

To: Bob Hall  
From: Fred Crews  
Subj: GBT Siting Data and Recommendations.

25 January 1990

#### I. GENERAL:

A total of 7 sites on the Green Bank property of the NRAO have been examined as possibilities for the GBT. In evaluating these sites, the following criteria in rough priority order have been used.

A. Elevations of surrounding terrain, trees, or other structures that would significantly limit the use of the telescope at various observing positions.

Sites having horizons less than 10 degrees elevation are assumed to be most desirable. 7 to 8 degrees or less would be even better.

B. Elevations of surrounding terrain, trees, or other structures that would be helpful in providing RFI protection to the telescope.

It was realized early in the study that the GBT focal point will be so high as to always present line of sight from virtually everything in Deer Creek Valley. This is true to the east, north, and south. The west is generally protected by Little Mountain.

C. Proximity to locally generated RFI.

It is felt unwise to locate the GBT near property boundaries. The directions of vulnerability again are to the east, north and south of the property. Since the NRAO property essentially follows the top of Little Mountain, to the west is not a problem- in most cases. Of concern also is the interference generated on the property itself. Proximity to the Works Area Building where machining and welding operations are performed, and the Jansky Lab where RF tests and broadband interference sources (such as computers) are running continuously should be avoided if possible.

In any case, trees planted adjacent to potential interference sources such as roadways would likely be of some help.

#### D. Physical Suitability:

The same soil conditions generally prevail over the entire property. There is an alluvial overburden that is between 15 and 50 ft. deep over bedrock which consists of medium to soft shale. The overburden has an approximate bearing capacity of 4000 lbs./ft.<sup>2</sup> and bedrock 8000 lbs./ft.<sup>2</sup> or better. A complete soils investigation and report will be made for the site chosen.

Adequate natural drainage is desirable for the telescope foundation and supporting facilities. Gravity drainage for the telescope pintle bearing house, the azimuth cable wrap, and any pointing electronics located in the pintle bearing house is desirable.

#### E. Wind

Data reported over the years at the several telescope locations over the property indicates no strong differences in wind velocity, though a slight case might be made that the section of the property from the main gate to the 140 ft. generally experiences more wind than the vicinity of the Interferometer Control Building. This is not considered significant.

#### F. Physical Accessibility

Access to the site chosen should be reasonable and ideally would use and be near existing property paved roads. The crossing of Deer Creek should be avoided unless an otherwise outstanding site is found there.

#### G. Utilities

Ideally, the GBT site should be close to existing underground power and telephone lines. Current estimated power demand is 525 KVA. No decision has been made to put the GBT on a dedicated power line. If it could share a power line with another facility, initial cost savings would be realized. It would be desirable to take advantage of a fiber optic Ethernet connection to existing facilities which include the old 300 ft. Control Center.

## Airstrip problems

While it may not be a significant consideration, the GBT site chosen can have significant impact on the use of the airstrip. Because of the Green Bank prevailing wind, aircraft normally take off to the west having to attain a certain altitude to get over Little Mountain or bank inside of Little Mountain, usually to the south. The 140 ft. telescope presents an obstacle to banking to the north.

## II. Initial sites

Initially, 7 sites were chosen, and evaluated for the conditions outlined above. See the attached SITE MAP LAND USE for a location of these sites. Sites 3, 4, and 5 are strong candidates and are considered separately. Those ruled out as candidates are described in brief in this section.

### A. Site 1:

This site is on the southeast property boundary, just behind a ridge, and was initially thought of for interference protection to the south. In reality, the ridge rises to less than 100 ft., the site is in a very swampy area, and would require an extension of all utilities including site roads. For these reasons, this site is no longer considered.

### B. Site 2:

This site is at the Recreation Area and would require crossing Deer Creek necessitating building a road above the flood plane. Power and telephone would have to be brought from the substation over rough terrain for a distance of 2850 ft. Connection to the existing Ethernet fiber optic cable would require about the same extension as the power line plus about 200 ft. Physical access, unless other provisions were made would be through the town of Arbovale. The western horizon presents limitations due to Little Mountain which has an elevation of 10 degrees from this site. It had been thought that the abrupt rise of the valley floor to the east would provide some interference protection from the town of Arbovale. This is not so, since the rise is only 80 ft. This site is no longer considered.

### C. Site 6:

This site is at station 3 (1800 meters) of the Interferometer baseline and is almost due east of the old 300 ft. site. It is ruled out because of the rise of Little Mountain to the west, resulting in a horizon of 10 degrees elevation.

## III. SITES 3, 4, AND 5.

Sites 3, 4, and 5 offer the best features of the 7 sites looked at. A description of each of them follows:

### A. Site 3:

This site lies somewhat between the Works Area Building and 85-1, on the north side of the main site road to the 140 ft.

