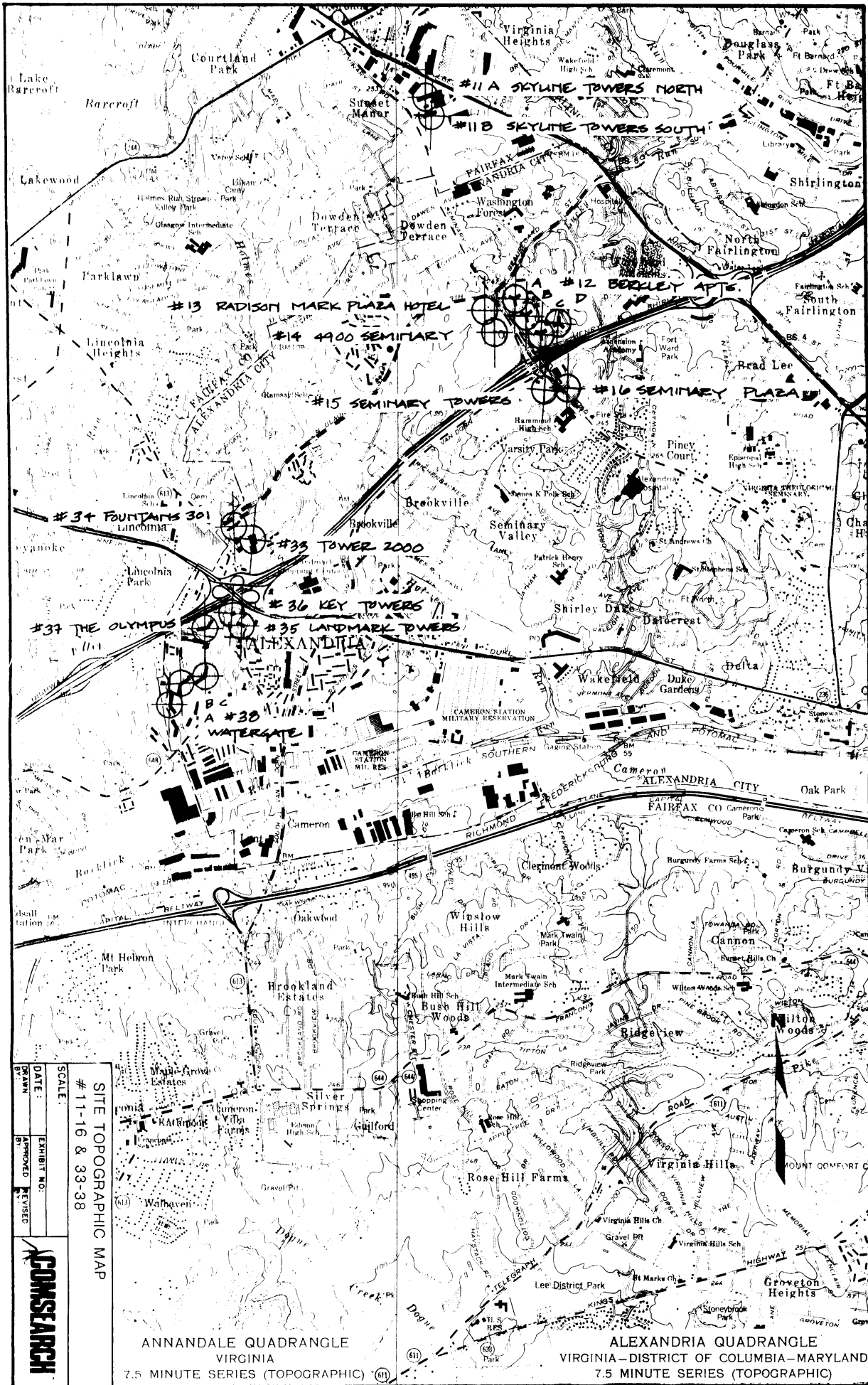


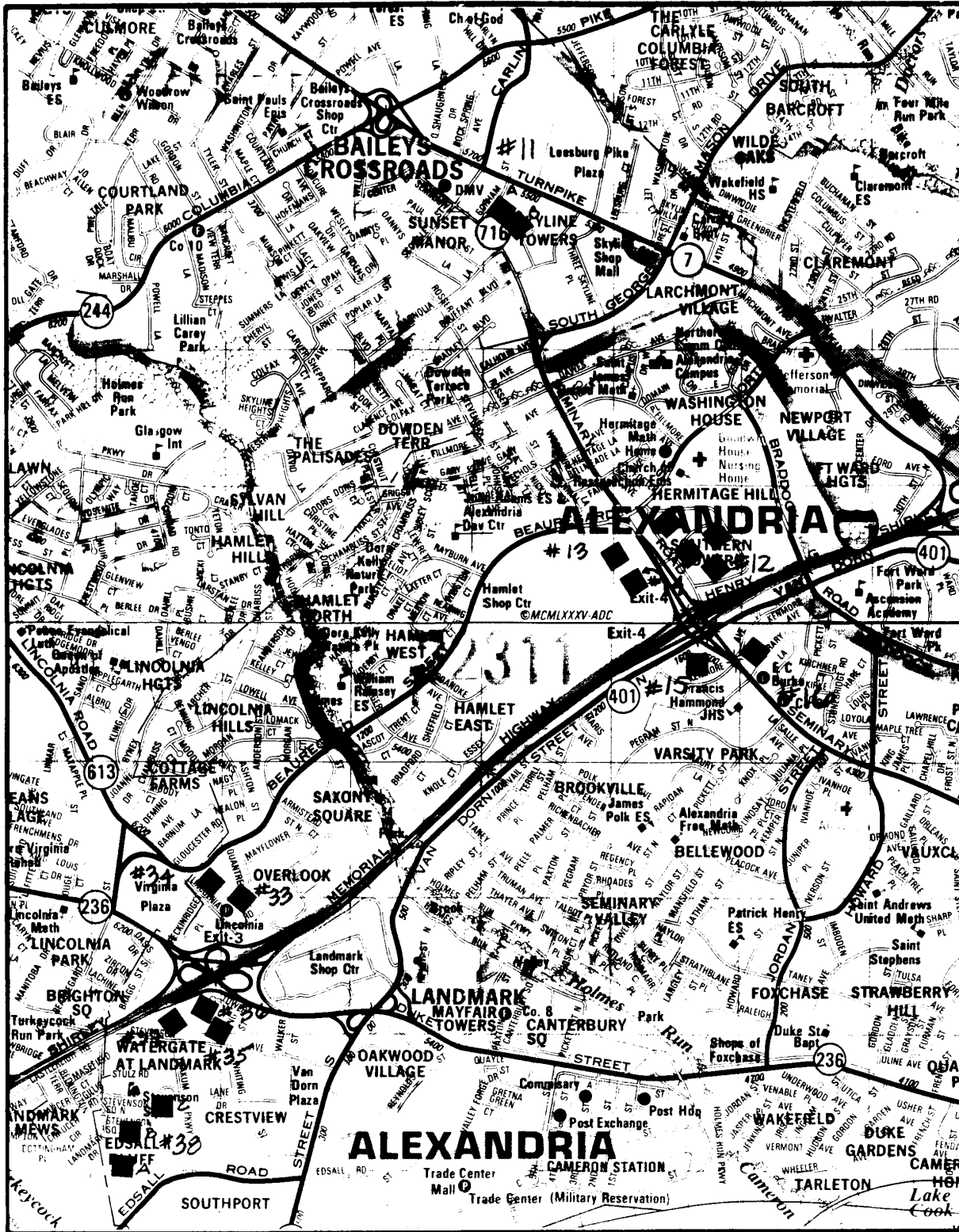


SITE LOCATION MAP

#9 & 10



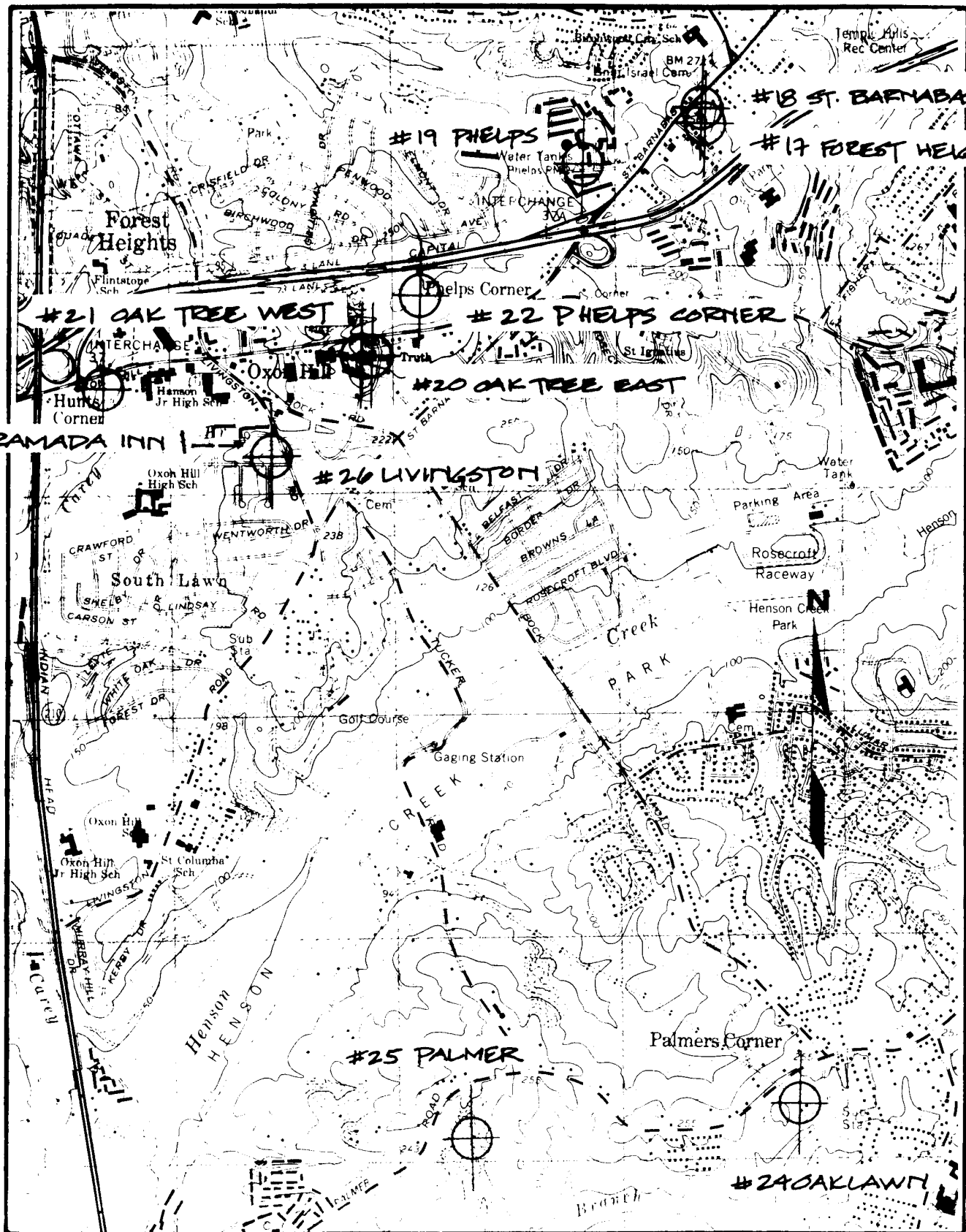




SITE LOCATION MAP

#11-16 & 33-38

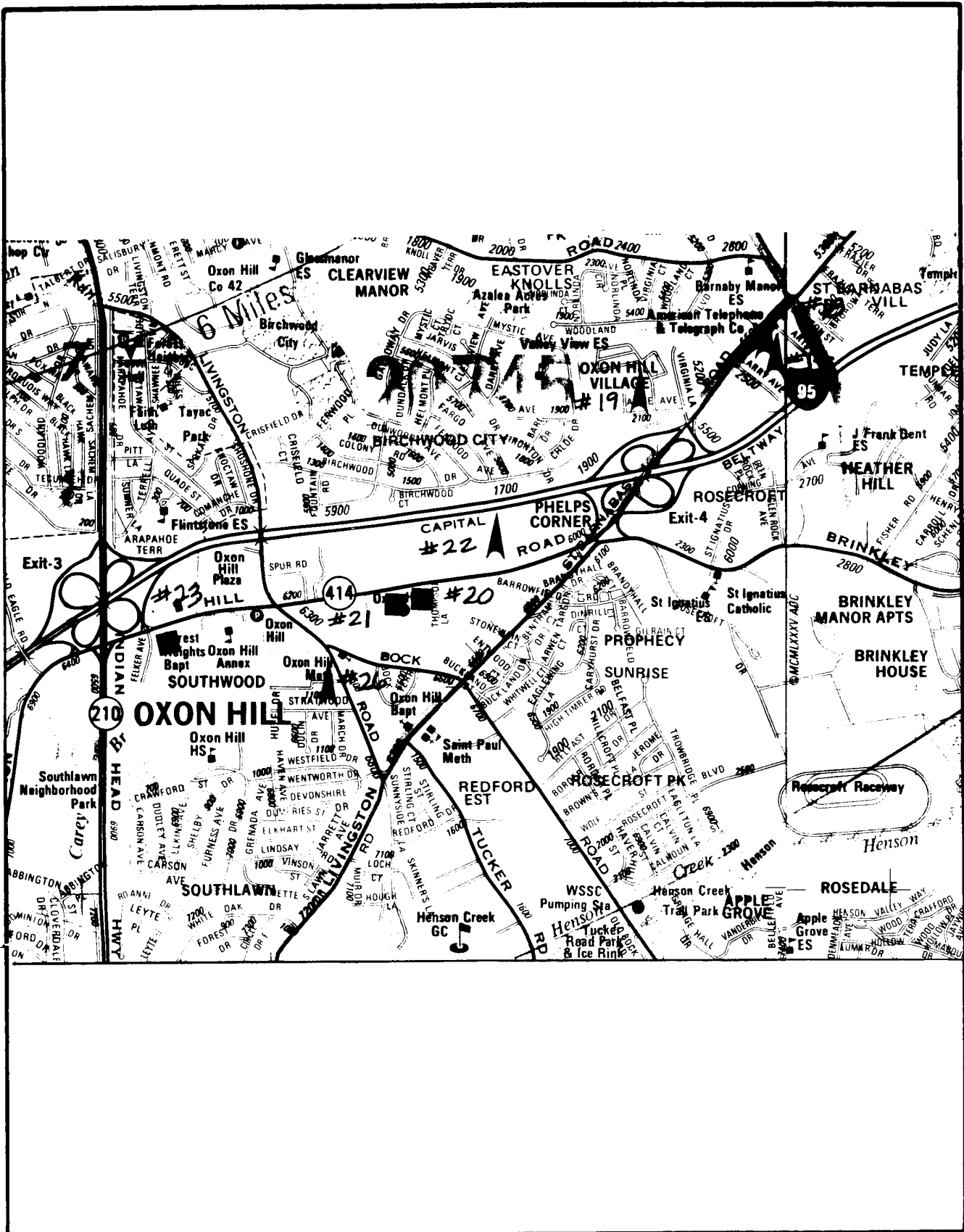




ANACOSTIA QUADRANGLE
 DISTRICT OF COLUMBIA-MARYLAND
 7.5 MINUTE SERIES (TOPOGRAPHIC-BATHYMETRIC)

SITE TOPOGRAPHIC MAP
 #17-26

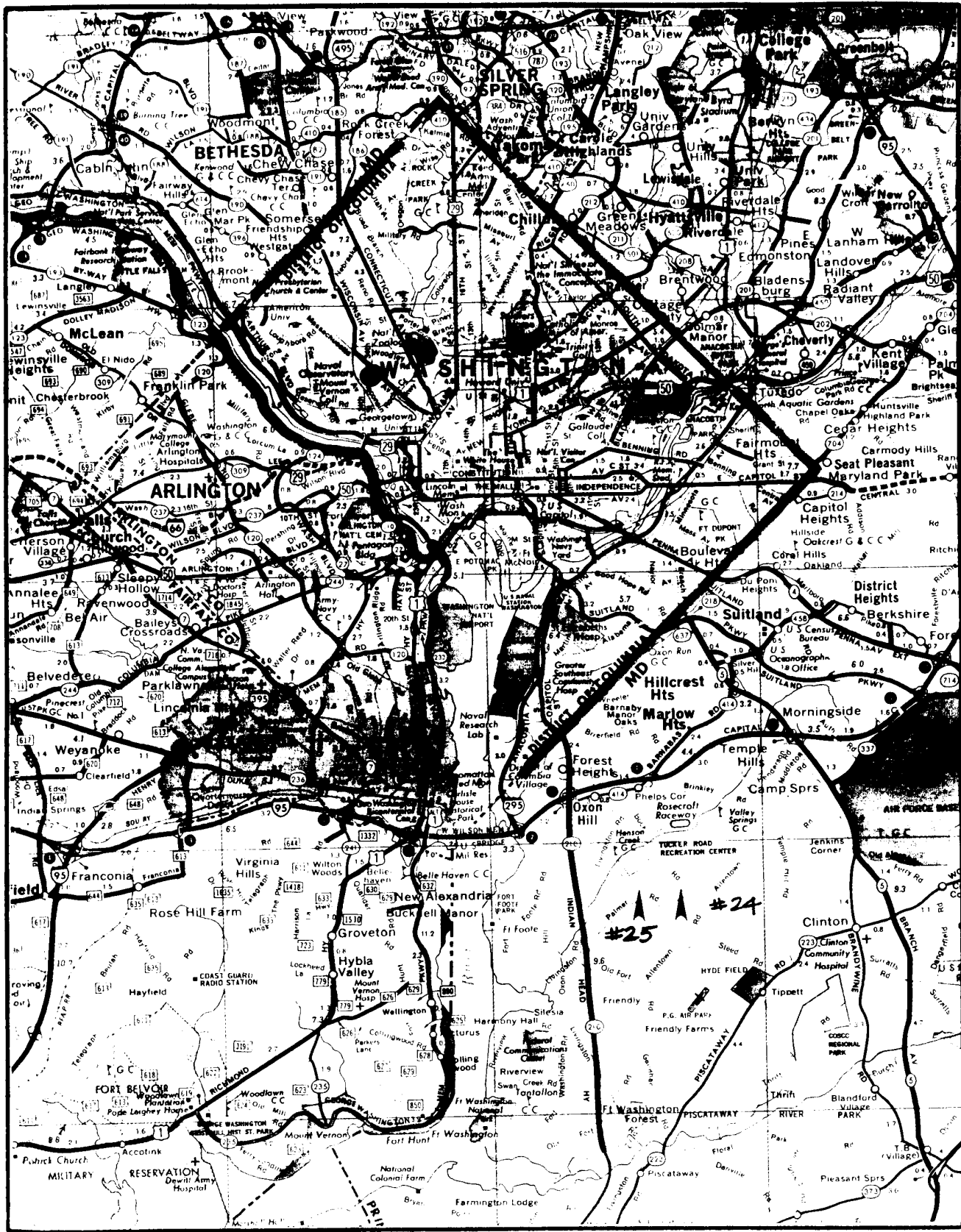




SITE LOCATION MAP

17-23 & 26

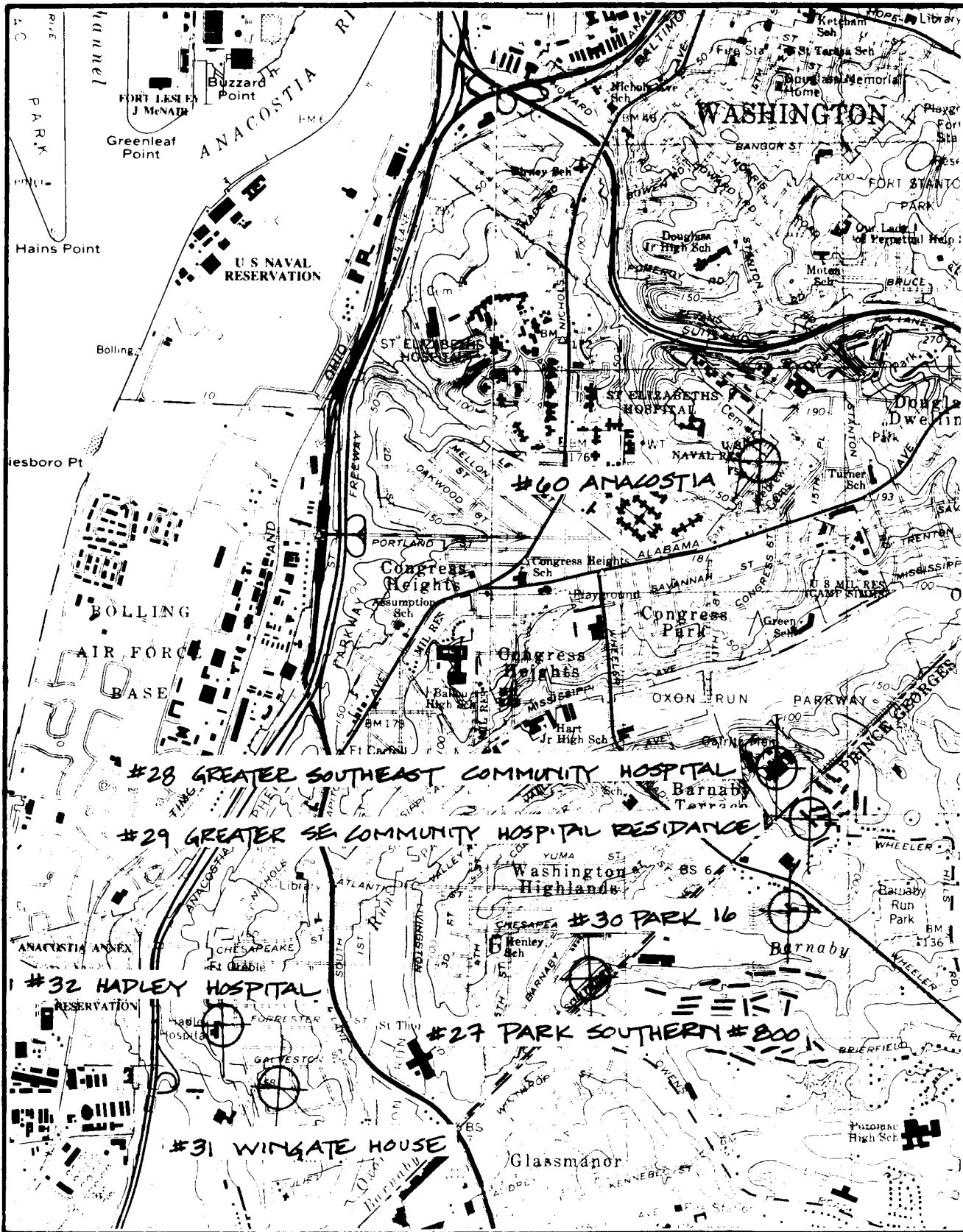




SITE LOCATION MAP

#24 & 25



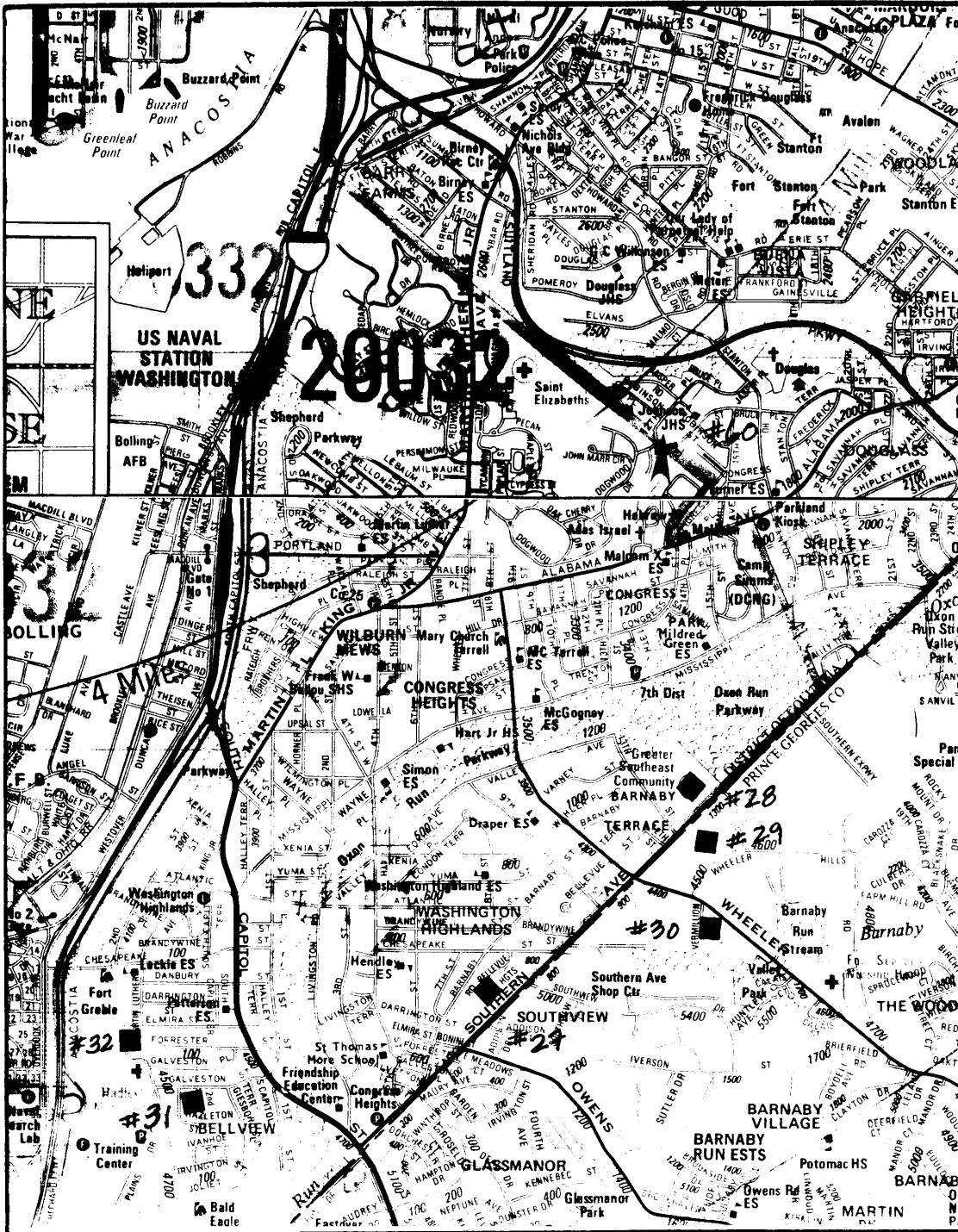


ALEXANDRIA, VA. - D. C. - MD.
N3845--W7700/7.5

SITE TOPOGRAPHIC MAP
#27-32 & 60

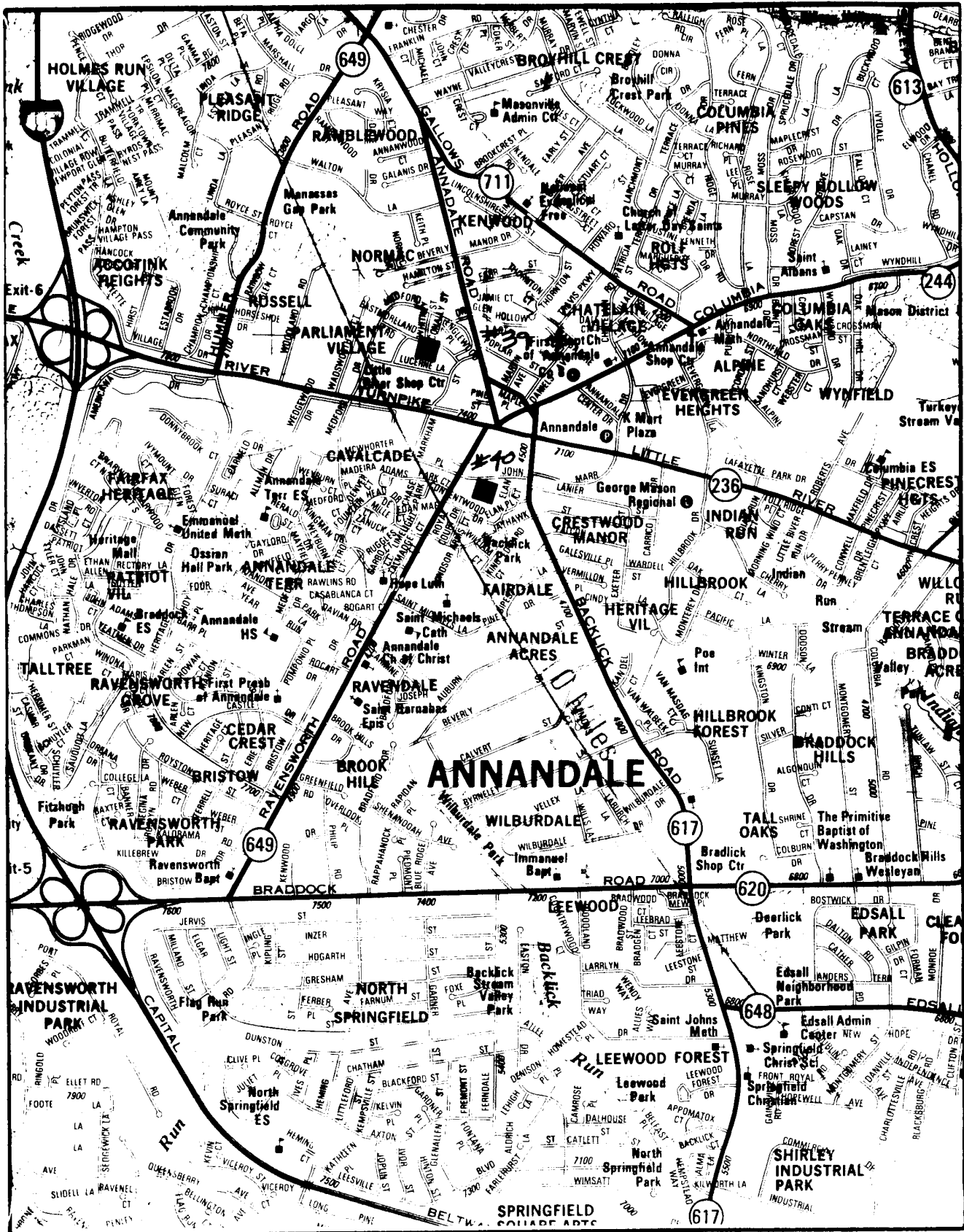
ANACOSTIA, D.C. - MD.
N3845 - W7652 5/7.5





SITE LOCATION MAP
#27-32 & 60





SITE TOPOGRAPHIC MAP
#39 & 40

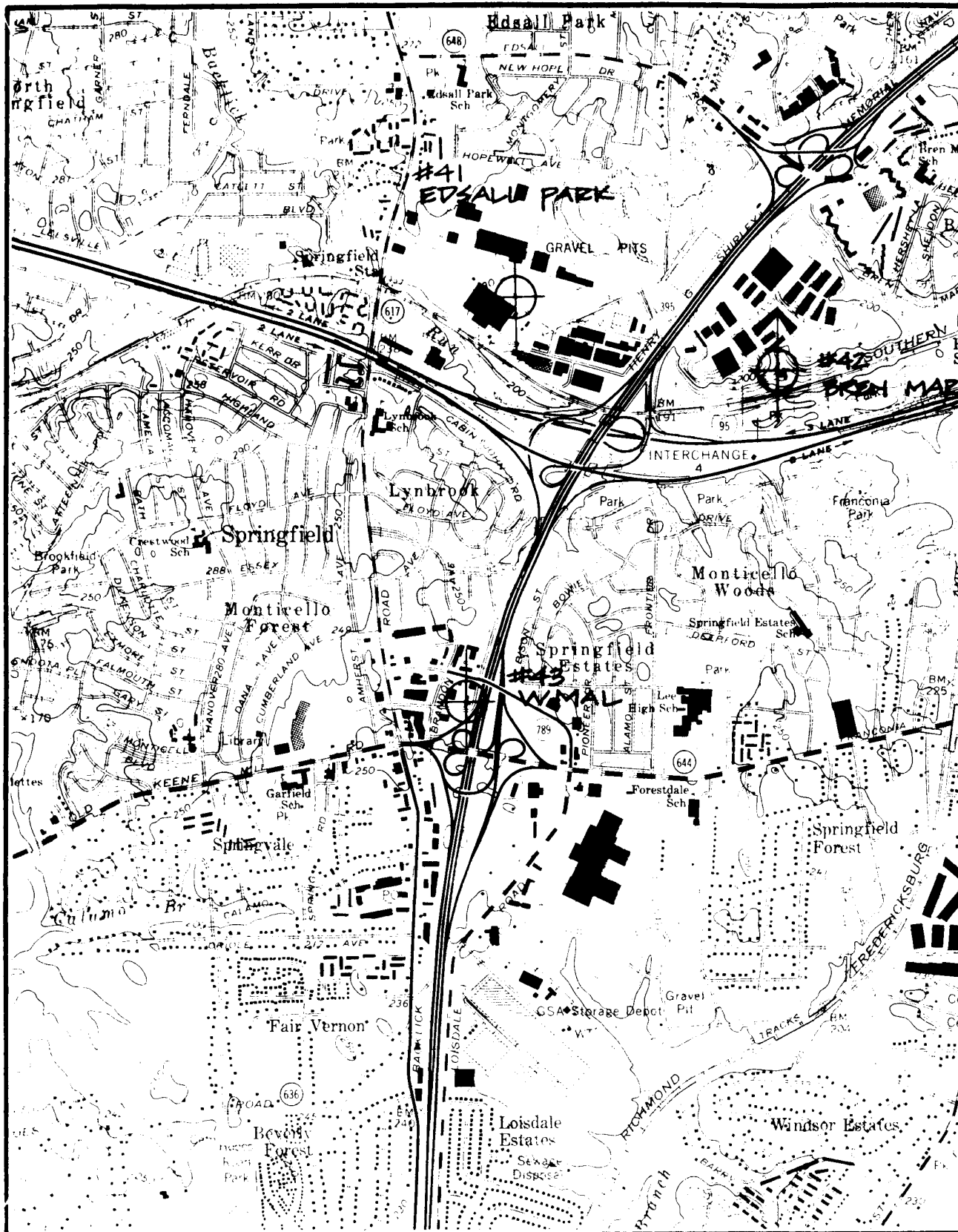




ANNANDALE, VA.
38077-G2 TF-024

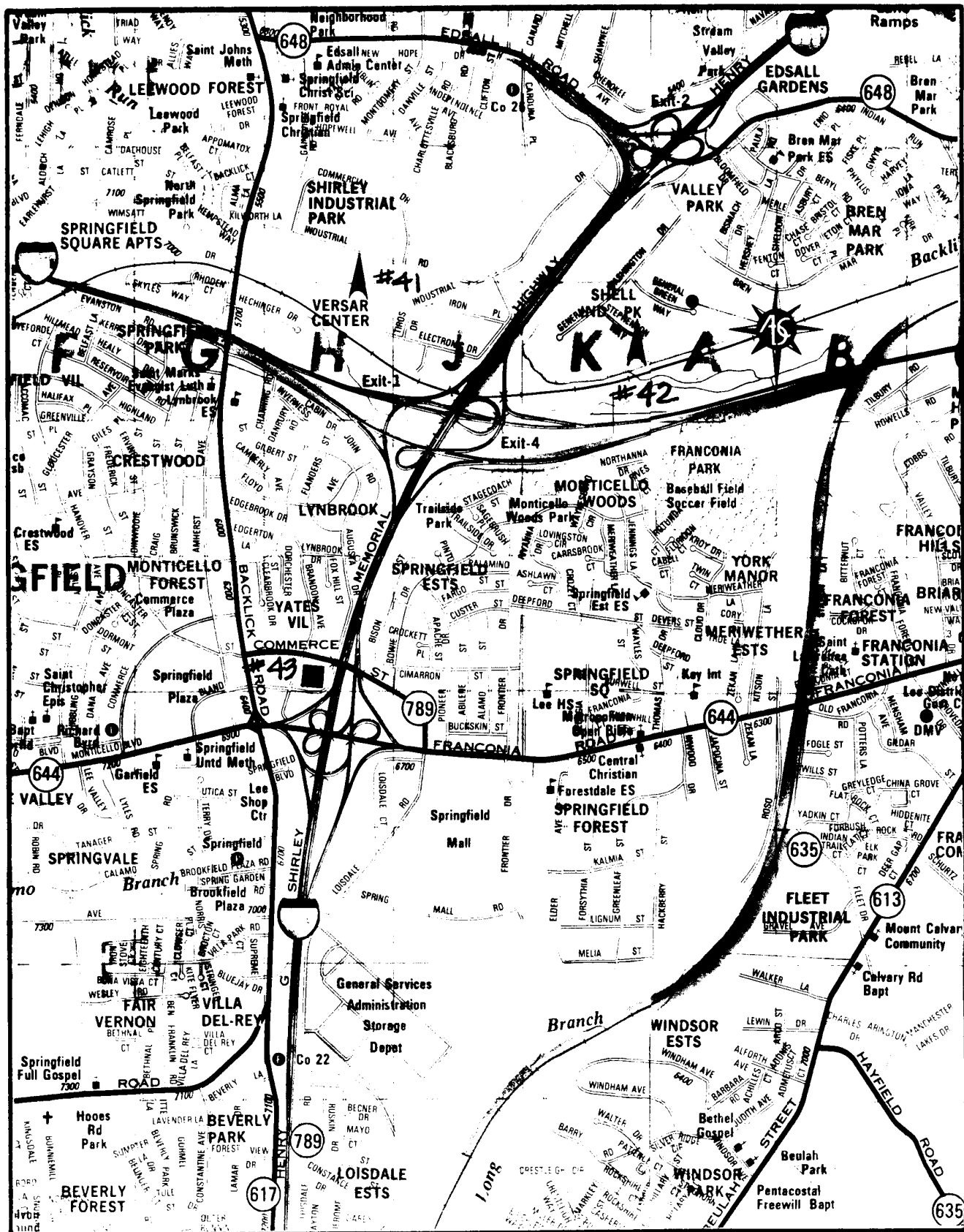
SITE LOCATION MAP
#39 & 40





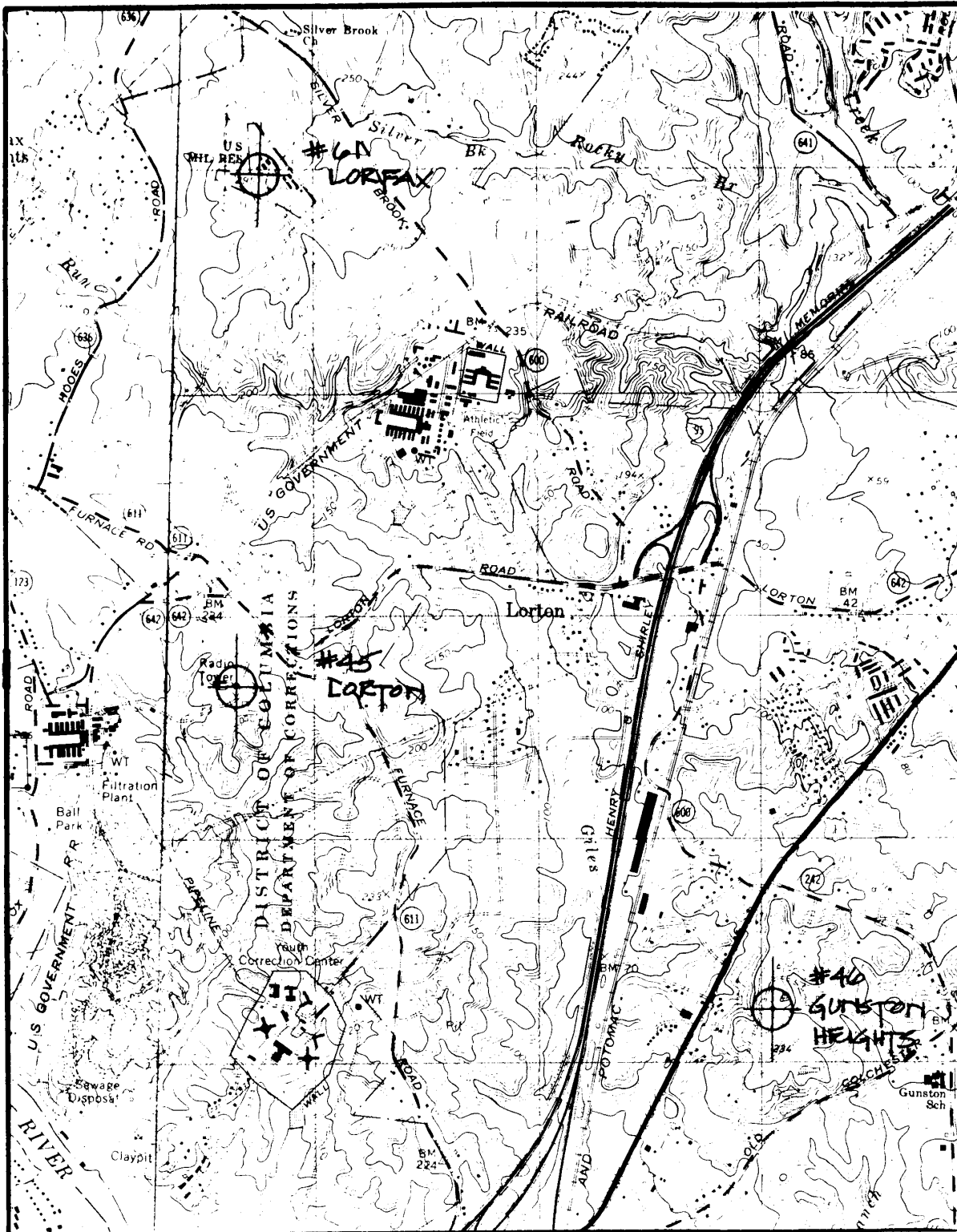
SITE TOPOGRAPHIC MAP
#41, 42, & 43





SITE LOCATION MAP
#41,42, & 43

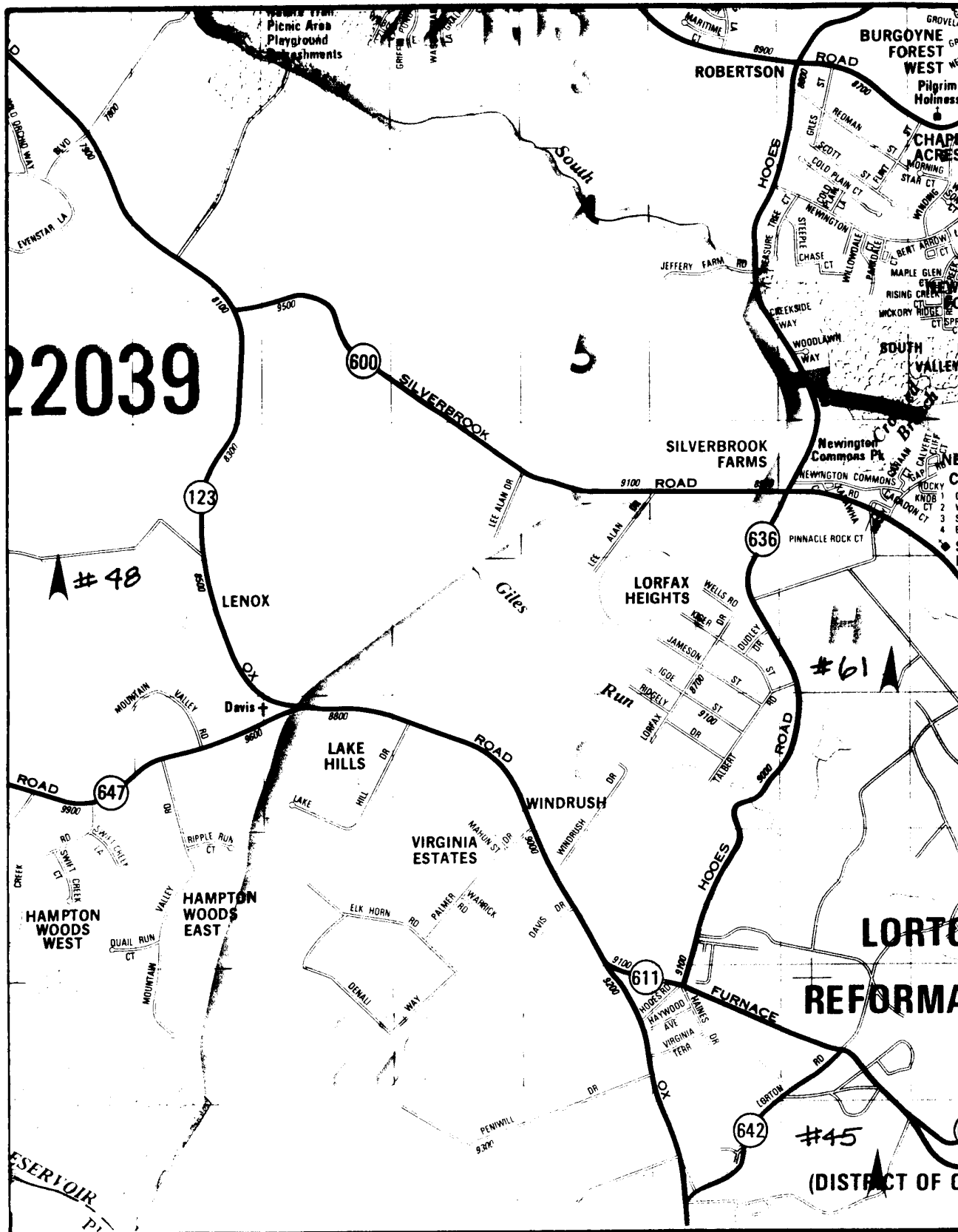




FORT BELVOIR QUADRANGLE
 VIRGINIA - MARYLAND
 7.5 MINUTE SERIES (TOPOGRAPHIC - BATHYMETRIC)

SITE TOPOGRAPHIC MAP
 #45, 46, & 61

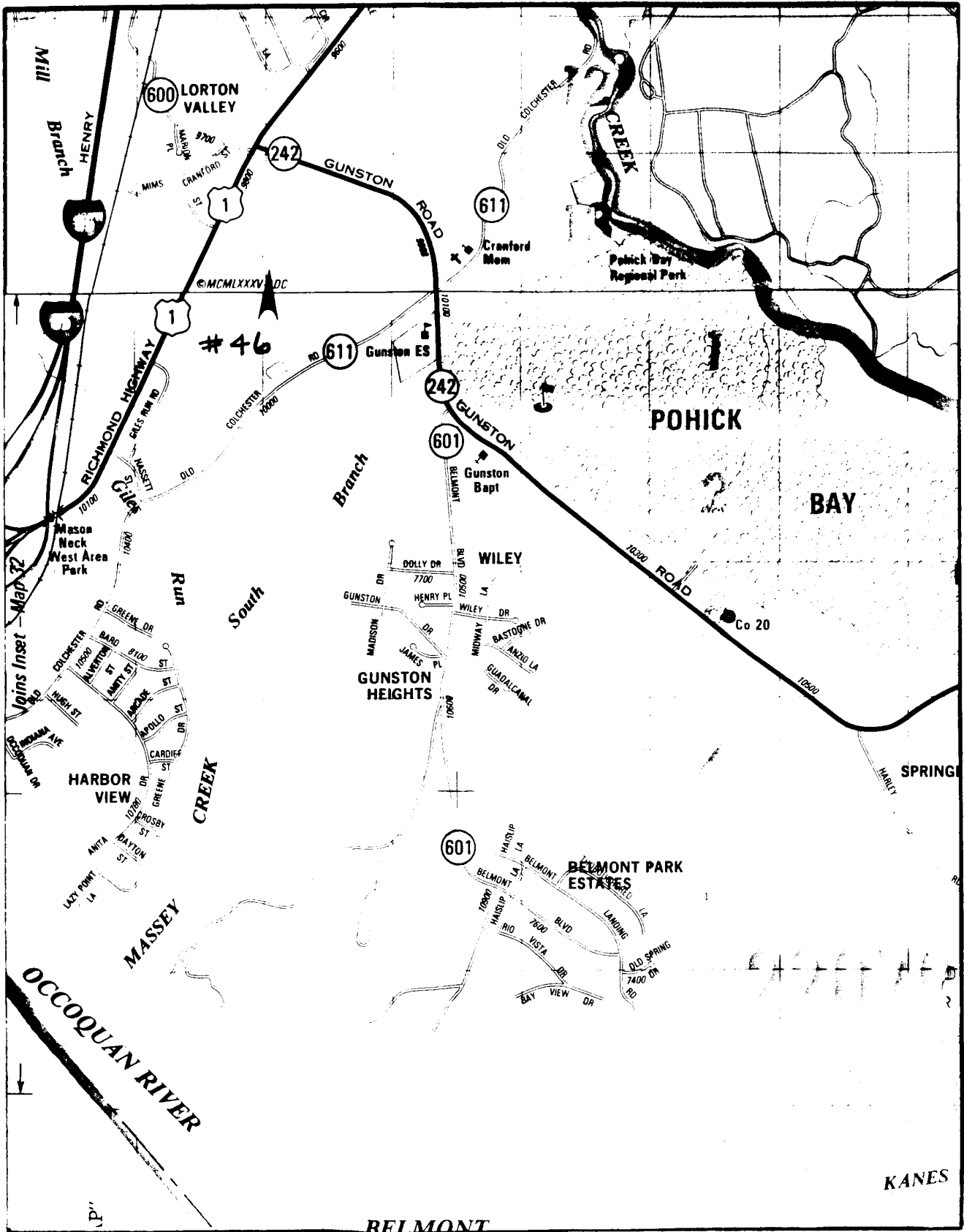




SITE LOCATION MAP

#45, 48, & 61

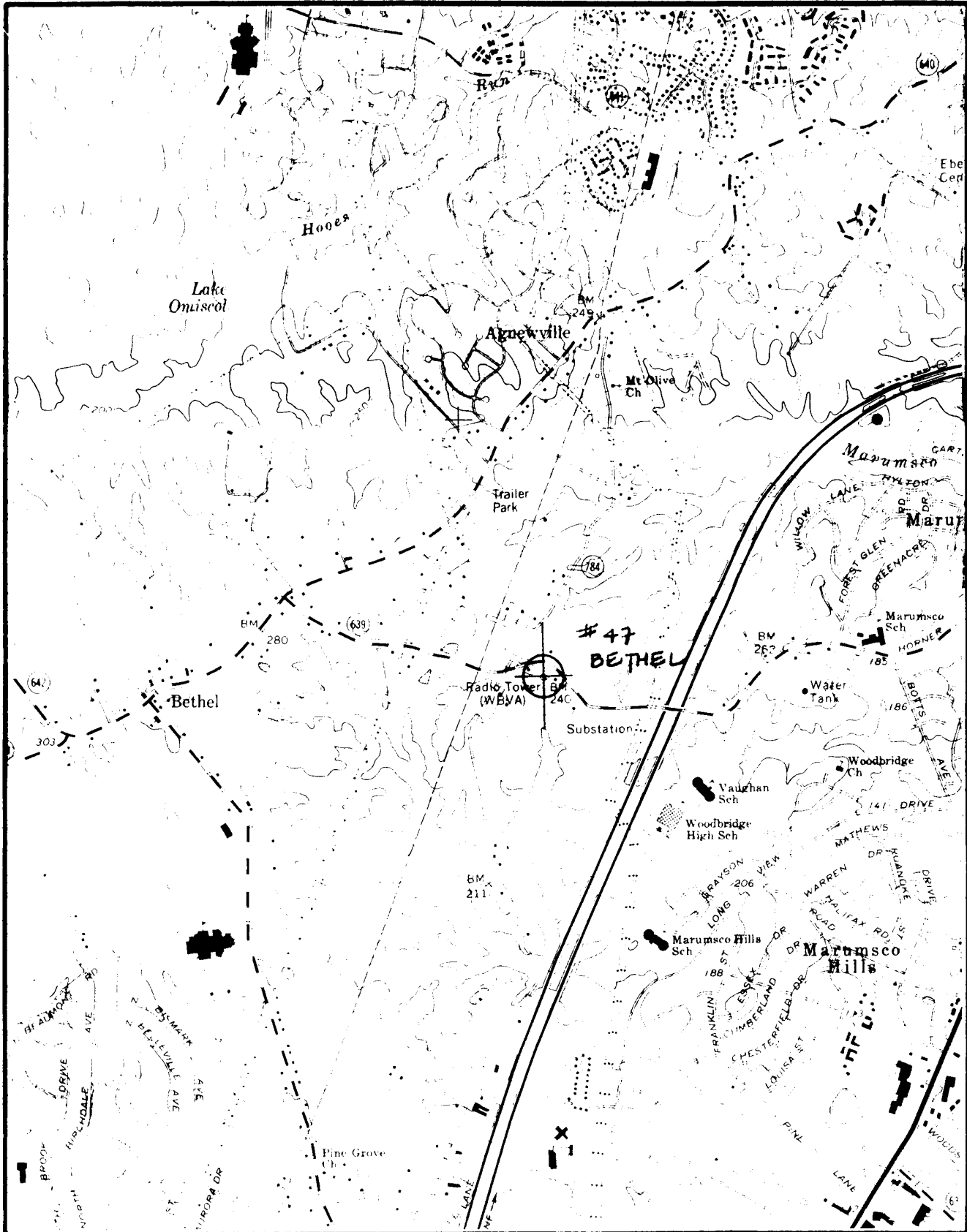




SITE LOCATION MAP

46

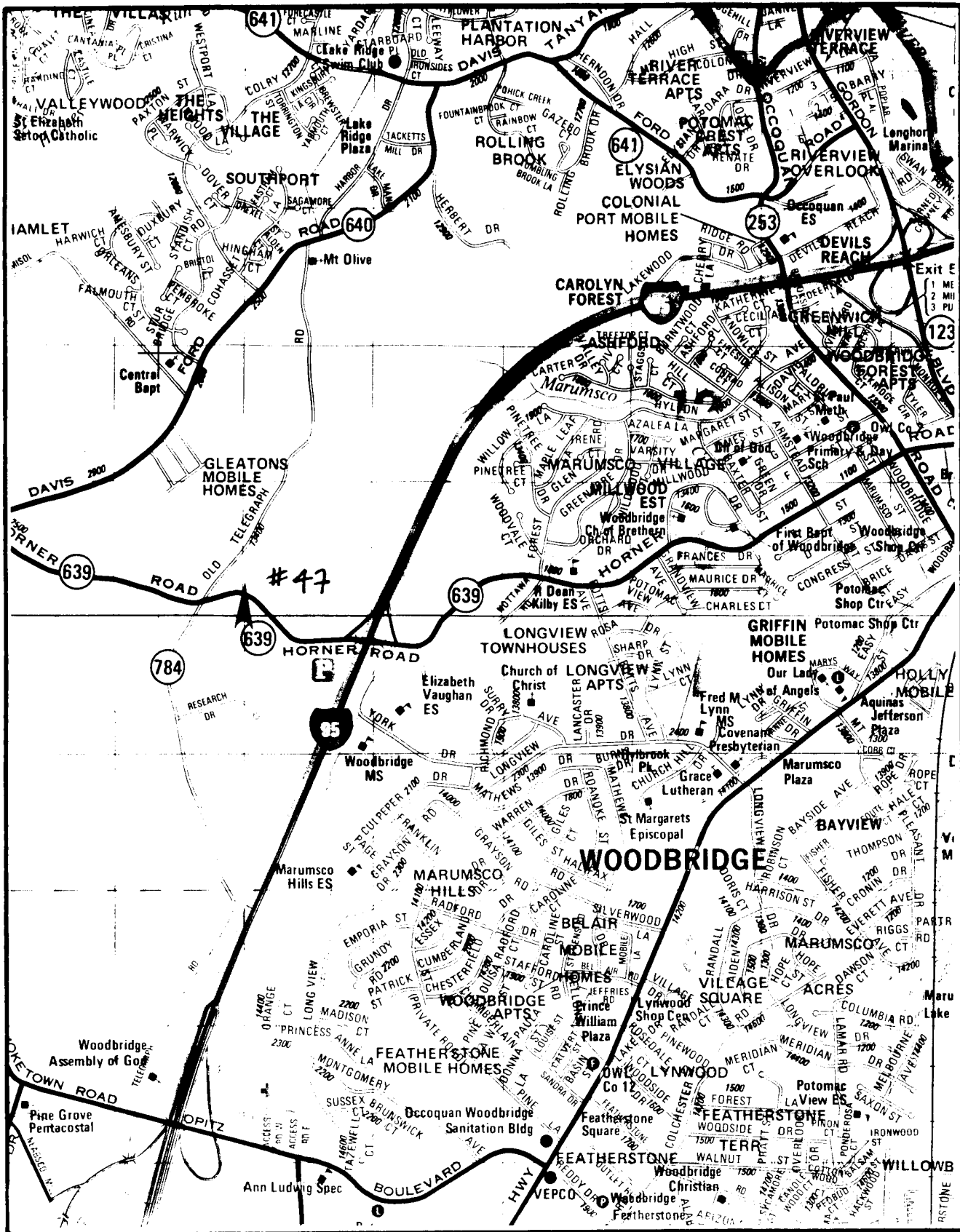




OCCOQUAN, VA.
 NE 4 QUANTICO 15 QUADRANGLE
 N3837.5 - W7715.7.5

SITE TOPOGRAPHIC MAP
 # 47

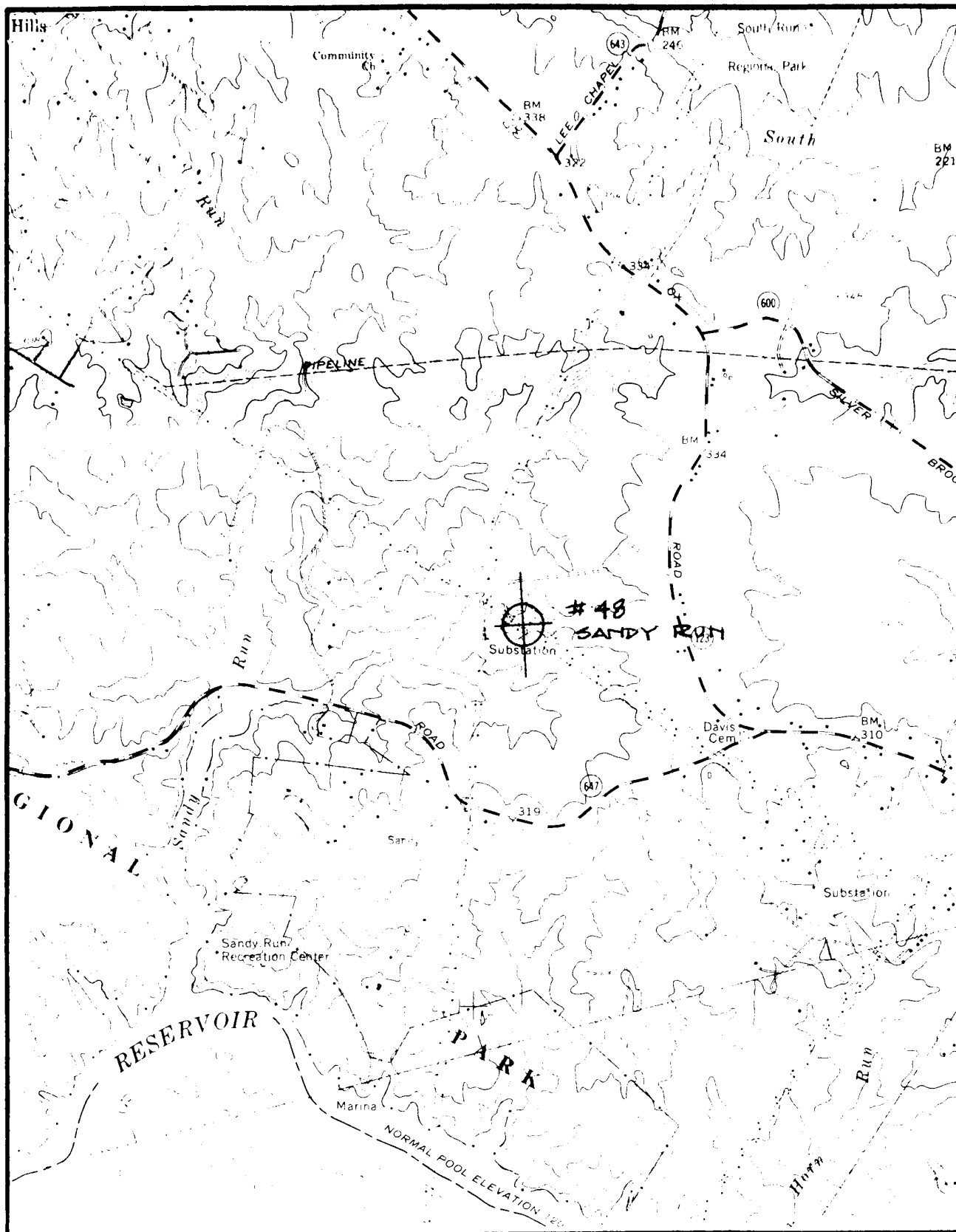




SITE LOCATION MAP

#47

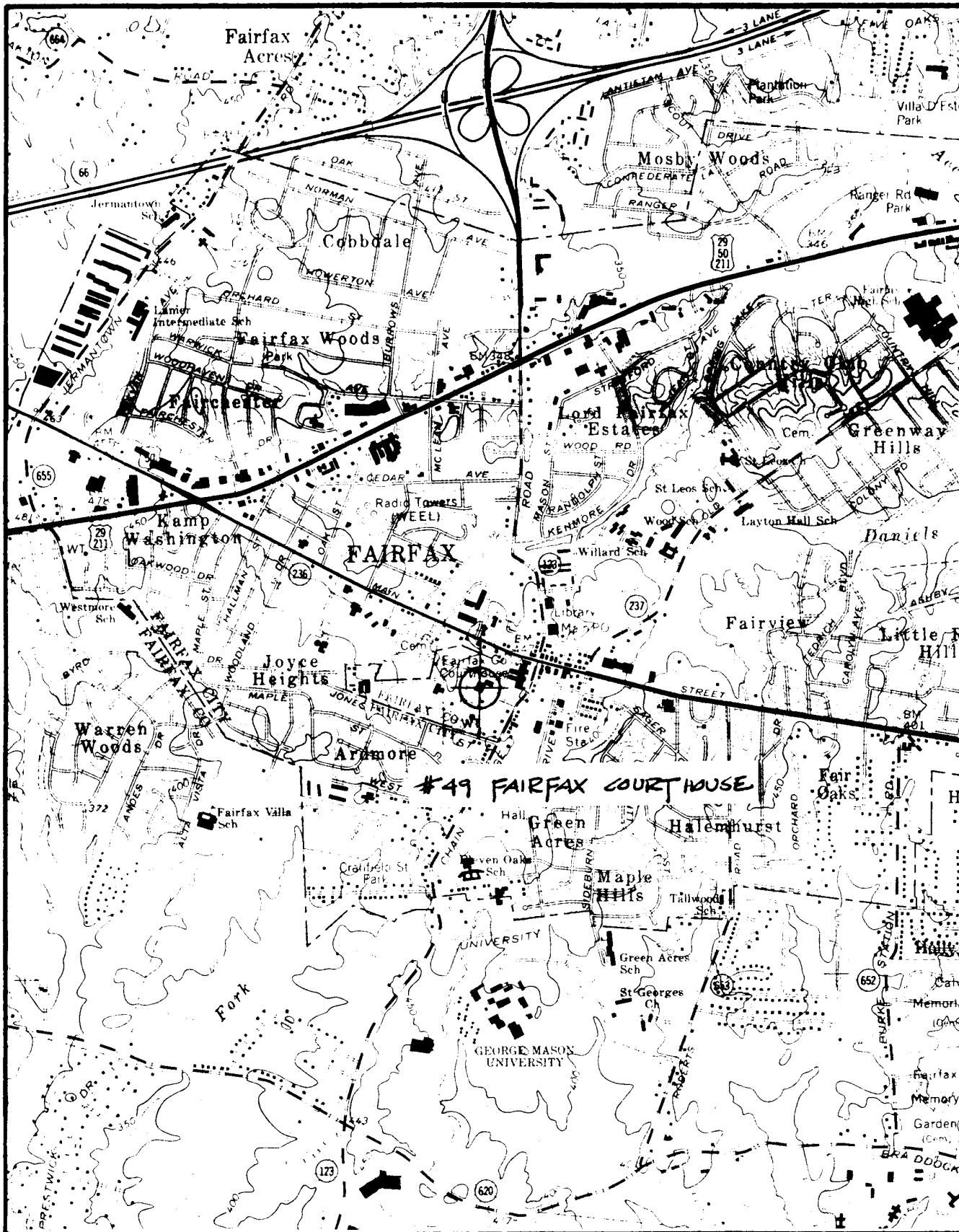




OCCOQUAN, VA.
NE/4 QUANTICO 15 QUADRANGLE

SITE TOPOGRAPHIC MAP
48

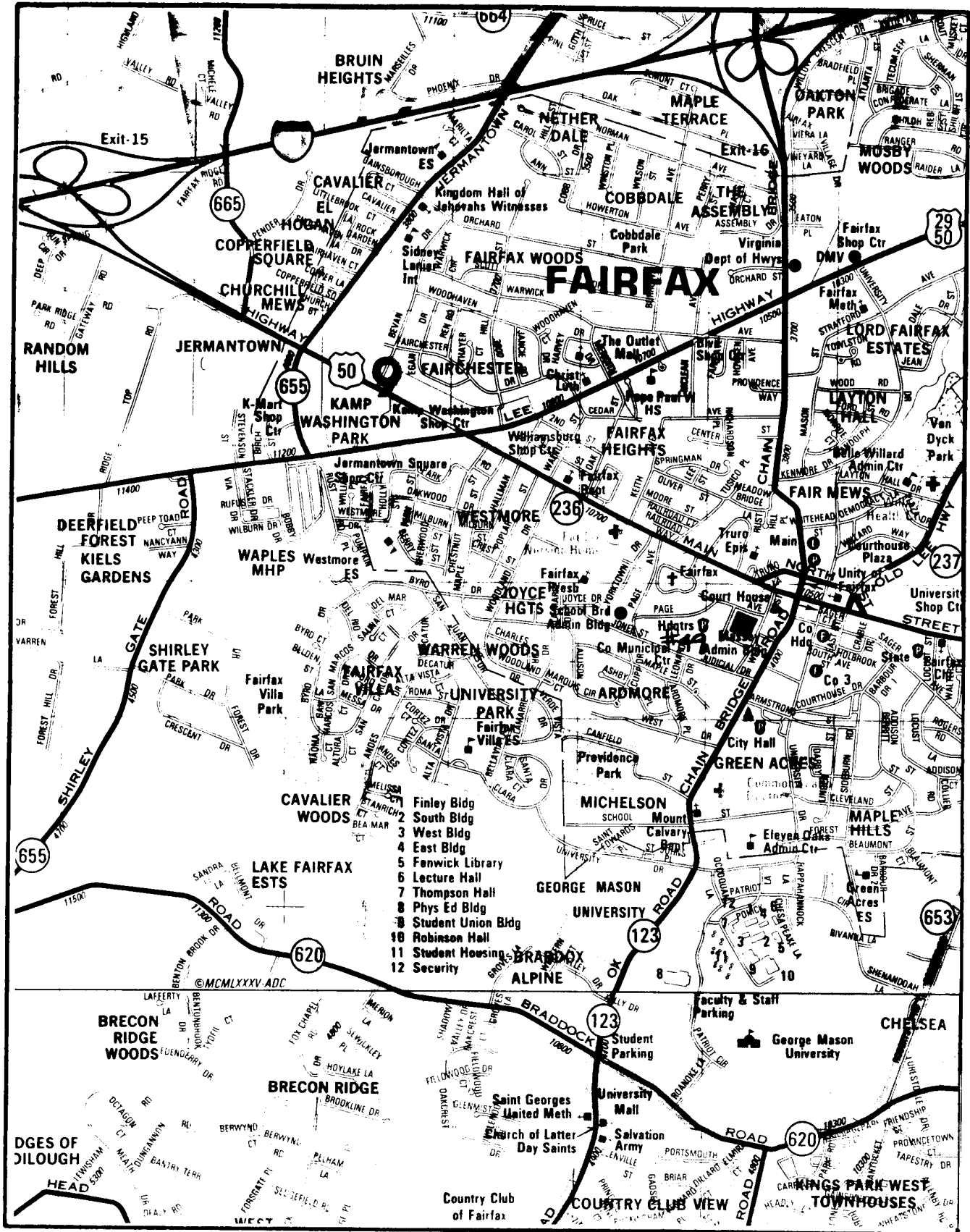




FAIRFAX QUADRANGLE
 VIRGINIA
 7.5 MINUTE SERIES (TOPOGRAPHIC)

SITE TOPOGRAPHIC MAP
 #49

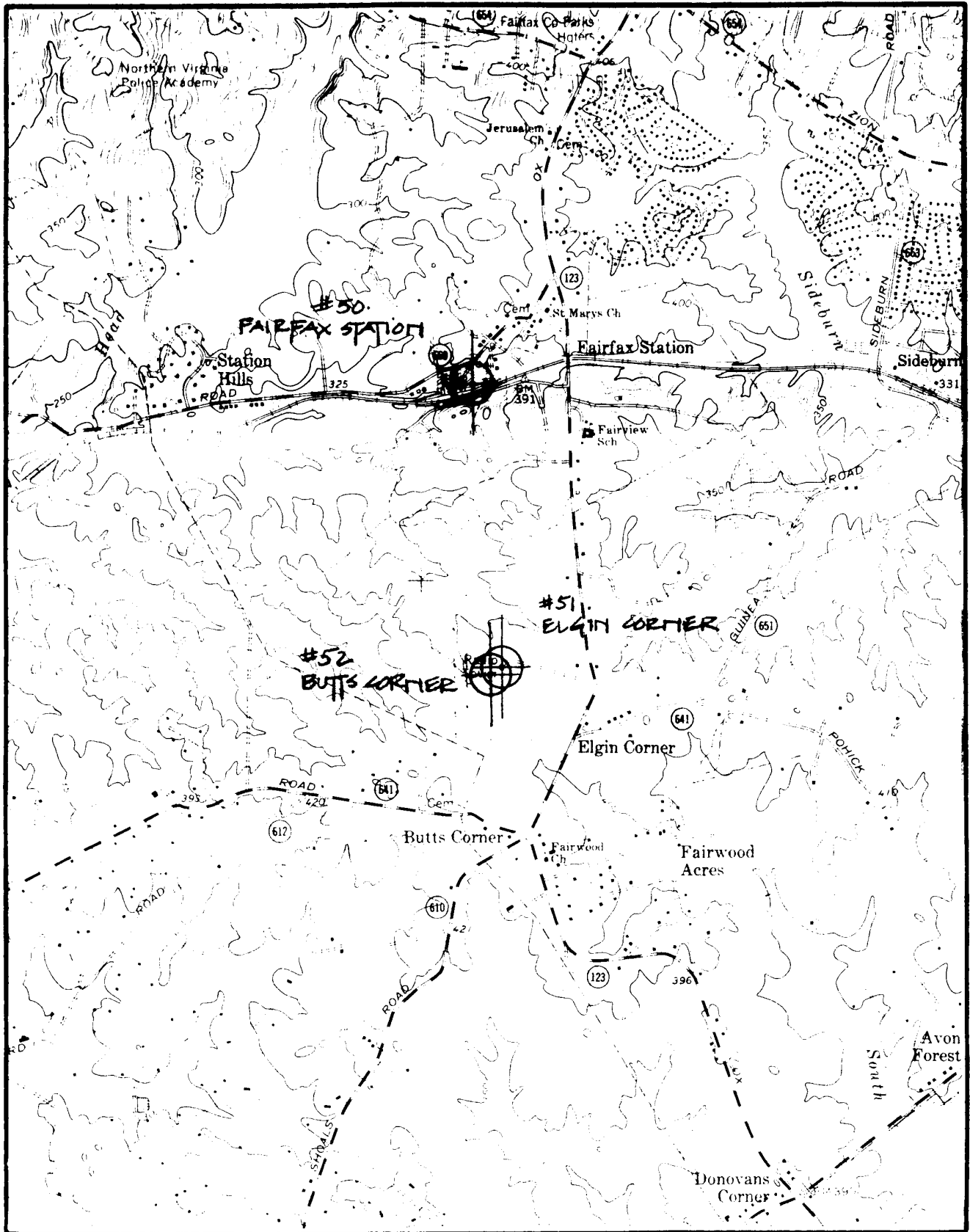




SITE LOCATION MAP

49

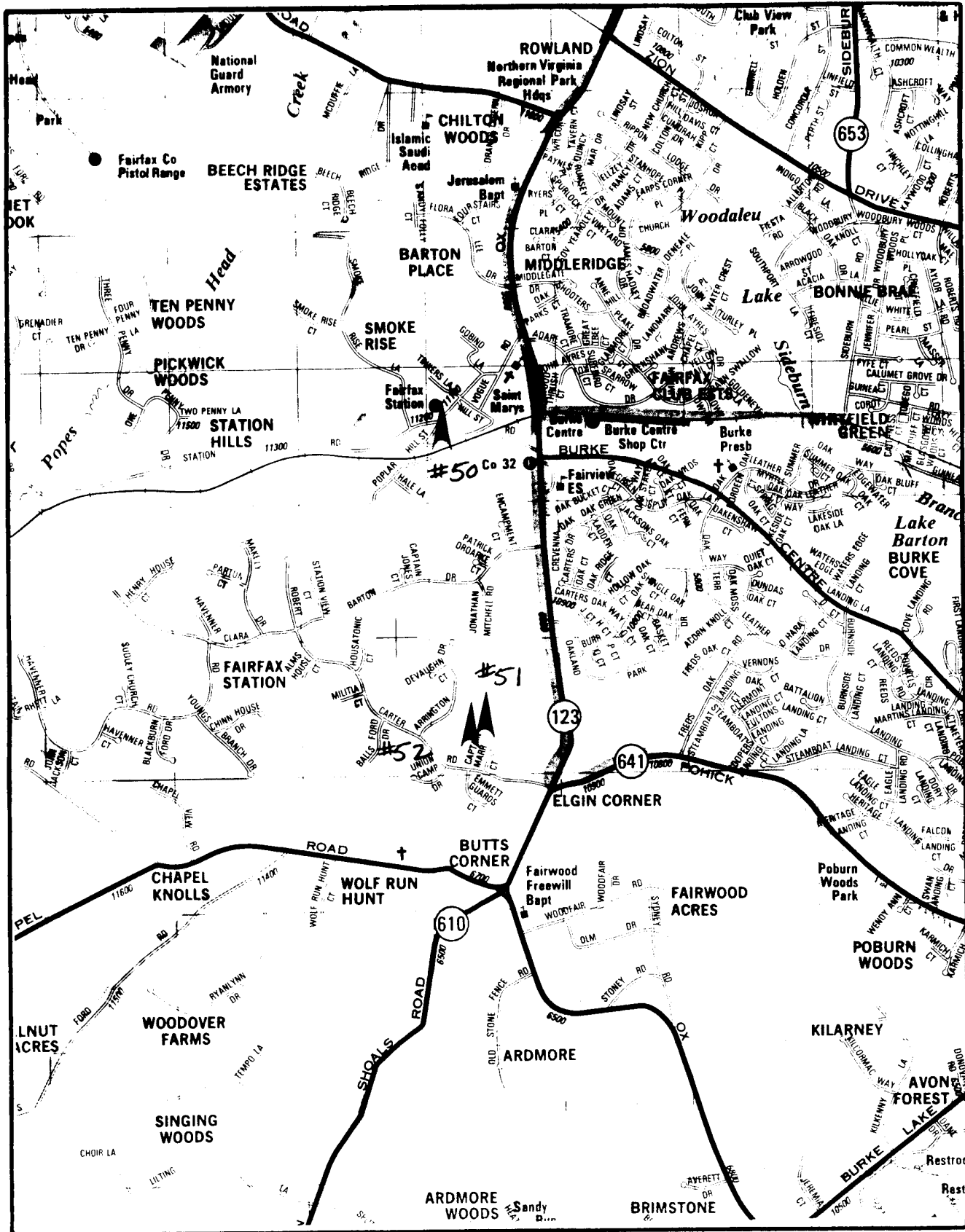




FAIRFAX, VA.
N. 38° 45' - W. 77° 15' 30"

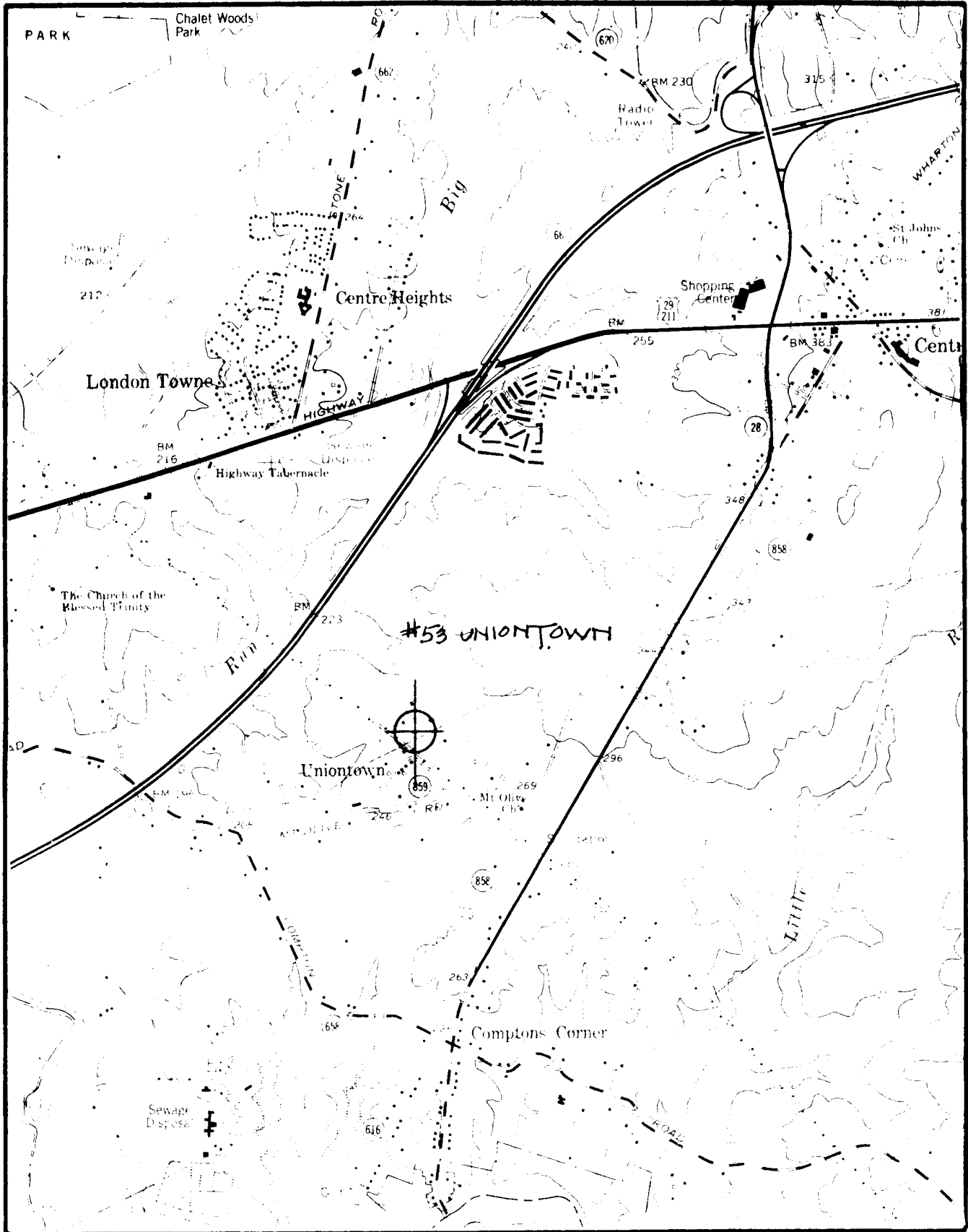
SITE TOPOGRAPHIC MAP
50, 51, & 52





SITE LOCATION MAP
#50,51, & 52

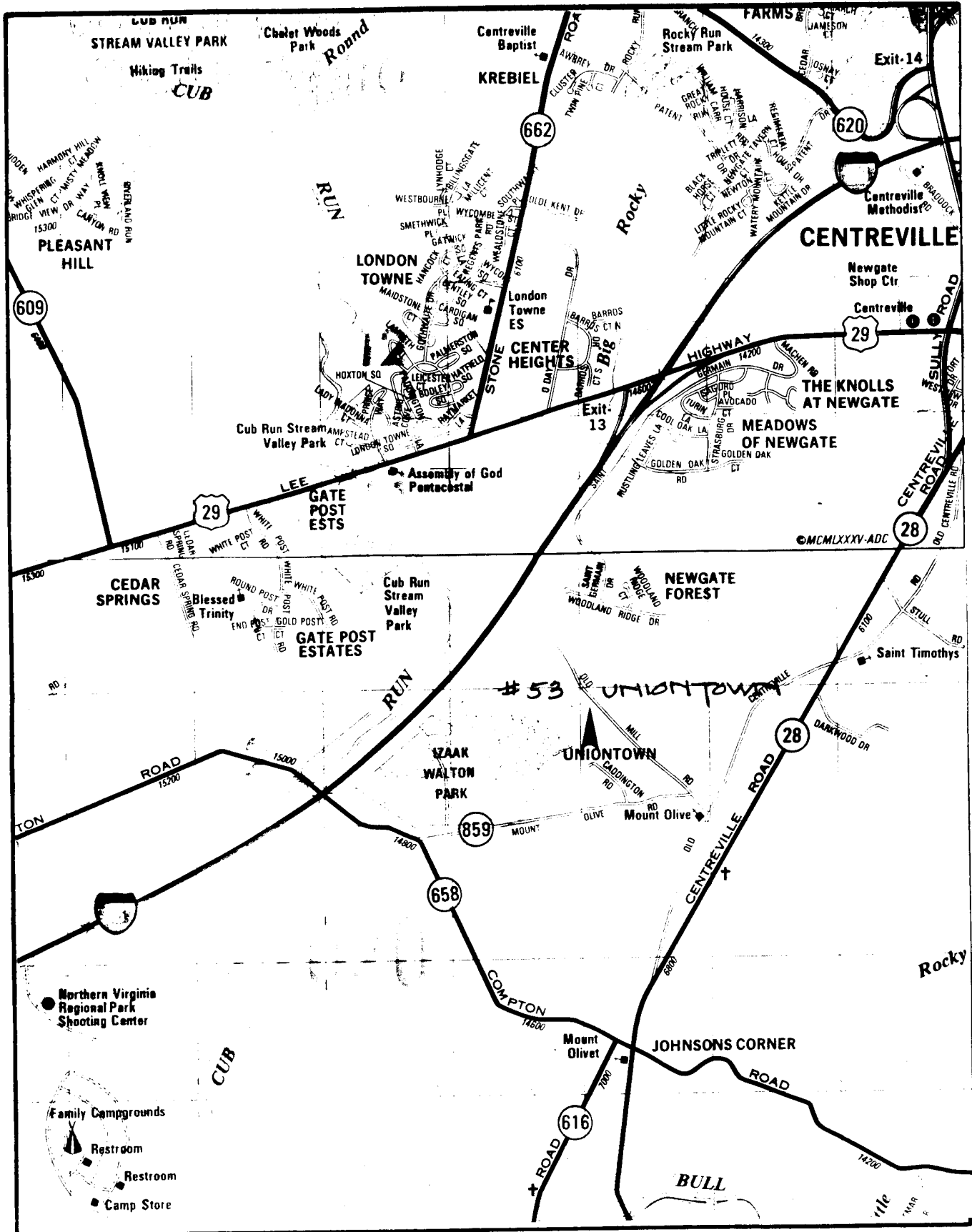




MANASSAS, VA.
N. 38.45° W. 122.5° 11'

SITE TOPOGRAPHIC MAP
53

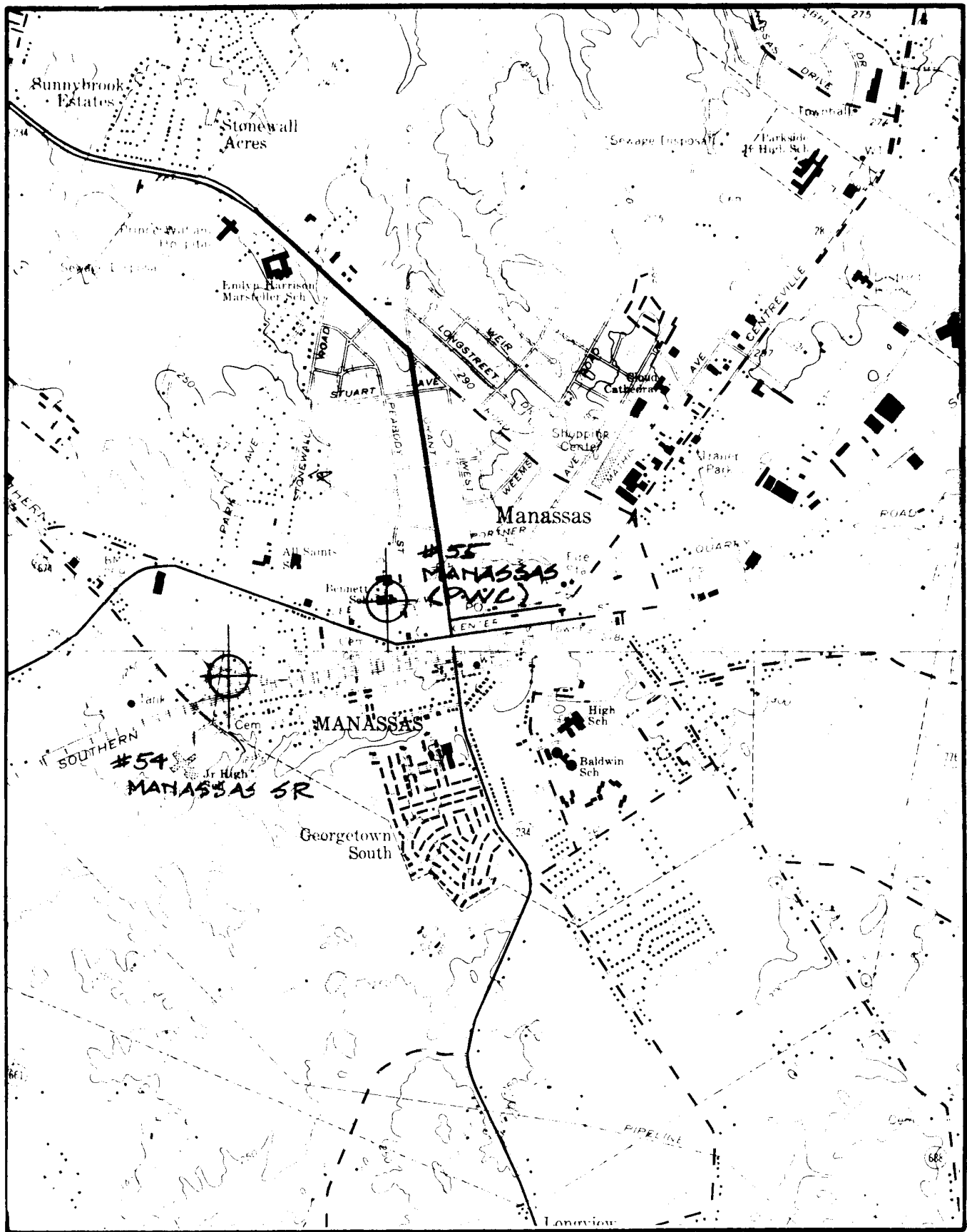




SITE LOCATION MAP

#53





MANASSAS QUADRANGLE
VIRGINIA

7.5 MINUTE SERIES (TOPOGRAPHIC)

INDEPENDENT HILL, VA.

NO. 1 QUADRANGLE

SITE TOPOGRAPHIC MAP

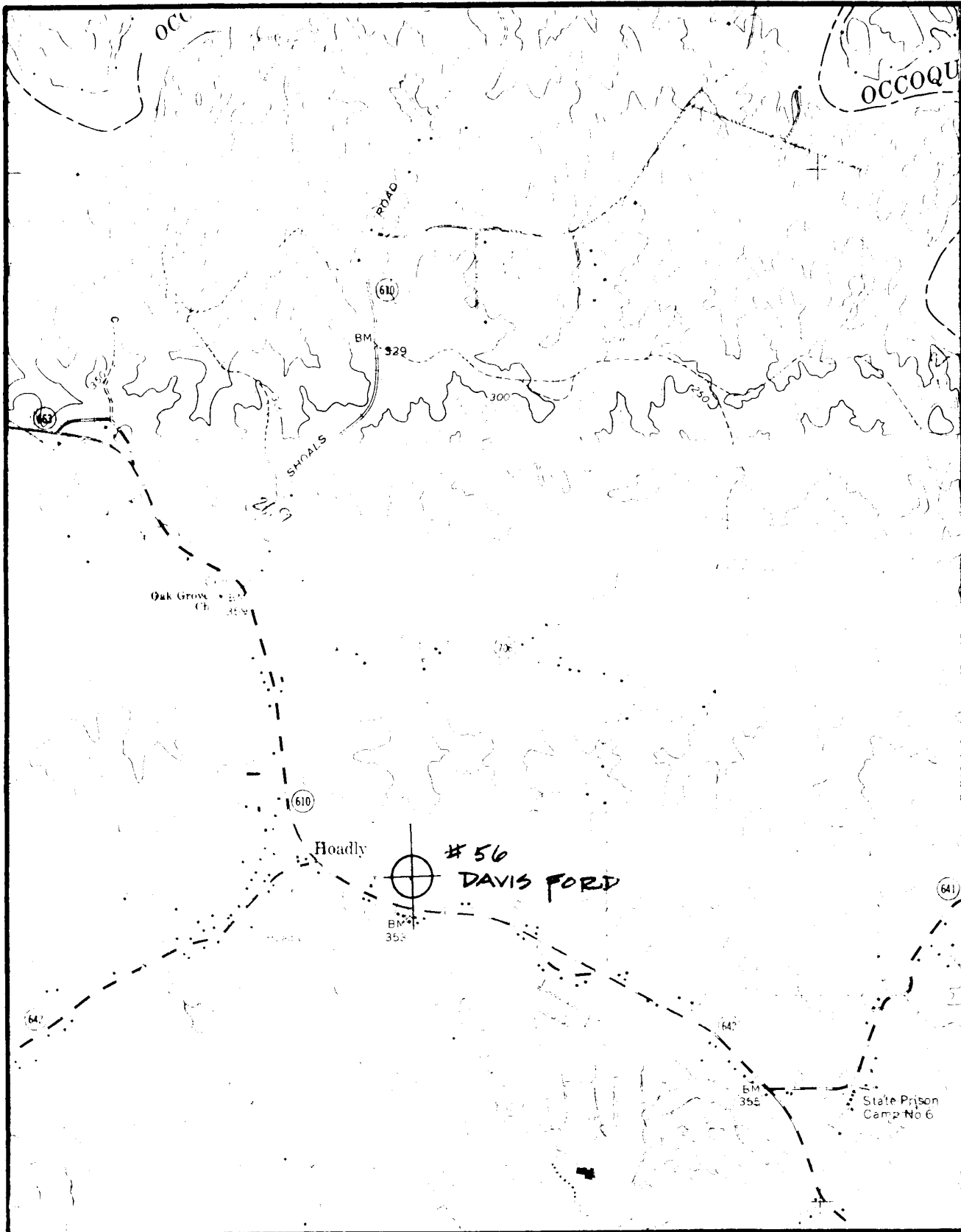
#54 & 55





SITE LOCATION MAP
#54 & 55

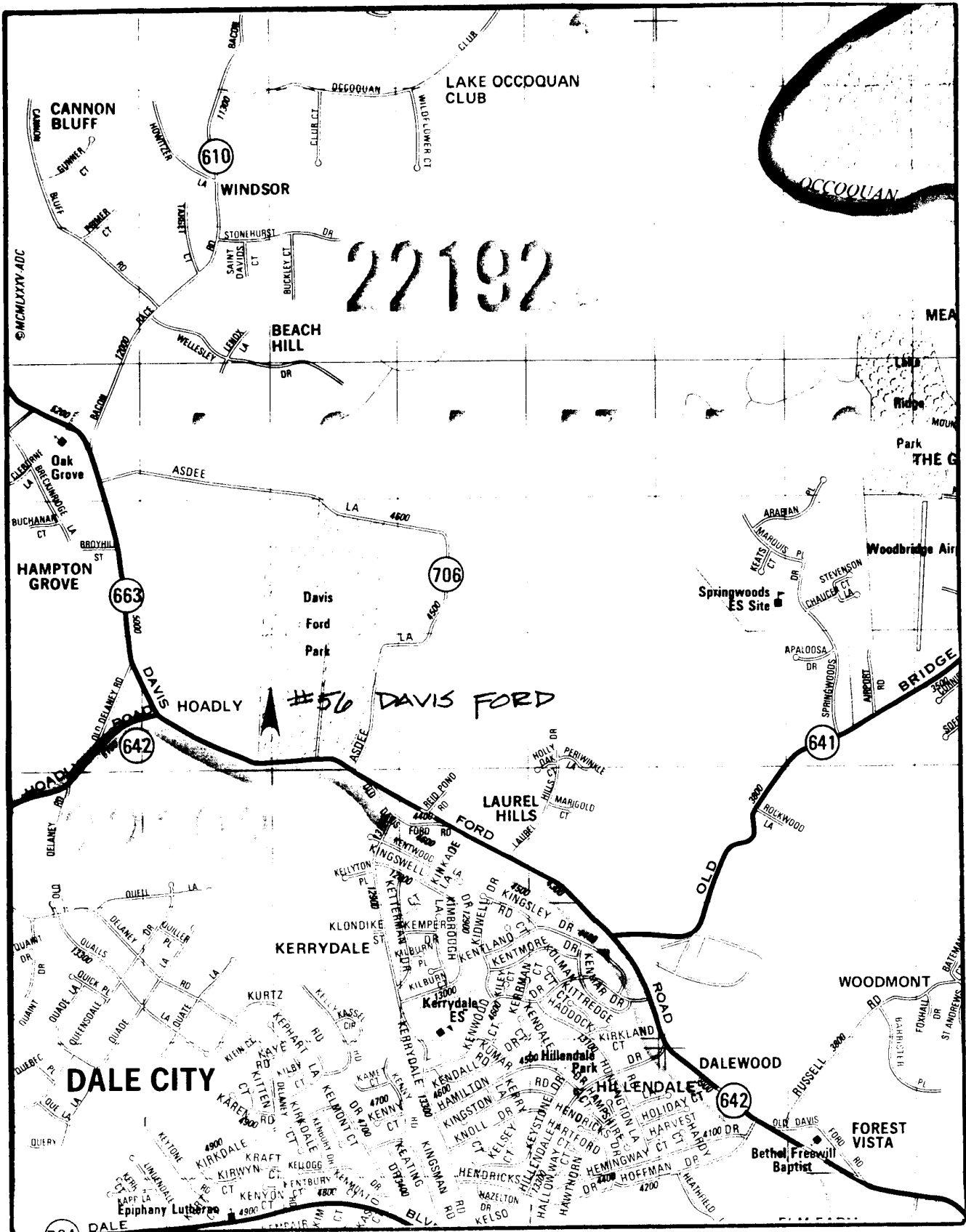




OCCOQUAN QUADRANGLE
VIRGINIA
7.5 MINUTE SERIES (TOPOGRAPHIC)

SITE TOPOGRAPHIC MAP
56

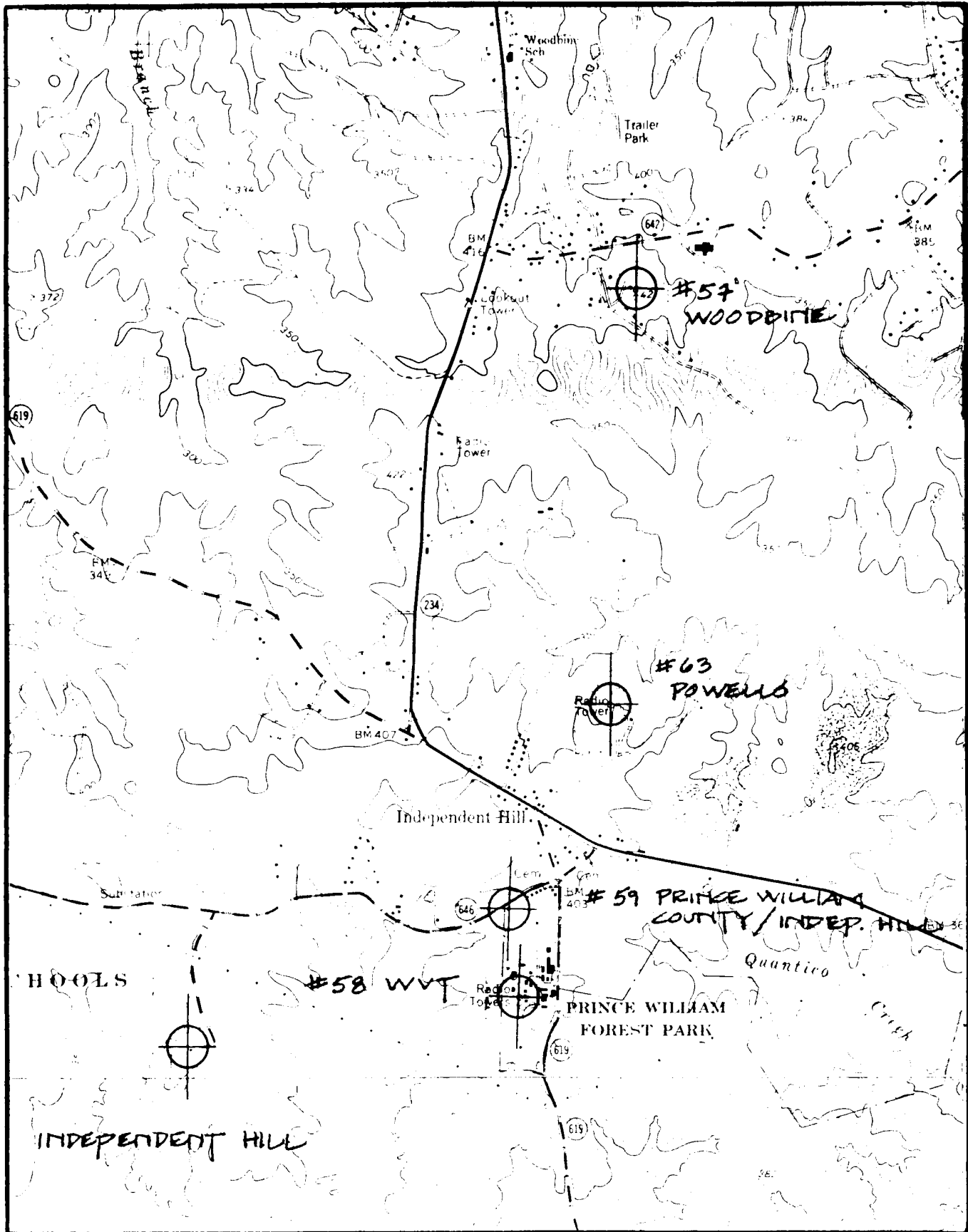




SITE LOCATION MAP

#56

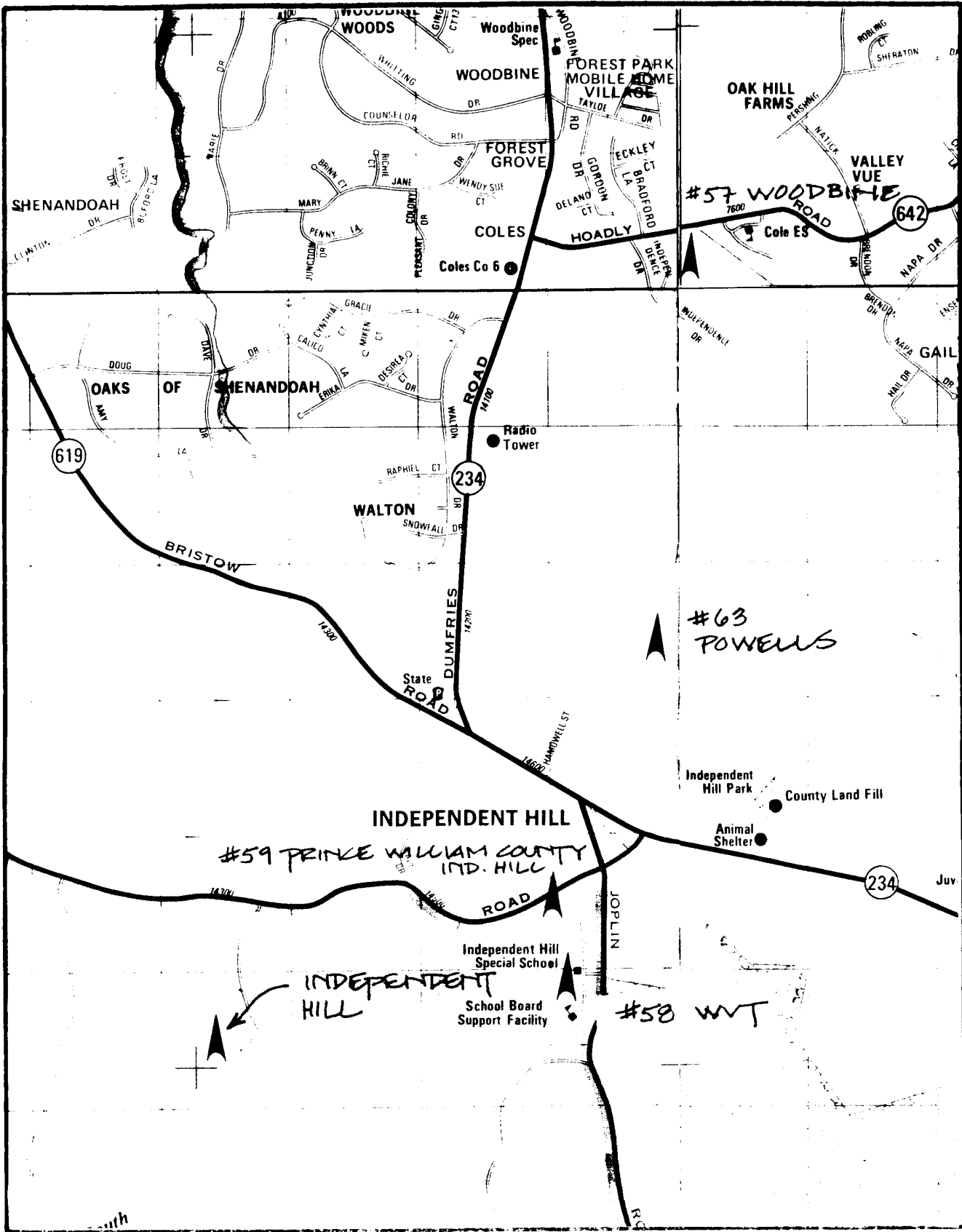




INDEPENDENT HILL QUADRANGLE
 VIRGINIA
 7.5 MINUTE SERIES (TOPOGRAPHIC)
 JOPLIN QUADRANGLE
 VIRGINIA
 7.5 MINUTE SERIES (TOPOGRAPHIC)