**Access:** Adjacent to the main site road. Access would be trivial.

**Elevation of horizon:** See attached Green Bank Site 3 Elevation of Horizon Data and plot. There are no elevations greater than 5 degrees that would limit observing, except 85-1 which could create a bit of a problem by being in the field of the GBT.

**Proximity to locally generated RFI:** See attached SITE MAP LAND USE, and the topographic map section. Although this topographic section is not up to date (houses are now much more dense), it is submitted to show the proximity of the town of Arbovale and the fact that this site is close to property where we have less control of activities. This site is also close to welding and machining activities at the Works Area Building. While this is under control, welding has been known to interfere at the 140 ft. but never at the 300 ft. It is also closest of all sites to the Jansky Laboratory. It is not known what broadband interference (due to computers) or other interference currently comes from this building. Some distances are: Works Area Building (approx. 1640 ft.), Lab (approx. 2725 ft.), heart of Arbovale (approx. 2400 ft.), and closest distance to Rte. 92 (approx. 2400 ft.).

**Physical Suitability:** This site is very well drained, and providing a pintle bearing gravity drain would require about 400 ft. of pipe.

**Utilities:** Access to underground main site power and telephone and fiber optic Ethernet is about 300 feet away and would require crossing the road. If the existing east feeder power line is used, it would be about 75% loaded. A dedicated power line would require a new line of about 3000 ft. to the main substation.

**Airstrip problems:** This site is approximately 2200 ft. north and east of the airstrip, out of the approach zone. No problem.

#### **B. Site 4:**

This site is in a field along the paved grade school- Hosterman Road. It is surrounded by local trees some of which would need to be cut, which would not alter interference protection.

**Access:** Adjacent to paved grade school Hosterman Road. Access road would be trivial.

**Elevation of horizon:** See attached Green Bank Site 4 Elevation of Horizon Data and plot. There are no elevations greater than 5.5 degrees that would limit observing. Note that the 140 ft. is in the field of the GBT to the north. This is assumed not to be a problem for the GBT, but could be a problem for the 140 ft.

**Proximity to locally generated RFI:** This site is next to best in regard to the proximity of possible sources of local interference. These distances are Works Area Building (approx. 3700 ft.), Lab (approx. 4600 ft.), heart of Green Bank (approx. 4375 ft.), heart of Arbovale (approx. 5025 ft.), and the closest distance to Rte. 92 (approx. 3280 ft.). It is close to 85-3 and the Interferometer Control Building.

**Physical Suitability:** This site is not as generally well drained as might be desired. A gravity drain for the pintle bearing can be provided to a 2 ft. culvert about 650 feet away, and it will not be necessary to dig under the site power line and buried Interferometer cables in that area.

**Utilities:** It is approximately 300 ft. to the Interferometer power feeder. Connecting the GBT to this line would result in a 61% load for this feeder. It is approximately 600 ft. to existing buried telephone line conduit and the site fiber optic Ethernet cable.

**Airstrip problems:** The site is approximately 700 ft. southwest of the west approach center line, just outside the clear zone and higher than the slope path. It can be a problem for people using less than the full runway for take off.

#### C. Site 5:

This site is in a field just after the Hosterman Road/ Interferometer intersection (on the Interferometer road).

**Access:** Adjacent to Interferometer paved road. Access road would be trivial.

**Elevation of horizon:** See attached Green Bank Site 5 Elevation of Horizon Data and plot. There is no obstruction of the horizon greater than 7 degrees. Note that the 140 ft. is in the field of the GBT to the north. This is assumed not to be a problem for the GBT, but could be a problem for the 140 ft.

**Proximity to locally generated RFI:** This site is the best site of all in terms of its proximity to the Works Area Building (approx. 5025 ft.), Lab (approx. 5900 ft.), heart of Green bank (approx. 5250 ft.), heart of Arbovale (approx. 6125 ft.), and closest distance to Rte. 92 (approx. 4600 ft.). It is close to the Interferometer Control Building and 85-3.

**Physical Suitability:** Excellent drainage. Soil firm. A gravity drain for the azimuth pintle bearing can be provided in 400 ft.

**Utilities:** The 1000 KVA underground service that was used for the 300 ft. telescope is available, and is about 500 ft. away. This circuit is less than 5% loaded now powering only the 300 ft. control building. Telephone and fiber optic Ethernet connections are within 1000 ft.

**Airstrip problems:** The site is approximately 1000 ft. southwest of the west approach center line just outside the clear zone and higher than the slope path. In this respect, this is the worst of the sites.

#### IV. CONCLUSIONS:

Sites 4 and 5 are unquestionably the best sites, keeping all criteria in mind. The elevation of the horizons is good, they are not near property boundaries, they are away from the on site sources of interferences and communities; access is easy, useable utilities are nearby, and they offer reasonable solutions for gravity draining of the pintle bearing.