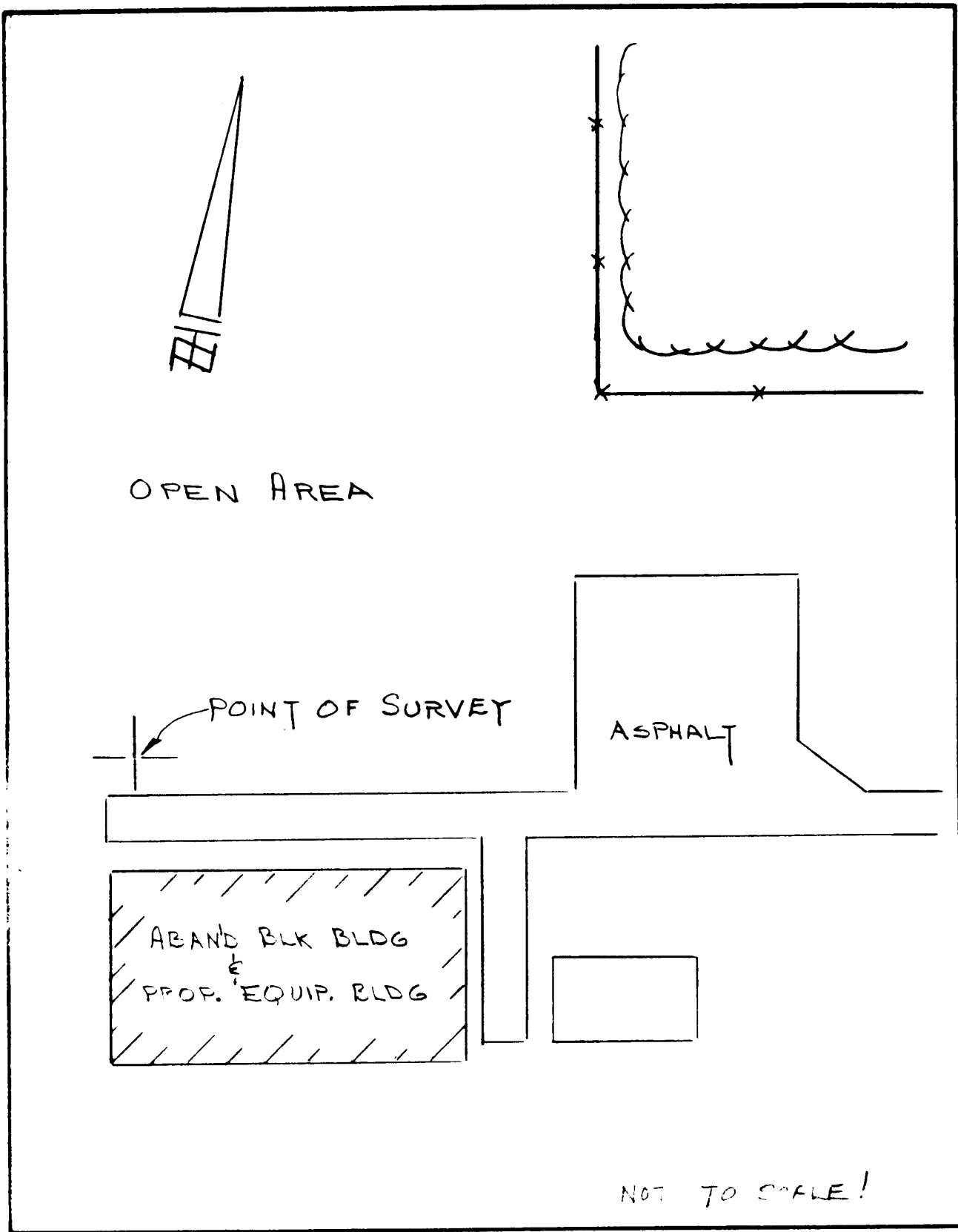
SITE TOPOGRAPHIC MAP
 #57,58,59,63 & INDEPENDENT HILL





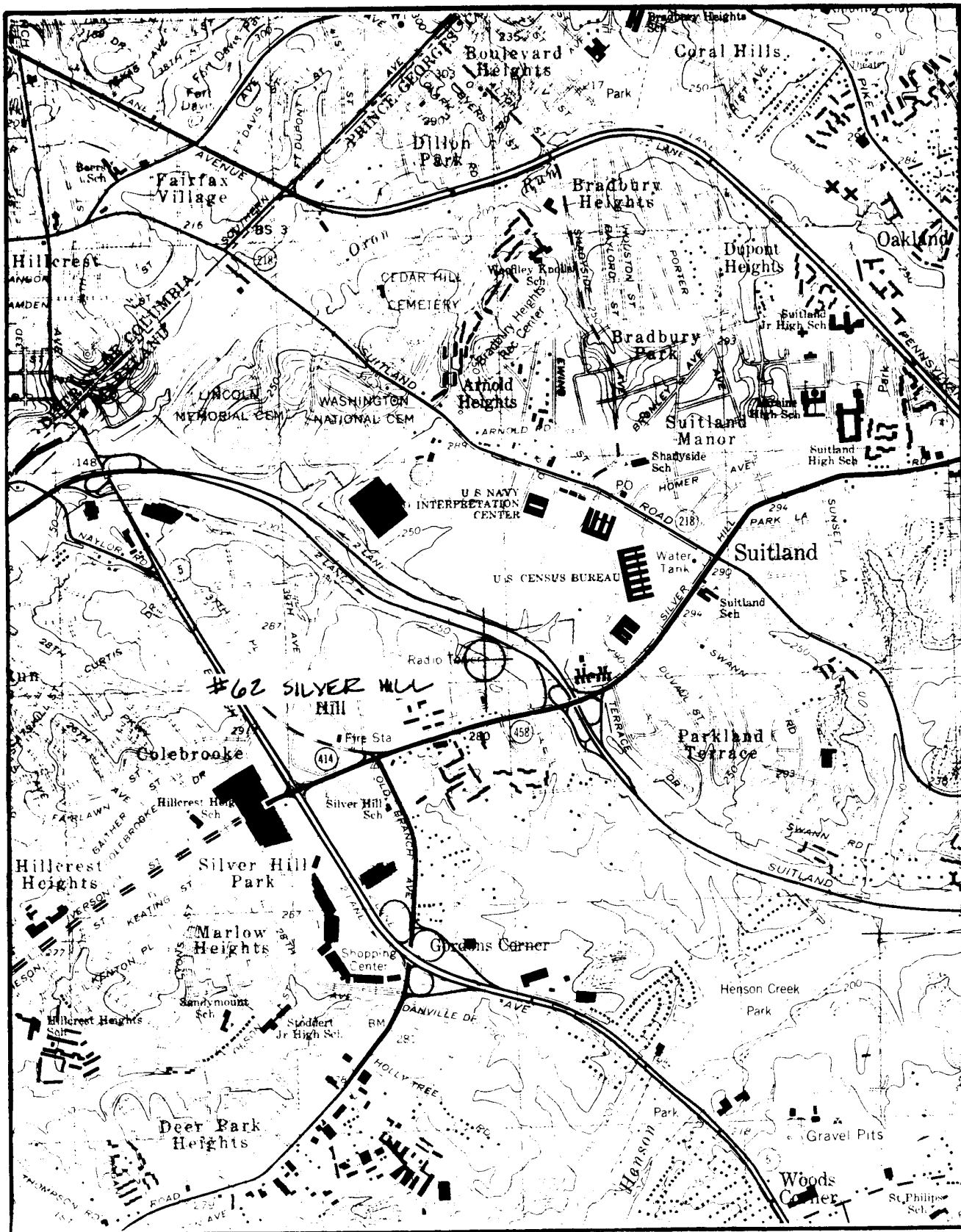
SITE LOCATION MAP
#57,58,59,63 & INDEPENDENT HILL





INDEPENDENT SITE SKETCH

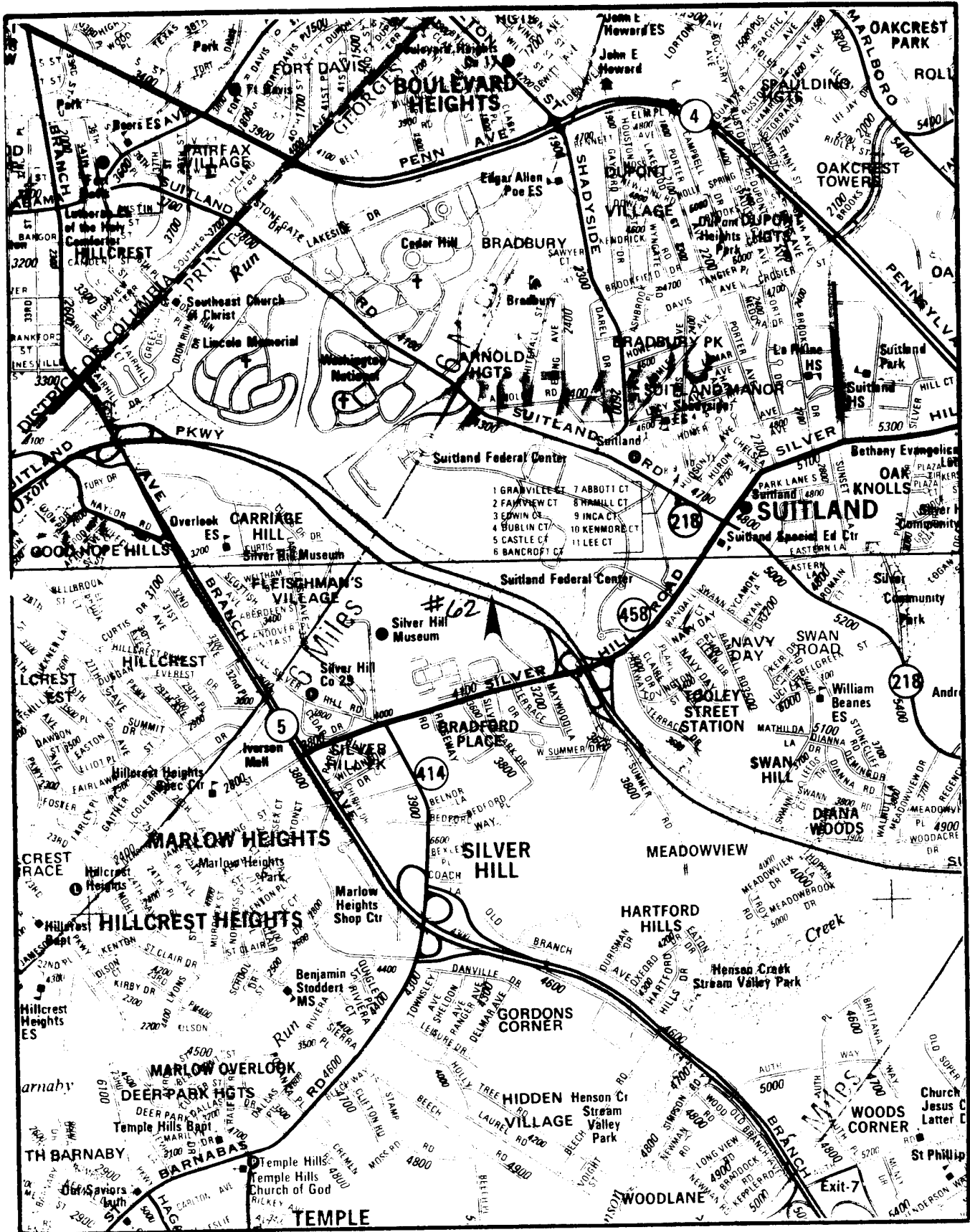




ANACOSTIA, D.C. - MD.
N3845 - W7652.5/7.5

SITE TOPOGRAPHIC MAP
#62





SITE LOCATION MAP

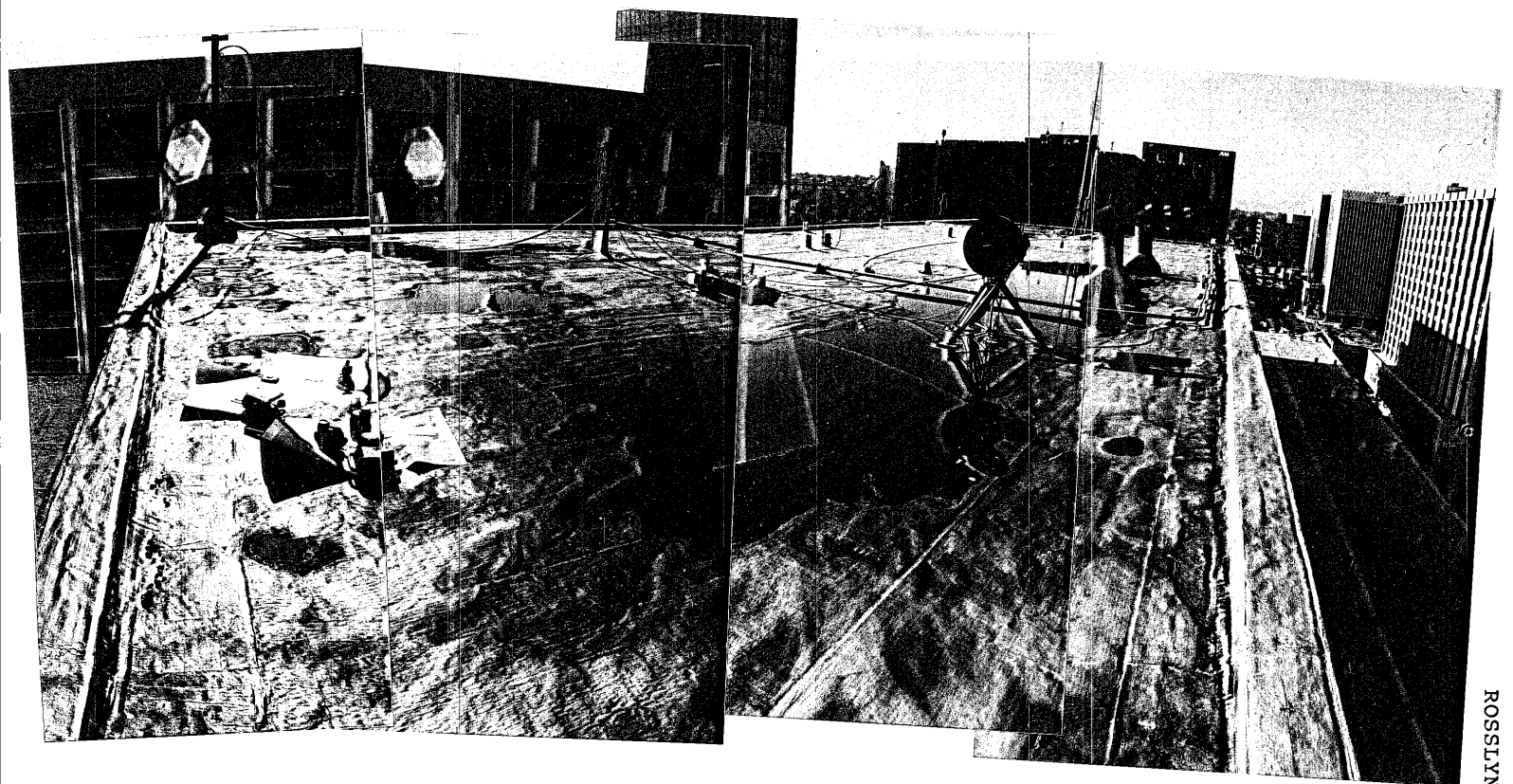
#62



IV. SUPPORTING DOCUMENTATION

F. SITE PHOTOGRAPHS

Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4

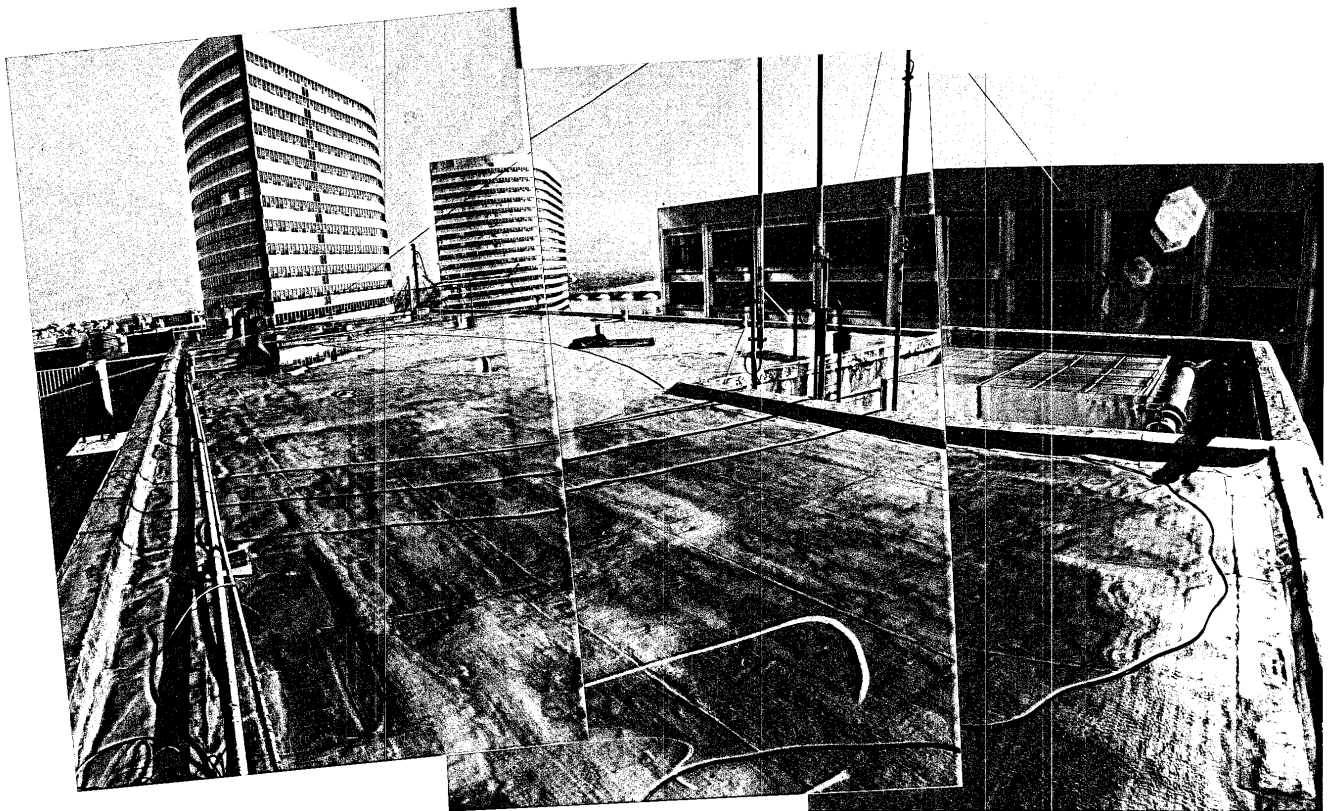


ROSSLYN

VIEW SOUTH TO WEST OF MECHANICAL ROOF

Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4

Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4

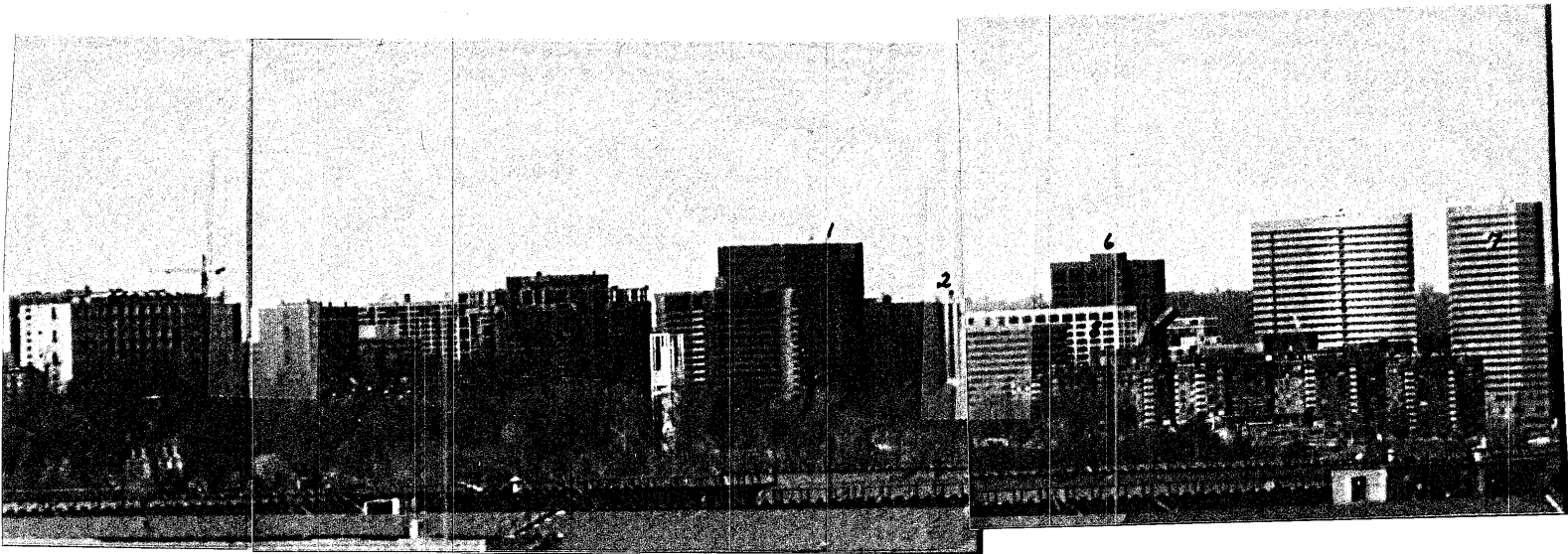


ROSSLYN

VIEW EAST TO SOUTH OF MECHANICAL ROOF

Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4

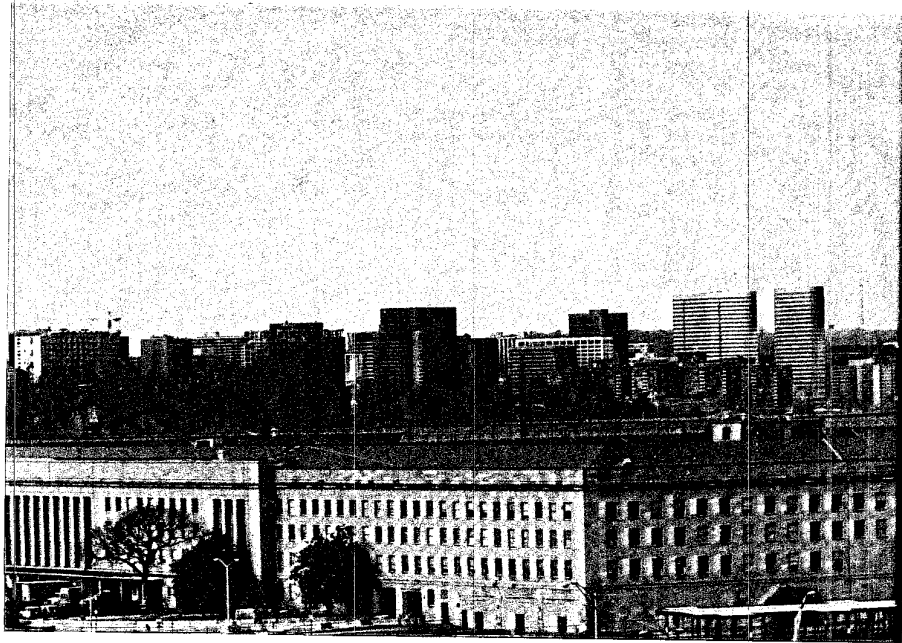
Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4



VIEW NORTHWEST OF ROSSLYN AREA WITH ARROW
INDICATING EAST CORNER OF BUILDING (400mm LENS)

ROSSLYN

Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4



VIEW NORTHWEST OF ROSSLYN AREA
(200mm LENS)

Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4

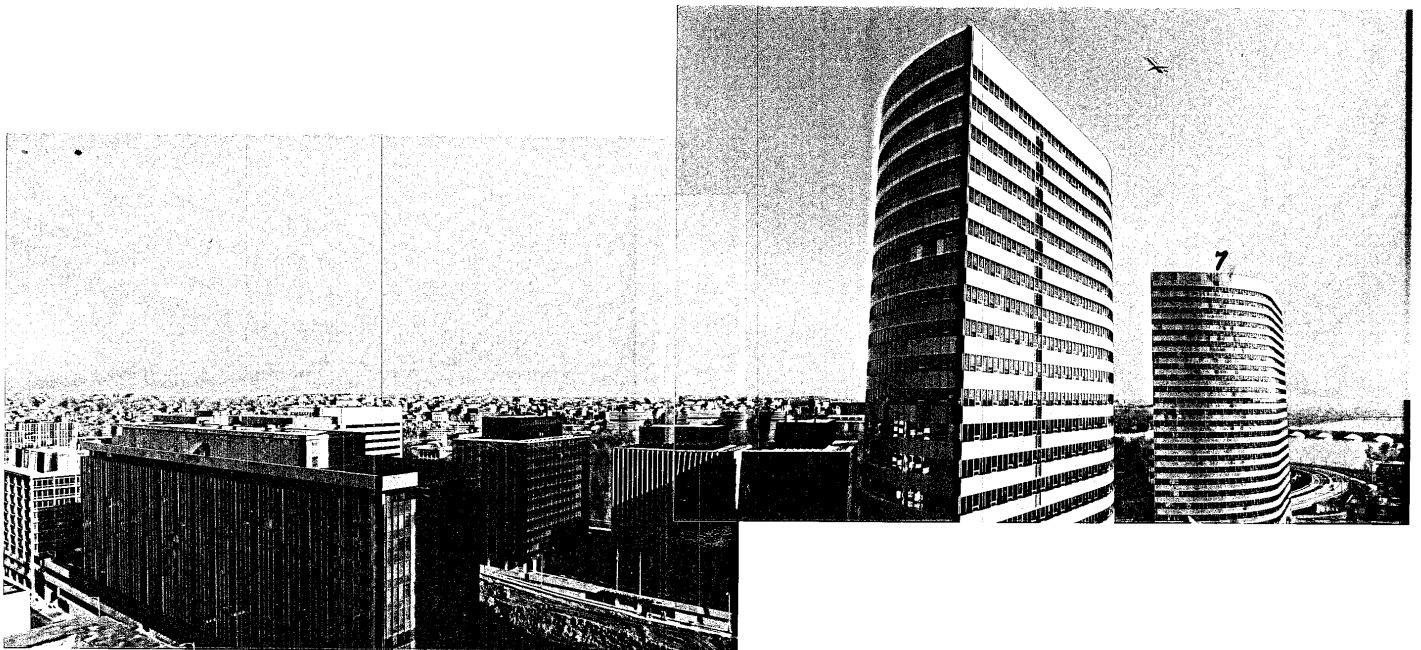


HORIZON VIEW WEST TO NORTH (28mm LENS)

ROSSLYN

Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4

Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4

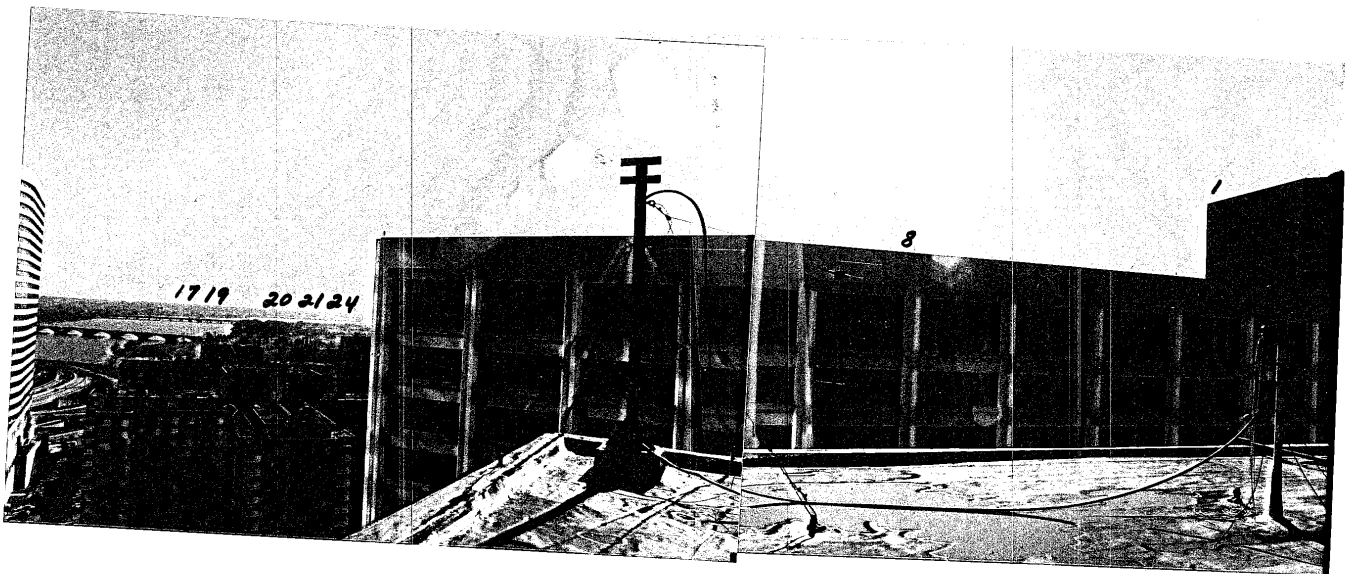


HORIZON VIEW NORTH TO SOUTHEAST (28mm LENS)

ROSSLYN

Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4

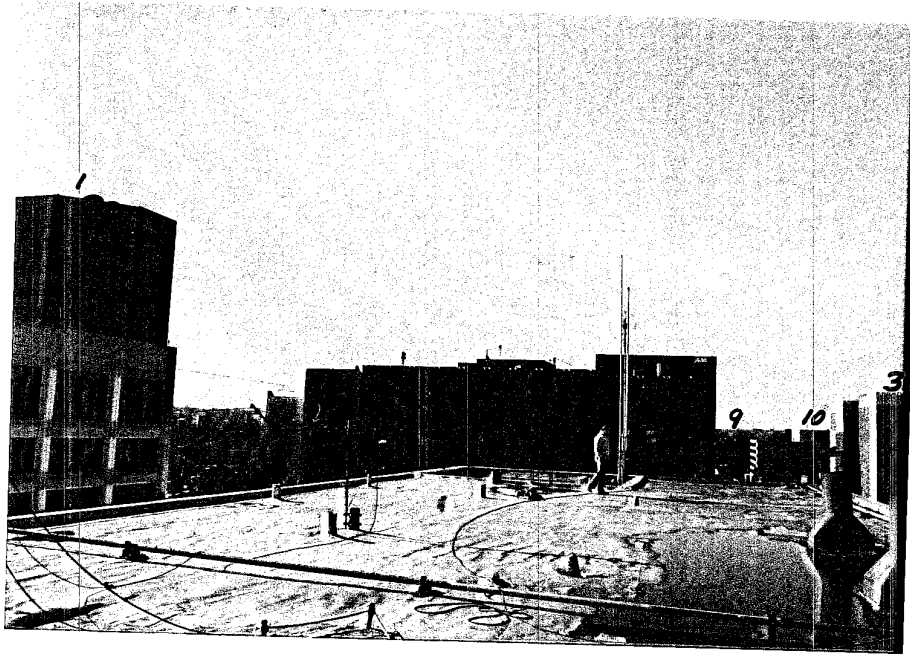
Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4



HORIZON VIEW SOUTHEAST TO SOUTHWEST
(28mm LENS)

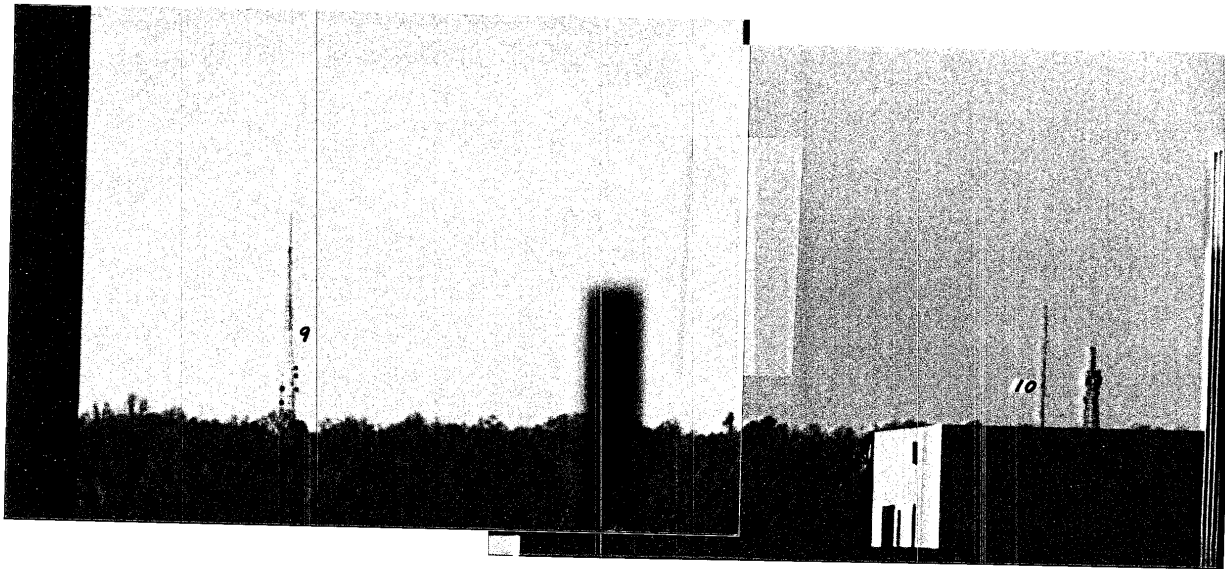
ROSSLYN

Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4



HORIZON VIEW SOUTH WEST TO WEST
(28mm LENS)

Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4

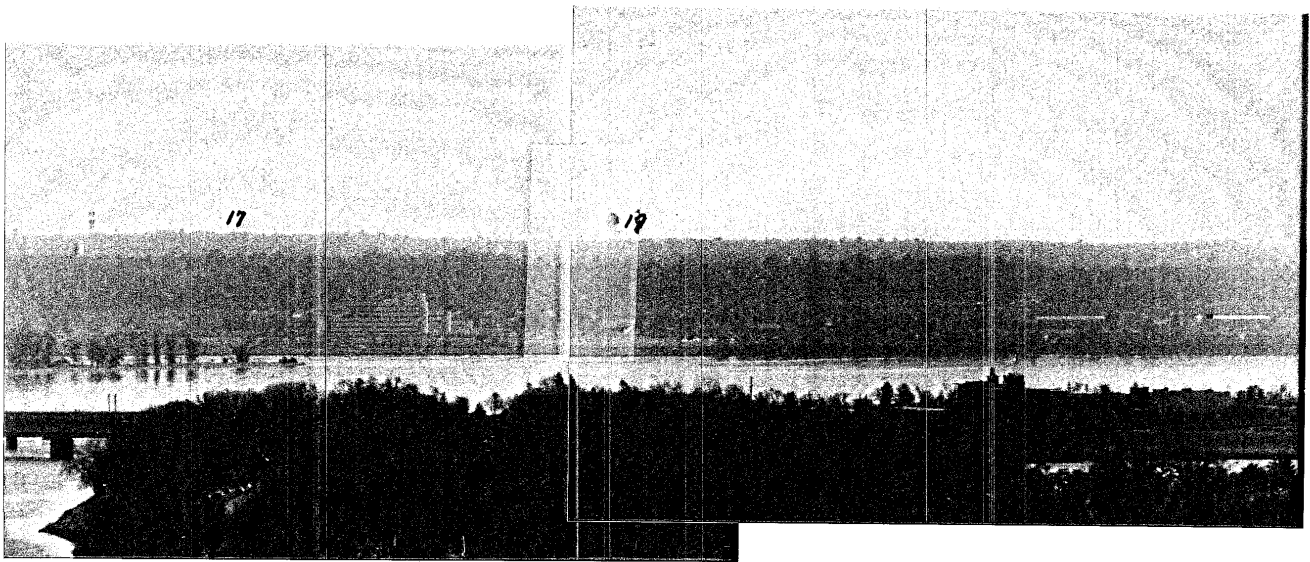


VIEW WEST (400mm LENS)

ROSSIYN

Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4

Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4

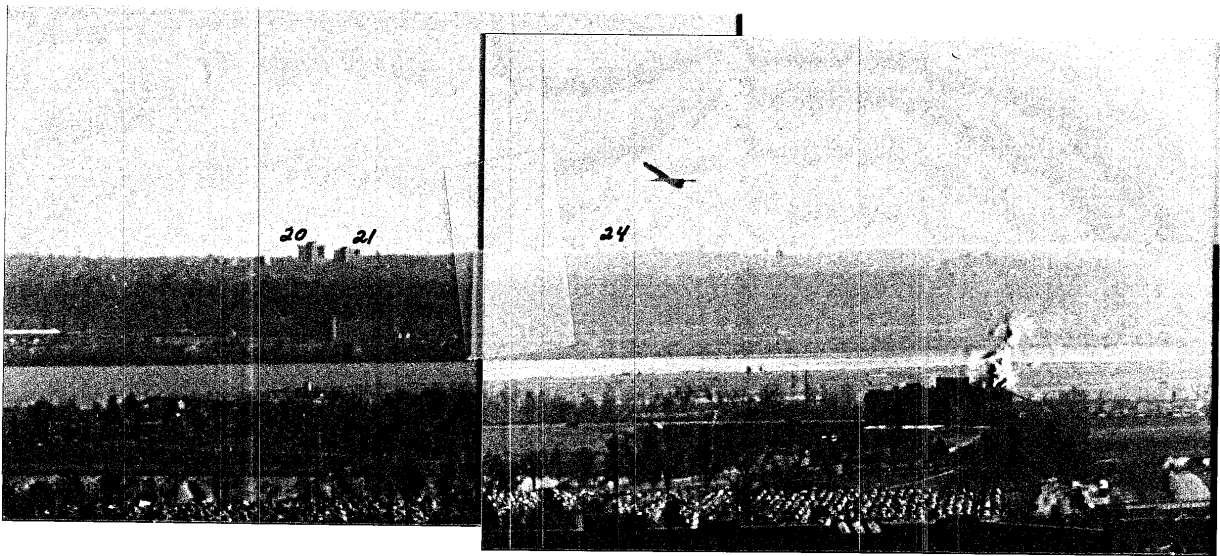


VIEW SOUTHEAST (400mm LENS)

ROSLYN

Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4

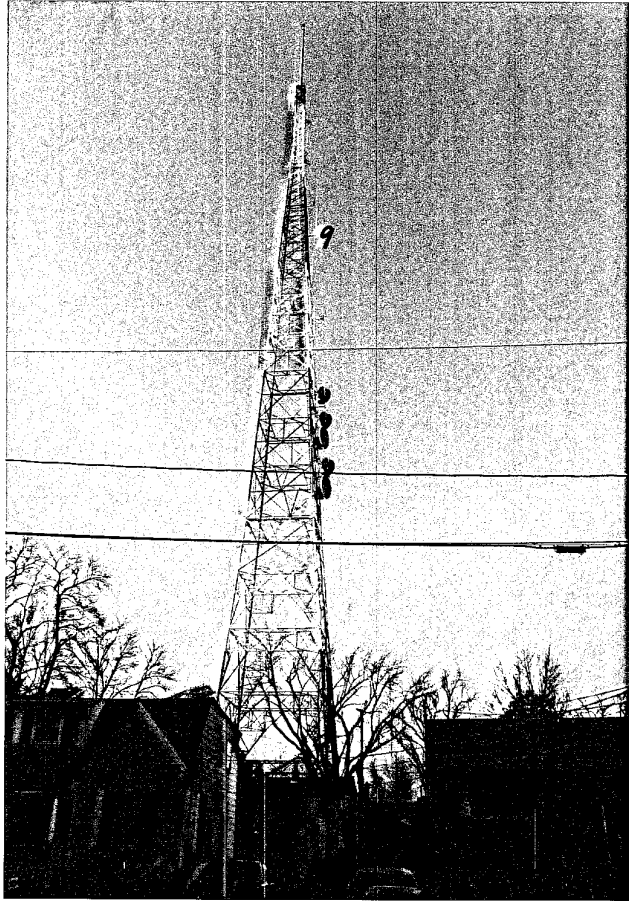
Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4



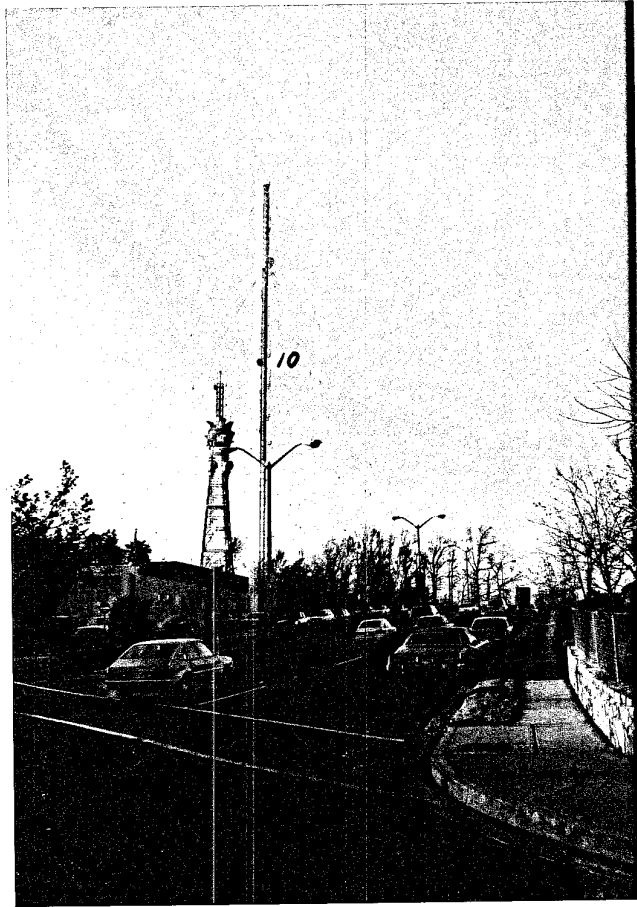
VIEW SOUTHEAST (400mm LENS)

ROSSLYN

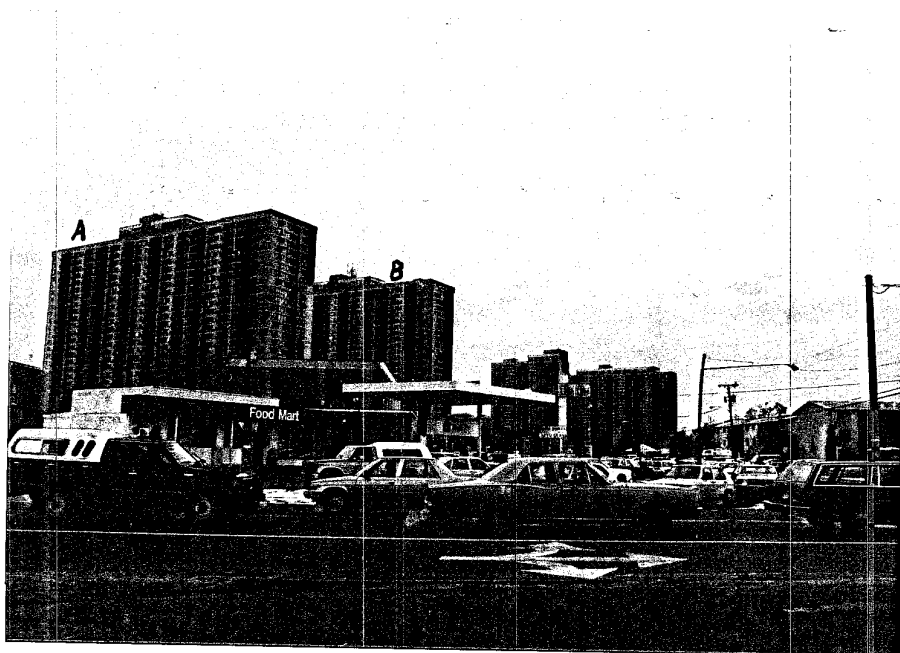
Sanitized Copy Approved for Release 2011/05/31 : CIA-RDP88-01418R000200130013-4



VIEW NORTHWEST



VIEW NORTHWEST (BELL TOWER ON THE LEFT)



SKYLINE TOWERS NORTH (A) AND SOUTH (B)
OTHER BUILDINGS TO THE SOUTH OF (A) ARE PART OF
THE SAME COMPLEX



#11B) SKYLINE TOWERS SOUTH BUILDING
VIEW NORTHWEST



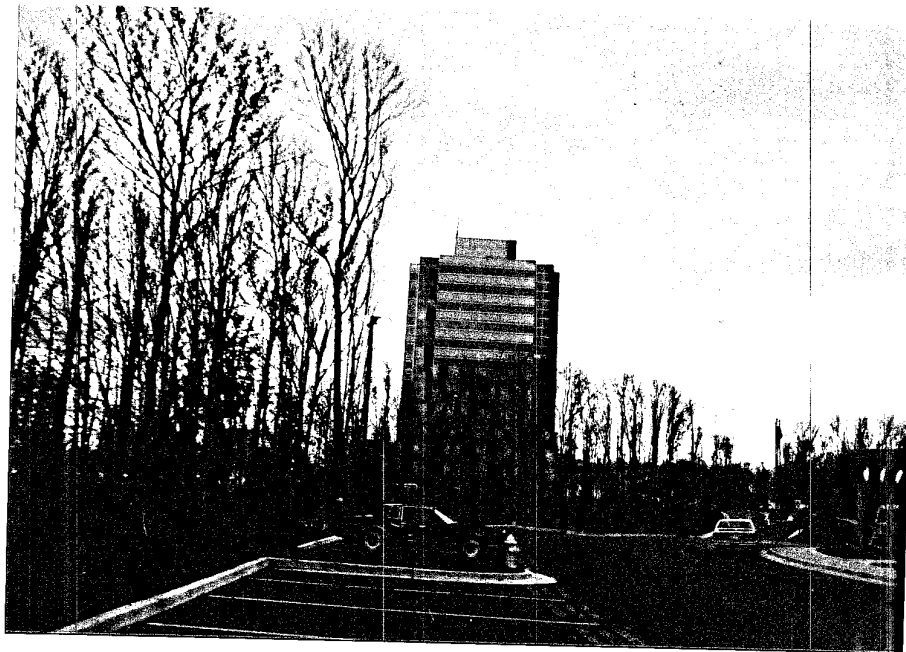
VIEW EAST



VIEW SOUTHEAST



VIEW SOUTHWEST



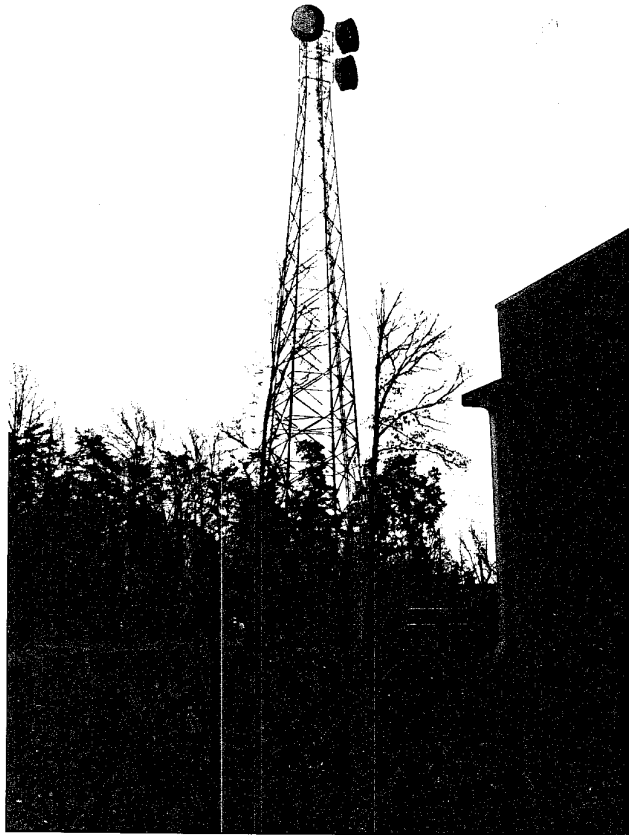
VIEW SOUTH



VIEW WEST



VIEW EAST



VIEW SOUTH

London Market

44 1 493 - 1232 x 7210

(50740)(2) = 920

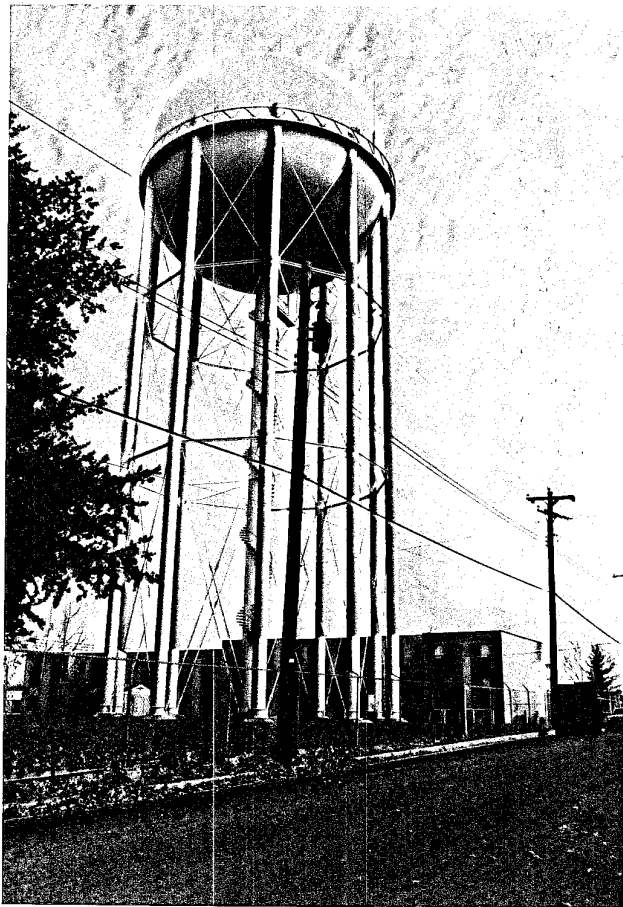
480

10200

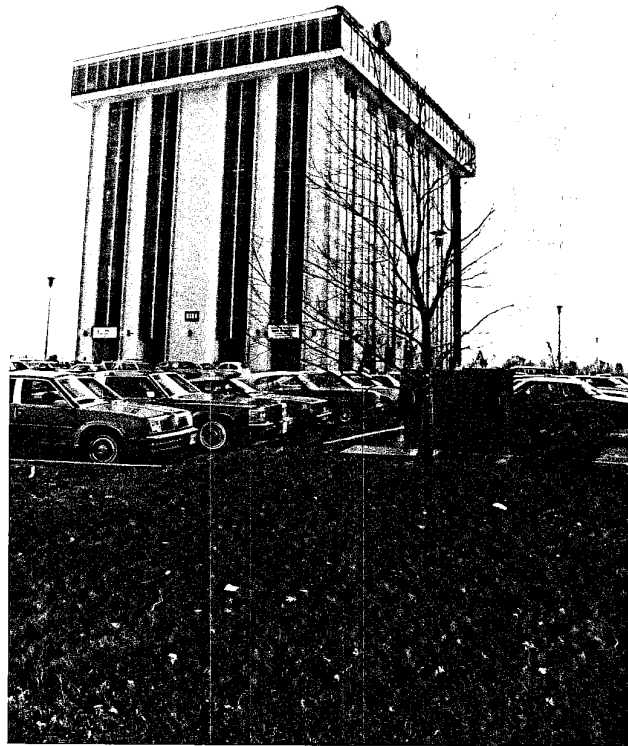


HELMS ROAD
NEED NIGHT
MONT HOUSE HOTEL
HEREFORD

EXISTING BELL TOWER LOCATED 800 FEET
EAST OF #17) FOREST HEIGHTS



VIEW NORTHEAST

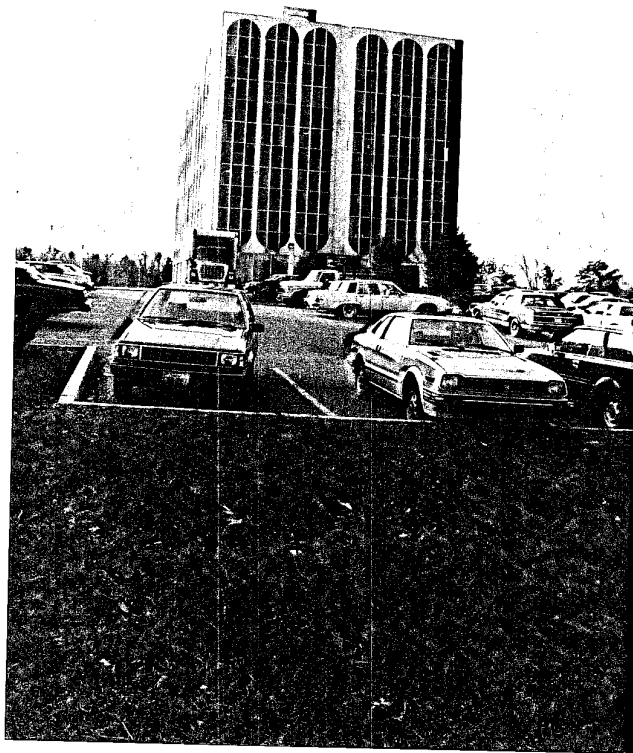


VIEW SOUTH

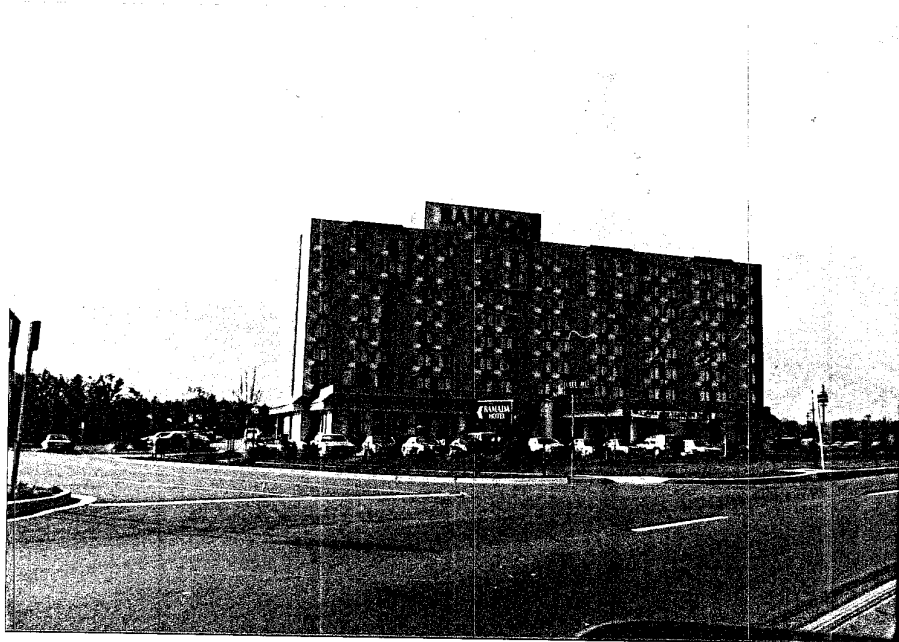
#20) OAK TREE EAST
#21) OAK TREE WEST



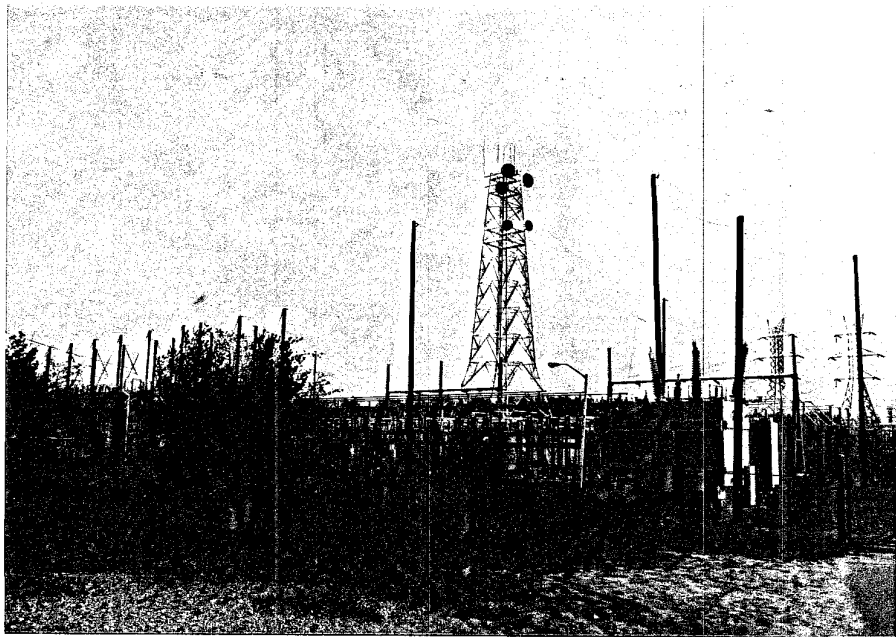
VIEW SOUTHEAST



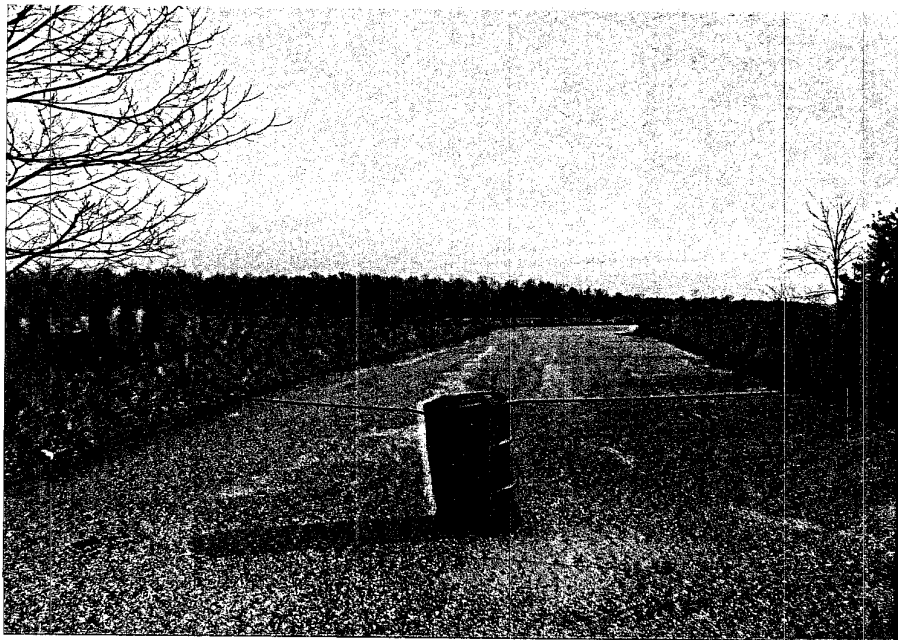
VIEW SOUTH



VIEW SOUTHWEST



VIEW SOUTHEAST



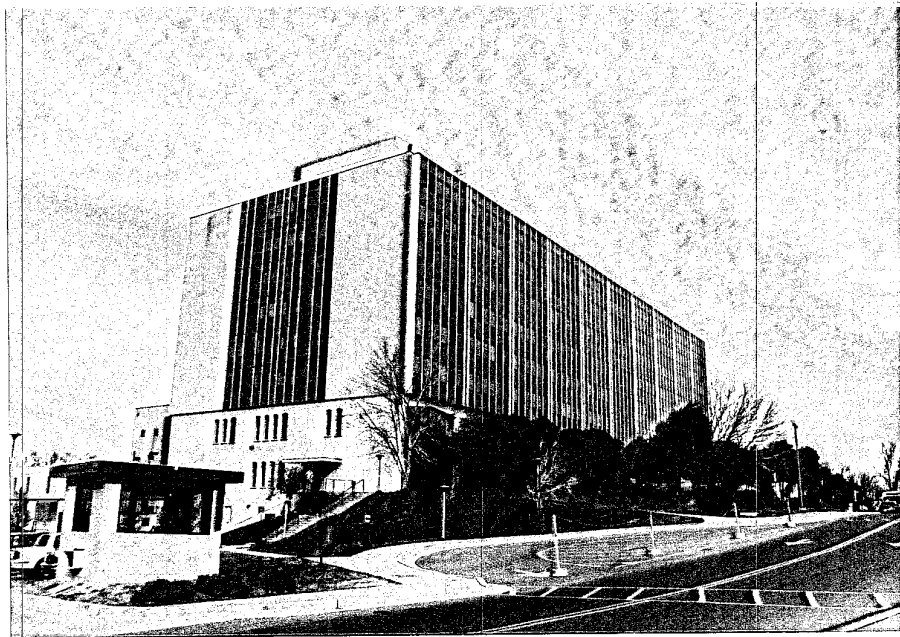
VIEW OF SITE



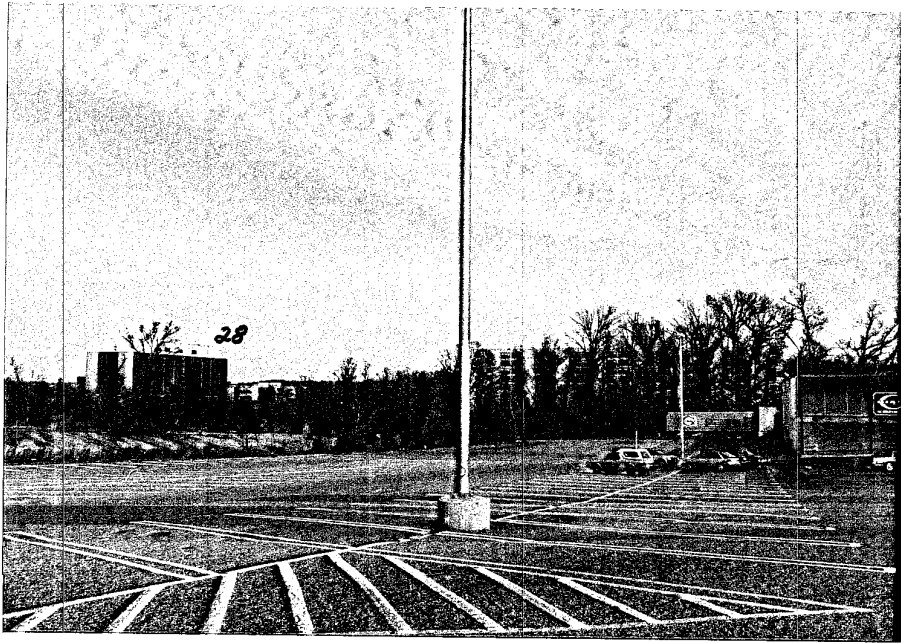
VIEW SOUTHWEST



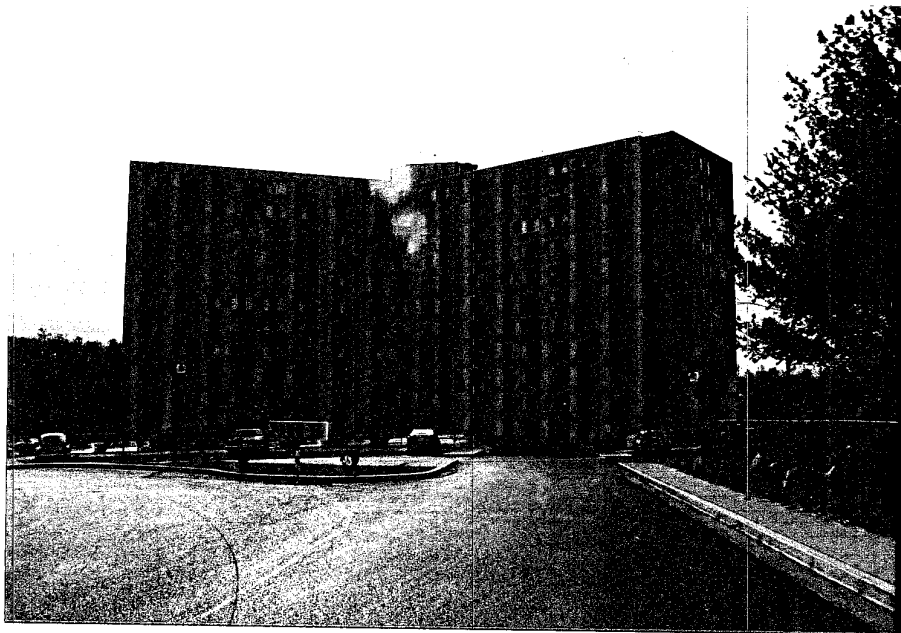
VIEW WEST



VIEW OF SITE



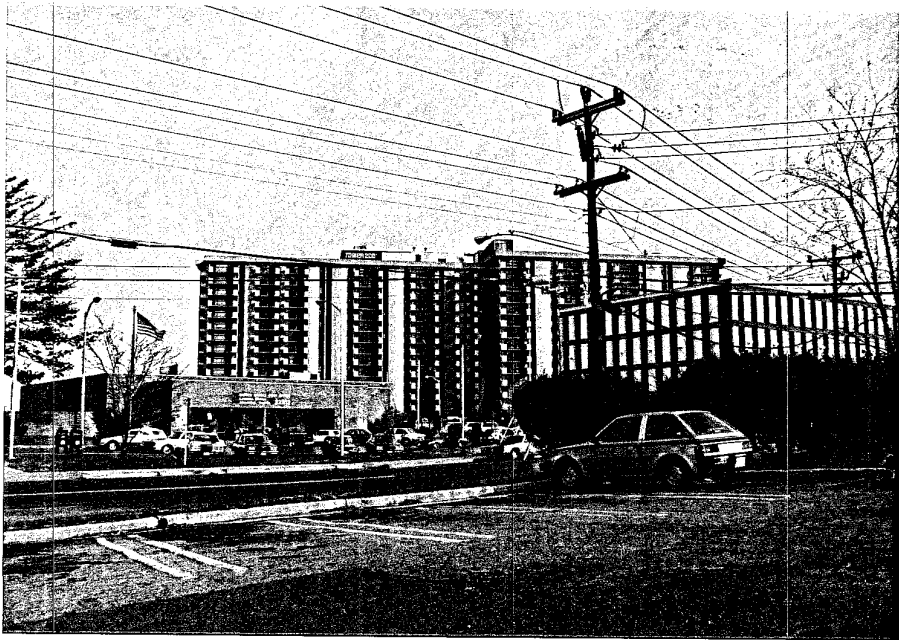
VIEW NORTH



VIEW SOUTH



VIEW OF SITE



VIEW WEST



VIEW WEST



VIEW SOUTHWEST



VIEW WEST



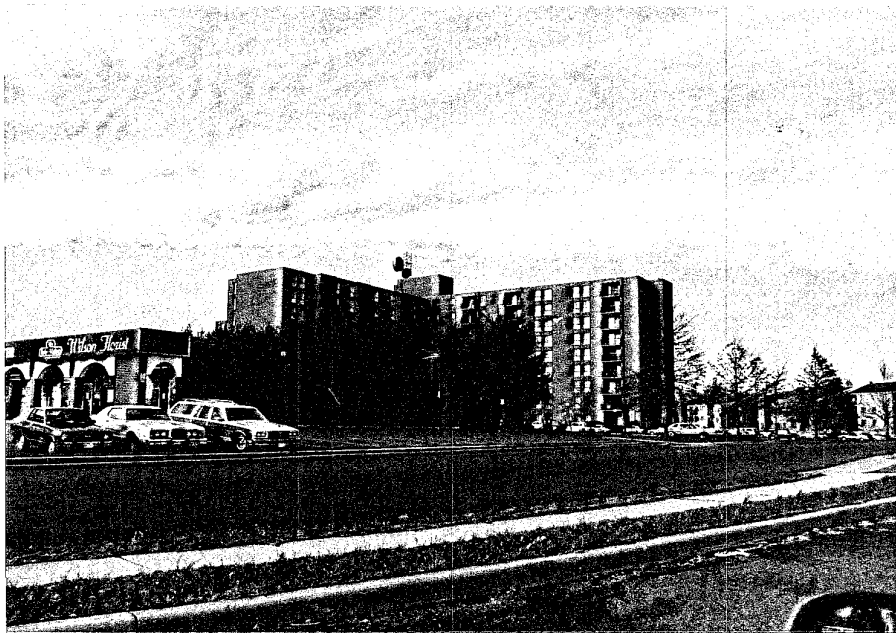
VIEW NORTH



VIEW NORTHWEST

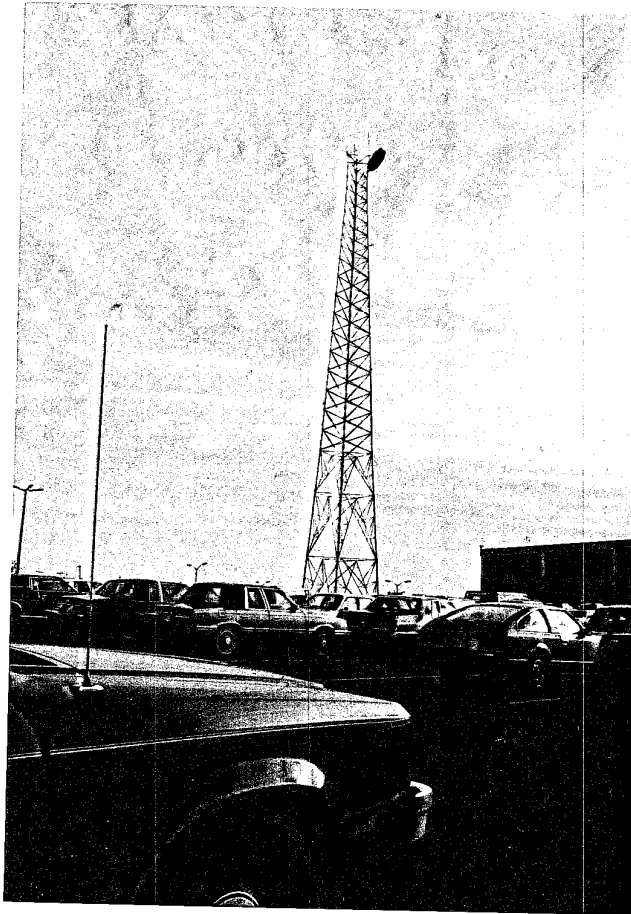


VIEW WEST



VIEW NORTHWEST

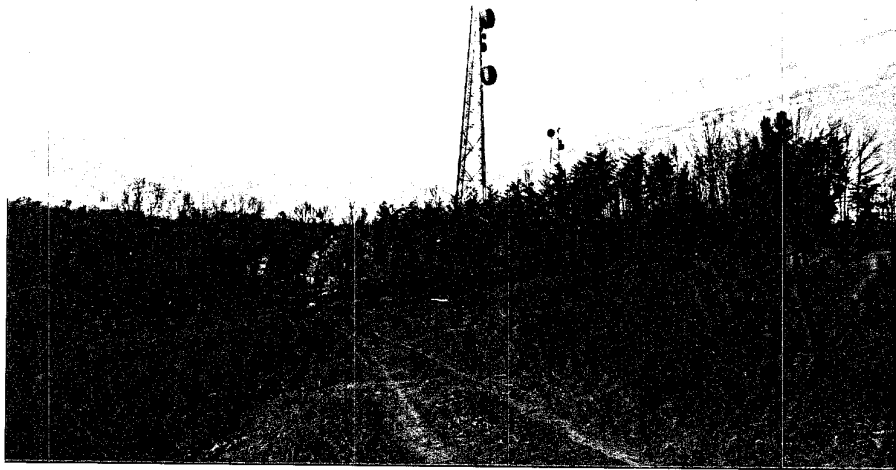
#41) ED SALL PARK
WASHINGTON P&L



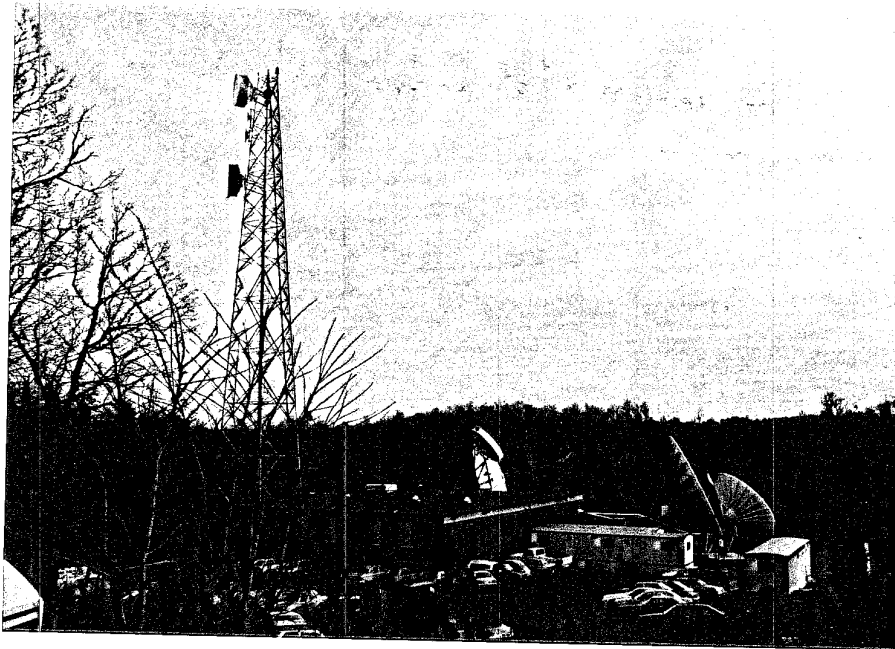
VIEW SOUTH



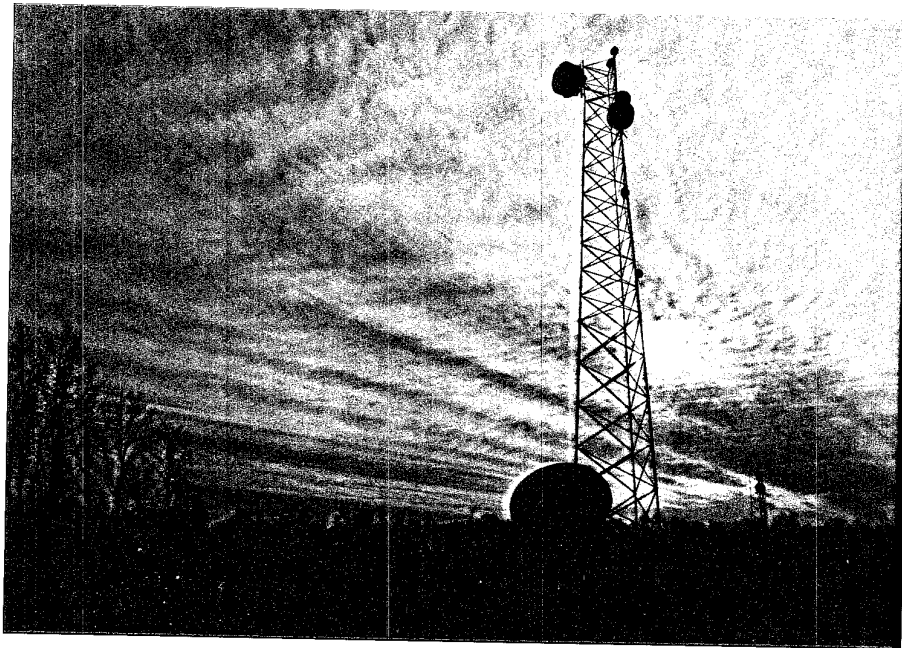
VIEW NORTHEAST



VIEW SOUTHWEST



VIEW SOUTHEAST



VIEW WEST

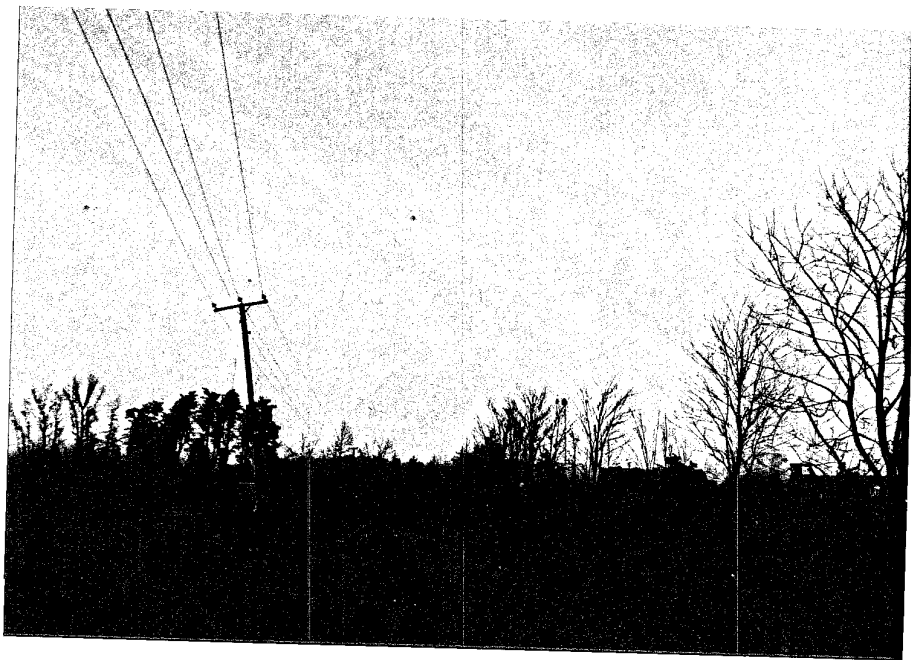
#44) NEWINGTON



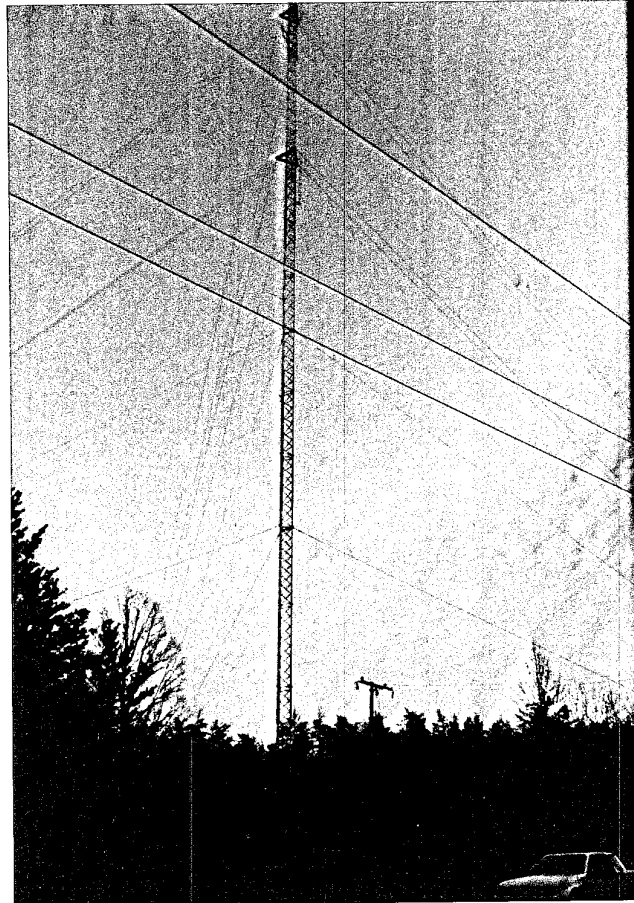
VIEW NORTHWEST



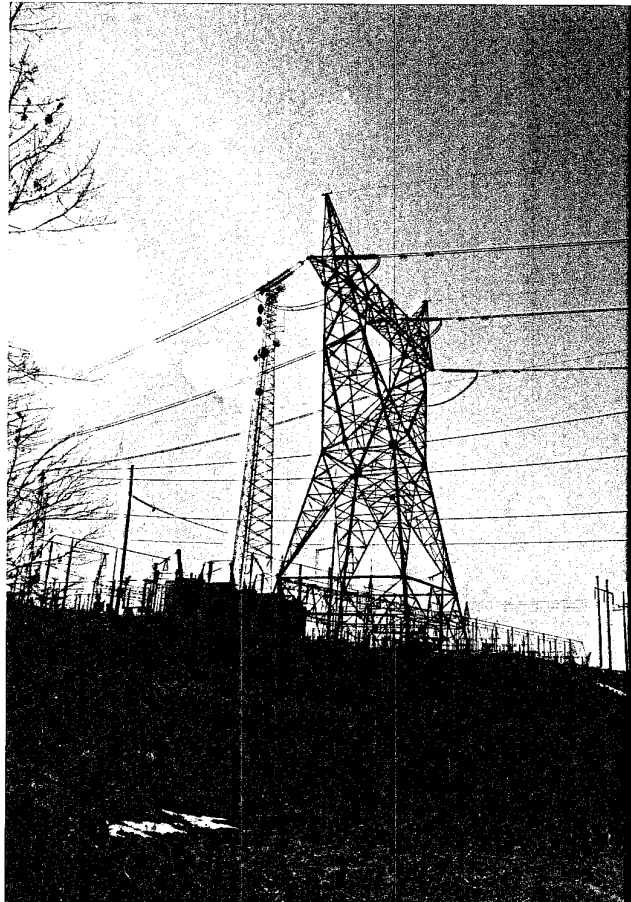
VIEW SOUTHWEST



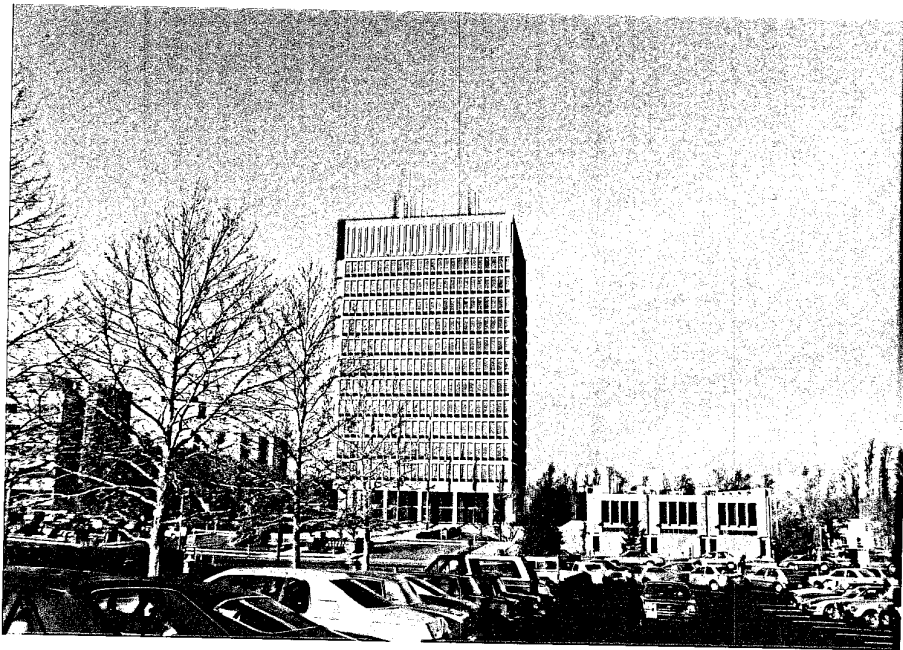
VIEW NORTH



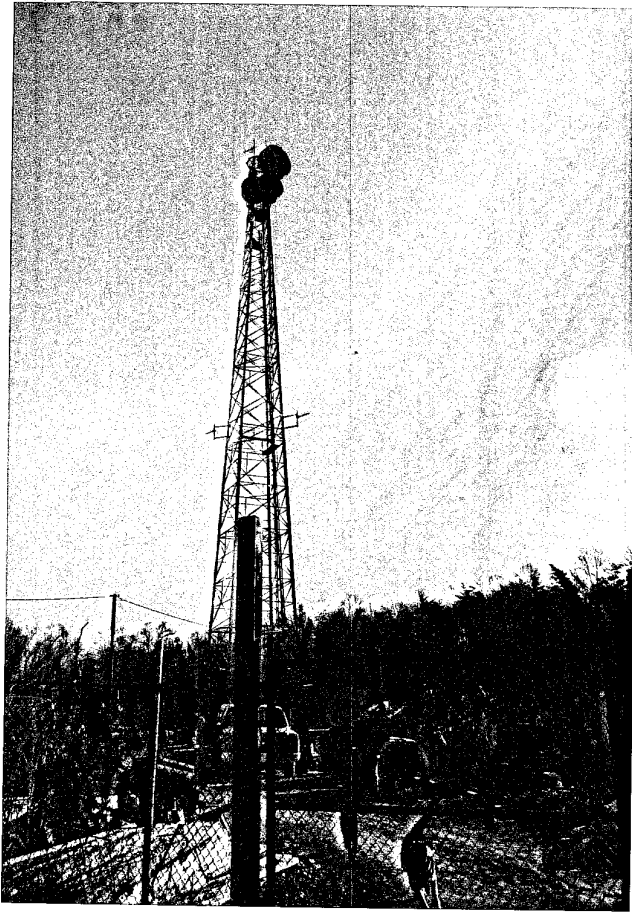
VIEW SOUTH



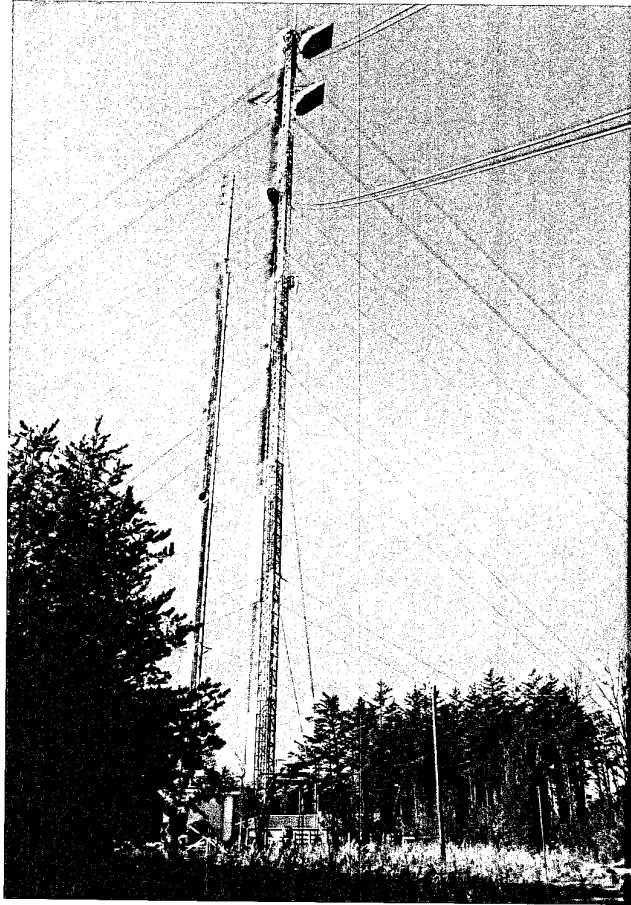
VIEW SOUTHEAST



VIEW OF SITE



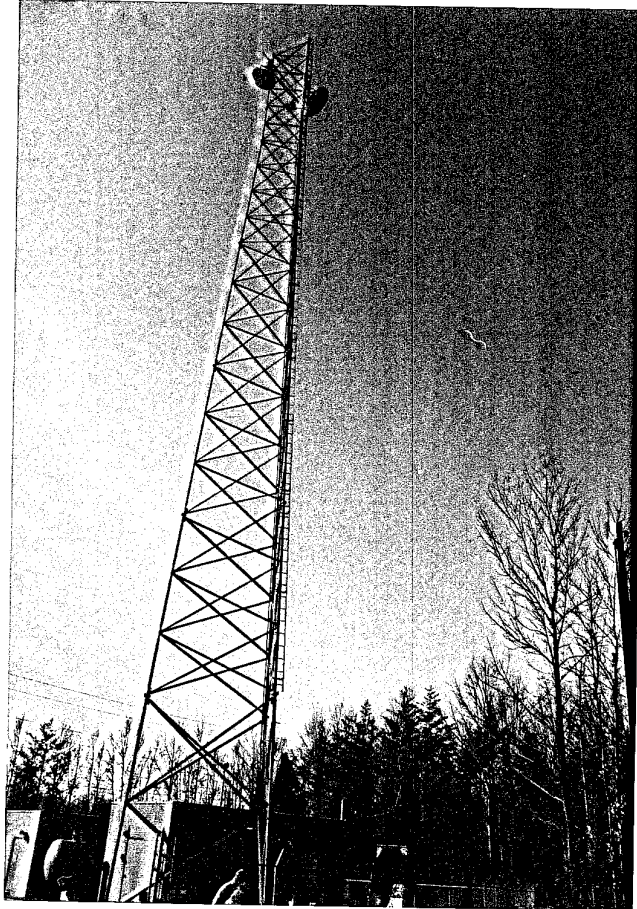
VIEW OF SITE



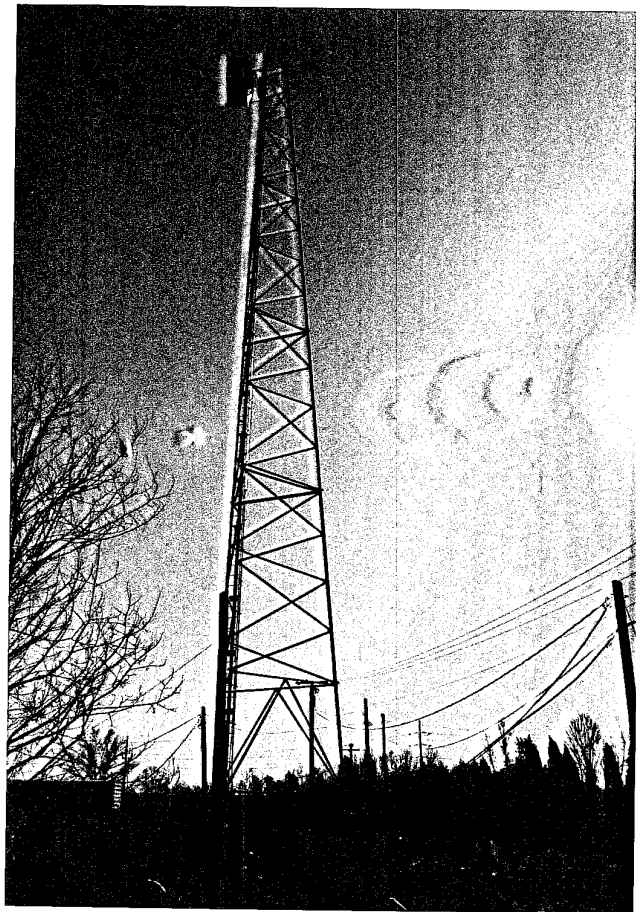
VIEW SOUTHWEST



VIEW SOUTHWEST

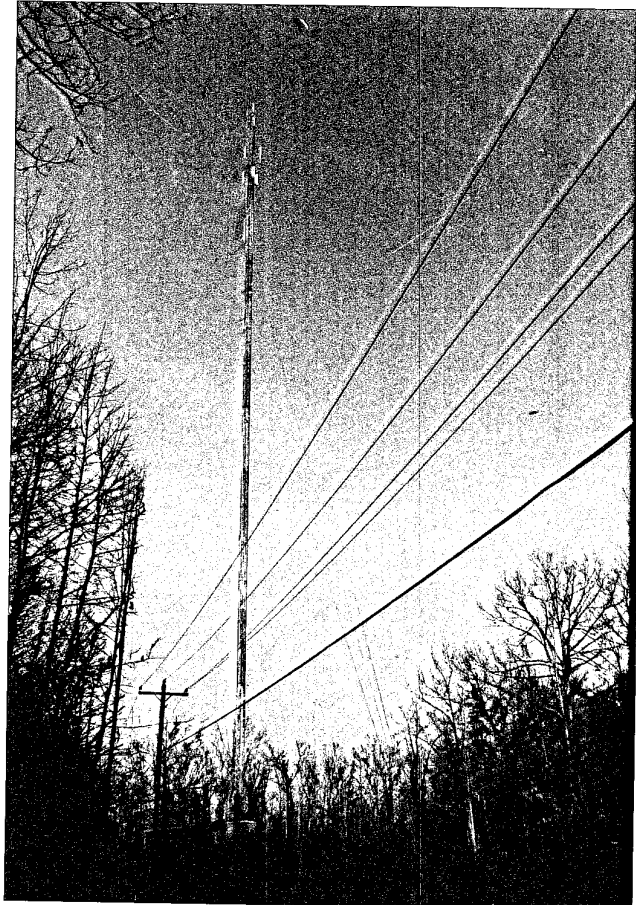


VIEW SOUTHWEST

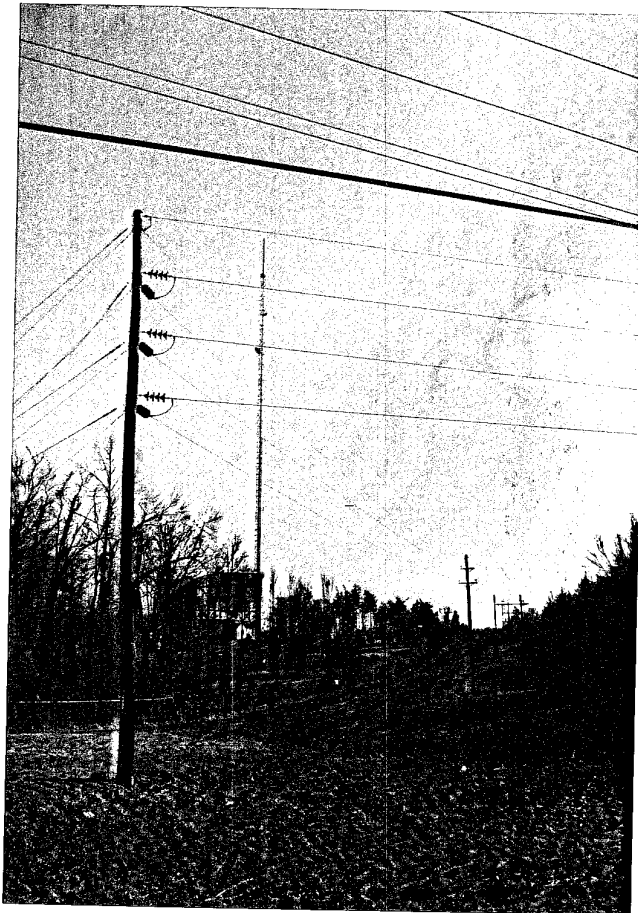


VIEW OF SITE

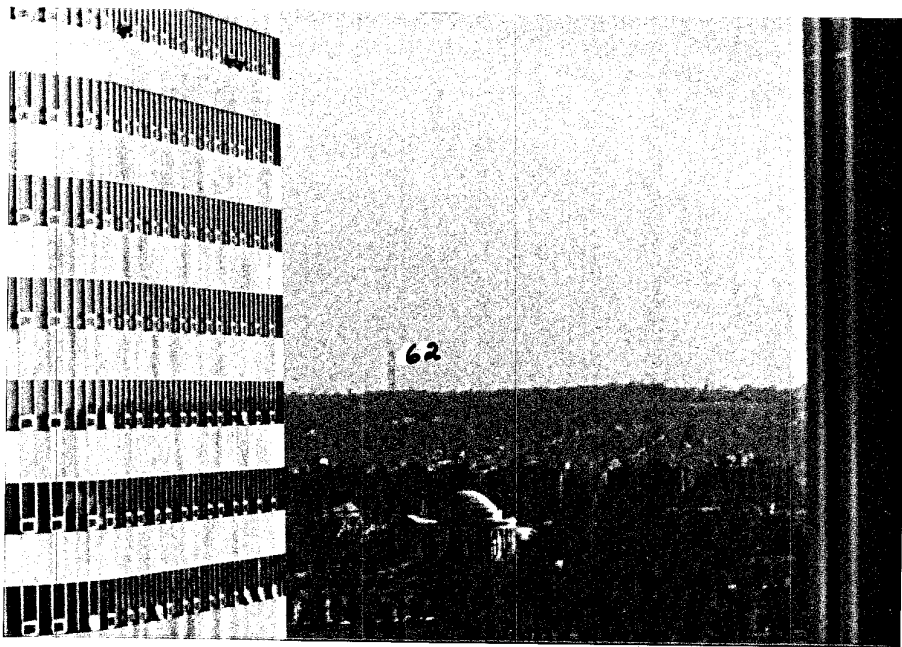
#57) WOODBINE



VIEW NORTHEAST



VIEW SOUTH



VIEW EAST OF SITE

IV. SUPPORTING DOCUMENTATION

G. PATH PROFILES

H. MICROWAVE PATH PROFILE DATA SHEETS

USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE HORIZONTAL RADIUS PATHS

- USE THE HORIZONTAL RADIUS BELOW
- USE A CONSISTENT SCALE FOR DISTANCES AND ELEVATIONS
- REPRESENT THE PATH AS A STRAIGHT LINE
- CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$c = \frac{1}{8} x^2 \cdot 79.2$$

WHERE

- HORIZONTAL RADIUS IN FEET
- HEIGHT OF CORRECTION IN FEET
- FLAT EARTH ELEVATION
- FLAT EARTH HORIZONTAL DISTANCE

- 1) DISTANCE FROM STATION 'A' TO POINT UNDER CONSIDERATION IN STATUTE MILES
- 2) DISTANCE FROM STATION 'B' TO POINT UNDER CONSIDERATION IN STATUTE MILES

- AND ANY MAN MADE STRUCTURES AND OBSTACLES
- CALCULATE THE HORIZONTAL DISTANCE FROM THE POINTS AND INTERFERENCES TO THE POINTS UNDER CONSIDERATION
- EXTENDED PROFILE

$$f = \sqrt{\frac{2R}{g}} \left[\sqrt{g \cdot h} + \sqrt{g \cdot h_1} \right]$$

WHERE

- R IS THE RADIUS OF THE EARTH (3960 MILES)
- h IS THE FREQUENCY (UNDER CONSIDERATION IN HERTZ) (MHz)
- h₁ IS THE FREQUENCY (UNDER CONSIDERATION IN HERTZ) (MHz)
- g IS THE GRAVITATIONAL CONSTANT (9.8 M/S²)
- h IS THE TOTAL PATH LENGTH IN MILES
- h₁ IS THE RADIUS OF THE 1ST FREZEL ZONE IN FEET
- h₂ IS THE RADIUS OF THE 2ND FREZEL ZONE IN FEET
- h₃ IS THE ORDER OF THE FREZEL ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

EXAMPLES

OBSTACLE
 FREZEL ZONE CLEARANCE
 EARTH CURVATURE FROM E (ft)
 MAN MADE STRUCTURE
 DISTANCE FROM STATION 'A' TO POINT UNDER CONSIDERATION
 DISTANCE FROM STATION 'B' TO POINT UNDER CONSIDERATION
 PREDICTED VEGETATION GROWTH
 EXISTING HEIGHT OF VEGETATION
 EXISTING ELEVATION (MILES) (ft)
 POSSIBLE REFLECTION POINT
 HORIZONTAL DISTANCE FROM STATION 'A' TO POINT UNDER CONSIDERATION
 HORIZONTAL DISTANCE FROM STATION 'B' TO POINT UNDER CONSIDERATION
 ABOVE GROUND

STATION (A) BOSSLYN

LONG 33 53 41 W
 LAT 33 12 03 N
 ELEVATION 170 FT ABOVE MEAN SEA LEVEL
 AZIMUTH (A TO B) 120°

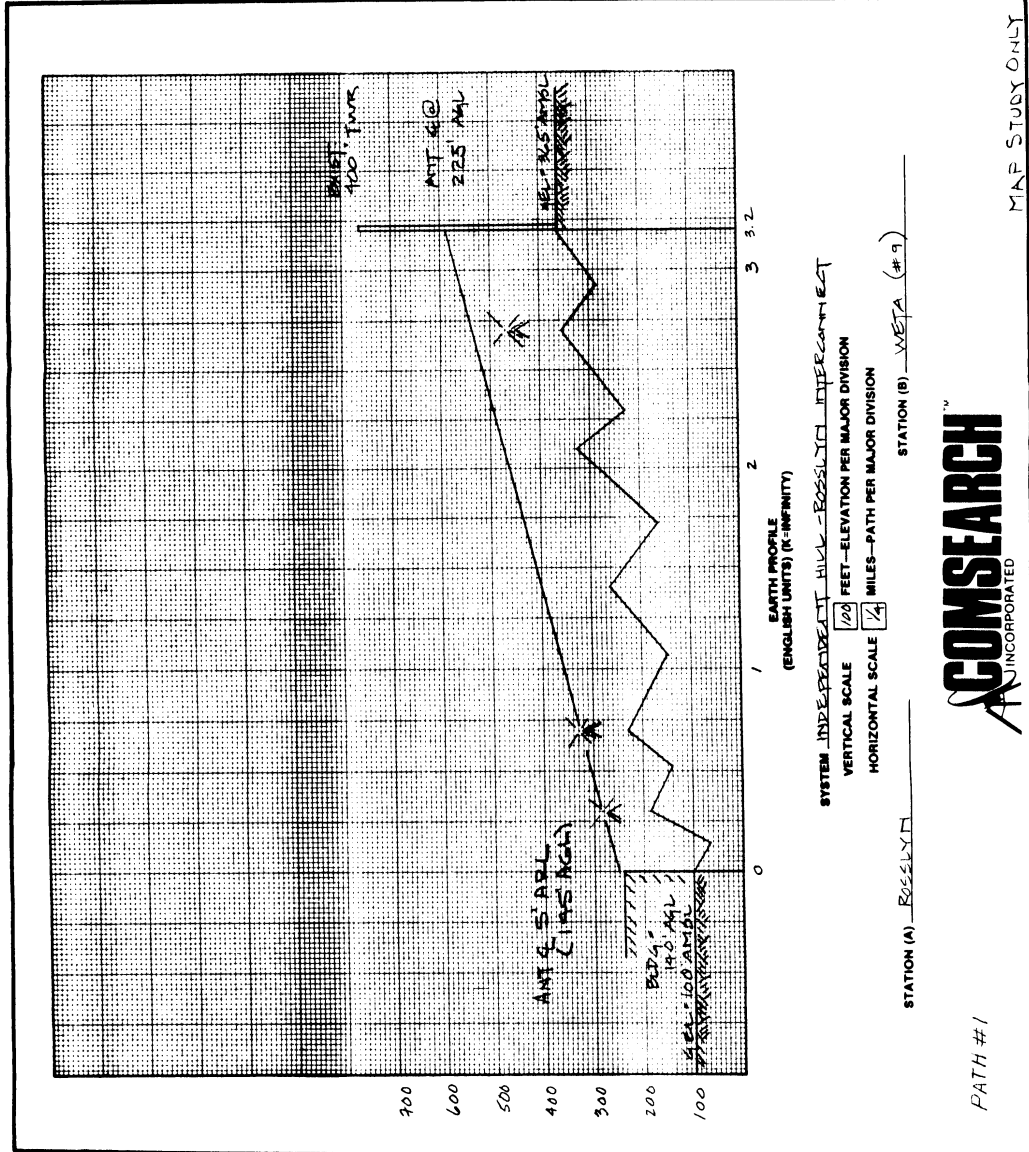
STATION (B) VETA (#9)