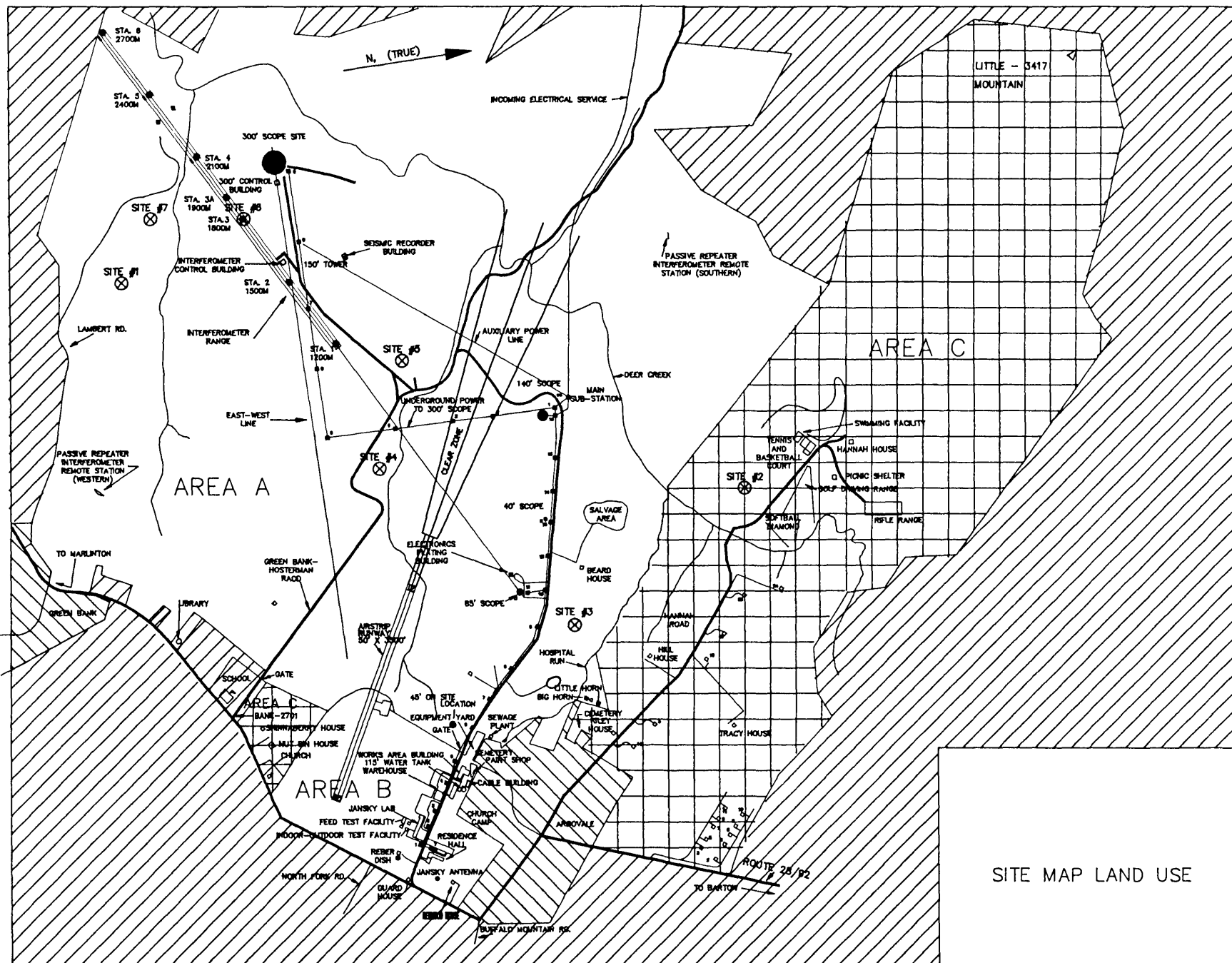
Their positions in relation to Little Mountain is such that interference screening to the background Cheat Mountain is good as opposed to (for example) Site 3.

Both Sites 4 and 5 pose difficulties for the safe use of the airstrip- Site 5 slightly more so than Site 4. Recently when Larry D'Addario was in Green Bank with his plane, we placed blue tarpaulins on the ground at Sites 4 and 5 and asked him to observe and comment on them. After take off, Larry reported that Site 5 was a definite problem and Site 4 would be less of a problem than Site 5 unless a pilot lifted off early and proceeded with a turn to the south. Based on this information, he recommended that we consider south and a bit west of Site 4 near where the buried power line makes a sharp right turn. We have looked at that site and found it to be swampy and present a problem for gravity drain and access. I do not recommend pursuing this.

Site 4 tends to be a bit swampy, although this is not a great problem.