LONG 33 53 29 W
 LAT 33 03 55 N
 ELEVATION 310 FT ABOVE MEAN SEA LEVEL
 AZIMUTH (B TO A) 300°

SCALE: 1" = 1 MILE
 MAGNETIC DECLINATION: 11° WEST
 PATH NUMBERS AND DISTANCES ARE IN MILES

CERTIFICATION

DATE 12/24/25



COMSEARCH
 INCORPORATED

MAP STUDY ONLY

2

USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE HORIZON MADE IN THE

1. USE THE SYMBOLS SHOWN BELOW
2. USE A CONVENIENT SCALE FOR DISTANCE AND ELEVATION
3. REPRESENT THE PATH AS A STRAIGHT LINE
4. CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND USE TO CUT CORRECT ELEVATION

$$b = \sqrt{2Rh} + h^2$$

WHERE

- b = HEIGHT OF CORRECTION IN FEET
- R = RADIUS OF EFFECTIVE EARTH
- h = TRUE EARTH BULGE

1. DISTANCE FROM STATION "A" TO POINT UNDER CONSIDERATION IN STATUTE MILES
2. DISTANCE FROM STATION "B" TO POINT UNDER CONSIDERATION IN STATUTE MILES

5. ADD ANY WIND BARRIERS AND OBSTACLES
6. CALCULATE THE EARTH CURVATURE AND ADD TO THE EXTENDED PROFILE

$$f = \frac{1}{2} \left[\frac{R}{R+h} + \frac{R}{R+h_1} \right] \sqrt{2Rh} + h^2$$
 WHERE

- f IS THE RADIUS OF THE FIRST PRESUMED ZONE IN FEET
- $R+h$ IS THE FREQUENCY WAVELENGTH CONSIDERATION IN INCHES (1 INCH = 25.4 MM)
- $R+h_1$ IS THE FREQUENCY WAVELENGTH CONSIDERATION IN INCHES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- D IS THE TOTAL PATH LENGTH IN MILES
- D_1 IS THE RADIUS OF THE 1ST PRESUMED ZONE IN FEET
- R IS THE RADIUS OF THE EARTH IN FEET AND CAN BE ANY WHOLE POSITIVE NUMBER

EXAMPLES

PRELIMINARY ZONE CLEARANCE

STATION (A) XETA (#9)

STATION (B) INDEPENDENT HILL

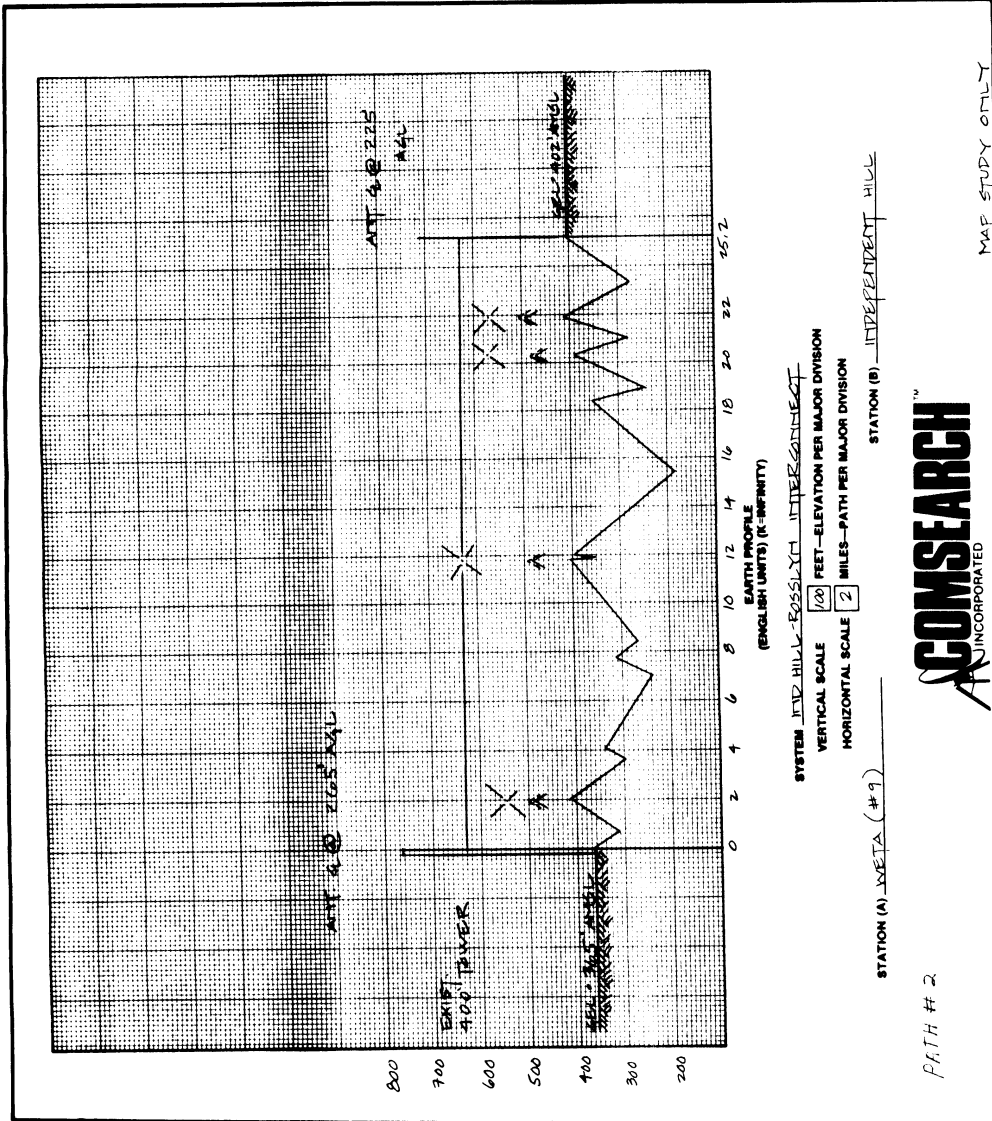
EARTH CURVATURE FROM (A) 33
 WIND BARRIERS 0.3
 TOTAL WIND BARRIERS 0.3
 DISTANCE FROM STATION (A) TO POINT UNDER CONSIDERATION 12.5
 DISTANCE FROM STATION (B) TO POINT UNDER CONSIDERATION 12.5
 TOTAL PATH LENGTH 25
 EARTH CURVATURE FROM (A) 33
 EARTH CURVATURE FROM (B) 33
 TOTAL EARTH CURVATURE 66
 WIND BARRIERS 0.3
 TOTAL WIND BARRIERS 0.3
 PRELIMINARY ZONE CLEARANCE 66.3
 FREQUENCY WAVELENGTH CONSIDERATION 11.5
 FREQUENCY WAVELENGTH CONSIDERATION FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION 11.5
 RADIUS OF THE 1ST PRESUMED ZONE 11.5
 RADIUS OF THE EARTH 3960
 HEIGHT OF FINAL MONITOR CENTERLINE ABOVE GROUND 11.5

STATION (A) XETA (#9) 39
 STATION (B) INDEPENDENT HILL 53
 DISTANCE FROM STATION (A) TO POINT UNDER CONSIDERATION 12.5
 DISTANCE FROM STATION (B) TO POINT UNDER CONSIDERATION 12.5
 TOTAL PATH LENGTH 25
 EARTH CURVATURE FROM (A) 33
 EARTH CURVATURE FROM (B) 33
 TOTAL EARTH CURVATURE 66
 WIND BARRIERS 0.3
 TOTAL WIND BARRIERS 0.3
 PRELIMINARY ZONE CLEARANCE 66.3
 FREQUENCY WAVELENGTH CONSIDERATION 11.5
 FREQUENCY WAVELENGTH CONSIDERATION FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION 11.5
 RADIUS OF THE 1ST PRESUMED ZONE 11.5
 RADIUS OF THE EARTH 3960
 HEIGHT OF FINAL MONITOR CENTERLINE ABOVE GROUND 11.5

CERTIFICATION

EARTH PROFILE
 CLIENT SURVEYOR
 DESIGN
 PATH FROM (A)
 TO (B)
 PATH LENGTH
 INFEET
 MILES
 OTHER

SURVEYED BY
 DRAWN BY
 DATE 12/20/05
 INCHES
 FEET
 MILES
 OTHER



RECEIVE PATH PROFILE DATA

SITE: WETA (#9)
 LAT: 38 ° 53 ' 29 " °
 LONG: 77 ° 07 ' 55 " °
 ELEVATION: 365 'ASL
 AZIMUTH FORWARD: _____ ° ' " °
 PATH DISTANCE: _____

SITE: INDEPENDENT HILL
 LAT: 38 ° 37 ' 35 " °
 LONG: 77 ° 27 ' 23 " °
 ELEVATION: 402 'ASL
 AZIMUTH REVERSE: _____ ° ' " °
 FREQUENCY: 11

DIST	ELEV	OBST	K(1) + G	K(2) + F	NOTE
0	365	TWR ^{400'}			
2.0	410		30.9 + 17.6		
11.8	402		105.4 + 32.0		
12.0	395		105.6 + 32.6		
18.4	355		83.4 + 29.0		
20.2	390		64.3 + 25.8		
21.9	410		48.2 + 22.0		
25.2	402				

(3)

USE OF FLAT EARTH PROFILE FOR WITHIN-THE-HORIZON AND BEYOND-THE-HORIZON RADIO PATHS

1. USE THE SYMBOLS SHOWN BELOW
2. USE A CONSISTENT SCALE FOR DISTANCE AND ELEVATIONS
3. REPRESENT THE PATH AS A STRAIGHT LINE
4. CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BALANCE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$s = \left(\frac{0.867}{k} \right) \sqrt{h_1 h_2}$$

WHERE
 s = HEIGHT OF CORRECTION IN FEET
 k = RADIUS OF EFFECTIVE EARTH IN FEET
 h₁ = STATUTE MILES FROM STATION "A" TO POINT UNDER CONSIDERATION IN STATUTE MILES
 h₂ = STATUTE MILES FROM STATION "B" TO POINT UNDER CONSIDERATION IN STATUTE MILES

AND ANY AND ALL WAVE STRUCTURES AND FREQUENCY UNDER CONSIDERATION. CALCULATE THE REQUIRED FREQUENCY UNDER CONSIDERATION IN GIGACYCLES PER SECOND AND ADD TO THE EXTENDED PROFILE

$$f = \frac{17.3}{\sqrt{d}} \text{ GHz}$$

WHERE
 f₁ IS THE RADIUS OF THE FIRST FRESNEL ZONE IN FEET
 f₂ IS THE FREQUENCY UNDER CONSIDERATION IN GIGACYCLES PER SECOND
 d IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
 D IS THE TOTAL PATH LENGTH IN MILES
 F_n IS THE RADIUS OF THE NTH FRESNEL ZONE IN FEET
 n IS THE ORDER OF THE FRESNEL ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

FRESNEL ZONE CLEARANCE: 0.6' - 20'

EARTH CURVATURE FROM K (∞): 1/11-25.8'

MAN MADE STRUCTURE: 8-45'

OBSTRUCTION OFF PATH WITHIN 1000 FEET: TOWER 200' SOUTH OF PATH

PREDICTED VEGETATION GROWTH: F 6' - 10'

EXISTING HEIGHT OF VEGETATION: 1 - 10'

GROUND ELEVATION ABOVE K (∞): 6 - 600'

POSSIBLE REFLECTION POINT: R

HEIGHT OF FINAL INDIATOR CENTERLINE ABOVE GROUND: 5' 200'

EXAMPLES

0.6' - 20'

1/11-25.8'

8-45'

TOWER 200' SOUTH OF PATH

F 6' - 10'

1 - 10'

6 - 600'

R

5' 200'

STATION (A) WETA (#9)
 LAT 38° 53' 29" N
 LONG 77° 03' 33" W
 GROUND ELEV 37' 33" FEET ABOVE MEAN SEA LEVEL
 REQUIRED HEIGHT OF FINAL INDIATOR CENTERLINE 0' CW FROM TRUE NORTH
 AZIMUTH (A) TO (B) 0' FEET ABOVE MEAN SEA LEVEL

STATION (B) PR. WILLIAM CO. IND. HILL (#59)
 LAT 38° 37' 26" N
 LONG 77° 33' 11" W
 GROUND ELEV 37' 33" FEET ABOVE MEAN SEA LEVEL
 REQUIRED HEIGHT OF FINAL INDIATOR CENTERLINE 0' CW FROM TRUE NORTH
 AZIMUTH (B) TO (A) 0' FEET ABOVE MEAN SEA LEVEL
 FREQUENCY CALCULATION 10.0 GIGACYCLES PER SECOND
 PATH LENGTHS AND DISTANCES ARE UNSCALED INVERSE POSITION OTHER

CERTIFICATION

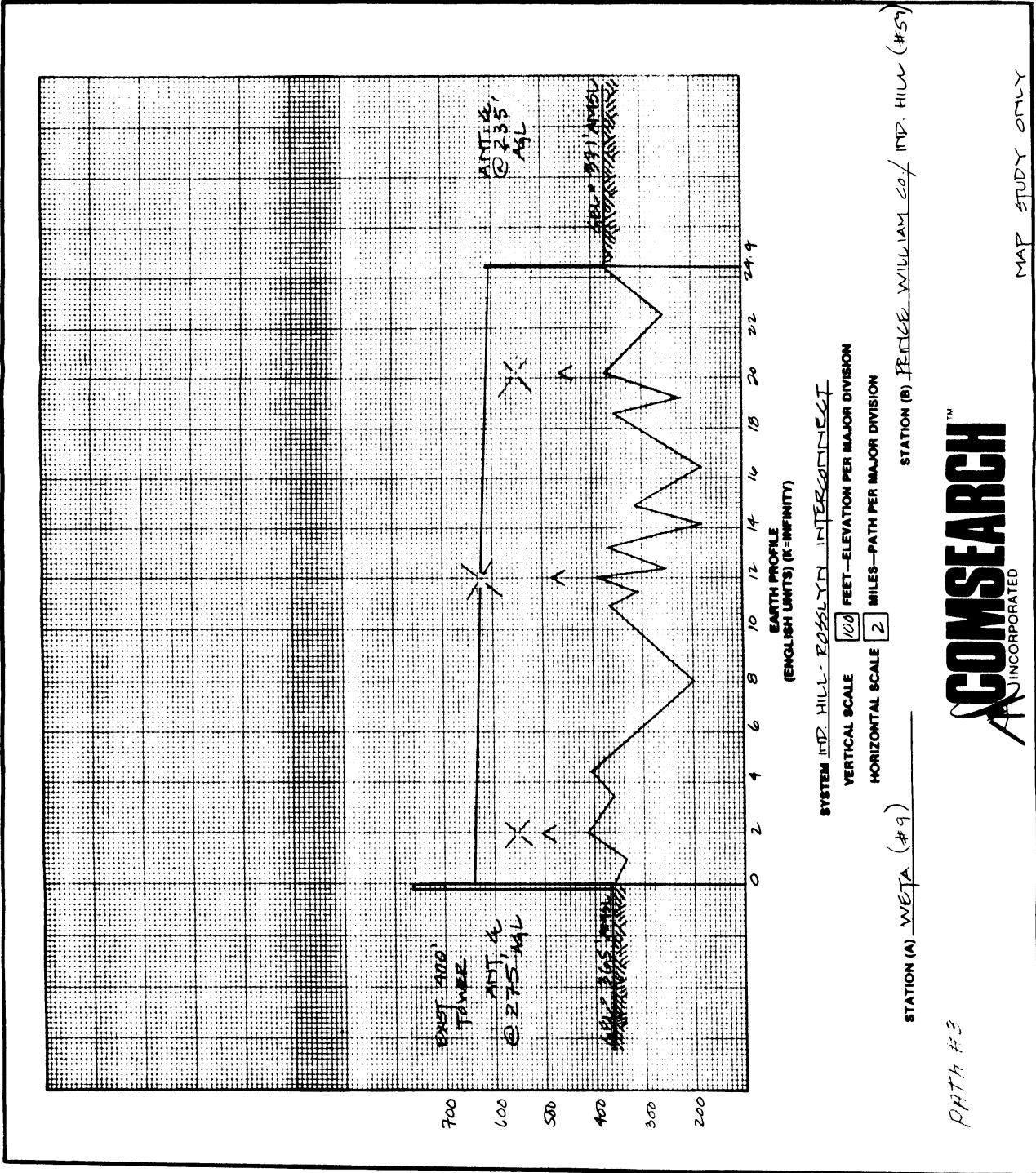
SURVEY BY: _____

DRAWN BY: _____

DATE: 12/26/05

EARTH PROFILE
 (ENGLISH UNITS) (K = INFINITY)
 CUSTOMER: _____
 PATH FROM (A) _____ MILES
 PATH FROM (B) _____ MILES
 PATH LENGTH: _____ MILES

CLIENT: SURVEYOR
 DESIGN DEPARTMENT
 OTHER



③

RECEIVE PATH PROFILE DATA

SITE: WETA (#9)
LAT: 39° 53' 29" N
LONG: 77° 07' 55" W
ELEVATION: 365' ASL
AZIMUTH FORWARD: ° ' "
PATH DISTANCE: 24.4

SITE: PRINCE WILLIAM CO/IND. HILL (#59)
LAT: 38° 37' 54" N
LONG: 77° 26' 25" W
ELEVATION: 371' ASL
AZIMUTH REVERSE: ° ' "
FREQUENCY: 6 GHz

DIST	ELEV	OBST	K() + G F	K() + F	NOTE
0	365	100' SS TWR			
2.0	412		29.9 + 23.9		
4.4	402				
8.0	200				
10.0	365				
12.0	390		99.2 + 43.6		
13.2	365				
14.9	315				
18.6	355				
20.2	372		56.6 + 32.9		
22.0	410				
24.4	371	TWR			

USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE HORIZON RADIUS IN THE

- USE THE SYMBOLS SHOWN BELOW
- USE A CONVENIENT SCALE FOR DISTANCE AND ELEVATIONS
- REPRESENT THE PATH AS A STRAIGHT LINE
- CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BALG AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$h = \left(\frac{R \theta^2}{2} \right) + h_0$$

WHERE

- h = HEIGHT OF CORRECTION IN FEET
- R = RADIUS OF EFFECTIVE EARTH RADIUS
- θ = ANGLE OF EFFECTIVE EARTH RADIUS
- h₀ = HEIGHT OF OBJECT

1. DISTANCE FROM STATION "A" TO POINT UNDER CONSIDERATION IN STATUTE MILES
2. DISTANCE FROM STATION "B" TO POINT UNDER CONSIDERATION IN STATUTE MILES

ADD ANY MAN MADE STRUCTURES AND FREQUENCY UNDER CONSIDERATION

1. CHECK FOR THE EFFECT OF FREQUENCY UNDER CONSIDERATION ON THE PATH AND INFLUENCES
2. INTERPOLATE THE FREQUENCY UNDER CONSIDERATION USING THE FOLLOWING TABLE AS AID AND ADD TO THE EXTENDED PROFILE

$$f = \frac{1}{\sqrt{1 - \frac{2h}{R}}} \approx 1 + \frac{h}{R}$$

WHERE

- f = IS THE FREQUENCY UNDER CONSIDERATION IN GHz
- R = IS THE RADIUS OF THE EARTH IN MILES
- h = IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- D = IS THE TOTAL PATH LENGTH IN MILES
- F_n = IS THE FREQUENCY OF THE "n" TH FREQUENCY UNDER CONSIDERATION
- n = IS THE ORDER OF THE FREQUENCY UNDER CONSIDERATION AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

EXAMPLES

FRESNEL ZONE CLEARANCE: 8'-0" 20'-0" 40'-0" 60'-0" 80'-0" 100'-0" 120'-0" 140'-0" 160'-0" 180'-0" 200'-0" 220'-0" 240'-0" 260'-0" 280'-0" 300'-0" 320'-0" 340'-0" 360'-0" 380'-0" 400'-0" 420'-0" 440'-0" 460'-0" 480'-0" 500'-0" 520'-0" 540'-0" 560'-0" 580'-0" 600'-0" 620'-0" 640'-0" 660'-0" 680'-0" 700'-0" 720'-0" 740'-0" 760'-0" 780'-0" 800'-0" 820'-0" 840'-0" 860'-0" 880'-0" 900'-0" 920'-0" 940'-0" 960'-0" 980'-0" 1000'-0"

MAN MADE STRUCTURE: TOWER 200' SOUTH OF PATH

PREDICTED VEGETATION GROWTH: 1'-7"

EXISTING HEIGHT OF VEGETATION: 6'-0"

GROUND ELEVATION ANGLE: 1.75°

POSSIBLE REFLECTION POINT: N

HEIGHT OF FINAL INDICATOR CENTERLINE ABOVE GROUND: 5'-0"

STATION (A) IR WILLIAM CO / INDEPENDENT HILL (#5)

LAT: 38° 37' 54" N
 LONG: 77° 33' 23" W

REQUIRED HEIGHT OF FINAL INDICATOR CENTERLINE: 5'-0" FROM TRUE NORTH

STATION (B) INDEPENDENT HILL

LAT: 38° 37' 35" N
 LONG: 77° 33' 23" W

REQUIRED HEIGHT OF FINAL INDICATOR CENTERLINE: 5'-0" FROM TRUE NORTH

PRELIMINARY CALCULATIONS MADE FOR: 3.3 GHz

MAGNETIC DECLINATION: OF TRUE NORTH

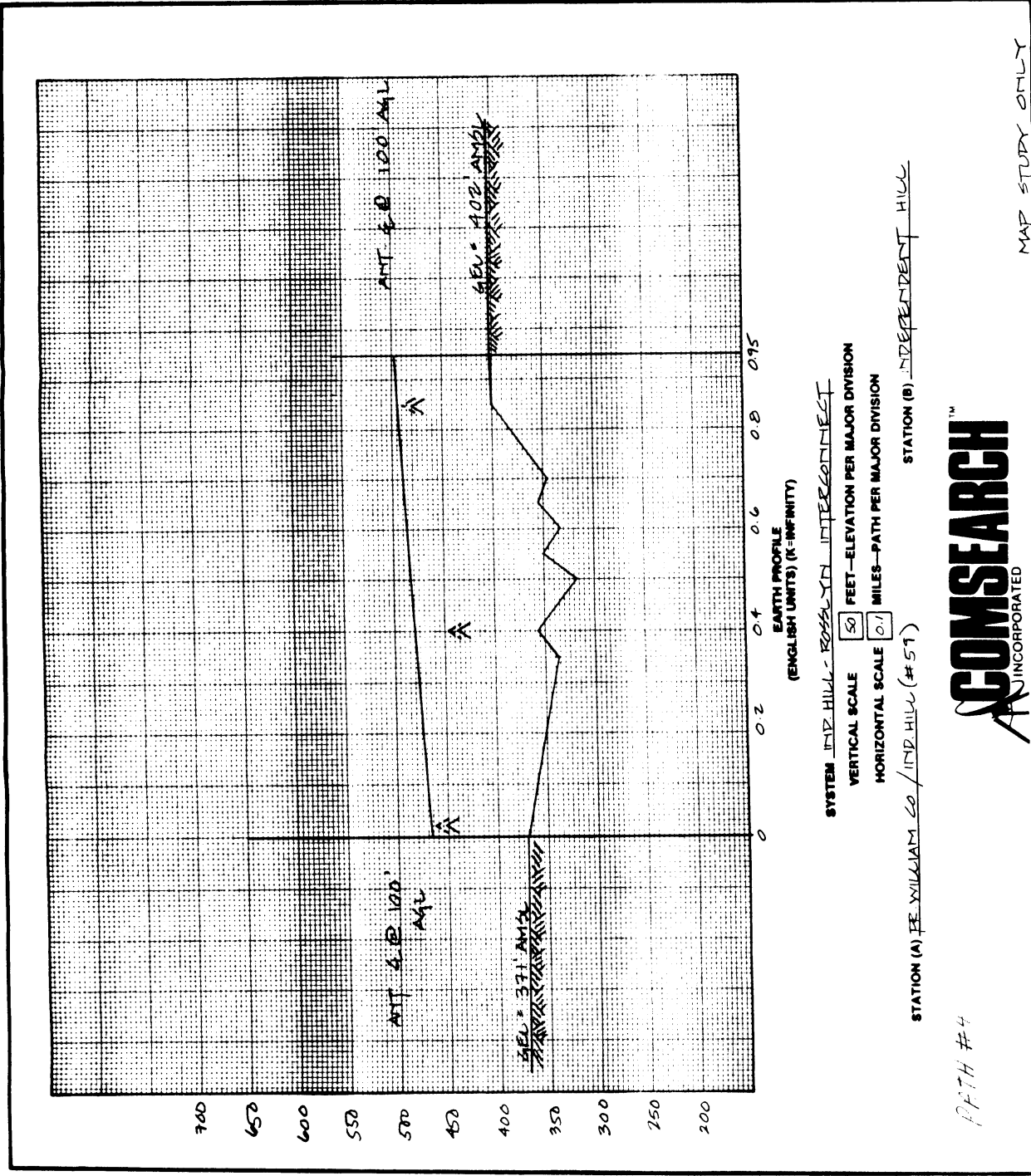
PATH AZIMUTHS AND DISTANCES ARE SCALED INVERSE POSITION OTHER:

CERTIFICATION

EARTH PROFILE (ENGLISH UNITS) (K=INFINITY)

CLIENT: SURVEYOR
 SYSTEM: DESIGN DEPARTMENT
 PATH FROM (A) TO (B): MILES
 PATH LENGTH: MILES

SURVEY BY: DATE: 12/16/05



(ROUTE 2-1)

④

ALTERNATE PATH PROFILE DATA

#59
 SITE: PRINCE WILLIAM CO (IND HILL) SITE: INDEPENDENT HILL
 LAT: 38 ° 37 ' 54 " N LAT: 38 ° 37 ' 35 " N
 LONG: 77 ° 26 ' 25 " W LONG: 77 ° 27 ' 23 " W
 ELEVATION: 371 'ASL ELEVATION: 402 'ASL
 AZIMUTH FORWARD: AZIMUTH REVERSE:
 PATH DISTANCE: 0.95 FREQUENCY: 23

DIST	ELEV	OBST	K() + F	K() + F	NOTE
0	377				
0.25	333				
0.4	356				
0.5	318				
0.55	350				
0.6	335				
0.65	355				
0.7	340				
0.85	400				
0.95	402	SITE			

6

USE OF THIS PROFILE FOR THE DESIGN AND CONSTRUCTION OF THE WORKS AND BEYOND THE ADJACENT ROAD PATHS.

1. USE THE SYMBOLS SHOWN BELOW TO IDENTIFY THE PROPOSED WORKS AND ELEVATIONS.

2. REPRESENT THE PATH AS A STRAIGHT LINE.

3. CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH CURVATURE AT THE CRITICAL POINTS AND ADD TO THE PLAT EARTH ELEVATION.

4. $C = \frac{1}{2} P^2$

WHERE:

1. HEIGHT OF CORRECTION IN FEET.

2. DISTANCE FROM STATION TO POINT UNDER CONSIDERATION IN FEET.

3. RADIUS OF EARTH IN FEET.

4. DISTANCE FROM STATION TO POINT UNDER CONSIDERATION IN STATUTE MILES.

5. DISTANCE FROM STATION TO POINT UNDER CONSIDERATION IN STATUTE MILES.

6. ANY WORKS UNDER CONSIDERATION.

7. ELEVATION OF THE PROPOSED WORKS.

8. ELEVATION OF THE PROPOSED WORKS AND PROJECTIONS UNDER CONSIDERATION.

9. ELEVATION OF THE PROPOSED WORKS AND PROJECTIONS UNDER CONSIDERATION.

10. ELEVATION OF THE PROPOSED WORKS AND PROJECTIONS UNDER CONSIDERATION.

11. ELEVATION OF THE PROPOSED WORKS AND PROJECTIONS UNDER CONSIDERATION.

12. ELEVATION OF THE PROPOSED WORKS AND PROJECTIONS UNDER CONSIDERATION.

13. ELEVATION OF THE PROPOSED WORKS AND PROJECTIONS UNDER CONSIDERATION.

14. ELEVATION OF THE PROPOSED WORKS AND PROJECTIONS UNDER CONSIDERATION.

15. ELEVATION OF THE PROPOSED WORKS AND PROJECTIONS UNDER CONSIDERATION.

16. ELEVATION OF THE PROPOSED WORKS AND PROJECTIONS UNDER CONSIDERATION.

17. ELEVATION OF THE PROPOSED WORKS AND PROJECTIONS UNDER CONSIDERATION.

18. ELEVATION OF THE PROPOSED WORKS AND PROJECTIONS UNDER CONSIDERATION.

19. ELEVATION OF THE PROPOSED WORKS AND PROJECTIONS UNDER CONSIDERATION.

20. ELEVATION OF THE PROPOSED WORKS AND PROJECTIONS UNDER CONSIDERATION.

STATION (A) 13 NORTH 17TH ST (#1)

STATION (B) WVT (#58)

VERTICAL SCALE 100 FEET—ELEVATION PER MAJOR DIVISION

HORIZONTAL SCALE 2 MILES—PATH PER MAJOR DIVISION

SYSTEM INTER-HILL—BOSSLETH INTERCONNECT

VERTICAL SCALE 100 FEET—ELEVATION PER MAJOR DIVISION

HORIZONTAL SCALE 2 MILES—PATH PER MAJOR DIVISION

STATION (A) 13 NORTH 17TH ST (#1)

STATION (B) WVT (#58)

VERTICAL SCALE 100 FEET—ELEVATION PER MAJOR DIVISION

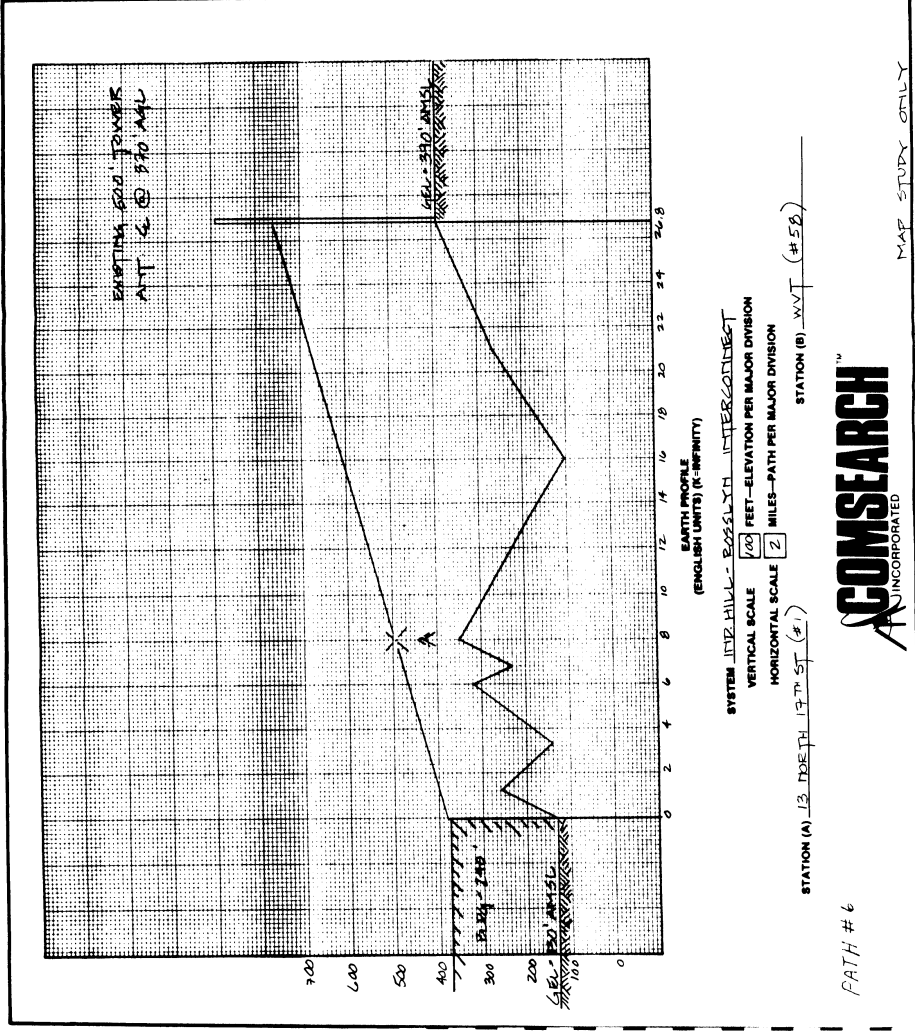
HORIZONTAL SCALE 2 MILES—PATH PER MAJOR DIVISION

SYSTEM INTER-HILL—BOSSLETH INTERCONNECT

VERTICAL SCALE 100 FEET—ELEVATION PER MAJOR DIVISION

HORIZONTAL SCALE 2 MILES—PATH PER MAJOR DIVISION

DATE	12/14/88
DRAWN BY	
CHECKED BY	
DESIGNED BY	
APPROVED BY	
SCALE	
OTHER	



EMERGENCY 500 FT. TOWER AT 6 @ 570 MSL

EARTH PROFILE (ENGLISH UNITS) (R=INFINITY)

SYSTEM INTER-HILL—BOSSLETH INTERCONNECT

VERTICAL SCALE 100 FEET—ELEVATION PER MAJOR DIVISION

HORIZONTAL SCALE 2 MILES—PATH PER MAJOR DIVISION

STATION (A) 13 NORTH 17TH ST (#1)

STATION (B) WVT (#58)

MAP STUDY ONLY

COMSEARCH INCORPORATED

FAITH # 6

USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE HORIZON IS MADE IN THE

1. USE THE SYMBOLS SHOWN BELOW
2. USE A CONSISTENT SCALE FOR DISTANCE AND ELEVATION
3. CALCULATE THE FREQUENCY UNDER CONSIDERATION IN GIGHERTS (MHz)
4. CALCULATE THE EFFECTIVE EARTH RADIUS TO CORRECT FOR EARTH CURVATURE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$R_e = \left(\frac{R_e}{2} \right) + h_1 + h_2$$

WHERE

1. R_e = RADIUS OF EARTH IN FEET
2. h₁ = HEIGHT OF TRANSMITTER IN FEET
3. h₂ = HEIGHT OF EFFECTIVE EARTH RADIUS
4. R = RADIUS OF EARTH IN FEET
5. DISTANCE FROM STATION "A" TO POINT UNDER CONSIDERATION IN STATUTE MILES
6. DISTANCE FROM STATION "B" TO POINT UNDER CONSIDERATION IN STATUTE MILES

AND ANY MAIN WIRE STRUCTURES AND FREQUENCY UNDER CONSIDERATION

1. AND ANY MAIN WIRE STRUCTURES AND FREQUENCY UNDER CONSIDERATION
2. CALCULATE THE FREQUENCY UNDER CONSIDERATION IN GIGHERTS (MHz)
3. CALCULATE THE EFFECTIVE EARTH RADIUS TO CORRECT FOR EARTH CURVATURE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$f_c = \sqrt{\frac{2}{R_e}} \sqrt{h_1 + h_2}$$

WHERE

1. f_c IS THE FREQUENCY UNDER CONSIDERATION IN GIGHERTS (MHz)
2. h₁ IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
3. h₂ IS THE DISTANCE IN MILES FROM THE OTHER END OF THE PATH TO THE POINT UNDER CONSIDERATION
4. R IS THE RADIUS OF THE EARTH IN FEET
5. R_e IS THE RADIUS OF THE EFFECTIVE EARTH AND CAN BE ANY WHOLE POSITIVE NUMBER

EXAMPLES

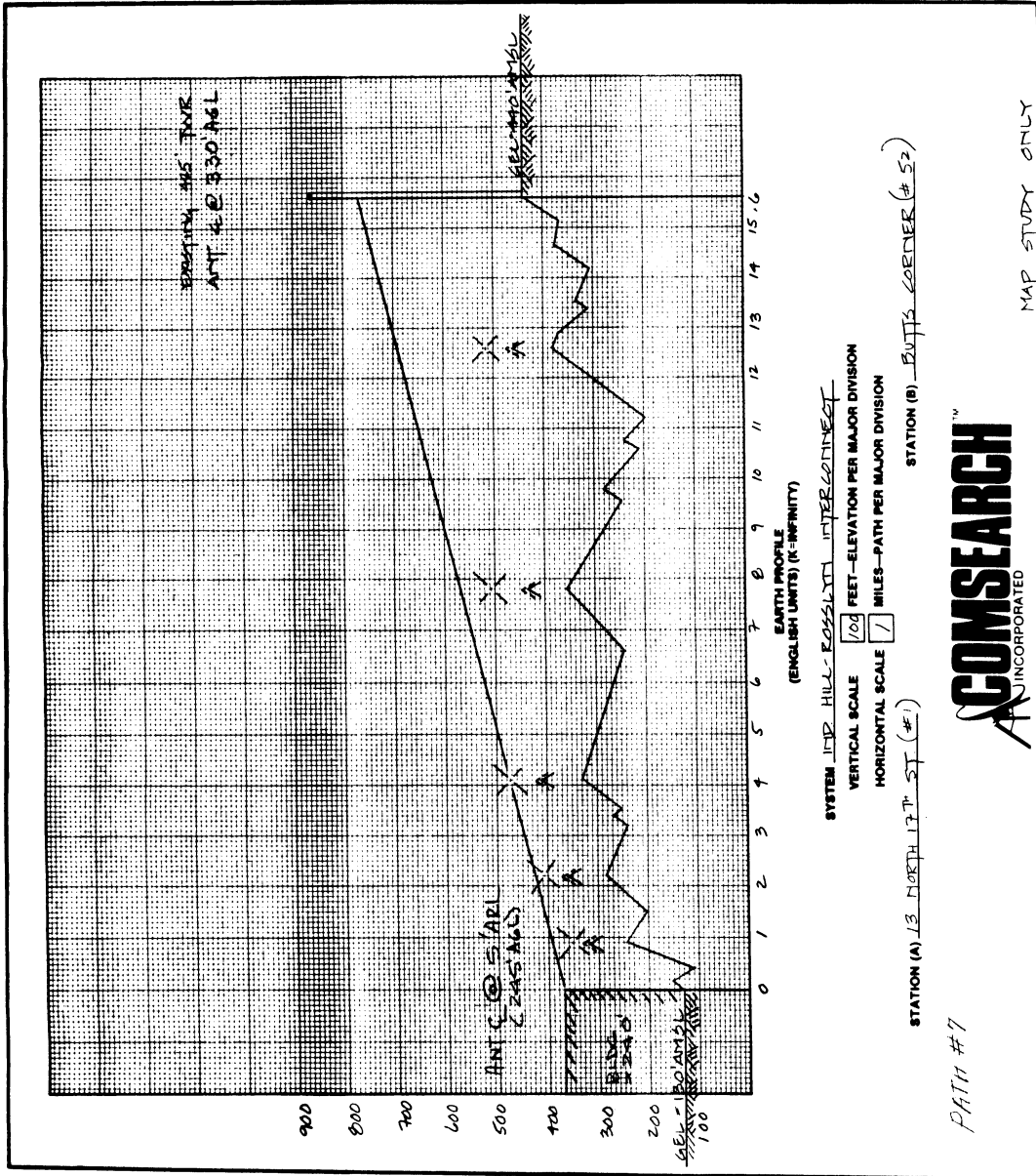
FRESNEL ZONE CLEARANCE
 400 - 200 FT
 EARTH CURVATURE FROM 0 (in)
 MAIN WIRE STRUCTURE
 DISTANCE OFF PATH WITHIN 1000 FEET
 NUMBER OF STATIONS
 FREQUENCY UNDER CONSIDERATION
 ELEVATION HEIGHT OF TRANSMITTER
 ELEVATION HEIGHT OF RECEPTION
 GROUND ELEVATION (in)
 POSSIBLE REFLECTION POINT
 HEIGHT OF FINAL INDIATOR CENTERLINE ABOVE GROUND

STATION (A) IS NORTH 17th ST (#1)
 STATION (B) BUTTS CORNER (#52)

GROUND ELEVATION OF FINAL INDIATOR CENTERLINE: 1500
 HEIGHT OF TRANSMITTER ABOVE MEAN SEA LEVEL: 200
 HEIGHT OF RECEPTION ABOVE MEAN SEA LEVEL: 200
 DISTANCE FROM STATION (A) TO STATION (B): 15.6
 DISTANCE FROM STATION (A) TO REFLECTION POINT: 7.8
 DISTANCE FROM STATION (B) TO REFLECTION POINT: 7.8

CERTIFICATION
 SURVEY BY: []
 DRAWN BY: []
 DATE: 12/26/65

EARTH PROFILE (ENGLISH UNITS) (K-INFINITY)
 CLIENT: []
 SYSTEM: []
 PATH LENGTH: []
 DESIGN DEPARTMENT: []
 OTHER: []



RECORDING PATH PROFILE DATA

SITE: 13 NORTH 17TH ST (#1) SITE: BVTS CORNER (#52)
 LAT: 38° 53' 37" N LAT: 38° 47' 17" N
 LONG: 77° 04' 26" W LONG: 77° 19' 47" W
 ELEVATION: 130' ASL ELEVATION: 440' ASL
 AZIMUTH FORWARD: AZIMUTH REVERSE:
 PATH DISTANCE: FREQUENCY: 11 GHz

DIST	ELEV	GRST	K(L) + E	K(L) + E	NOTE
0.0	130	B=190'			
0.9	240		8.8 + 12.0		
2.2	280		19.7 + 17.9		
4.1	330		31.4 + 22.6		
7.8	352		40.6 + 25.7		
12.6	381		25.2 + 20.2		
15.6	440	TWR = 425'			

9

USE OF FLAT EARTH PROFILE FOR WITHIN-THE-HORIZON AND BEYOND-THE-HORIZON RADIO PATHS

- USE THE SYMBOLS SHOWN BELOW
- USE A CONVENIENT SCALE FOR DISTANCE AND ELEVATIONS
- REPRESENT THE PATH AS A STRAIGHT LINE
- CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$h = \left(\frac{R \theta^2}{2} \right) + h_1^2$$

WHERE

- h = HEIGHT OF CORRECTION IN FEET
- R = RADIUS OF EFFECTIVE EARTH IN FEET
- θ = ANGLE OF EFFECTIVE EARTH IN RADIANS
- h₁ = STATUTE MILES
- h₂ = DISTANCE FROM STATION "A" TO POINT UNDER CONSIDERATION IN STATUTE MILES
- h₃ = DISTANCE FROM STATION "B" TO POINT UNDER CONSIDERATION IN STATUTE MILES

- ADD ANY MAN MADE STRUCTURES AND FORESTAL GROWTH
- CALCULATE THE BULGE PRESURE ZONE RADIUS FOR THE PATHS AND PRESSURES UNDER CONSIDERATION USING THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE

$$r = \sqrt{\frac{2R}{\pi} \left(\frac{d \theta}{\theta} \right)} \quad \theta = \sqrt{\pi \cdot r}$$

WHERE

- r = IS THE RADIUS OF THE FIRST PRESURE ZONE IN FEET
- dθ = IS THE FREQUENCY UNDER CONSIDERATION IN GIGAHERTZ (HP/MZ)
- θ = IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- D = IS THE TOTAL PATH LENGTH IN MILES
- F_n = IS THE RADIUS OF THE NTH PRESURE ZONE IN FEET
- n = IS THE ORDER OF THE PRESURE ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

EXAMPLES

FRESHET ZONE CLEARANCE 80' - 20'

EARTH CURVATURE FROM R (m) 101-25.0'

MAN MADE STRUCTURE TOWER 200' SOUTH OF PATH

OBSTRUCTION OFF PATH WITHIN 1000 FEET

PREDICTED VEGETATION GROWTH F 6 - 10'

EXISTING HEIGHT OF VEGETATION 1 - 10'

GROUND ELEVATION ANSL. 4 (m) 5 - 100'

POSSIBLE REFLECTION POINT R

HEIGHT OF FINAL INDIATOR CENTERLINE ABOVE GROUND 5' 200'

STATION (A) BUTTS CORNER (#52)

GROUND ELEV 33

REQUIRED HEIGHT OF FINAL INDIATOR CENTER LINE FEET ABOVE MEAN SEA LEVEL 440

AZIMUTH (A TO B) 17

STATION (B) INDEPENDENT HILL

GROUND ELEV 37

REQUIRED HEIGHT OF FINAL INDIATOR CENTER LINE FEET ABOVE MEAN SEA LEVEL 402

AZIMUTH (A TO B) 35

FRESHET CALCULATIONS MADE FOR 11 GIGAHERTZ

PATH AZIMUTHS AND DISTANCES ARE SCALED INVERSE POSITION OTHER

CERTIFICATION

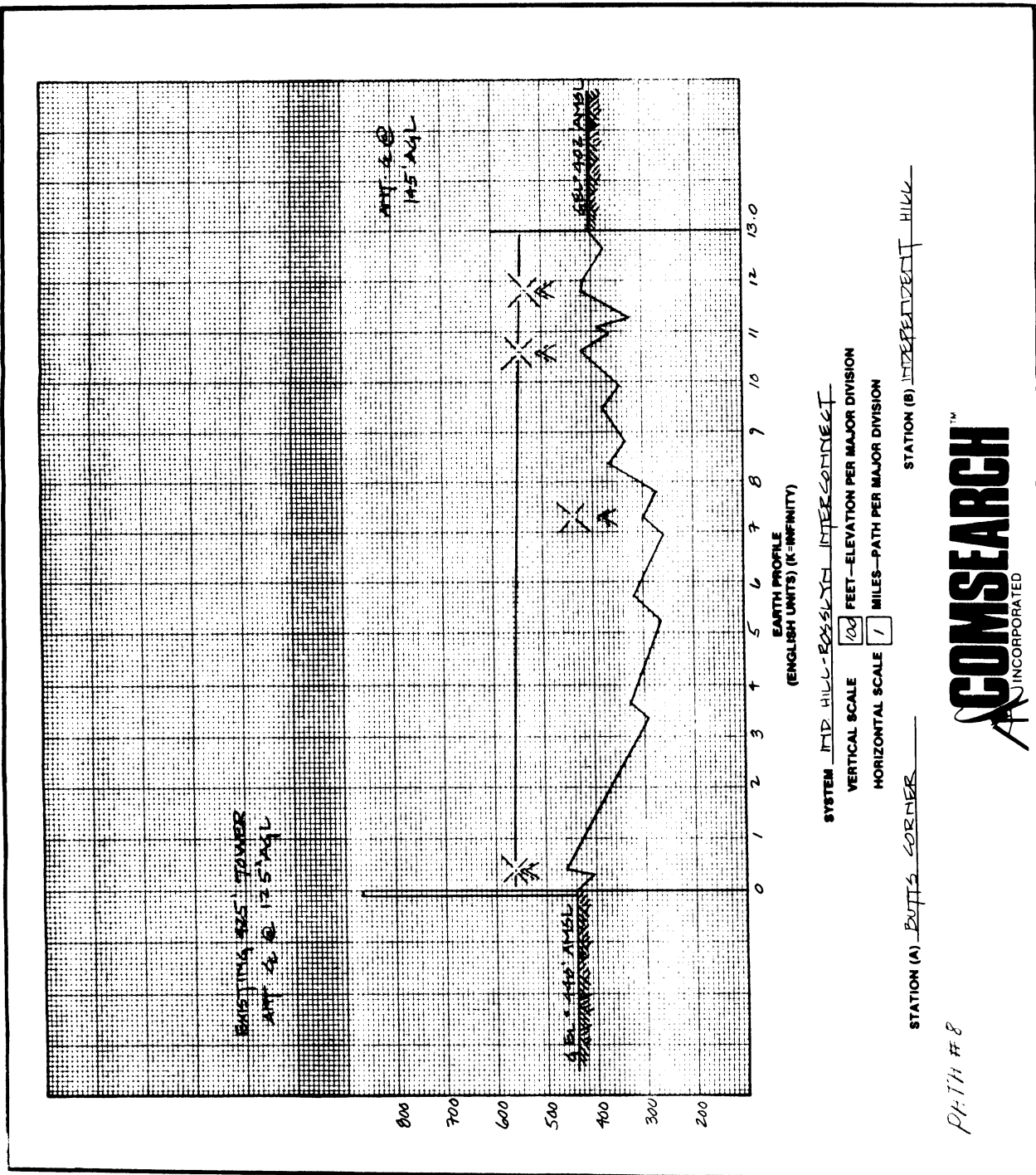
EARTH PROFILE

(ENGLISH UNITS) (K=INFINITY)

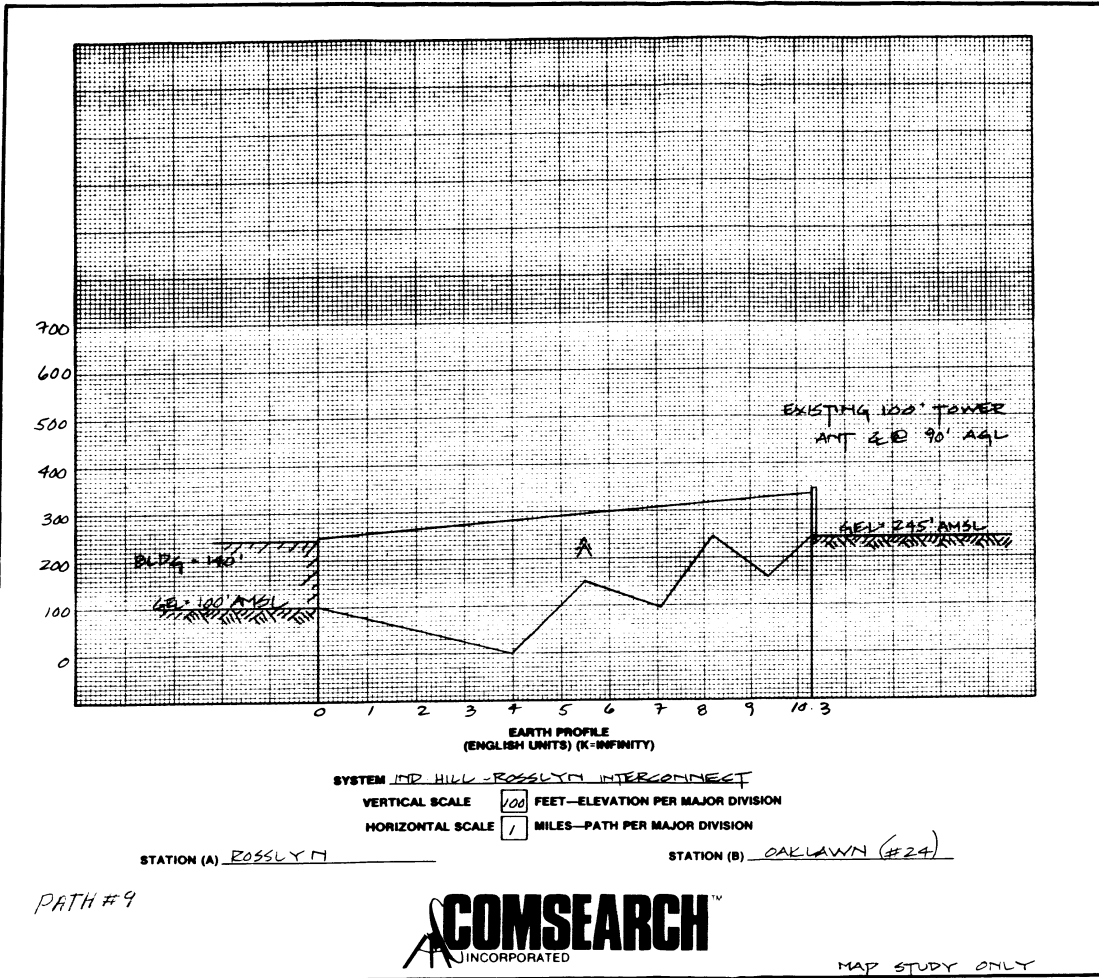
SURVEY BY: CUSTOMER

DRAWN BY: PATH FROM (A) TO (B)

DATE: PATH LENGTH: MILES: OTHER: IN



COMSEARCH
INCORPORATED



LINE OF FLAT EARTH PROFILE FOR WITHIN-THE-HORIZON AND BEYOND-THE-HORIZON RADIO PATHS

1. USE THE SYMBOLS SHOWN BELOW
2. USE A CONVENIENT SCALE FOR DISTANCE AND ELEVATIONS
3. REPRESENT THE PATH AS A STRAIGHT LINE
4. CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$h = \left(\frac{0.867}{k} \right) d_1^2$$

WHERE
 h = HEIGHT OF CORRECTION IN FEET
 k = RATIO OF EFFECTIVE EARTH RADIUS
 TRUE EARTH RADIUS
 d₁ = DISTANCE FROM STATION "A" TO POINT UNDER CONSIDERATION IN STATUTE MILES
 d₂ = DISTANCE FROM STATION "B" TO POINT UNDER CONSIDERATION IN STATUTE MILES

5. ADD ANY MAN MADE STRUCTURES AND FORESTRY GROWTH
6. CALCULATE THE REQUIRED FRESNEL ZONE CLEARANCE FOR THE POINTS AND FREQUENCIES UNDER CONSIDERATION USING THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE

$$F_1 \left[\sqrt{\frac{72}{\text{MHz}}} \sqrt{\frac{100-d}{d}} \right]^2 \leq \sqrt{h} + F_1$$

WHERE
 F₁ IS THE RADIUS OF THE FIRST FRESNEL ZONE IN FEET
 MHz IS THE FREQUENCY UNDER CONSIDERATION IN GIGHERTZ (10⁹ HZ)
 d IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
 D IS THE TOTAL PATH LENGTH IN MILES
 F_n IS THE RADIUS OF THE NTH FRESNEL ZONE IN FEET
 n IS THE ORDER OF THE FRESNEL ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOL	EXAMPLES
FRESNEL ZONE CLEARANCE	80' - 20' F
EARTH CURVATURE FROM K (∞)	K(1)-25.0'
MAN MADE STRUCTURE	B=45.0'
OBSTRUCTION OFF PATH WITHIN 1000 FEET	TOWER 200' SOUTH OF PATH
PREDICTED VEGETATION GROWTH	F G - 10'
EXISTING HEIGHT OF VEGETATION	T - 75'
GROUND ELEVATION AMSL K (∞)	G - 800'
POSSIBLE REFLECTION POINT	R
HEIGHT OF FINAL RADIATOR CENTERLINE ABOVE GROUND	C 200'

STATION (A) ROSSLYN
 LAT. 38 53 41 N
 LONG. 77 04 19 W
 GROUND ELEV. 100 FEET ABOVE MEAN SEA LEVEL
 REQUIRED HEIGHT OF FINAL RADIATOR CENTER LINE _____ FEET ABOVE GROUND
 AZIMUTH (A) TO (B) _____ CW FROM TRUE NORTH

STATION (B) OAKLAWN (#24)
 LAT. 38 46 24 N
 LONG. 76 53 33 W
 GROUND ELEV. 245 FEET ABOVE MEAN SEA LEVEL
 REQUIRED HEIGHT OF FINAL RADIATOR CENTER LINE _____ FEET ABOVE GROUND
 AZIMUTH (B) TO (A) _____ CW FROM TRUE NORTH
 FREQUENCY CALCULATIONS MADE FOR 11 GIGHERTZ
 MAGNETIC DECLINATION _____ OF TRUE NORTH
 PATH AZIMUTHS AND DISTANCES ARE _____ INVERSE POSITION _____ OTHER _____

CERTIFICATION: EARTH PROFILE (ENGLISH UNITS) (K=INFINITY) CLEARANCE CRITERIA BY: _____
 SURVEY BY: _____ CLIENT: SURVEYOR _____
 DRAWN BY: _____ SYSTEM: _____ DESIGN DEPARTMENT: _____
 DATE: 12/26/85 PATH LENGTH: _____ MILES KM OTHER: _____

RECORDING PATH PROFILE DATA

SITE: <u>ROSELYN</u>	SITE: <u>OAKHAWN (#24)</u>
LAT: <u>37</u> \cdot <u>33</u> \cdot <u>41</u> \cdot <u>N</u>	LAT: <u>38</u> \cdot <u>46</u> \cdot <u>29</u> \cdot <u>N</u>
LONG: <u>77</u> \cdot <u>09</u> \cdot <u>19</u> \cdot <u>W</u>	LONG: <u>76</u> \cdot <u>57</u> \cdot <u>33</u> \cdot <u>W</u>
ELEVATION: <u>100</u> \cdot <u>ASL</u>	ELEVATION: <u>245</u> \cdot <u>ASL</u>
AZIMUTH FORWARD: \cdot \cdot \cdot	AZIMUTH REVERSE: \cdot \cdot \cdot
PATH DISTANCE: <u> </u>	FREQUENCY: <u>11.217</u>

DIST	ELEV	OBST	K () + F	K () + F	NOTE
0	100	B-140'			
1	0				
5.5	150				
8.2	245				
10.3	245	TOWER = 100'			

- USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE HORIZON FROM RADIO PATHS
- USE THE SYMBOLS SHOWN BELOW
 - USE A CONVENIENT SCALE FOR DISTANCES AND ELEVATIONS
 - REPRESENT THE PATH AS A STRAIGHT LINE
 - CALCULATE THE EFFECTIVE EARTH CURVATURE TO CONNECT FOR EARTH IN A FLAT AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$h = \frac{(D^2) \cdot k}{2}$$

- WHERE
- h = HEIGHT OF CONNECTION IN FEET
 - D = RATIO OF EFFECTIVE EARTH RADIUS TO TRUE EARTH RADIUS
 - k = DISTANCE FROM STATION "A" TO POINT UNDER CONSIDERATION IN STATUTE MILES
 - k' = DISTANCE FROM STATION "B" TO POINT UNDER CONSIDERATION IN STATUTE MILES

- ADD ANY MAN MADE STRUCTURES AND PERSONAL GROWTH
 - CALCULATE THE FREQUENCY UNDER CONSIDERATION IN GHz (F) AND FREQUENCIES WHICH CORRESPOND USING THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE
- $$f_1 = \sqrt{\frac{30}{40.7}} \sqrt{\frac{D}{k}}$$
- $$f_2 = \sqrt{\frac{30}{40.7}} \sqrt{\frac{D}{k'}}$$

- WHERE
- f_1 IS THE RADIUS OF THE FIRST FRESNEL ZONE IN FEET
 - f_2 IS THE FREQUENCY UNDER CONSIDERATION IN GHz (F)
 - D IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
 - D IS THE TOTAL PATH LENGTH IN MILES
 - F IS THE RADIUS OF THE NTH FRESNEL ZONE IN FEET
 - n IS THE ORDER OF THE FRESNEL ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER



- SYMBOLS
- FRESNEL ZONE CLEARANCE
 - EARTH CURVATURE FROM K (m)
 - MAN MADE STRUCTURE
 - OBSTRUCTION OFF PATH WITHIN 1000 FEET
 - PREDICTED VEGETATION GROWTH
 - EXISTING HEIGHT OF VEGETATION
 - GROUND ELEVATION ANS. K (m)
 - POSSIBLE REFLECTION POINT
 - HEIGHT OF FINAL RADIATOR CENTERLINE ABOVE GROUND

- EXAMPLES
- 0.6' - 20' F
 - 410' - 36.9' F
 - 8 - 45' F
 - TOWER 200' SOUTH OF PATH
 - F.G. - 10'
 - 1 - 75'
 - G. - 800'
 - R
 - 200'

STATION (A) OAKLAND (#24)

LAT 38 LONG 76

GROUND ELEV 46 FEET ABOVE MEAN SEA LEVEL

REQUIRED HEIGHT OF FINAL RADIATOR CENTER LINE 24 FEET ABOVE MEAN SEA LEVEL

AZIMUTH (A) TO (B) 33 CW FROM TRUE NORTH

STATION (B) WV (#58)

LAT 38 LONG 77

GROUND ELEV 37 FEET ABOVE MEAN SEA LEVEL

REQUIRED HEIGHT OF FINAL RADIATOR CENTER LINE 22 FEET ABOVE MEAN SEA LEVEL

AZIMUTH (B) TO (A) 37 CW FROM TRUE NORTH

FRESNEL CALCULATIONS MADE FOR 1.6 GHz OF TRUE NORTH

MAGNETIC DECLINATION FOR THIS AREA IS 16 WEST

PATH AZIMUTHS AND DISTANCES ARE SCALED INVERSE POSITION OTHER

CERTIFICATION

SURVEY BY: _____

DRAWN BY: _____

DATE: 12/27/05

EARTH PROFILE (ENGLISH UNITS) (K = INFINITY)

CUSTOMER: _____

SYSTEM: _____

PATH FROM (A) TO (B): _____

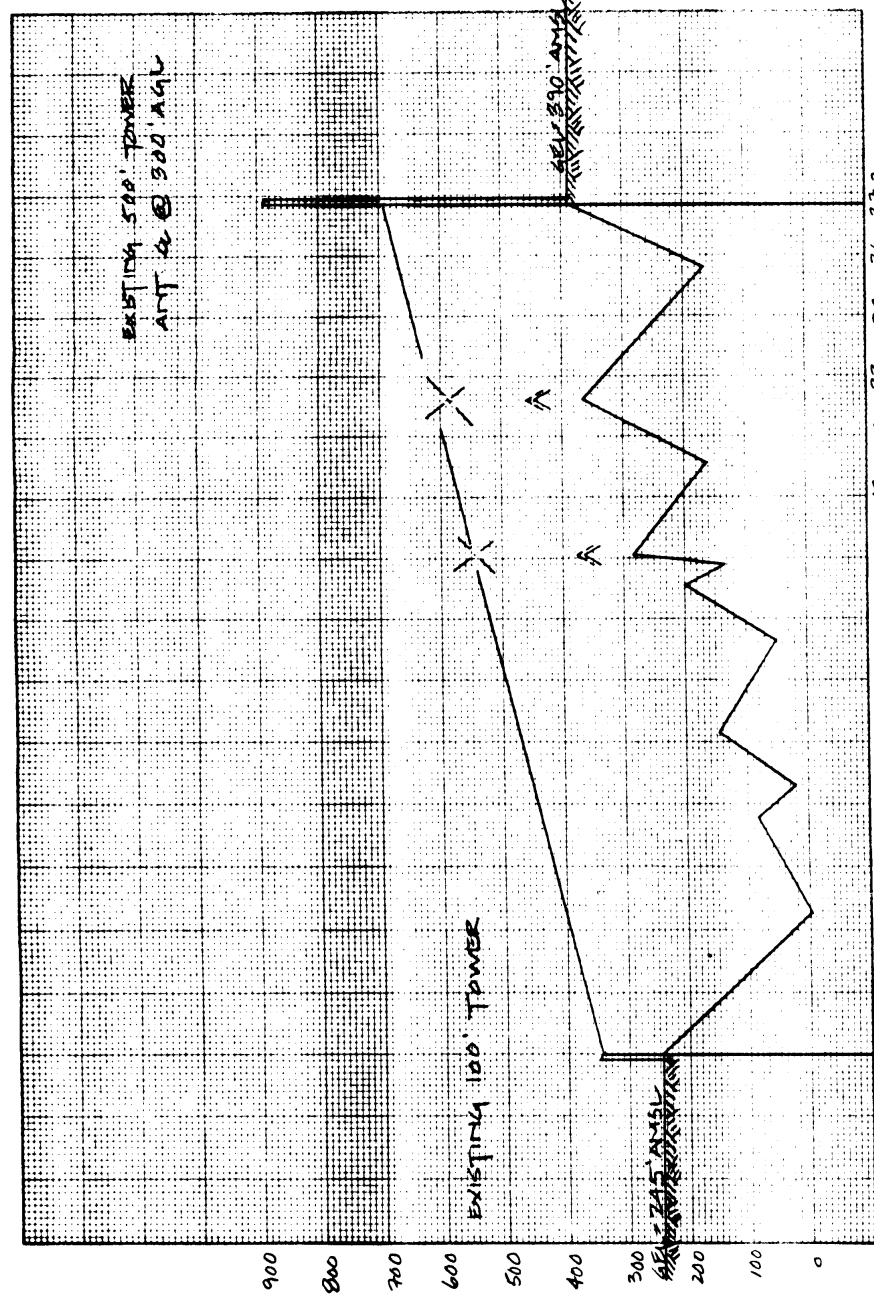
PATH LENGTH: _____ MILES

SCALE: _____

CLEARANCE CRITERIA BY: _____

CLIENT: SURVEYOR DESIGN DEPARTMENT

OTHER: _____



SYSTEM IND HILL- ROSSLYN INTERCONNECT

VERTICAL SCALE 100 FEET—ELEVATION PER MAJOR DIVISION

HORIZONTAL SCALE 2 MILES—PATH PER MAJOR DIVISION

STATION (A) OAKLAND (#24) STATION (B) WV (#58)



PATH # 10

MAP STUDY ONLY

USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE HORIZON THE RADIO PATH

1. USE THE SYMBOLS SHOWN BELOW
2. USE A CONVENIENT SCALE FOR DISTANCE AND ELEVATIONS
3. REPRESENT THE PATH AS A STRAIGHT LINE
4. CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$b = \left(\frac{R}{2} \right) \left(\frac{d}{R} \right)^2$$

WHERE

- b = HEIGHT OF CORRECTION IN FEET
- R = RADIUS OF EFFECTIVE EARTH RADIUS
- d = DISTANCE FROM STATION 'A' TO POINT UNDER CONSIDERATION IN STATUTE MILES
- d₁ = DISTANCE FROM STATION 'B' TO POINT UNDER CONSIDERATION IN STATUTE MILES
- d₂ = TOTAL PATH LENGTH IN MILES

5. ADD ANY WIND BARRIERS AND OBSTACLES
6. CALCULATE THE BARRIERS UNDER CONSIDERATION FROM THE POINTS AND PRESUMED EXTREMES

$$f = \sqrt{\frac{2R}{d}} \left(\sqrt{h_1} + \sqrt{h_2} \right)$$

WHERE

- f = IS THE FREQUENCY UNDER CONSIDERATION IN GIGACYCLES PER SECOND (GHz)
- d = IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- R = IS THE RADIUS OF THE EARTH IN FEET
- h₁ = IS THE HEIGHT OF THE BARRIERS IN FEET
- h₂ = IS THE HEIGHT OF THE BARRIERS IN FEET

SYMBOLS

EXAMPLES

FRESNEL ZONE CLEARANCE
 A-B 30-F
 C-D 45-F
 E-F 200-F SOUTH OF PATH
 G-H 1-F
 I-J 1-F
 K-L 200-F

PREDICTED VEGETATION BARRIER
 VEGETATION HEIGHT IN FEET
 VEGETATION WIDTH IN FEET
 VEGETATION CENTERLINE ABOVE GROUND

STATION (A) ROSSLYN

GROUND ELEVATION 33.53
 REQUIRED HEIGHT OF FINAL INMATOR CENTER LINE 41.1
 DISTANCE TO BARRIERS 100
 DISTANCE TO BARRIERS FROM TRUE NORTH 100

STATION (B) OAK TREE EAST (#20)

GROUND ELEVATION 36.48
 REQUIRED HEIGHT OF FINAL INMATOR CENTER LINE 42.2
 DISTANCE TO BARRIERS 100
 DISTANCE TO BARRIERS FROM TRUE NORTH 100

FRESNEL CALCULATIONS MADE FOR 11 GHz
 MAGNETIC DECLINATION ON FROM TRUE NORTH
 PATH ADJUSTING AND DISTANCES ARE INVERSE POSITION

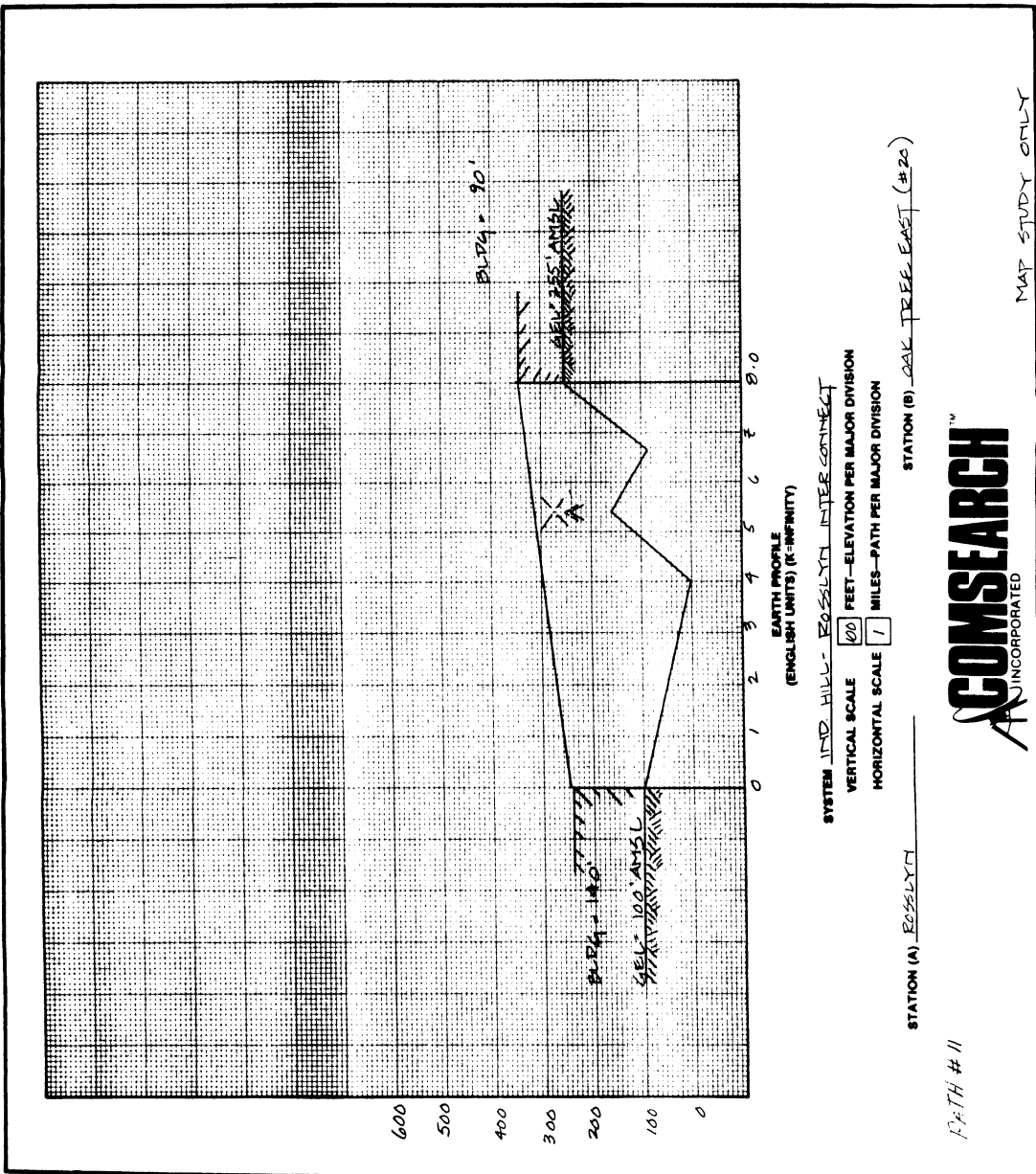
CERTIFICATION

OTHER: _____

EARTH PROFILE
 (ENGLISH UNITS) (K=INFINITY)

DESIGNED BY: _____
 DRAWN BY: _____
 DATE: 12/26/85

CLIENT: _____
 DESIGN DEPARTMENT: _____
 BILLS: _____
 OTHER: _____



MICROWAVE PATH PROFILE DATA

SITE: Rosslyn SITE: DAKOTA EIS- (#25)
 LAT: 38° 53' 41" N LAT: 38° 48' 12" N
 LONG: 77° 09' 19" W LONG: 76° 58' 54" W
 ELEVATION: 100 'ASML ELEVATION: 255 'ASML
 AZIMUTH FORWARD: _____ AZIMUTH REVERSE: _____
 PATH DISTANCE: _____ FREQUENCY: 11 GHz

DIST	ELEV	OBST	K(1) + G	K() + F	NOTE
0	100	B=140'			
4.0	0				
5.4	160		9.9 + 17.2		
8.0	255	B=90'			

USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE 7000'70M RADIO PATHS

- USE THE SYMBOLS SHOWN BELOW
- USE A CONVENIENT SCALE FOR DISTANCES AND ELEVATIONS
- REPRESENT THE PATH AS A STRAIGHT LINE
- CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$b = \left(\frac{1.494}{E} \right) \cdot f_1 \cdot f_2$$

WHERE

- b = HEIGHT OF CORRECTION IN FEET
- E = RATIO OF EFFECTIVE EARTH RADIUS TO TRUE EARTH RADIUS
- f₁ = DISTANCE FROM STATION 'A' TO POINT UNDER CONSIDERATION IN STATUTE MILES
- f₂ = DISTANCE FROM STATION 'B' TO POINT UNDER CONSIDERATION IN STATUTE MILES

- AND ANY MAN MADE STRUCTURES AND FORESTRY GROWTH
- CALCULATE THE REQUIRED PRESERVE ZONE MAP FOR THE POINTS AND FREQUENCIES UNDER CONSIDERATION USING THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE

$$f_1 \cdot \sqrt{\frac{2 \cdot (R - d)}{R}} \quad f_2 \cdot \sqrt{r \cdot f_1}$$

WHERE

- f₁ IS THE RADIUS OF THE FIRST PRESERVE ZONE IN FEET
- R/d IS THE FREQUENCY UNDER CONSIDERATION IN GIGAHERTZ (MHz)
- d IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- D IS THE TOTAL PATH LENGTH IN MILES
- r IS THE RADIUS OF THE 2ND PRESERVE ZONE IN FEET
- R IS THE ORDER OF THE PRESERVE ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

PRESERVE ZONE CLEARANCE: 8-6' - 20' 0'

EARTH CURVATURE FROM K (m): 10'-10' 0'

MAN MADE STRUCTURE: TOWER 200' SOUTH OF PATH

CONSTRUCTION OFF PATH WITHIN 1000 FEET

PREDICTED VEGETATION GROWTH: F 6' - 10'

EXISTING HEIGHT OF VEGETATION: T 7' 5'

GROUND ELEVATION (MSL) K (m): G 1' 00'

POSSIBLE REFLECTION POINT: R

HEIGHT OF FINAL RADATOR CENTERLINE ABOVE GROUND: 200'

EXAMPLES

8-6' - 20' 0'

10'-10' 0'

TOWER 200' SOUTH OF PATH

F 6' - 10'

T 7' 5'

G 1' 00'

R

200'

STATION (A) OAK TREE EAST

GROUND ELEV: 30'

REQUIRED HEIGHT OF FINAL RADATOR CENTERLINE: 40'

FEET ABOVE MEAN SEA LEVEL

AZIMUTH (A TO B): 255

FEET ABOVE GROUND: 50'

CH FROM TRILE NORTH: 54'

STATION (B) W.V.I. (# 58)

GROUND ELEV: 30'

REQUIRED HEIGHT OF FINAL RADATOR CENTERLINE: 30'

FEET ABOVE MEAN SEA LEVEL

AZIMUTH (B TO A) LONGS MADE FOR: 6'

CH FROM TRILE NORTH: 37'

MAJOR DIVISION CALCULATION: 37'

SCALE: 1" = 100'

PATH AZIMUTHS AND DISTANCES ARE SCALED: INVERSE POSITION: OTHER

CERTIFICATION

SURVEY BY: _____

DRAWN BY: _____

DATE: 12/24/05

EARTH PROFILE

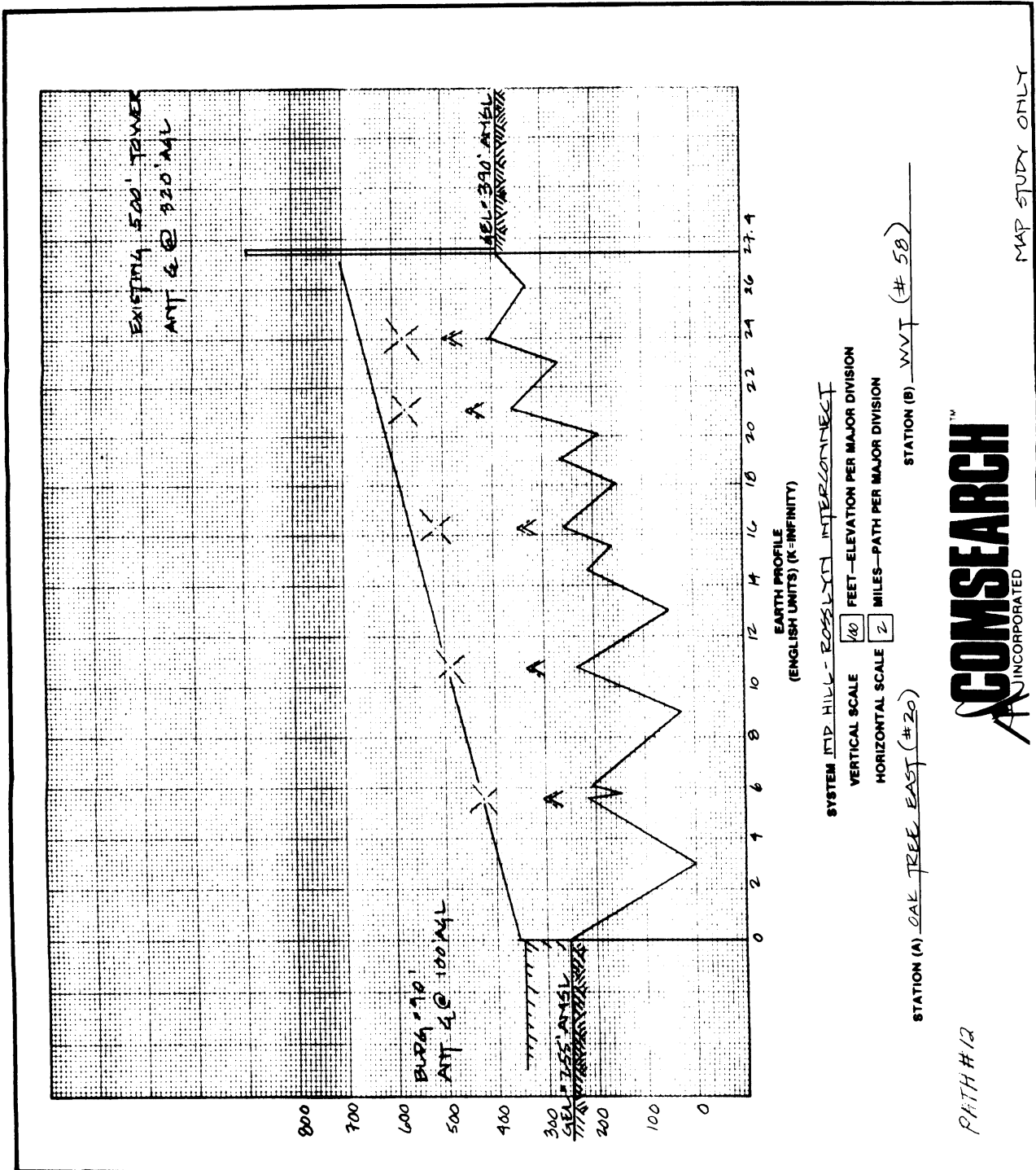
(ENGLISH UNITS) (K=INFINITY)

CLIENT: SURVEYOR _____

DESIGN DEPARTMENT: _____

OTHER: _____

MILES: _____



IRIDIUM PATH PROFILE DATA

SITE: <u>OAK TREE EAST (#20)</u>	SITE: <u>WVT (#58)</u>
LAT: <u>38 ° 40 ' 12 " N</u>	LAT: <u>38 ° 37 ' 42 " N</u>
LONG: <u>76 ° 58 ' 54 " W</u>	LONG: <u>77 ° 26 ' 22 " W</u>
ELEVATION: <u>225</u> 'ASL	ELEVATION: <u>390</u> 'ASL
AZIMUTH FORWARD: _____ ° ' "	AZIMUTH REVERSE: _____ ° ' "
PATH DISTANCE: _____	FREQUENCY: <u>6</u>

DIST	ELEV	CRST	K()	+ F	NOTE
0.0	255	B=90'			
3.0	0				
5.6	215		81.4	+37.2	
6.1	205		86.6	+38.3	
9.0	30				
10.8	236		119.5	+45.0	
13.0	50				
14.6	210				
16.3	260		120.6	+45.2	
19.1	265				
21.1	360		88.6	+38.8	
24.0	405		54.4	+30.4	
27.4	390	Twt 500'			

USE OF PLATE EARTH PROFILE FOR DETERMINING THE CLEARANCE AND LOCATING THE OPTIMUM TRACK PATH

1. USE THE PROFILE'S GRADE SCALE.
2. DRAW A CONTOUR LINE AT THE CLEARANCE HEIGHT AND DRAW A TRACK LINE THROUGH THE PATH AS A STRAIGHT LINE.
3. CALCULATE THE EFFECTIVE EARTH CLEARANCE TO CORRECT FOR GRADE SCALE AT THE CONTINUOUS POINTS TO THE PATH'S EXTENSION.

$$s = \left(\frac{L}{R} \right) \cdot H \cdot 4$$

WHERE:
 s = HEIGHT OF CORRECTION IN FEET
 L = DISTANCE FROM STATION TO THE POINT OF INTEREST IN FEET
 R = RADIUS OF EARTH IN FEET
 H = HEIGHT OF CLEARANCE IN FEET

4. DISTANCE FROM STATION "X" TO POINT OF INTEREST CONSIDERATION IN STATIONING.
5. DISTANCE FROM STATION "Y" TO POINT OF INTEREST CONSIDERATION IN STATIONING.

NOTE: ANY TRACKS MADE CONSIDERATIONS AND PROBABILITIES. CALCULATE THE TRACK PROFILE, ONE WAY FOR THE PROFILE AND PROBABILITIES. CONSIDERATIONS UNDER THE FOLLOWING FORMULAS AND ADD TO THE PROFILE.

$$\sqrt{\frac{2R}{H}} \left(\frac{H}{2} + \sqrt{\frac{H^2}{4} + R^2} \right)$$

WHERE:
 R = IN THE RANGE OF THE FIRST PRESERVE ZONE IN FEET
 H = IN THE PRESERVE ZONE CONSIDERATION IN FEET
 s = IN THE RANGE IN FEET FROM THE END OF THE PATH TO THE POINT OF INTEREST
 L = IN THE RANGE OF THE 2ND PRESERVE ZONE IN FEET
 P = IN THE RANGE OF THE 2ND PRESERVE ZONE IN FEET
 P = IN THE RANGE OF THE PRESERVE ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER.

EXAMPLES

PROFILE ZONE CLEARANCE: 200 FT
 GRADE SCALE: 1:20
 TRACKS 200' SOUTH OF PATH

PROPOSED LOCATION (MILES): 1.75
 GRADE ELEVATION ANGLE: 1:20
 POSSIBLE REFLECTION POINT: 0
 HEIGHT OF FINAL INVERT CENTERLINE: 5' 200'

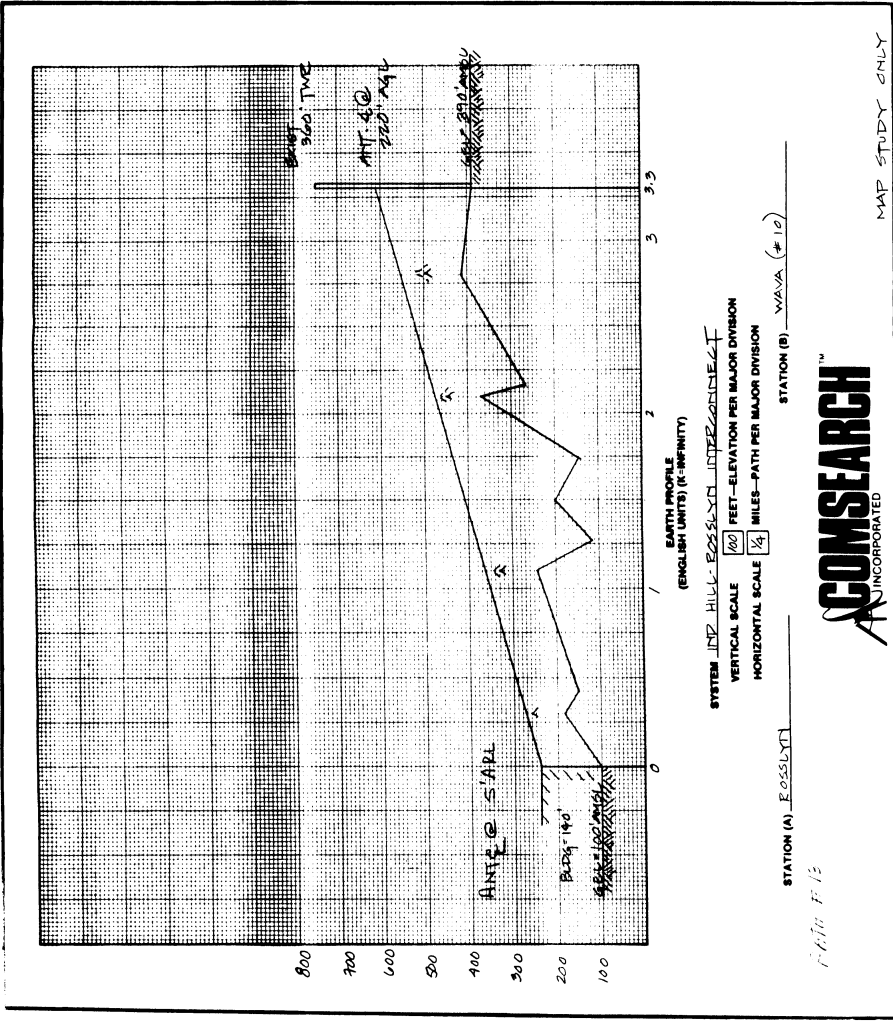
STATION (A) ESSLON
 UAL: 30
 REQUIRED HEIGHT OF FINAL INVERT CENTERLINE: 100
 FEET ABOVE MEAN SEA LEVEL

STATION (B) WAVA (#10)
 UAL: 53
 REQUIRED HEIGHT OF FINAL INVERT CENTERLINE: 100
 FEET ABOVE MEAN SEA LEVEL

GROUND ELEVATION: 33
 GRADE ELEVATION: 53
 DISTANCE FROM STATION (A) TO POINT OF INTEREST: 1.75
 DISTANCE FROM STATION (B) TO POINT OF INTEREST: 0.44
 DISTANCE FROM STATION (A) TO POINT OF INTEREST: 3.3

PROBABILITIES MADE FOR MULTIPLE TRACKS: 0.5
 INVERSE POSITION: 0.5

OTHER:
 CLEARANCE CRITERIA: (R=INFINITY)
 CLIENT: BUREAU OF REVENUE DEPARTMENT
 DRAWN BY: [Signature]
 DATE: 12/24/68



RECEIVE PATH PROFILE DATA

SITE: ROSSLYN SITE: WAJA (#10)
 LAT: 38 • 53 • 41 • N LAT: 38 • 53 • 44 • N
 LONG: 77 • 04 • 19 • W LONG: 77 • 08 • 04 • W
 ELEVATION: 100 'ASML ELEVATION: 390 'ASML
 AZIMUTH FORWARD: _____ AZIMUTH REVERSE: _____
 PATH DISTANCE: 3.3 FREQUENCY: 11

DIST	ELEV	OBST	K() + F	K() + F	NOTE
0	100'	B=140'			
0.3	183				
1.1	242				
1.5	200				
2.1	370				
2.8	415				
3.3	370	TOWER			

USE OF FLAT EARTH PROFILE FOR WITHIN THE ZONE AND BEYOND THE ZONE UNDER CONSIDERATION

1. USE THE SYMBOLS SHOWN BELOW
2. USE A CONSISTENT SCALE FOR DISTANCE AND ELEVATION
3. DESCRIBE THE PATH AND STATION POINTS
4. CALCULATE THE EFFECTIVE EARTH RADIUS TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$R_e = \left(\frac{R_e}{R} \right) + 1/2$$

WHERE

- R = HEIGHT OF CORRECTION IN FEET
- R_e = RATIO OF EFFECTIVE EARTH RADIUS TO TRUE EARTH RADIUS

1. DISTANCE FROM STATION "A" TO POINT UNDER CONSIDERATION IN STATUTE MILES
2. DISTANCE FROM STATION "B" TO POINT UNDER CONSIDERATION IN STATUTE MILES

1. AND ANY MAN MADE STRUCTURES AND FORESTRY GROWTH
2. CALCULATE THE REQUIRED PRESURE ZONE FROM THE POINTS AND PRELIMINARY UNDER CONSIDERATION UNDER THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE

$$r = \sqrt{\frac{2}{g} \left(\frac{d \cdot g}{2} \right)} \quad f = \sqrt{2 \cdot r}$$

WHERE

- r = IS THE RADIUS OF THE FIRST PRESURE ZONE IN FEET
- f = IS THE FREQUENCY UNDER CONSIDERATION IN DEGREES (WIND)
- d = IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- D = IS THE TOTAL PATH LENGTH IN MILES
- P_n = IS THE RADIUS OF THE NTH PRESURE ZONE IN FEET
- n = IS THE ORDER OF THE PRESURE ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

EXAMPLES

PRESURE ZONE CLEARANCE: 8-6" - 20' F
 BATH CURVATURE FROM A (h): 8-11-38' F
 MAN MADE STRUCTURE: 8-4-8' F
 OBSTRUCTION OFF PATH WITHIN 1000 FEET: 1-6-10' F
 PREDICTED VEGETATION GROWTH: 1-7-75' F
 EXISTING HEIGHT OF VEGETATION: 6-1-80' F
 GROUND ELEVATION ANSL. E (h): R
 POSSIBLE REFLECTION POINT: R
 HEIGHT OF FINAL RADATION CENTERLINE ABOVE GROUND: 5-20' F

STATION (A) WAVA (#10)
 LAT: 33-08-44 N
 LONG: 08-04-04 W

STATION (B) SANDY RUN (#48)
 LAT: 33-04-26 N
 LONG: 07-13-21 W

REQUIRED HEIGHT OF FINAL RADATION CENTERLINE: FEET ABOVE MEAN SEA LEVEL
 ASYMUTH (A TO B): CW FROM TRUE NORTH

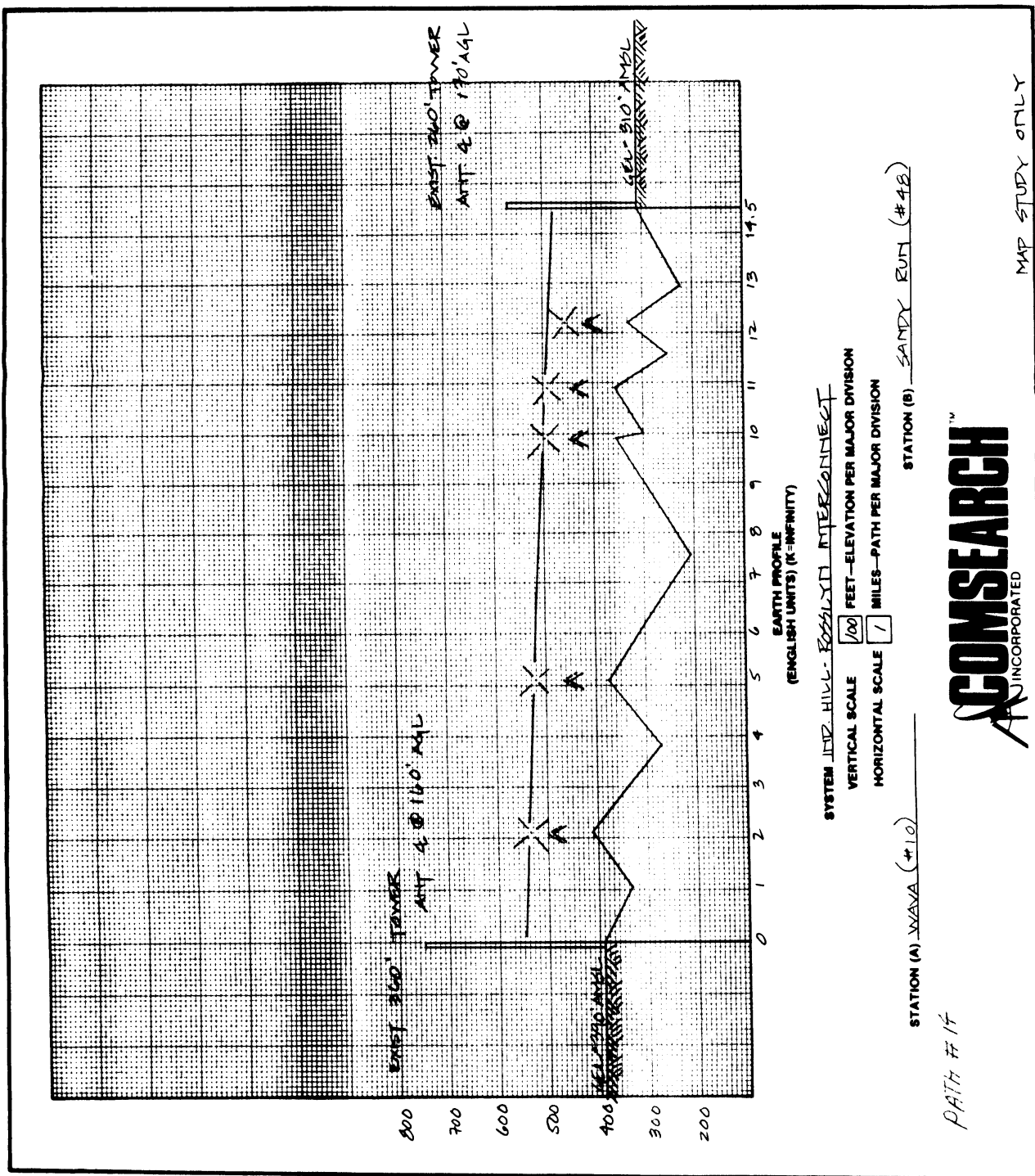
REQUIRED HEIGHT OF FINAL RADATION CENTERLINE: FEET ABOVE MEAN SEA LEVEL
 ASYMUTH (B TO A): CW FROM TRUE NORTH

FRESNEL CALCULATIONS MADE FOR: GRANITZ
 MAGNETIC DECLINATION: OF TRUE NORTH
 PATH AZIMUTHS AND DISTANCES ARE SCALED: INVERSE POSITION: OTHER

CERTIFICATION

EARTH PROFILE (ENGLISH UNITS) (K=INFINITY)
 CUSTOMER: SURVEYOR
 PATH FROM (A) TO (B): DESIGN DEPARTMENT
 PATH LENGTH: MILES: 8.0

SURVEY BY: DATE: 12/4/65



REVERSE PATH PROFILE DATA

SITE: <u>WAUA (#10)</u>	SITE: <u>SANDY FJW (#98)</u>
LAT: <u>38 ° 52 ' 49 " N</u>	LAT: <u>37 ° 43 ' 26 " N</u>
LONG: <u>97 ° 08 ' 24 " W</u>	LONG: <u>97 ° 17 ' 21 " W</u>
ELEVATION: <u>390 ' ASL</u>	ELEVATION: <u>310 ' ASL</u>
AZIMUTH FORWARD: <u> </u>	AZIMUTH REVERSE: <u> </u>
PATH DISTANCE: <u> </u>	FREQUENCY: <u>11 GHz</u>

DIST	ELEV	OBST	K () + F	K () + F	NOTE
0	390	FWR			
0	400		18.4 + 18.4		
5.1	325		22.0 + 23.6		
7.9	355		20.4 + 23.0		
10	300		22.0 + 22.9		
10.9	305		24.2 + 21.4		
15.7	332		18.9 + 18.1		
14.5	310	FWR			

USE OF FLAT EARTH PROFILE FOR WITHIN THE MAGNETIC ZONE AND BEYOND THE MAGNETIC ZONE

- USE THE SYMBOLS SHOWN BELOW
- USE A CONSISTENT SCALE FOR DISTANCES AND ELEVATIONS
- REPRESENT THE PATH AS A STRAIGHT LINE
- CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$b = \left(\frac{R \cdot D^2}{2E} \right) + 1/2$$

WHERE

- b = HEIGHT OF CORRECTION IN FEET
- R = RADIUS OF EFFECTIVE EARTH RADIUS
- D = DISTANCE FROM STATION "A" TO POINT UNDER CONSIDERATION IN STATUTE MILES
- E = DISTANCE FROM STATION "B" TO POINT UNDER CONSIDERATION IN STATUTE MILES

- AND ANY MAN MADE STRUCTURES AND PERSONAL GROWTH
- CALCULATE THE EARTH PROFILE, ZONE MARKS FOR THE POINTS AND FREQUENCIES UNDER CONSIDERATION USING THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE

$$f = \sqrt{\frac{7.7}{1000} \cdot \frac{1}{\lambda}} \cdot \sqrt{1 + f_1}$$

WHERE

- f = IS THE RADIUS OF THE FIRST PRESNEL ZONE IN FEET
- f₁ = IS THE FREQUENCY UNDER CONSIDERATION IN GIGAHERTZ (GPHZ)
- D = IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- D = IS THE TOTAL PATH LENGTH IN MILES
- P₁ = IS THE RADIUS OF THE 1ST PRESNEL ZONE IN FEET
- n = IS THE ORDER OF THE PRESNEL ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

EXAMPLES

FRESNEL ZONE CLEARANCE: R.F. = 20'

EARTH CURVATURE FROM K (M): K = 1.5

MAN MADE STRUCTURE: 20' x 10'

OBSTRUCTION OFF PATH WITHIN 1000 FEET: 200' SOUTH OF PATH

PREDICTED VEGETATION GROWTH: F.G. = 30'

EXISTING HEIGHT OF VEGETATION: 1 - 75'

GROUND ELEVATION ANGLE K (M): G = 100'

POSSIBLE REFLECTION POINT: R

HEIGHT OF FINAL INANIMATOR CENTERLINE ABOVE GROUND: C = 200'

STATION (A) SANDY RUN (#48)

LAT: 38° 43' 24" N

LONG: 77° 17' 31" W

GROUND ELEV: 37'

REQUIRED HEIGHT OF FINAL INANIMATOR CENTERLINE: 200' FEET ABOVE MEAN SEA LEVEL

AZIMUTH (A) TO (B): 111° 07' 00" CW FROM TRUE NORTH

STATION (B) INDEPENDENT HILL

LAT: 38° 37' 35" N

LONG: 77° 23' 00" W

GROUND ELEV: 37'

REQUIRED HEIGHT OF FINAL INANIMATOR CENTERLINE: 200' FEET ABOVE MEAN SEA LEVEL

AZIMUTH (B) TO (A): 111° 07' 00" CW FROM TRUE NORTH

FRESNEL CALCULATIONS MADE FOR: 11 GIGAHERTZ

MAGNETIC ORIENTATION: _____

PATH AZIMUTHS AND DISTANCES ARE _____ OF TRUE NORTH

SCALE: _____ INVERSE POSITION: _____ OTHER: _____

CERTIFICATION

EARTH PROFILE: _____

CLEARANCE CRITERIA BY: _____

CLIENT: SURVEYOR _____

DESIGN DEPARTMENT: _____

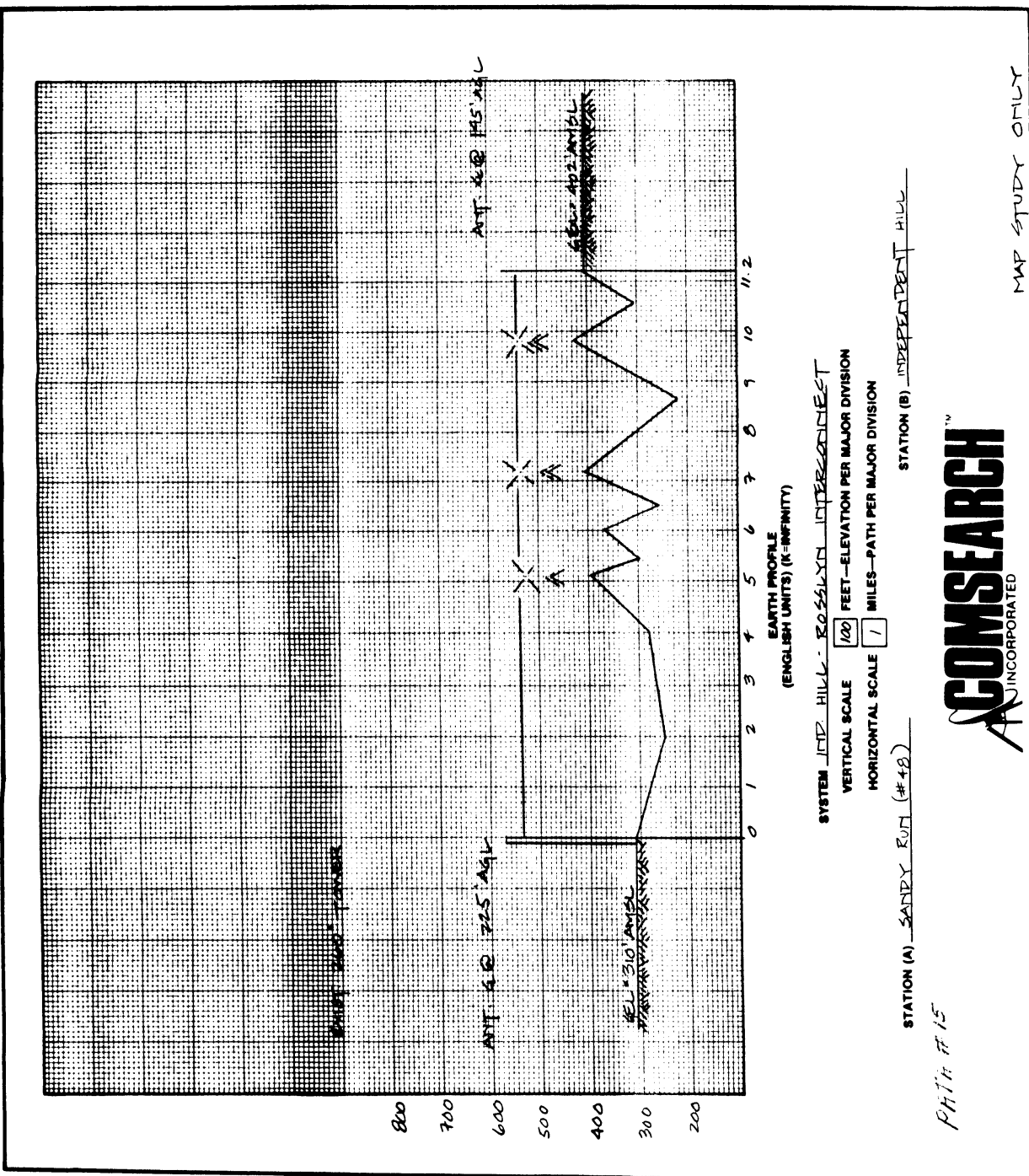
SYSTEM: _____

PATH FROM (A) TO (B): _____ MILES

DATE: 12/26/85

DRAWN BY: _____

OTHER: _____



MICROWAVE PATH PROFILE DATA

SITE: SANDY RUN (#48) SITE: INDEPENDENT HILL
 LAT: 38 • 43 • 26 • N LAT: 38 • 37 • 35 • N
 LONG: 77 • 17 • 21 • W LONG: 77 • 27 • 23 • W
 ELEVATION: 310 'ASL ELEVATION: 402 'ASL
 AZIMUTH FORWARD: • • • AZIMUTH REVERSE: • • •
 PATH DISTANCE: • • • FREQUENCY: 11.6 GHz

DIST	ELEV	OBST	K() + 6F	K() + F	NOTE
0	310	260' TWR			
2.0	250				
4.0	280				
5.1	395		20.7 + 21.7		
6.0	365				
7.2	402		19.2 + 20.9		
9.8	426		9.1 + 14.4		
11.2	402				

USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE HORIZON IN THE

1. USE THE SYMBOLS SHOWN BELOW
2. USE A CONSISTENT SCALE FOR DISTANCE AND ELEVATIONS
3. REPRESENT THE PATH AS A STRAIGHT LINE
4. CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$d = \left(\frac{2R}{3} \right)^{1/2} \sqrt{h_1 + h_2}$$

WHERE

- d = HEIGHT OF CORRECTION IN FEET
- R = RADIUS OF EFFECTIVE EARTH RADIUS
- h₁ = DISTANCE FROM STATION "A" TO POINT UNDER CONSIDERATION IN STATUTE MILES
- h₂ = DISTANCE FROM STATION "B" TO POINT UNDER CONSIDERATION IN STATUTE MILES

5. AND ANY MAN MADE STRUCTURES AND FORESTRAL GROWTH
6. CALCULATE THE REQUIRED PRESERVE ZONE BARS FOR THE POINTS AND PRESERVE ZONE UNDER CONSIDERATION USING THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE

$$r_1 = \frac{2R}{3} \sqrt{\frac{d + h_1}{h_1}} \quad r_2 = \sqrt{r_1^2 + h_1^2}$$

WHERE

- r₁ IS THE RADIUS OF THE FIRST PRESERVE ZONE IN FEET
- r₂ IS THE RADIUS OF THE SECOND PRESERVE ZONE IN FEET
- d IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- D IS THE TOTAL PATH LENGTH IN MILES
- r₁ IS THE RADIUS OF THE 1ST PRESERVE ZONE IN FEET
- r₂ IS THE RADIUS OF THE 2ND PRESERVE ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

EXAMPLES

PRESERVE ZONE CLEARANCE: 8' @ 200'

EARTH CURVATURE FROM 1 (m): 8'-11" @ 50'

MAN MADE STRUCTURE: TOWER 200' SOUTH OF PATH

DISTRICTION OFF PATH WITHIN 1000 FEET: F @ 10'

PREDICTED VEGETATION GROWTH: 1'-7"

EXISTING HEIGHT OF VEGETATION: 6'-00"

GROUND ELEVATION (MSL): 4'-00"

POSSIBLE REFLECTION POINT: R

HEIGHT OF FINAL RADATOR CENTERLINE ABOVE GROUND: 5' 200'

STATION (A) WETA (#9)

LAT: 38° 53' 29" N

LONG: 77° 32' 33" W

REQUIRED HEIGHT OF FINAL RADATOR CENTERLINE: FEET ABOVE MEAN SEA LEVEL

AZIMUTH (A) TO (B): 326.3° CW FROM TRUE NORTH

STATION (B) ELGIN CORNER (#51)

LAT: 38° 47' 18" N

LONG: 77° 49' 45" W

REQUIRED HEIGHT OF FINAL RADATOR CENTERLINE: FEET ABOVE MEAN SEA LEVEL

AZIMUTH (B) TO (A): 49.7° CW FROM TRUE NORTH

FRESH CALCULATIONS MADE FOR: 1/1 GEARHERTZ

MAGNETIC DECLINATION: OF TIME NORTH

PATH AZIMUTHS AND DISTANCES ARE SCALED INVERSE POSITION OTHER

CERTIFICATION

EARTH PROFILE (ENGLISH UNITS) (K=INFINITY)

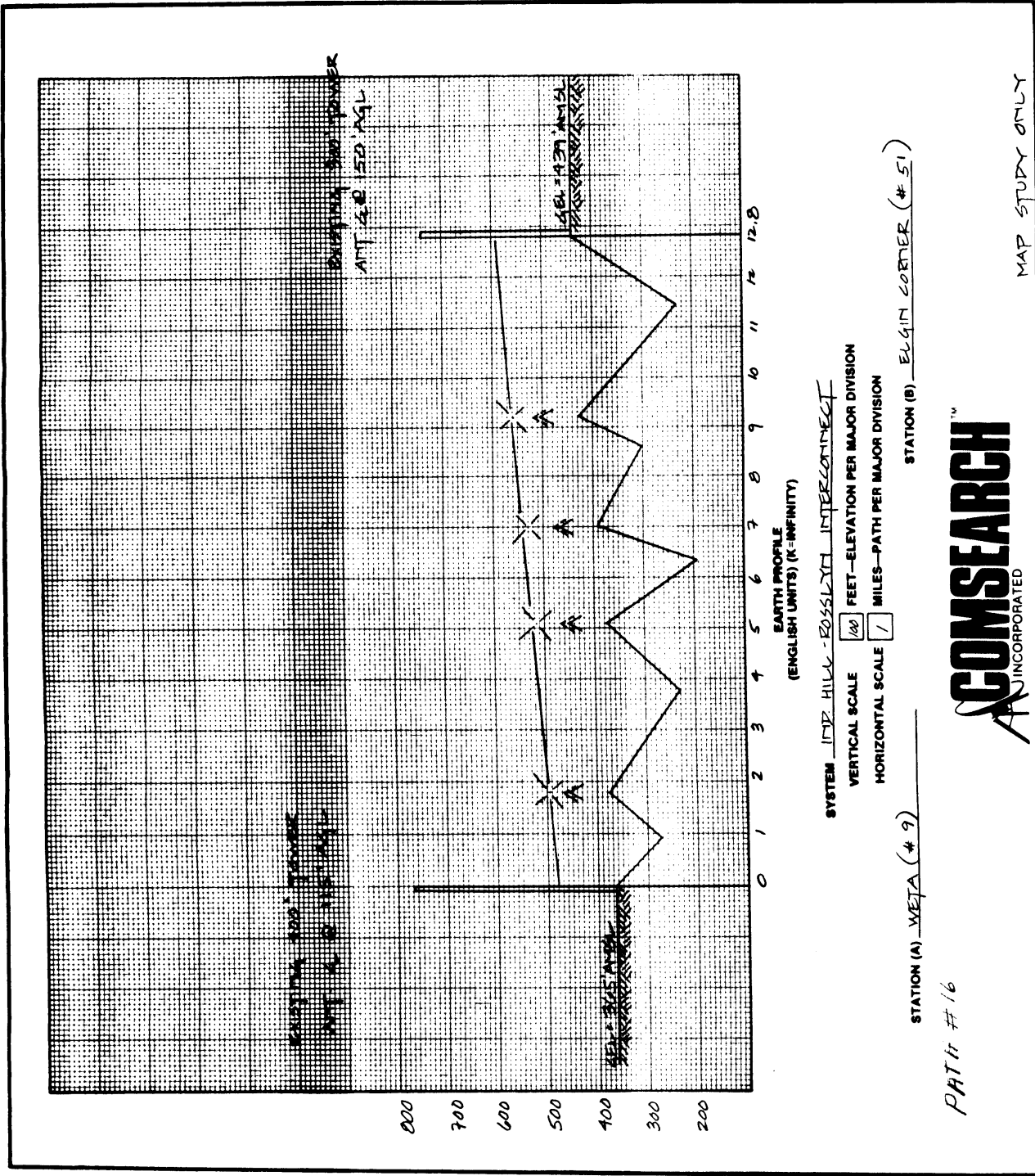
SURVEY BY: CUSTOMER

DRAWN BY: PATH FROM (A) TO (B)

DATE: 12/10/85

PATH LENGTH: MILES

DESIGN DEPARTMENT: OTHER



USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE HORIZON RADIO PATHS

- USE THE SYMBOLS SHOWN BELOW
- USE A CONVENIENT SCALE FOR DISTANCE AND ELEVATIONS
- REPRESENT THE PATH AS A STRAIGHT LINE
- CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$d = \left(\frac{800}{k} \right) \cdot 1.42$$

WHERE

- HEIGHT OF CORRECTION IN FEET
- RATIO OF EFFECTIVE EARTH RADIIUS
- TRUE EARTH RADIIUS
- DISTANCE FROM STATION "A" TO POINT UNDER CONSIDERATION IN STATUTE MILES
- DISTANCE FROM STATION "B" TO POINT UNDER CONSIDERATION IN STATUTE MILES

AND ANY MAN MADE STRUCTURES AND PERSONAL GROWTH

- CALCULATE THE DESIRED PROFILE ZONE MARKS FOR THE PROFITS AND PRESENTANCES UNDER CONSIDERATION USING THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE

$$f = \sqrt{\frac{7}{16k}} \sqrt{\frac{800}{k}} \cdot \sqrt{h} \cdot \sqrt{r} \cdot 1.42$$

WHERE

- IS THE RADIIUS OF THE FIRST PRESNEL ZONE IN FEET
- IS THE FREQUENCY UNDER CONSIDERATION IN GIGAHERTZ (HPND)
- IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- IS THE TOTAL PATH LENGTH IN MILES
- IS THE RADIIUS OF THE NTH PRESNEL ZONE IN FEET
- IS THE ORDER OF THE PRESNEL ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

EXAMPLES

FRESNEL ZONE CLEARANCE 0.6' - 20.0'

EARTH CURVATURE FROM A (m) 1011-35.0'

MAN MADE STRUCTURE 0-40.0'

DISTORTION OFF PATH WITHIN 1000 FEET 0-100.0'

PREDICTED VEGETATION GROWTH 1-7.5'

EXISTING HEIGHT OF VEGETATION 6-80.0'

GROUND ELEVATION ANSL. K (m) R

POSSIBLE REFLECTION POINT 5-200'

HEIGHT OF FINAL RADIIATOR CENTERLINE ABOVE GROUND

STATION (A) ELGIN CENTER (#51)

LAT. 30. 17. 10. N

LONG. 82. 42. 15. W

GROUND ELEV. 440 FEET ABOVE MEAN SEA LEVEL

REQUIRED HEIGHT OF FINAL RADIIATOR CENTERLINE FEET ABOVE GROUND

AZIMUTH (A) TO (B) LOW FROM TRUE NORTH

STATION (B) INDEPENDENT HILL

LAT. 30. 32. 35. N

LONG. 82. 42. 25. W

GROUND ELEV. 402 FEET ABOVE MEAN SEA LEVEL

REQUIRED HEIGHT OF FINAL RADIIATOR CENTERLINE FEET ABOVE GROUND

AZIMUTH (B) TO (A) LOW FROM TRUE NORTH

PRESNEL CALCULATIONS MADE FOR GIGAHERTZ

MAGNETIC DECLINATION AND DISTANCES ARE OF TRUE NORTH

PATH ADJUSTING AND DISTANCES ARE INVERSE POSITION OTHER

CERTIFICATION

EARTH PROFILE

(ENGLISH UNITS) (K=INFINITY)

SURVEY BY: CUSTOMER

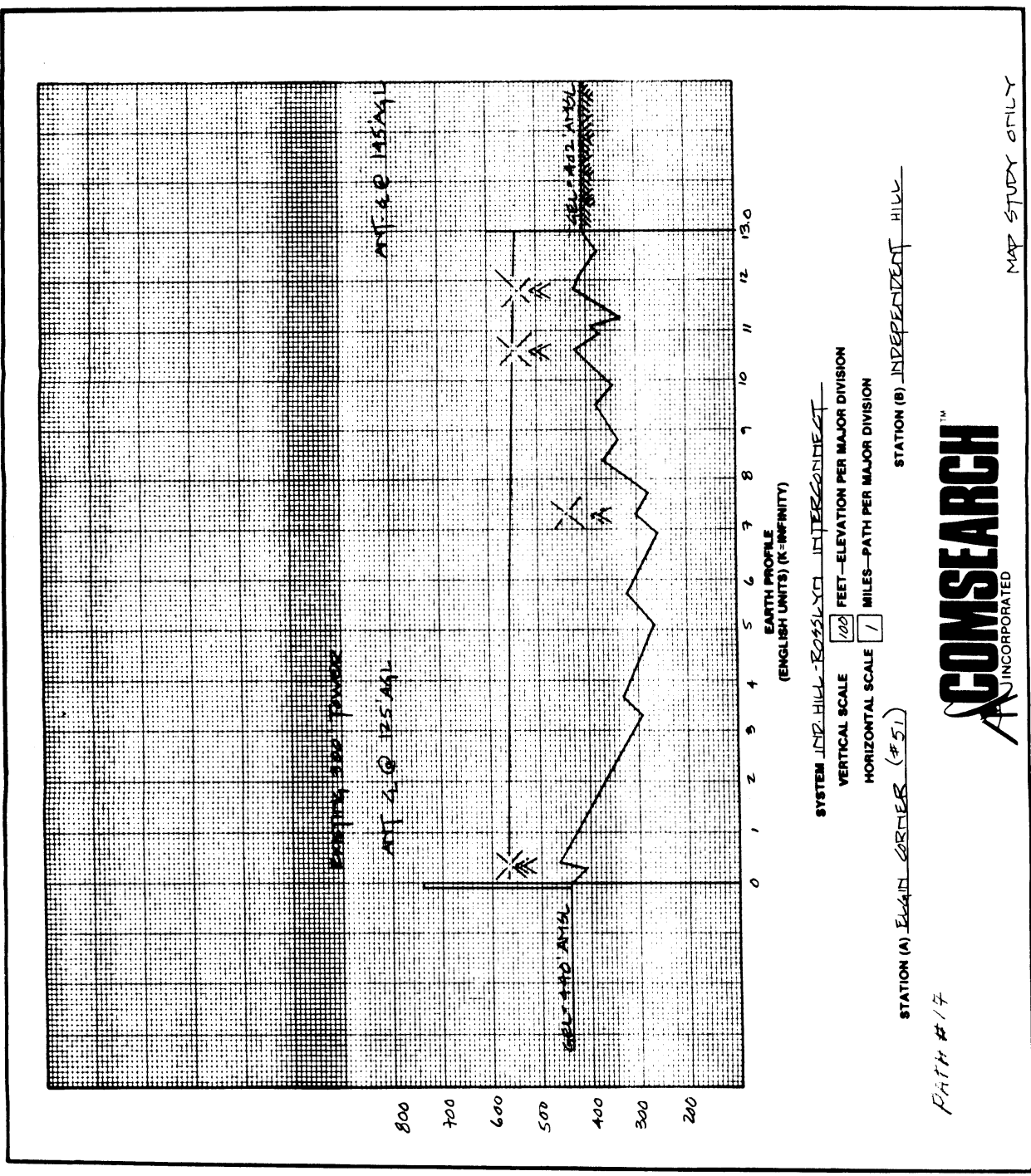
DRAWN BY: PATH FROM (A) TO (B)

DATE: 12/26/85 PATH LENGTH: MILES

OTHER: KM

CLEARANCE CRITERIA BY: CLIENT: SURVEYOR

DESIGN DEPARTMENT: OTHER:



MICROWAVE PATH PROFILE DATA

SITE: ELGIN CORNER (PSI) SITE: INDEPENDENCE HILL
 LAT: 38 ° 47 ' 18 " N LAT: 38 ° 37 ' 35 " N
 LONG: 77 ° 19 ' 45 " W LONG: 77 ° 27 ' 23 " W
 ELEVATION: 440 ' ASL ELEVATION: 402 ' ASL
 AZIMUTH FORWARD: _____ ° AZIMUTH REVERSE: _____ °
 PATH DISTANCE: _____ FREQUENCY: 11 GHz

DIST	ELEV	OBST	K() + F	K() + F	NOTE
0	440	300' TOWER			
0.4	460				
7.3	300				
10.6	420				
11.8	420				
13.0	402				

18

USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE HORIZON RADII PATHS

1. USE THE SYMBOLS SHOWN BELOW
2. USE A CONVENIENT SCALE FOR DISTANCE AND ELEVATIONS
3. REPRESENT THE PATH AS A STRAIGHT LINE
4. CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$a = \left(\frac{0.00067}{k} \right) \cdot d^2$$

WHERE

- a = HEIGHT OF CORRECTION IN FEET
- k = RADII OF EFFECTIVE EARTH RADII
- d = TRUE EARTH RADII

1. DISTANCE FROM STATION 'A' TO POINT UNDER CONSIDERATION IN STATUTE MILES
2. DISTANCE FROM STATION 'B' TO POINT UNDER CONSIDERATION IN STATUTE MILES

5. ADD ANY MAN MADE STRUCTURES AND FORESTRY GROWTH

6. CALCULATE THE DESIRED FREQUENCY ZONE BAND FOR THE POINTS AND FREQUENCIES UNDER CONSIDERATION USING THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE

$$f_1 = \sqrt{\frac{30}{40d}} \quad f_2 = \sqrt{\frac{30}{d}}$$

WHERE

- f₁ IS THE RADII OF THE FIRST FREQUENCY ZONE IN FEET
- f₂ IS THE FREQUENCY UNDER CONSIDERATION IN GIGAHERTZ (10⁹ HZ)
- d IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- D IS THE TOTAL PATH LENGTH IN MILES
- f IS THE FREQUENCY IN MEGAHERTZ
- R IS THE RADII OF THE EARTH IN FEET
- R IS THE RADII OF THE EARTH IN FEET
- R IS THE RADII OF THE EARTH IN FEET
- R IS THE RADII OF THE EARTH IN FEET
- R IS THE RADII OF THE EARTH IN FEET
- R IS THE RADII OF THE EARTH IN FEET

SYMBOLS

PRESEEL ZONE CLEARANCE	0.6 - 20'
EARTH CURVATURE FROM A (in)	0.11 - 26.0'
MAN MADE STRUCTURE	R-45 0'
OBSTRUCTION OFF PATH WITHIN 1000 FEET	TR-100 SOUTH OF PATH
PREDICTED VEGETATION GROWTH	F 6 - 10'
EXISTING HEIGHT OF VEGETATION	1 - 7.5'
GROUND ELEVATION ANGLE R (in)	6 - 100'
POSSIBLE REFLECTION POINT	R
HEIGHT OF FINAL RADIATOR CENTERLINE ABOVE GROUND	ξ 200'

STATION (A) ROSSLYN

LAT 39° 53' LONG 77° 04'

GROUND ELEV 120 FEET ABOVE MEAN SEA LEVEL

REQUIRED HEIGHT OF FINAL RADIATOR CENTERLINE 120 FEET ABOVE MEAN SEA LEVEL

AZIMUTH (A TO B) 120 CW FROM TRUE NORTH

STATION (B) SILVER HILL (# 62)

LAT 38° 50' LONG 76° 53'

GROUND ELEV 50 FEET ABOVE MEAN SEA LEVEL

REQUIRED HEIGHT OF FINAL RADIATOR CENTERLINE 50 FEET ABOVE MEAN SEA LEVEL

AZIMUTH (B TO A) 300 CW FROM TRUE NORTH

MAGNETIC CALCULATIONS MADE FOR 12/20/88 GMAERTZ

SCALE: 1" = 1 MILE INVERSE POSITION: OTHER

CERTIFICATION

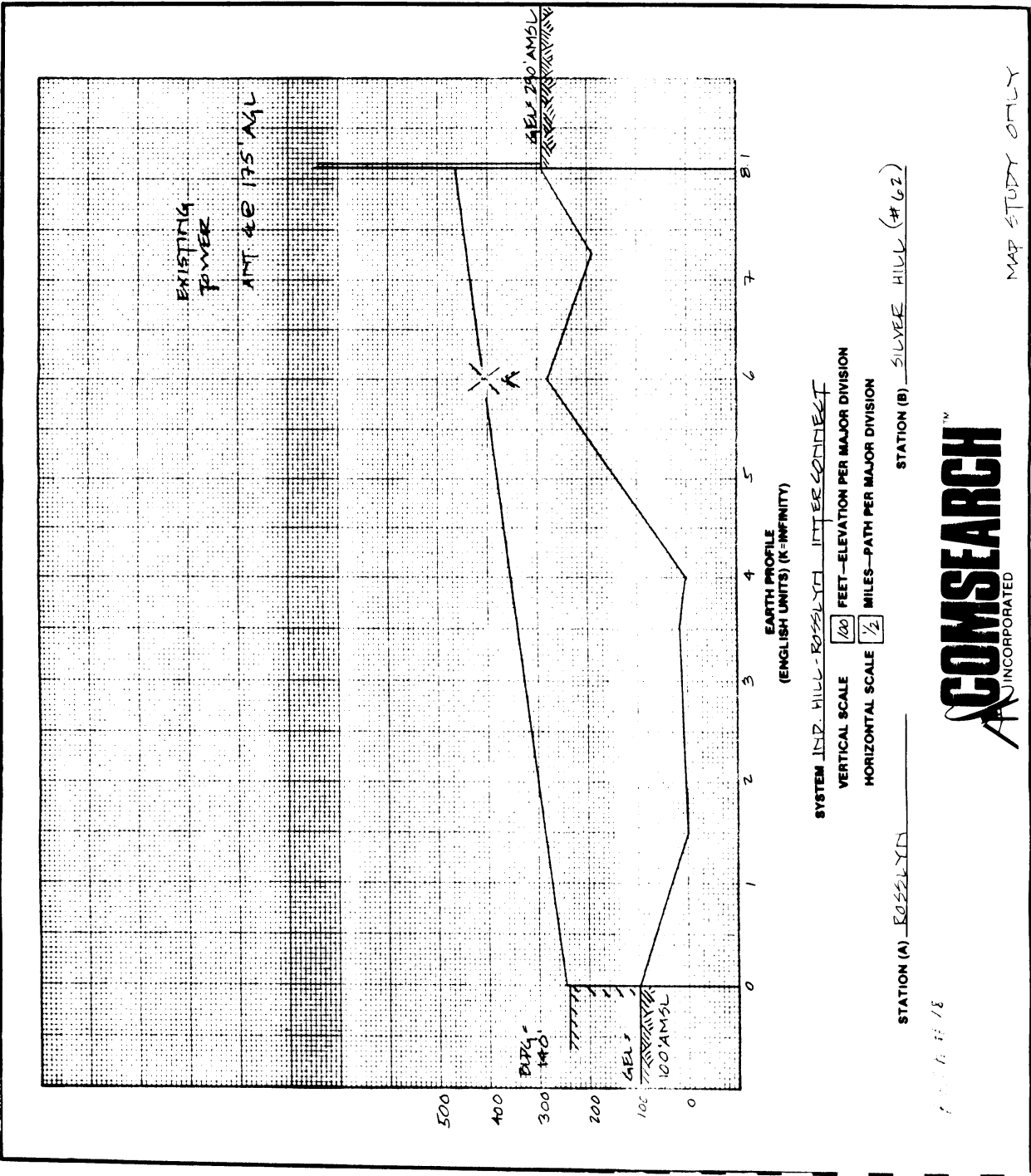
EARTH PROFILE (ENGLISH UNITS) (K=INFINITY)

CLIENT SURVEYOR

DESIGN DEPARTMENT

OTHER

DATE 12/20/88



MICROWAVE PATH PROFILE DATA

SITE: <u>ROSE HILL</u>	SITE: <u>SILVER HILL / #62</u>
LAT: <u>38 ° 53 ' 41 " N</u>	LAT: <u>38 ° 50 ' 53 " °</u>
LONG: <u>77 ° 04 ' 19 " W</u>	LONG: <u>76 ° 59 ' 10 " °</u>
ELEVATION: <u>100 ' ASHL</u>	ELEVATION: <u>290 ' ASHL</u>
AZIMUTH FORWARD: <u> ° ' "</u>	AZIMUTH REVERSE: <u> ° ' "</u>
PATH DISTANCE: <u> </u>	FREQUENCY: <u>11 GHz</u>

DIST	ELEV	OBST	K () + LF	K () + F	NOTE
0	100	B=140			
1.5	0				
3.5	15				
4	0				
6.0	280		8.4 + 16.2		
8.1	290	Tower			

USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE HORIZON RADIO PATHS

- USE THE SYMBOLS SHOWN BELOW
- USE A CONVENIENT SCALE FOR DISTANCE AND ELEVATIONS
- REPRESENT THE PATH AS A STRAIGHT LINE
- CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$h = \left(\frac{d^2}{2k} \right) + h_1 + h_2$$

WHERE

- h = HEIGHT OF CONNECTION IN FEET
- k = RATIO OF EFFECTIVE EARTH RADIUS TO TRUE EARTH RADIUS
- d₁ = DISTANCE FROM STATION "A" TO POINT UNDER CONSIDERATION IN STATUTE MILES
- d₂ = DISTANCE FROM STATION "B" TO POINT UNDER CONSIDERATION IN STATUTE MILES

- ADD ANY MAN MADE STRUCTURES AND PERSONAL GROWTH
- CALCULATE THE BESSER FRESEHL ZONE INDEX FOR THE POINTS AND FREQUENCIES UNDER CONSIDERATION USING THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE

$$f_1 = \sqrt{\frac{7.5}{f_1}} \sqrt{\frac{30-d_1}{1}}$$

$$f_2 = \sqrt{\frac{7.5}{f_2}} \sqrt{\frac{30-d_2}{1}}$$

WHERE

- f₁ IS THE FREQUENCY OF THE FIRST FRESEHL ZONE IN FEET
- f₂ IS THE FREQUENCY UNDER CONSIDERATION IN GIGAHERTZ (GP/Hz)
- d IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- D IS THE TOTAL PATH LENGTH IN MILES
- F IS THE RADIUS OF THE FIRST FRESEHL ZONE IN FEET
- n IS THE ORDER OF THE FRESEHL ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

FRESHET ZONE CLEARANCE

EARTH CURVATURE FROM K (M)

MAN MADE STRUCTURE

OBSTRUCTION OFF PATH WITHIN 1000 FEET

PREDICTED VEGETATION GROWTH

EXISTING HEIGHT OF VEGETATION

GROUND ELEVATION AMSL, K (M)

POSSIBLE REFLECTION POINT

HEIGHT OF FINAL RADATOR CENTERLINE ABOVE GROUND

EXAMPLES

OB = 200

K(1) = 300

BLMS = 0

TOWER 200' SOUTH OF PATH

F = 6 - 30

T = 75

G = 100

R

§ 200'

STATION (A) SILVER HILL (#62)

LAT 38 50 53 N

LONG 76 29 10 W

GROUND ELEV 290 FEET ABOVE MEAN SEA LEVEL

REQUIRED HEIGHT OF FINAL RADATOR CENTERLINE FEET ABOVE GROUND

AZIMUTH (A) TO (B) 10

STATION (B) BETHEL (#47)

LAT 38 39 22 N

LONG 77 24 14 W

GROUND ELEV 240 FEET ABOVE MEAN SEA LEVEL

REQUIRED HEIGHT OF FINAL RADATOR CENTERLINE FEET ABOVE GROUND

AZIMUTH (A) TO (B) 14

FRESHET ZONE CALCULATIONS MADE FOR 6 GIGAHERTZ CW FROM TRUE NORTH

MAGNETIC DECLINATION

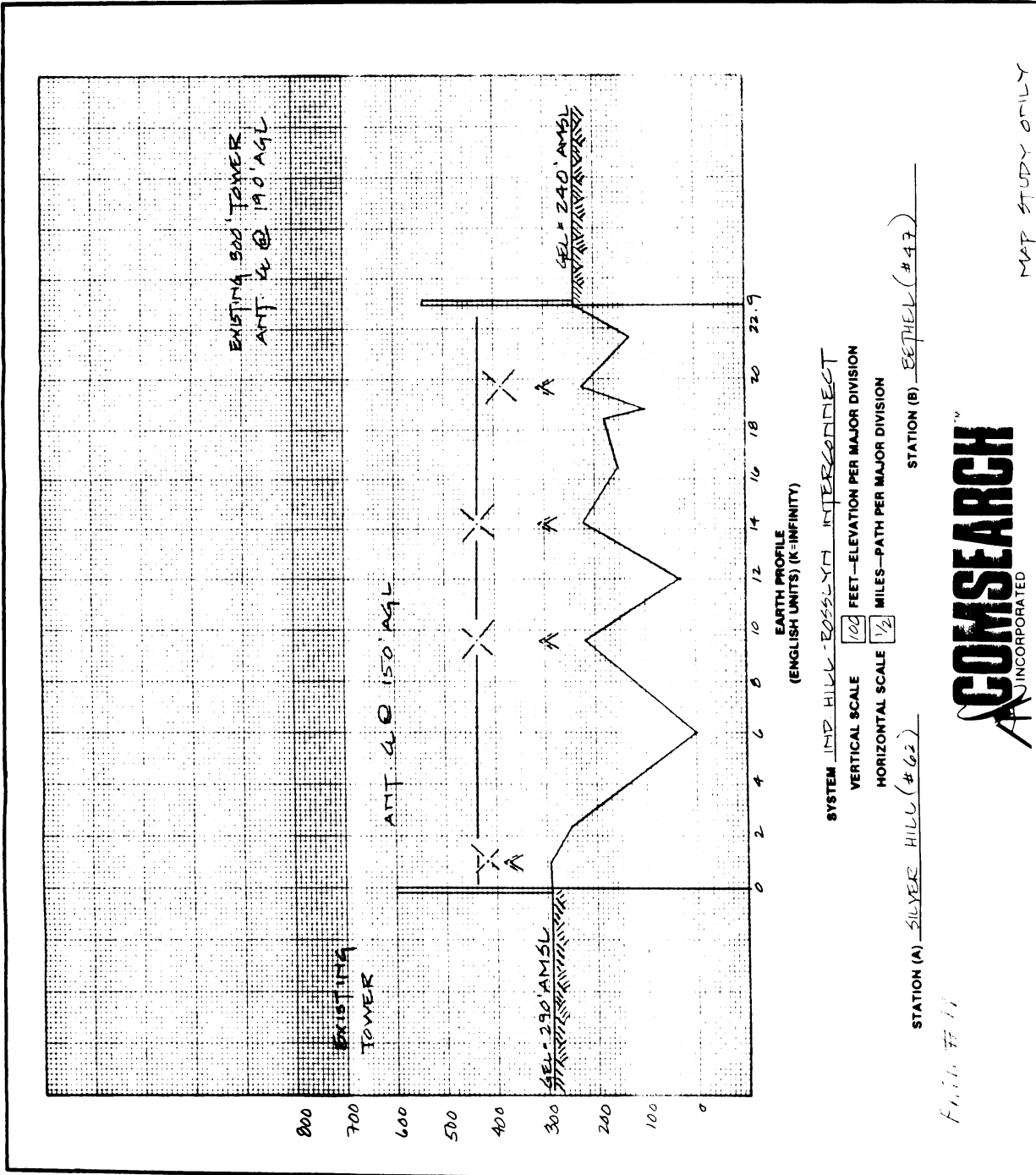
PATH AZIMUTHS AND DISTANCES ARE SCALED INVERSE POSITION OTHER

CERTIFICATION

EARTH PROFILE CLEARANCE CRITERIA BY (ENGLISH UNITS) (K=INFINITY)

SURVEY BY CUSTOMER CLIENT SURVEYOR

DRAWN BY DATE 12/26/83 PATH FROM A TO B PATH LENGTH MILES DESIGN DEPARTMENT OTHER



INCREMENTAL PATH PROFILE DATA

SITE: SILVER HILL (#62) SITE: BETHEL (#47)
 LAT: 38 ° 50' 53 " LAT: 38 ° 39' 22 "
 LONG: 76 ° 59' 10 " LONG: 77 ° 17' 14 "
 ELEVATION: 290 'ASL ELEVATION: 240 'ASL
 AZIMUTH FORWARD: _____ AZIMUTH REVERSE: _____
 PATH DISTANCE: _____ FREQUENCY: 6 GHz

DIST	ELEV	OBST	K(1) ± ΔF	K(2) ± F	NOTE
0	290	TOWER			
1.2	295		17.9 + 18.8		
2.3	250				
6	0				
9.6	220		85.1 + 41.6		
12	30				
14.2	220		82.4 + 40.9		
16.5	155				
18.4	180		55.2 + 33.5		
19.7	225		42.0 + 29.2		
22.9	290	TWR = 300'			

- USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE HORIZON/RADIO PATHS
1. USE THE SYMBOLS SHOWN BELOW
 2. USE A CONVENIENT SCALE FOR DISTANCE AND ELEVATIONS
 3. REPRESENT THE PATH AS A STRAIGHT LINE
 4. CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$h_c = \frac{(0.000146) \cdot D^2}{2}$$

- WHERE
- h_c = HEIGHT OF CORRECTION IN FEET
 - D = DISTANCE FROM STATION 'A' TO POINT UNDER CONSIDERATION IN STATUTE MILES
 - R = TRUE EARTH RADIUS
 - R₁ = DISTANCE FROM STATION 'A' TO POINT UNDER CONSIDERATION IN STATUTE MILES
 - R₂ = DISTANCE FROM STATION 'B' TO POINT UNDER CONSIDERATION IN STATUTE MILES

5. ADD ANY MAN MADE STRUCTURES AND FORESTRY GROWTH
6. CALCULATE THE RESULTING FREQUENCY ZONE DATA FOR THE PATHS AND FREQUENCIES UNDER CONSIDERATION USING THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE

$$F_1 = \sqrt{\frac{3000}{D_1}} \quad F_2 = \sqrt{\frac{3000}{D_2}}$$

- WHERE
- F₁ IS THE FREQUENCY UNDER CONSIDERATION IN GIGAHERTZ (GP/4Z)
 - D IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
 - D IS THE TOTAL PATH LENGTH IN MILES
 - F₂ IS THE FREQUENCY UNDER CONSIDERATION IN GIGAHERTZ (GP/4Z)
 - D IS THE DISTANCE IN MILES FROM THE OTHER END OF THE PATH TO THE POINT UNDER CONSIDERATION
 - n IS THE ORDER OF THE FREQUENCY ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

FRESNEL ZONE CLEARANCE: 0' F - 20' D
 EARTH CURVATURE FROM K (∞): K=1000
 MAN MADE STRUCTURE: B=45' D
 TOWER 200' SOUTH OF PATH
 PREDICTED VEGETATION GROWTH: F G-10
 EXISTING HEIGHT OF VEGETATION: F 1-75
 GROUND ELEVATION AMS. K (∞): G = 100
 POSSIBLE REFLECTION POINT: R
 HEIGHT OF FINAL RADATOR CENTERLINE ABOVE GROUND: 20'

EXAMPLES

0' F - 20' D
 K=1000
 B=45' D
 TOWER 200' SOUTH OF PATH
 F G-10
 F 1-75
 G = 100
 R
 20'

STATION (A) BETHEL (#47)

LAT: 39
 LONG: 37
 GROUND ELEV: 240
 REQUIRED HEIGHT OF F.M.A. RADATOR CENTERLINE: 22
 AZIMUTH (A TO B): 14
 FEET ABOVE MEAN SEA LEVEL

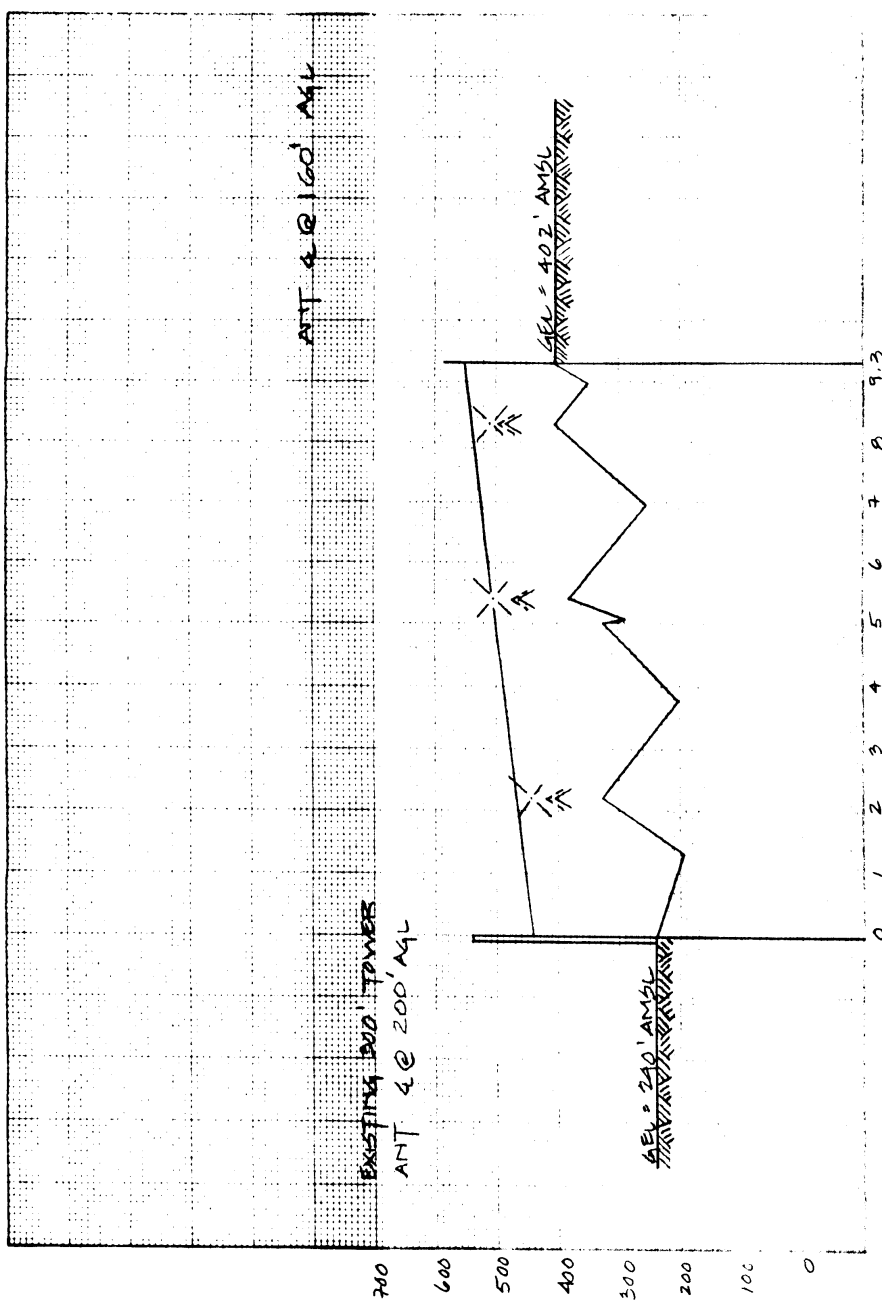
STATION (B) INDEPENDENT HILL

LAT: 38
 LONG: 37
 GROUND ELEV: 402
 REQUIRED HEIGHT OF F.M.A. RADATOR CENTERLINE: 23
 AZIMUTH (B TO A): 23
 FEET ABOVE MEAN SEA LEVEL

FRESNEL CALCULATIONS MADE FOR: 11 GIGAHERTZ
 MAGNETIC DECLINATION: _____ OF TRUE NORTH
 PATH FROM THE ANTENNAS ARE: _____ OF TRUE NORTH
 SCALE: _____ INVERSE POSITION: _____ OTHER: _____

CERTIFICATION

EARTH PROFILE (ENGLISH UNITS) (K=INFINITY)
 CLIENT: SURVEYOR
 SYSTEM: _____ DESIGN DEPARTMENT: _____
 PATH FROM 'A' TO 'B': _____ MILES
 PATH LENGTH: _____ MILES
 DATE: 2/17/62



SYSTEM IND HILL ROSSLIN INTERCONNECT

VERTICAL SCALE 100 FEET—ELEVATION PER MAJOR DIVISION

HORIZONTAL SCALE 1 MILES—PATH PER MAJOR DIVISION

STATION (A) BETHEL (#47) STATION (B) INDEPENDENT HILL



MAP STUDY ONLY

MICROWAVE PATH PROFILE DATA

SITE: <u>BETHEL (#47)</u>	SITE: <u>INDEPENDENT HILL</u>
LAT: <u>38 ° 39 ' 22 .</u>	LAT: <u>38 ° 37 ' 35 . N</u>
LONG: <u>77 ° 17 ' 19 .</u>	LONG: <u>77 ° 21 ' 23 . W</u>
ELEVATION: <u>240 'ASL</u>	ELEVATION: <u>402 'ASL</u>
AZIMUTH FORWARD: <u> ° .</u>	AZIMUTH REVERSE: <u> ° .</u>
PATH DISTANCE: <u> </u>	FREQUENCY: <u>11</u>

DIST	ELEV	OBST	K(1) + G	K() + F	NOTE
0	240	TWR = 320'			
2.2	325		10.4 + 16.8		
5.0	325				
5.9	380		14.0 + 19.6		
8.3	402		5.5 + 12.3		
9.3	402				

USE OF FLAT EARTH PROFILE FOR WITHIN-THE-HORIZON AND BEYOND-THE-HORIZON RADIO PATHS

1. USE THE SYMBOLS SHOWN BELOW
2. USE A CONVENIENT SCALE FOR DISTANCE AND ELEVATIONS
3. REPRESENT THE PATH AS A STRAIGHT LINE
4. CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$b = \left(\frac{800}{K} \right) \cdot f_1 \cdot f_2$$

WHERE

- b = HEIGHT OF CORRECTION IN FEET
- K = RATIO OF EFFECTIVE EARTH RADIIUS
- f₁ = TRUE EARTH RADIIUS
- f₂ = DISTANCE FROM STATION 'A' TO POINT UNDER CONSIDERATION IN STATUTE MILES
- f₃ = DISTANCE FROM STATION 'B' TO POINT UNDER CONSIDERATION IN STATUTE MILES

5. ADD ANY HAZI MASS STRUCTURES AND FORESTRY GROWTH
6. CALCULATE THE FREQUENCY UNDER CONSIDERATION IN GIGAHERTZ (GPHZ) UNDER CONSIDERATION UNDER THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE

$$f_1 = \frac{7.7}{\sqrt{K}} \left[\frac{1000}{K} \right] \cdot \sqrt{f_1 \cdot f_2}$$

WHERE

- f₁ IS THE RADIUS OF THE FIRST FRESNEL ZONE IN FEET
- f₂ IS THE FREQUENCY UNDER CONSIDERATION IN GIGAHERTZ (GPHZ)
- f₃ IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- D IS THE TOTAL PATH LENGTH IN MILES
- f₄ IS THE RADIUS OF THE 1ST FRESNEL ZONE IN FEET
- n IS THE ORDER OF THE FRESNEL ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

- FRESNEL ZONE CLEARANCE
- EARTH CURVATURE FROM K (∞)
- HAZI MASS STRUCTURE
- OBSTRUCTION OFF PATH WITHIN 1000 FEET
- PREDICTED VEGETATION GROWTH
- EXISTING HEIGHT OF VEGETATION
- GROUND ELEVATION AMSL K (∞)
- POSSIBLE REFLECTION POINT
- HEIGHT OF FINAL RADIIATOR CENTERLINE ABOVE GROUND



EXAMPLES

6.0' - 20'	GROUND ELEVATION
4.1' - 34.8'	HEIGHT OF FINAL RADIIATOR CENTERLINE
8 - 6.0'	HEIGHT OF VEGETATION
TOWER 200' SOUTH OF PATH	OBSTRUCTION OFF PATH WITHIN 1000 FEET
6.6 - 10'	PREDICTED VEGETATION GROWTH
1 - 7.5'	EXISTING HEIGHT OF VEGETATION
6 - 800'	GROUND ELEVATION AMSL K (∞)
0	POSSIBLE REFLECTION POINT
5 - 200'	HEIGHT OF FINAL RADIIATOR CENTERLINE ABOVE GROUND

STATION (A) SILVER HILL (# 62)

LAT 30.50.53.11
LONG 88.59.10.11
GROUND ELEV 210 FEET ABOVE MEAN SEA LEVEL
REQUIRED HEIGHT OF FINAL RADIIATOR CENTERLINE 348 FEET ABOVE MEAN SEA LEVEL
AZIMUTH (A) TO (B) 210 CW FROM TRUE NORTH

STATION (B) LOEFAX (# 61)

LAT 30.43.15.11
LONG 87.21.45.11
GROUND ELEV 215 FEET ABOVE MEAN SEA LEVEL
REQUIRED HEIGHT OF FINAL RADIIATOR CENTERLINE 345 FEET ABOVE MEAN SEA LEVEL
AZIMUTH (B) TO (A) 215 CW FROM TRUE NORTH
FRESNEL CALCULATIONS MADE FOR 6 GIGAHERTZ
MAGNETIC DECLINATION 6 OF TRUE NORTH
PATH AZIMUTHS AND DISTANCES ARE SCALED INVERSE POSITION OTHER

CERTIFICATION

SURVEY BY: _____

DRAWN BY: _____

DATE 12/26/85

EARTH PROFILE
(ENGLISH UNITS) (K=INFINITY)

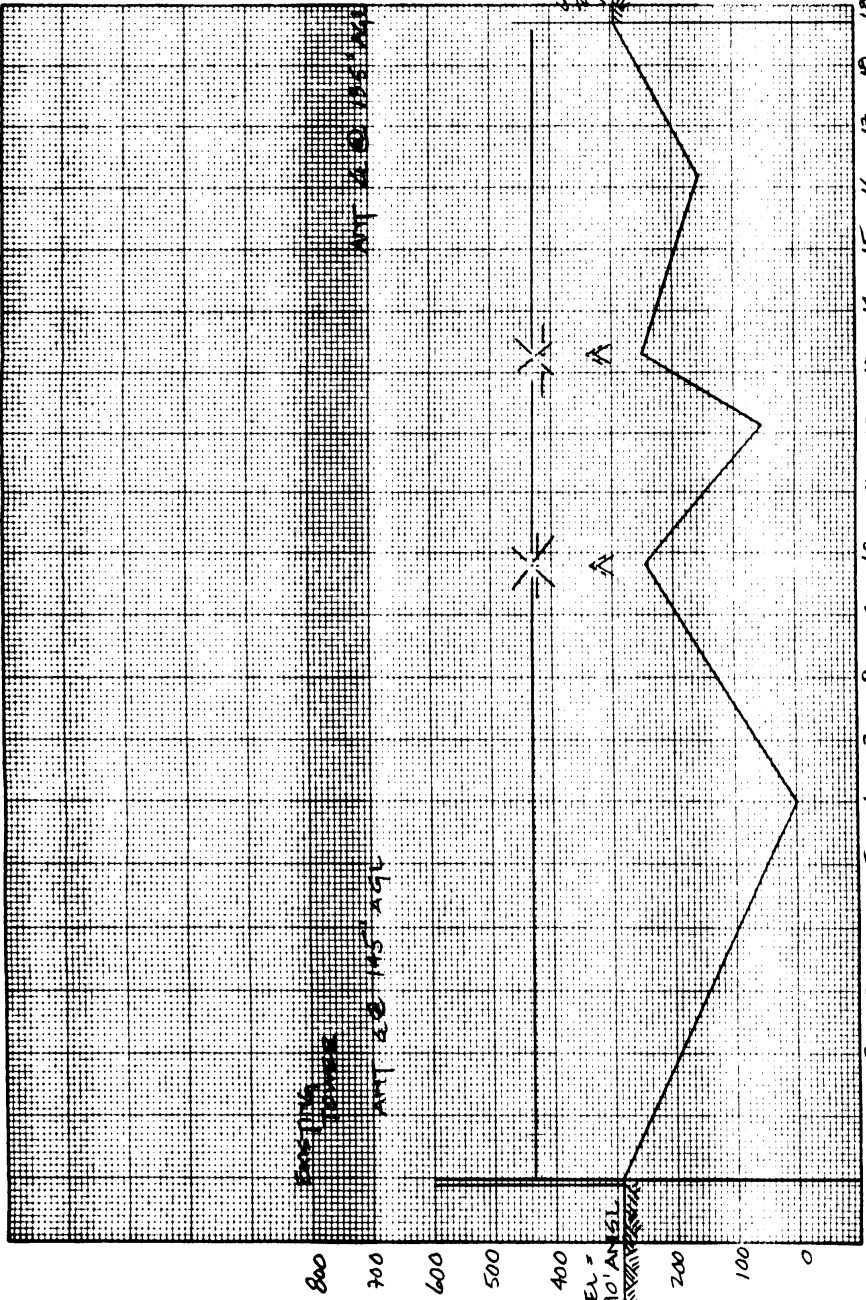
CLIENT: SURVEYOR: _____

DESIGN DEPARTMENT: _____

OTHER: _____

SCALE: _____

PATH LENGTH: _____ MILES _____ KM



SYSTEM INR HILL-ROSSLYN INTERCONNECT

VERTICAL SCALE 100 FEET-ELEVATION PER MAJOR DIVISION

HORIZONTAL SCALE 1 MILES-PATH PER MAJOR DIVISION

STATION (A) SILVER HILL (# 62) STATION (B) LOEFAX (# 61)



MAP STUDY ONLY

RECUMBENT PATH PROFILE DATA

SITE: SILVER HILL (#62)
 LAT: 38 ° 50' 53 "
 LONG: 76 ° 59' 10 "
 ELEVATION: 290' ASL
 AZIMUTH FORWARD: ° ' "
 PATH DISTANCE:

SITE: LORFAX (#61)
 LAT: 38 ° 42' 15 "
 LONG: 77 ° 14' 45 "
 ELEVATION: 295' ASL
 AZIMUTH REVERSE: ° ' "
 FREQUENCY: 6 GHz

DIST	ELEV	OBST	K(L) + G	K(R) + F	NOTE
0	290	TWR*			
6					
9.8	245		58.1 + 38.0		
13.3	250		47.7 + 34.5		
18.7	295				

USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE HORIZON RADIO PATHS

1. USE THE SYMBOLS SHOWN BELOW
2. USE A CONVERSION SCALE FOR DISTANCE AND ELEVATIONS
3. REPRESENT THE PATH AS A STRAIGHT LINE
4. CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$h = \left(\frac{0.87}{k} \right) f_1^2 + f_2^2$$

WHERE

- h = HEIGHT OF CORRECTION IN FEET
- k = RATIO OF EFFECTIVE EARTH RADIUS TO TRUE EARTH RADIUS
- f₁ = DISTANCE FROM STATION "A" TO POINT UNDER CONSIDERATION IN STATUTE MILES
- f₂ = DISTANCE FROM STATION "B" TO POINT UNDER CONSIDERATION IN STATUTE MILES

5. AND ANY MAN MADE STRUCTURES AND FORESTRY GROWTH
6. CALCULATE THE EFFECTIVE EARTH CURVATURE FROM THE POINTS AND PENETRATION UNDER CONSIDERATION USING THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE

$$f_1 \sqrt{\frac{0.87}{k}} + f_2 \sqrt{\frac{0.87}{k}}$$

WHERE

- f₁ IS THE RADIUS OF THE FIRST FRESNEL ZONE IN FEET
- f₂ IS THE RADIUS OF THE SECOND FRESNEL ZONE IN FEET
- h₁ IS THE FREQUENCY UNDER CONSIDERATION IN GIGAHERTZ (MHz)
- f IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- D IS THE TOTAL PATH LENGTH IN MILES
- F₁ IS THE RADIUS OF THE 1ST FRESNEL ZONE IN FEET
- F₂ IS THE RADIUS OF THE 2ND FRESNEL ZONE IN FEET
- n IS THE ORDER OF THE FRESNEL ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

	FRESNEL ZONE CLEARANCE
	EARTH CURVATURE FROM K (m)
	MAN MADE STRUCTURE
	OBSTRUCTION OFF PATH WITHIN 1000 FEET
	PREDICTED VEGETATION GROWTH
	EXISTING HEIGHT OF VEGETATION
	GROUND ELEVATION IN FEET
	POSSIBLE REFLECTION POINT
	HEIGHT OF FINAL RADIATOR CENTERLINE ABOVE GROUND

EXAMPLES
 0.87 / 20.7
 0.11 / 20.7
 0-45.7
 TOWER 200' SOUTH OF PATH
 F 6-10'
 1-75'
 0-100'
 A
 200'

STATION (A) OAK TREE EAST (#20)
 LAT 38.48.12 N
 LONG 76.25.54 W
 GROUND ELEV 30
 REQUIRED HEIGHT OF FINAL RADIATOR CENTERLINE FEET ABOVE MEAN SEA LEVEL 45
 AZIMUTH (A TO B) 100
 STATION (B) LOFTON (#45)
 LAT 38.42.47 N
 LONG 76.23.0 W
 GROUND ELEV 330
 REQUIRED HEIGHT OF FINAL RADIATOR CENTERLINE FEET ABOVE MEAN SEA LEVEL 45
 AZIMUTH (B TO A) 100
 FRESH CALCULATIONS MADE FOR 11 GIGAHERTZ
 MAGNETIC DECLINATION 11 OF TRUE NORTH
 PATH AZIMUTHS AND DISTANCES ARE SCALED INVERSE POSITION OTHER

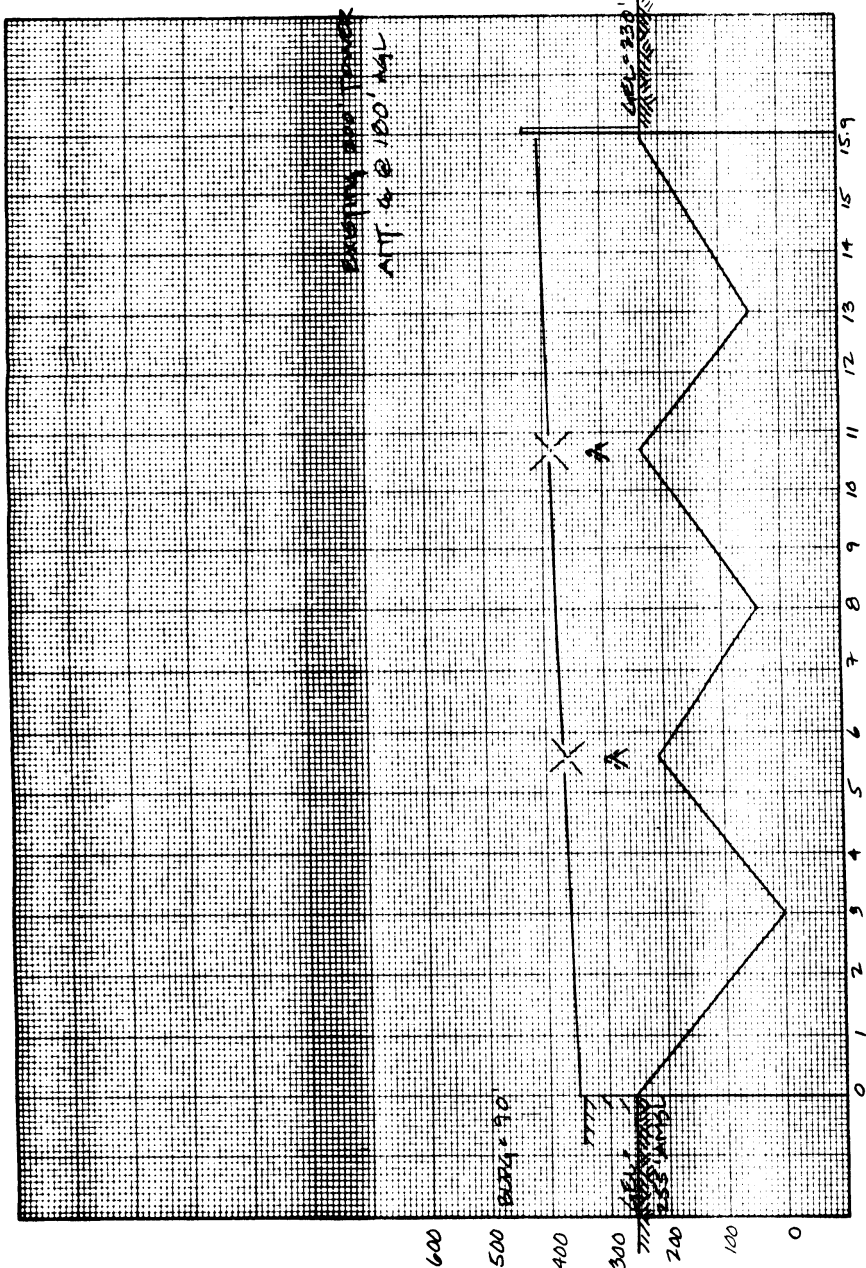
CERTIFICATION

DATE 12/26/85

DRAWN BY

DESIGN DEPARTMENT

OTHER



SYSTEM 100 HILL - 2030 FT INTERCONNECT
 VERTICAL SCALE 100 FEET - ELEVATION PER MAJOR DIVISION
 HORIZONTAL SCALE 1 MILE - PATH PER MAJOR DIVISION
 STATION (A) OAK TREE EAST (#20)
 STATION (B) LOFTON (#45)
 PATH # 23



MAP STUDY ONLY

ALTERNATE PATH PROFILE DATA

SITE: OAK TREE EAST (#20) SITE: LORTON (#45)
 LAT: 48° 48' 12" N LAT: 38° 42' 01"
 LONG: 76° 58' 54" W LONG: 77° 19' 47"
 ELEVATION: 255' ASL ELEVATION: 230' ASL
 AZIMUTH FORWARD: _____ AZIMUTH REVERSE: _____
 PATH DISTANCE: _____ FREQUENCY: 11 GHz

DIST	ELEV	OBST	K(1) + G	K() + F	NOTE
0	255	B=90'			
3	0				
5.6	210		38.5 + 24.8		
8	40				
10.7	235		37.1 + 24.3		
13	50				
15.7	230	TWR=200'			

USE OF FLAT EARTH PROFILE FOR WITHIN-THE-HORIZON AND BEYOND-THE-HORIZON RADIO PATHS

1. USE THE SYMBOLS SHOWN BELOW
 2. USE A CONVENIENT SCALE FOR DISTANCE AND ELEVATIONS
 3. REPRESENT THE PATH AS A STRAIGHT LINE
 4. CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$h = \left(\frac{0.87}{k} \right) \cdot d^2$$

WHERE
 h = HEIGHT OF CORRECTION IN FEET
 k = RATIO OF EFFECTIVE EARTH RADIUS TO TRUE EARTH RADIUS
 d₁ = DISTANCE FROM STATION 'A' TO POINT UNDER CONSIDERATION IN STATUTE MILES
 d₂ = DISTANCE FROM STATION 'B' TO POINT UNDER CONSIDERATION IN STATUTE MILES

5. ADD ANY MAN MADE STRUCTURES AND FORESTRAL GROWTH
 6. CALCULATE THE BULGE FRESEHEL ZONE FROM THE POINTS AND PRELIMINARY UNDER CONSIDERATION USING THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE

$$f_1 = \sqrt{\frac{2R}{k}} \quad f_2 = \sqrt{2 \cdot f_1}$$

WHERE
 f₁ IS THE RADIUS OF THE FIRST FRESEHEL ZONE IN FEET
 f₂ IS THE FREQUENCY UNDER CONSIDERATION IN GIGAHERTZ (HP NO.)
 R IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
 D IS THE TOTAL PATH LENGTH IN MILES
 F₁ IS THE RADIUS OF THE 1ST FRESEHEL ZONE IN FEET
 F₂ IS THE CIRCUMFERENCE OF THE FRESEHEL ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

EXAMPLES

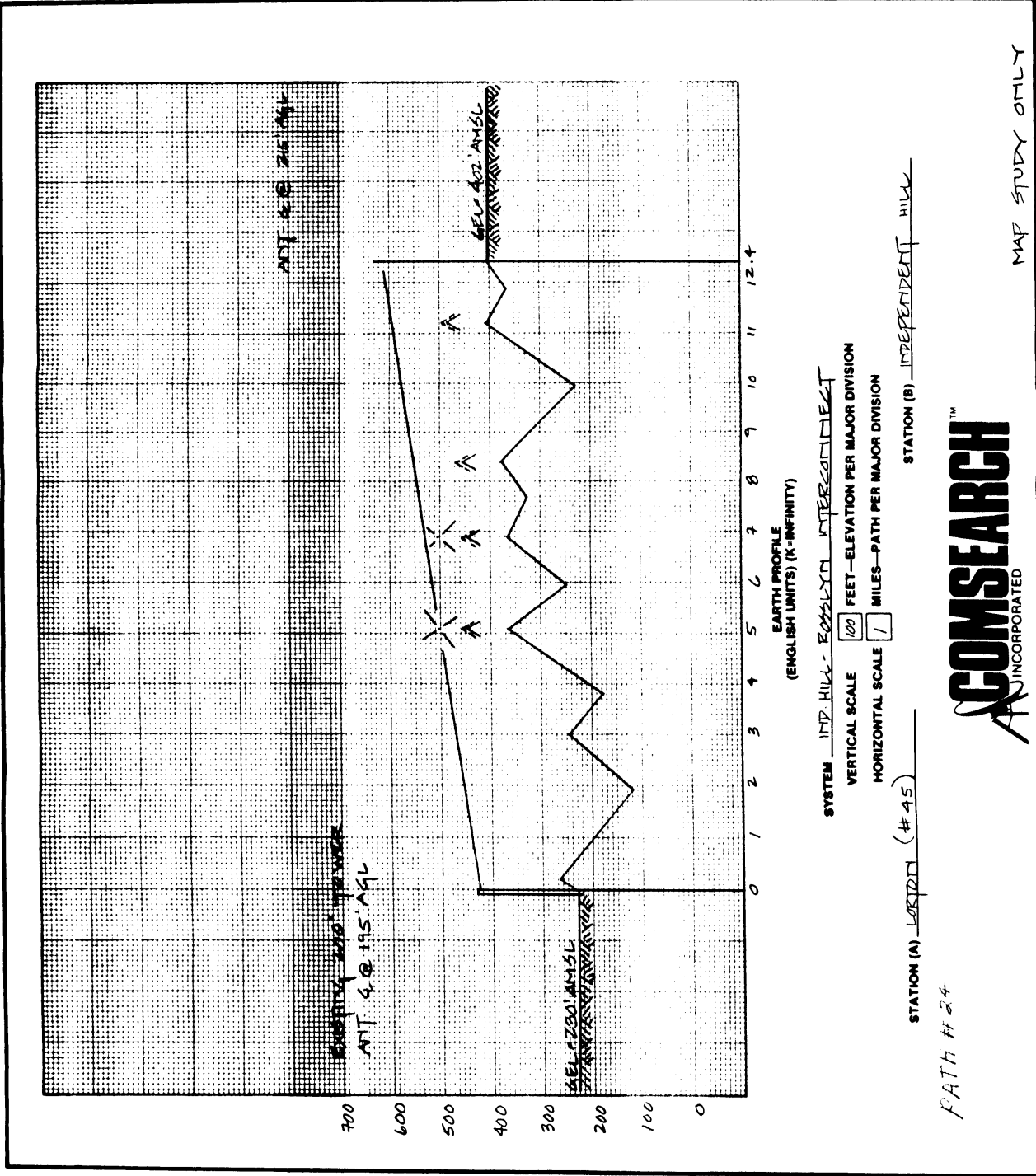
FRESHET ZONE CLEARANCE
 0.6" - 20.0'
 EARTH CURVATURE FROM K (∞)
 K=1-35.0'
 MAN MADE STRUCTURE
 TOWER 200' SOUTH
 OF PATH
 PREDICTED VEGETATION GROWTH
 1 - 75'
 EXISTING HEIGHT OF VEGETATION
 6 - 100'
 POSSIBLE REFLECTION POINT
 R
 HEIGHT OF FINAL RADATOR CENTER LINE
 5' 200'
 ABOVE GROUND

STATION (A) LORETON (#45)
 LAT 38 LONG 92
 GROUND ELEV 230 FEET ABOVE MEAN SEA LEVEL
 REQUIRED HEIGHT OF FINAL RADATOR CENTER LINE _____ FEET ABOVE GROUND
 AZIMUTH (A) TO (B) _____ CW FROM TRUE NORTH

STATION (B) INDEPENDENT HILL
 LAT 39 LONG 27
 GROUND ELEV 402 FEET ABOVE MEAN SEA LEVEL
 REQUIRED HEIGHT OF FINAL RADATOR CENTER LINE _____ FEET ABOVE GROUND
 AZIMUTH (B) TO (A) _____ CW FROM TRUE NORTH
 FRESEHEL CALCULATIONS MADE FOR 11 GIGAHERTZ OF TRUE NORTH
 PATH AZIMUTHS AND DISTANCES ARE _____ INVERSE POSITION OTHER _____

CERTIFICATION
 SURVEY BY: _____
 DRAWN BY: _____
 DATE: 12/26/05

EARTH PROFILE
 (ENGLISH UNITS) (K=INFINITY)
 CUSTOMER: _____
 SYSTEM: _____
 PATH FROM (A) TO (B): _____ MILES
 PATH LENGTH: _____ MILES
 DESIGN DEPARTMENT: _____
 OTHER: _____



USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE HORIZON RADIO PATHS

- USE THE SYMBOLS SHOWN BELOW
- USE A CONVERSION SCALE FOR DISTANCE AND ELEVATIONS
- REPRESENT THE PATH AS A STRAIGHT LINE
- CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$h = \left(\frac{R \theta^2}{2} \right) + h_1 + h_2$$

WHERE

- h = HEIGHT OF CORRECTION IN FEET
- R = RADIUS OF EFFECTIVE EARTH RADIUS
- θ = ANGLE OF EFFECTIVE EARTH RADIUS
- h₁ = DISTANCE FROM STATION 'A' TO POINT UNDER CONSIDERATION IN STATUTE MILES
- h₂ = DISTANCE FROM STATION 'B' TO POINT UNDER CONSIDERATION IN STATUTE MILES

- AND ANY MAN MADE STRUCTURES AND FORESTRAL OBSTACLES
- CALCULATE THE FREQUENCY UNDER CONSIDERATION IN GIGAHERTZ (GHz) AND HERTZ (Hz) IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- IS THE TOTAL PATH LENGTH IN MILES
- IS THE RADIUS OF THE 1ST FRESNEL ZONE IN FEET
- IS THE ORDER OF THE FRESNEL ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

$$r = \sqrt{\frac{2 \times 10^8}{f}} \quad f = \sqrt{r^2 + h^2}$$

WHERE

- r = IS THE RADIUS OF THE FIRST FRESNEL ZONE IN FEET
- f = IS THE FREQUENCY UNDER CONSIDERATION IN GIGAHERTZ (GHz)
- h = IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- D = IS THE TOTAL PATH LENGTH IN MILES
- F_n = IS THE RADIUS OF THE NTH FRESNEL ZONE IN FEET
- n = IS THE ORDER OF THE FRESNEL ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

FRESNEL ZONE CLEARANCE
 EARTH CURVATURE FROM K (∞)
 MAN MADE STRUCTURE
 OBSTRUCTION OFF PATH WITHIN 1000 FEET
 PREDICTED VEGETATION GROWTH
 EXISTING HEIGHT OF VEGETATION
 GROUND ELEVATION AMSL, K (∞)
 POSSIBLE REFLECTOR POINT
 HEIGHT OF FINAL RADAR CENTERLINE ABOVE GROUND

EXAMPLES

0.6" = 30.0'
 1(1) = 30.0'
 0 = 0.0'
 TOWER 200' SOUTH OF PATH
 F.G. = 10'
 1 = 75'
 0 = 0.00'
 R = 1000'
 f = 200'

STATION (A) OAK TREE EAST (#20)

GROUND ELEV. 30
 LAT. 38
 LONG. 46
 REQUIRED HEIGHT OF FINAL RADAR CENTERLINE 255
 AZIMUTH (A) TO (B) 48
 FEET ABOVE MEAN SEA LEVEL
 CW FROM TRUE NORTH

STATION (B) GUNSTON HEIGHTS (#46)

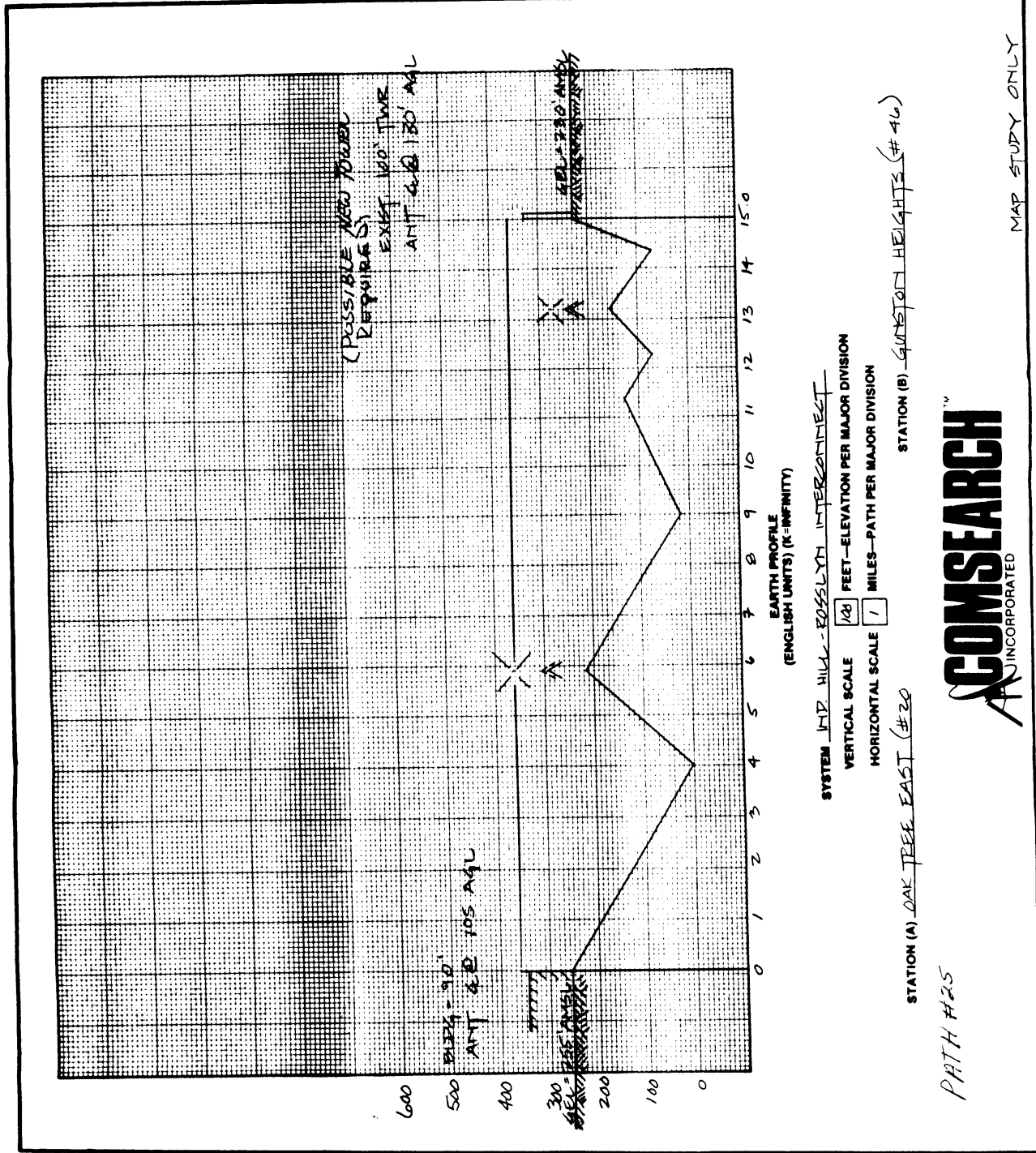
GROUND ELEV. 33
 LAT. 38
 LONG. 13
 REQUIRED HEIGHT OF FINAL RADAR CENTERLINE 230
 AZIMUTH (B) TO (A) 230
 FEET ABOVE MEAN SEA LEVEL
 CW FROM TRUE NORTH

FRESNEL CALCULATIONS MADE FOR 11 GIGAHERTZ
 MAGNETIC DECLINATION _____ OF TRUE NORTH
 PATH AZIMUTHS AND DISTANCES ARE _____ INVERSE POSITION
 SCALE: _____

EARTH PROFILE
 (ENGLISH UNITS) (K = INFINITY)

CLEARANCE CRITERIA BY:
 CLIENT: SURVEYOR
 DESIGN DEPARTMENT
 OTHER

SURVEY BY: _____
 DRAWN BY: _____
 DATE: 12/20/65
 PATH LENGTH: _____ MILES
 #46



RECORDING DATA PROFILE DATA

SITE: DAK TREE EAST (#20) SITE: GOUGTON HILLS (#96)
 LAT: 38 • 40 • 12 • N LAT: 38 • 41 • 16 •
 LONG: 76 • 58 • 54 • W LONG: 77 • 15 • 06 •
 ELEVATION: 255 'ASL ELEVATION: 230 'ASL
 AZIMUTH FORWARD: _____ AZIMUTH REVERSE: _____
 PATH DISTANCE: _____ FREQUENCY: 11GHZ

DIST	ELEV	OBST	K(1) + GF	K() + F	NOTE
0	255	$\beta = 90'$			
4	0				
5.9	215		35.8 + 24.6		
9	20				
11.4	130				
13.2	155		15.8 + 16.4		
15	230	100' Tower			

USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE HORIZON RADIO PATHS

- USE THE SYMBOLS SHOWN BELOW
- USE A CONVENIENT SCALE FOR DISTANCE AND ELEVATIONS
- REPRESENT THE PATH AS A STRAIGHT LINE
- CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$h = \left(\frac{0.0078}{k} \right) d^2$$

WHERE

- h = HEIGHT OF CORRECTION IN FEET
- k = RATIO OF EFFECTIVE EARTH RADIUS TO TRUE EARTH RADIUS
- d = DISTANCE FROM STATION "A" TO POINT UNDER CONSIDERATION IN STATUTE MILES
- d' = DISTANCE FROM STATION "B" TO POINT UNDER CONSIDERATION IN STATUTE MILES

- ADD ANY MAN MADE STRUCTURES AND PERSONAL GROWTH
- CALCULATE THE DESIRED FREQUENCY RANGE FOR THE PATHS AND FREQUENCIES UNDER CONSIDERATION USING THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE

$$f_c = \sqrt{\frac{3000}{d}}$$

$$f_s = \sqrt{\frac{3000}{d'}}$$

WHERE

- f_c IS THE FREQUENCY OF THE FIRST FRESNEL ZONE IN FEET
- f_s IS THE FREQUENCY UNDER CONSIDERATION IN GIGAHERTZ (GHz)
- d IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- D IS THE TOTAL PATH LENGTH IN MILES
- f₀ IS THE RADIUS OF THE 1ST FRESNEL ZONE IN FEET
- R IS THE RADIUS OF THE FRESNEL ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

- FRESNEL ZONE CLEARANCE
- EARTH CURVATURE FROM K (∞)
- MAN MADE STRUCTURE
- OBSTRUCTION OFF PATH WITHIN 1000 FEET
- PREDICTED VEGETATION GROWTH
- EXISTING HEIGHT OF VEGETATION
- GROUND ELEVATION AMSL K (∞)
- POSSIBLE REFLECTION POINT
- HEIGHT OF FINAL RADIATOR CENTERLINE ABOVE GROUND

EXAMPLES

- 0.5' - 20'
- 100-300'
- 8-45'
- TOWER 200' SOUTH OF PATH
- 1.75'
- 6 - 100'
- R
- ξ 200'

STATION (A) GUNSTON HEIGHTS (#416)

GROUND ELEV. 33' 13' 06' W
 REQUIRED HEIGHT OF FINAL RADIATOR CENTER LINE FEET ABOVE MEAN SEA LEVEL 230' CW FROM TRUE NORTH
 AZIMUTH (A) TO (B) 100° 10' 00" W

STATION (B) INDEPENDENT HILL

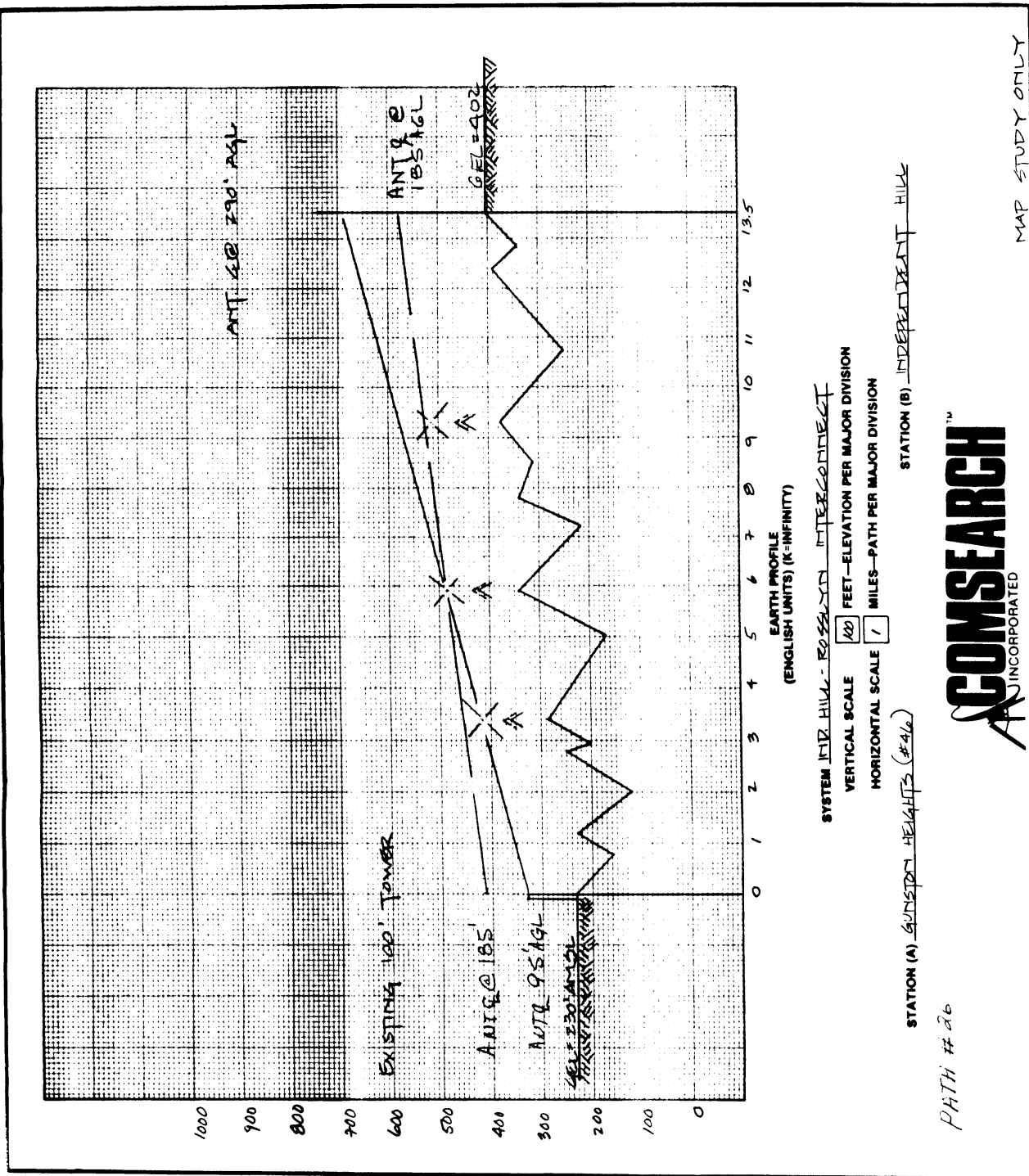
GROUND ELEV. 33' 37' 23' W
 REQUIRED HEIGHT OF FINAL RADIATOR CENTER LINE FEET ABOVE MEAN SEA LEVEL 402' CW FROM TRUE NORTH
 AZIMUTH (B) TO (A) 11° 00' 00" W
 FRESNEL CALCULATIONS MADE FOR 11' GIGAHERTZ
 MAGNETIC DECLINATION _____ OF TRUE NORTH
 PATH AZIMUTHS AND DISTANCES ARE SCALED _____ INVERSE POSITION _____ OTHER _____

CLEARANCE CRITERIA BY:

EARTH PROFILE (ENGLISH UNITS) (K=INFINITY)

CLIENT SURVEYOR
 DESIGN DEPARTMENT
 OTHER

SYMBOLS: SURVEYOR
SYSTEM: PATH FROM (A) TO (B) MILES EN
DATE: 2/27/68



BAROMETRIC PATH PROFILE DATA

SITE: <u>GUNSTON HEIGHTS (#46)</u>	SITE: <u>INDEPENDENT HILL</u>
LAT: <u>38 ° 41 ' 16 "</u>	LAT: <u> " "</u>
LONG: <u>77 ° 13 ' 06 "</u>	LONG: <u> " "</u>
ELEVATION: <u>230</u> 'ASL	ELEVATION: <u> </u> 'ASL
AZIMUTH FORWARD: <u> " "</u>	AZIMUTH REVERSE: <u> " "</u>
PATH DISTANCE: <u> </u>	FREQUENCY: <u>11</u>

DIST	ELEV	DBST	K(L) + G	K(L) + F	NOTE
0	230	Top 100'			
1.2	230				
2.8	250				
3.4	285		22.9 + 20.7		
5.9	390		29.9 + 23.9		
7.8	390				
9.3	375		26.0 + 22.1		
12.4	390				
13.5	402				

USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE HORIZON AND BEYOND THE HORIZON

- USE THE SYMBOLS SHOWN BELOW
- USE A CONVENIENT SCALE FOR DISTANCE AND ELEVATIONS
- REPRESENT THE PATH AS A STRAIGHT LINE
- CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$a = \left(\frac{D^2}{8} \right) + h_1 + h_2$$

WHERE

- a = HEIGHT OF CORRECTION IN FEET
- R = RADIUS OF EFFECTIVE EARTH
- D = THE EARTH RADIUS
- h₁ = DISTANCE FROM STATION "A" TO POINT UNDER CONSIDERATION IN STATUTE MILES
- h₂ = DISTANCE FROM STATION "B" TO POINT UNDER CONSIDERATION IN STATUTE MILES

- ADD ANY MAN MADE STRUCTURES AND PERSONAL GROWTH.
- CALCULATE THE EFFECTIVE PRESNEL ZONE RADIUS FROM THE POINTS AND FREQUENCIES UNDER CONSIDERATION USING THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE

$$f_1 \sqrt{\frac{2}{\lambda}} \sqrt{\frac{100-D}{9}}$$

$$f_2 \sqrt{\frac{2}{\lambda}} \sqrt{D + f_1}$$

WHERE

- f₁ IS THE RADIUS OF THE FIRST PRESNEL ZONE IN FEET
- f₂ IS THE FREQUENCY UNDER CONSIDERATION IN GHZ (MHz)
- D IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- D IS THE TOTAL PATH LENGTH IN MILES
- f₁ IS THE RADIUS OF THE ANY PRESNEL ZONE IN FEET
- n IS THE ORDER OF THE PRESNEL ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

FRESNEL ZONE CLEARANCE

EARTH CURVATURE FROM K (m)

MAN MADE STRUCTURE

DISTORTION OFF PATH WITHIN 1000 FEET

PREDICTED VEGETATION GROWTH

EXISTING HEIGHT OF VEGETATION

GROUND ELEVATION ANSL. K (m)

POSSIBLE REFLECTION POINT

HEIGHT OF FINAL RADATOR CENTERLINE ABOVE GROUND

EXAMPLES

0-6' - 20' F

40'-35' F

0-45' F

TOWER 200' SOUTH OF PATH

6.6 - 10'

1 - 75'

6 - 800'

1 - 200'

STATION (A) OAK LAWN (#24)

STATION (B) LOEFAX (#61)

LONG 38 - 46 - 24 - 17

LAT 38 - 43 - 15 - 17

GROUND ELEV 295 - 14 - 45 - 17

REQUIRED HEIGHT OF FINAL RADATOR CENTERLINE FEET ABOVE MEAN SEA LEVEL

AZIMUTH (A) TO (B) _____ CW FROM TRUE NORTH

FRESNEL CALCULATIONS MADE FOR _____ OF TRUE NORTH

MAGNETIC DECLINATION _____

PATH AZIMUTHS AND DISTANCES ARE _____ INVERSE POSITION _____ OTHER _____ SCALED _____

CERTIFICATION

DATE 12/26/85

DRAWN BY _____

SYSTEM _____

PATH FROM (A) TO (B) _____ MILES

DESIGN DEPARTMENT _____

CLIENT: SURVEYOR _____

OTHER _____

EARTH PROFILE

(ENGLISH UNITS) (K=INFINITY)

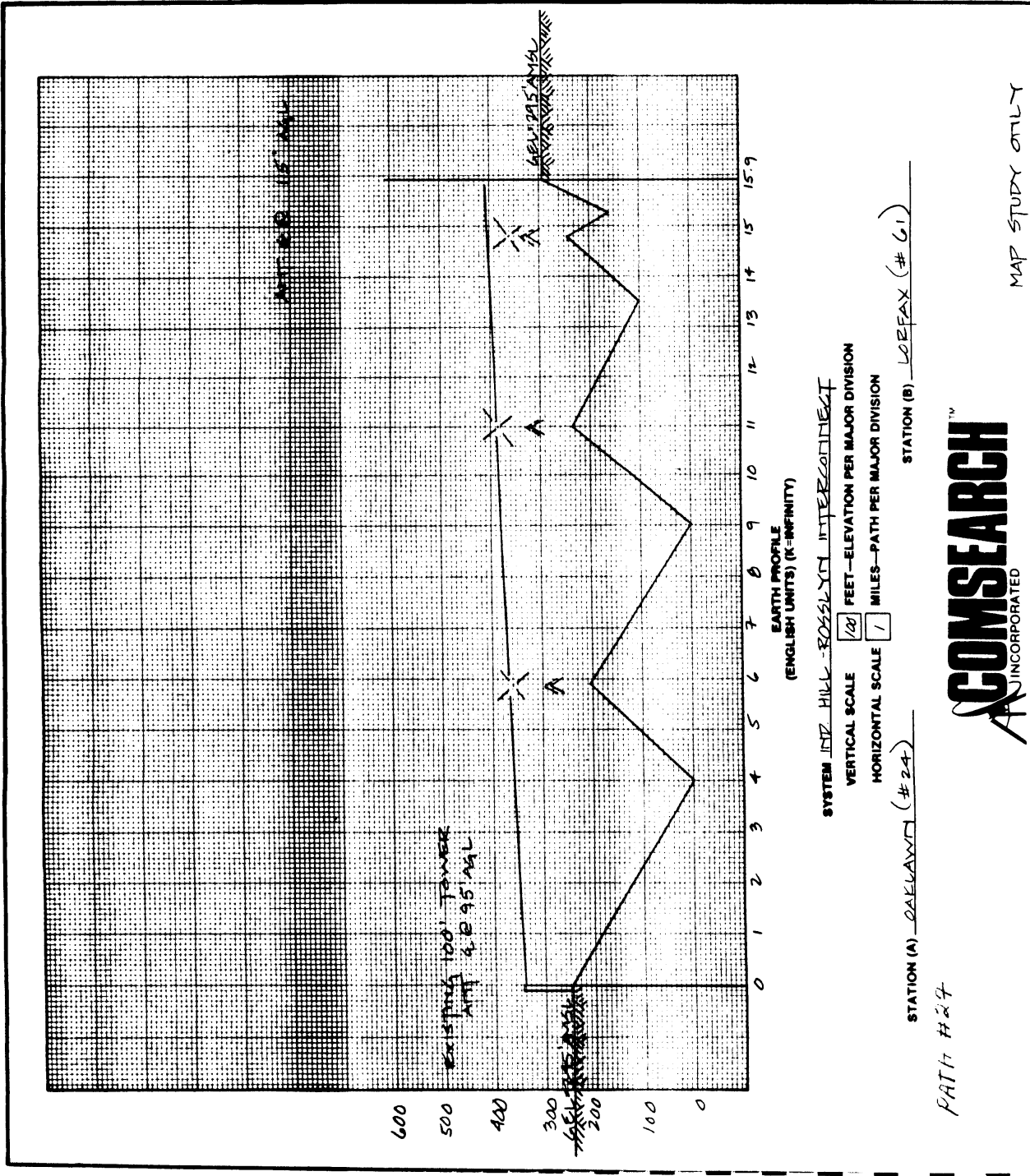
VERTICAL SCALE 100 FEET-ELEVATION PER MAJOR DIVISION

HORIZONTAL SCALE 1 MILES-PATH PER MAJOR DIVISION

STATION (A) OAK LAWN (#24) STATION (B) LOEFAX (#61)

PATH # 29

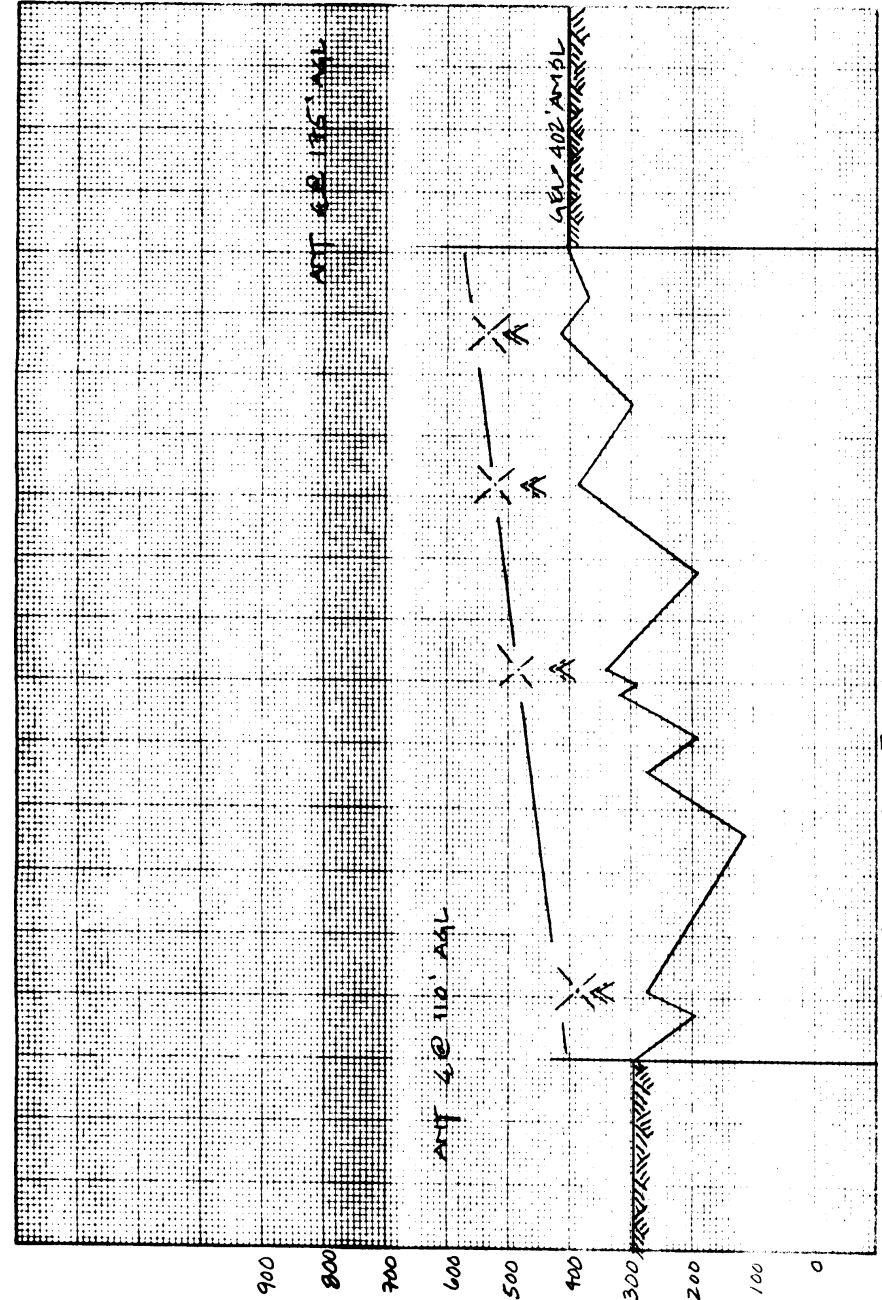
MAP STUDY ONLY



RECEIVE PATH PROFILE DATA

SITE:	<u>OAKLAWN (#2A)</u>	SITE:	<u>LORFAX (#61)</u>
LAT:	<u>38 ° 46 ' 29 " •</u>	LAT:	<u>38 ° 43 ' 15 " •</u>
LONG:	<u>76 ° 57 ' 33 " •</u>	LONG:	<u>77 ° 19 ' 45 " •</u>
ELEVATION:	<u>245 'ASL</u>	ELEVATION:	<u>295 'ASL</u>
AZIMUTH FORWARD:	<u> • • • </u>	AZIMUTH REVERSE:	<u> • • • </u>
PATH DISTANCE:	<u> </u>	FREQUENCY:	<u>11</u>

DIST	ELEV	OBST	K (/) + G	K () + F	NOTE
0	245	100' TOWER			
1.0	-				
5.9	205		39.3 + 25.0		
9	0				
11	235		35.9 + 23.9		
14.8	245		10.9 + 13.2		
15.9	295				



EARTH PROFILE
 (ENGLISH UNITS) (K=INFINITY)
VERTICAL SCALE 100 FEET—ELEVATION PER MAJOR DIVISION
HORIZONTAL SCALE 1 MILES—PATH PER MAJOR DIVISION
STATION (A) LOEFAX (#61) **STATION (B) INDEPENDENT HILL**

FRTN F-28

MAP STUDY ONLY



USE OF FLAT EARTH PROFILE FOR WITHIN-THE-HORIZON AND BEYOND-THE-HORIZON RADIOS PATHS
 1. USE THE SYMBOLS SHOWN BELOW
 2. USE A CONVENIENT SCALE FOR DISTANCE AND ELEVATIONS
 3. REPRESENT THE PATH AS A STRAIGHT LINE
 4. CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$a = \left(\frac{0.00067}{k} \right) \cdot 1, 2$$
 WHERE
 a = HEIGHT OF CORRECTION IN FEET
 k = RATIO OF EFFECTIVE EARTH RADIUS TO TRUE EARTH RADIUS
 1 = DISTANCE FROM STATION "A" TO POINT UNDER CONSIDERATION IN STATUTE MILES
 2 = DISTANCE FROM STATION "B" TO POINT UNDER CONSIDERATION IN STATUTE MILES
 5. ADD ANY MAN MADE STRUCTURES AND PERSONAL GROWTH
 6. CALCULATE THE REQUIRED FREQUENCY UNDER CONSIDERATION IN GRAHRTZ (MPC) UNDER CONSIDERATION USING THE FOLLOWING FORMULAS AND ADD TO THE EXTENDED PROFILE

$$f_1 = \sqrt{\frac{3000}{4D}} \quad f_2 = \sqrt{1.414 \cdot D}$$
 WHERE
 f₁ IS THE MAXIMUM OF THE FIRST FRESNEL ZONE IN FEET
 f₂ IS THE FREQUENCY UNDER CONSIDERATION IN GRAHRTZ (MPC)
 D IS THE DISTANCE IN MILES FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
 D IS THE TOTAL PATH LENGTH IN MILES
 n IS THE INDEX OF REFRACTION OF THE MEDIUM
 n IS THE ORDER OF THE FRESNEL ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS
 FRESNEL ZONE CLEARANCE
 EARTH CURVATURE FROM K (∞)
 MAN MADE STRUCTURE
 OBSTRUCTION OFF PATH WITHIN 400 FEET
 PREDICTED VEGETATION GROWTH
 EXISTING HEIGHT OF VEGETATION
 GROUND ELEVATION AMSL, K (∞)
 POSSIBLE REFLECTION POINT
 HEIGHT OF FINAL RADATOR CENTERLINE ABOVE GROUND

EXAMPLES
 0.6° - 20°
 K(∞)-35°
 8-40°
 TOWER 200' SOUTH OF PATH
 FG - 10
 T - 75
 G - 100
 R
 20'

STATION (A) LOEFAX (#61)
 LAT 33 43 15
 LONG 79 29 45
 GROUND ELEV 295
 REQUIRED HEIGHT OF FINAL RADATOR CENTERLINE FEET ABOVE MEAN SEA LEVEL 45
 AZIMUTH (A) TO (B) 110
 CM FROM TRUE NORTH

STATION (B) INDEPENDENT HILL
 LAT 33 27 33
 LONG 79 40 23
 GROUND ELEV 402
 REQUIRED HEIGHT OF FINAL RADATOR CENTERLINE FEET ABOVE MEAN SEA LEVEL 45
 AZIMUTH (B) TO (A) 110
 CM FROM TRUE NORTH

FRESNEL CALCULATIONS MADE FOR 11 GRAHRTZ
 MAGNETIC DECLINATION _____ OF TRUE NORTH
 PATH AZIMUTHS AND DISTANCES ARE SCALED _____ INVERSE POSITION OTHER _____

CERTIFICATION
 SURVEY BY: _____
 DRAWN BY: _____
 DATE: 12/27/85
 PATH LENGTH _____ MILES
 OTHER _____

EARTH PROFILE
 (ENGLISH UNITS) (K=INFINITY)
 CLIENT: _____ SURVEYOR: _____
 SYSTEM: _____ DESIGN DEPARTMENT: _____
 PATH FROM (A) TO (B): _____
 PATH LENGTH _____ MILES

RECEIVED PATH PROFILE DATA

SITE: LORFAX (#61) **SITE:** INDEPENDENT HILL
LAT: 38 ° 43 ' 15 " **LAT:** 38 ° 37 ' 35 " N
LONG: 77 ° 14 ' 45 " **LONG:** 77 ° 27 ' 23 " W
ELEVATION: 295 'ASL **ELEVATION:** 402 'ASL
AZIMUTH FORWARD: **AZIMUTH REVERSE:**
PATH DISTANCE: **FREQUENCY:** 11 GHz

DIST	ELEV	ORST	K(/) ± F	K() ± F	NOTE
0	295				
1.1	275		8.8 + 13.0		
4.6	275				
5.8	315				
6.2	390		28.5 + 23.5		
9.2	385		23.9 + 21.5		
11.7	415		10.9 + 14.5		
13.1	402				

USE OF FLAT EARTH PROFILE FOR WITHIN THE HORIZON AND BEYOND THE HORIZON RADIO PATH

- USE THE SYMBOLS SHOWN BELOW
- USE A CONVENIENT SCALE FOR DISTANCE AND ELEVATIONS
- REPRESENT THE PATH AS A STRAIGHT LINE
- CALCULATE THE EFFECTIVE EARTH CURVATURE TO CORRECT FOR EARTH BULGE AT THE CRITICAL POINTS AND ADD TO THE FLAT EARTH ELEVATION

$$h = \left(\frac{0.676}{R} \right) d^2$$

WHERE

- h = HEIGHT OF CORRECTION IN FEET
- R = RADIUS OF EFFECTIVE EARTH RADIUS
- d = TRAVELED DISTANCE IN STATUTE MILES

- 1 - DISTANCE FROM STATION 'A' TO POINT UNDER CONSIDERATION IN STATUTE MILES
- 2 - DISTANCE FROM STATION 'B' TO POINT UNDER CONSIDERATION IN STATUTE MILES

- AND ANY MAN MADE STRUCTURES AND PERSONAL GROWTH
- CALCULATE THE DESIRED PRESERVE ZONE FROM THE POINTS AND PREFERENCES UNDER CONSIDERATION USING THE FOLLOWING FORMULAE AND ADD TO THE EXTENDED PROFILE

$$r_1 = \sqrt{\frac{2R \cdot H}{1 + \frac{H}{R}}}$$

WHERE

- r₁ IS THE RADIUS OF THE FIRST PRESERVE ZONE IN FEET
- H IS THE PREDICTED UNDER CONSIDERATION IN FEET (MAY BE NEGATIVE)
- R IS THE PREDICTED RADIUS FROM ONE END OF THE PATH TO THE POINT UNDER CONSIDERATION
- D IS THE TOTAL PATH LENGTH IN MILES
- P₁ IS THE RADIUS OF THE 1ST PRESERVE ZONE IN FEET
- n IS THE ORDER OF THE PRESERVE ZONE AND CAN BE ANY WHOLE POSITIVE NUMBER

SYMBOLS

EXAMPLES

- 0.0' - 20.0'
- 10.0' - 20.0'
- 0 - 50.0'
- 10.0' - 10.0'
- 1.75'
- 6.0' - 100'
- R
- 200'

STATION (A) OAKLAWN (#24)

LAT. 38. 41. 24. N
 LONG. 77. 33. 24. W

STATION (B) GUNSTON HEIGHTS (#46)

LAT. 38. 41. 16. N
 LONG. 77. 33. 06. W

GROUND ELEV. 245 AMSL
 REQUIRED HEIGHT OF FINAL RADIATION CENTER LINE 245 FEET ABOVE MEAN SEA LEVEL
 AZIMUTH (A) TO (B) 100.0° CW FROM TRUE NORTH

GROUND ELEV. 16 AMSL
 REQUIRED HEIGHT OF FINAL RADIATION CENTER LINE 16 FEET ABOVE MEAN SEA LEVEL
 AZIMUTH (B) TO (A) 286.0° CW FROM TRUE NORTH

PRESUME CALCULATIONS MADE FOR 11 DEGREES
 MAGNETIC DECLINATION
 PATH AZIMUTHS AND DISTANCES ARE INVERSE POSITION OTHER

CERTIFICATION

COMSEARCH
 (ENGLISH UNITS) (K=INFINITY)
 SYSTEM
 PATH FROM (A) TO (B)
 PATH LENGTH 16.8 MILES

CLEARANCE CRITERIA BY:

CLIENT SURVEYOR
 DESIGN DEPARTMENT
 OTHER

SURVEY BY:
 DRAWN BY: D/27bs
 DATE: 12/27/65