Site 5 has only the airstrip problem and additionally offers plenty of space for staging, storing of materials, and a good area for fabrication. Furthermore, it is very near an essentially unused power line.

Based on all available information, it appears that Site 5 offers the most advantages of any site on the NRAO property and I recommend it as first choice with Site 4 running a close second.



- TELESCOPE
- POWER MANHOLE
- HOUSE
- BARN
- CONTROL BUILDING
- ⊗ PROPOSED SITE FOR NEW TELESCOPE
- CLEAR ZONE

NOTES

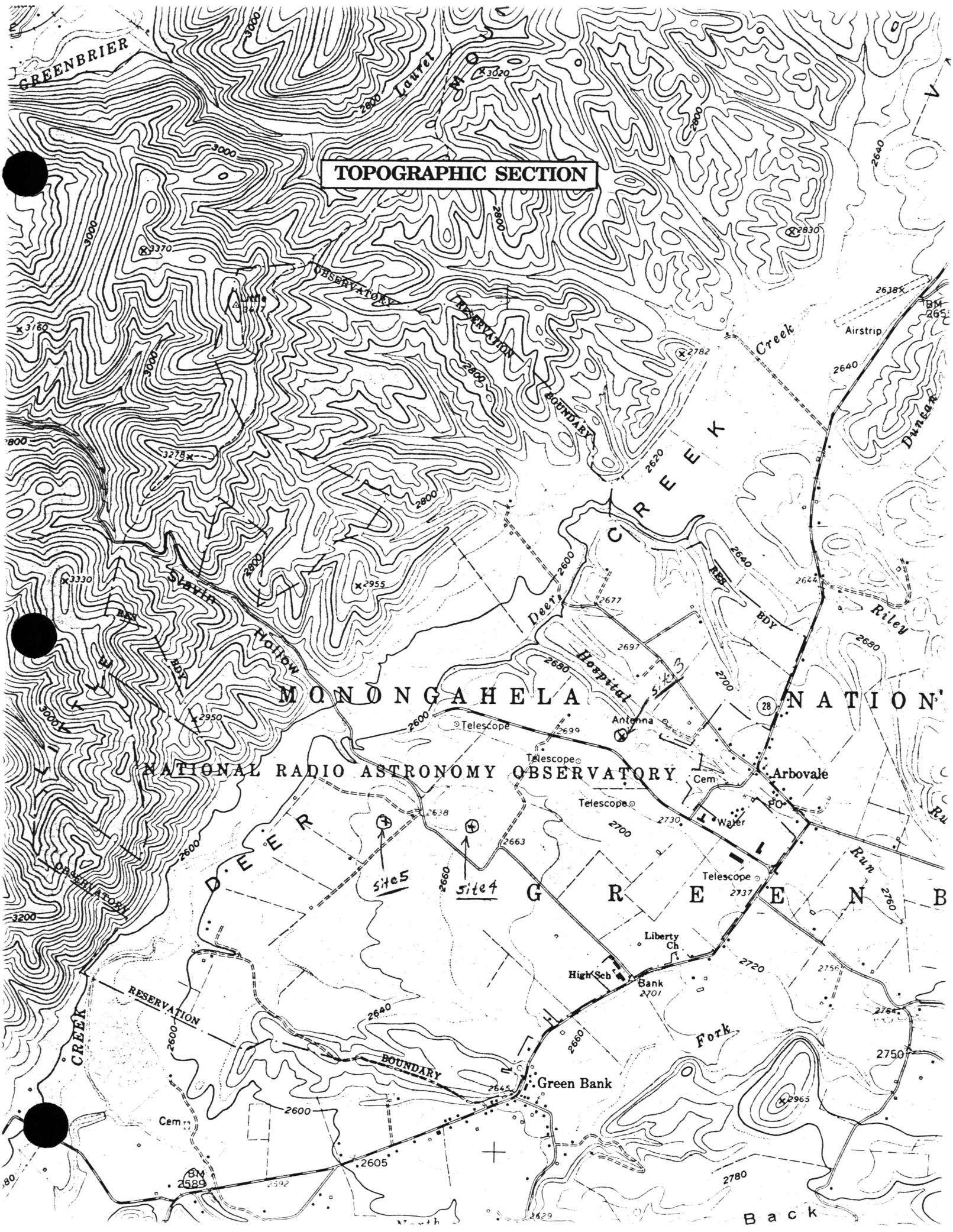
1. AREA A = TELESCOPE AREA.
2. AREA B = ADMINISTRATION AREA.
3. AREA C = RESIDENTIAL AND RECREATION AREA.

SITE MAP LAND USE



GREENBRIER

TOPOGRAPHIC SECTION



MONONGAHELA

NATIONAL RADIO ASTRONOMY OBSERVATORY

28 NATION

DEER

GREEN

RESERVATION

BOUNDARY

Green Bank

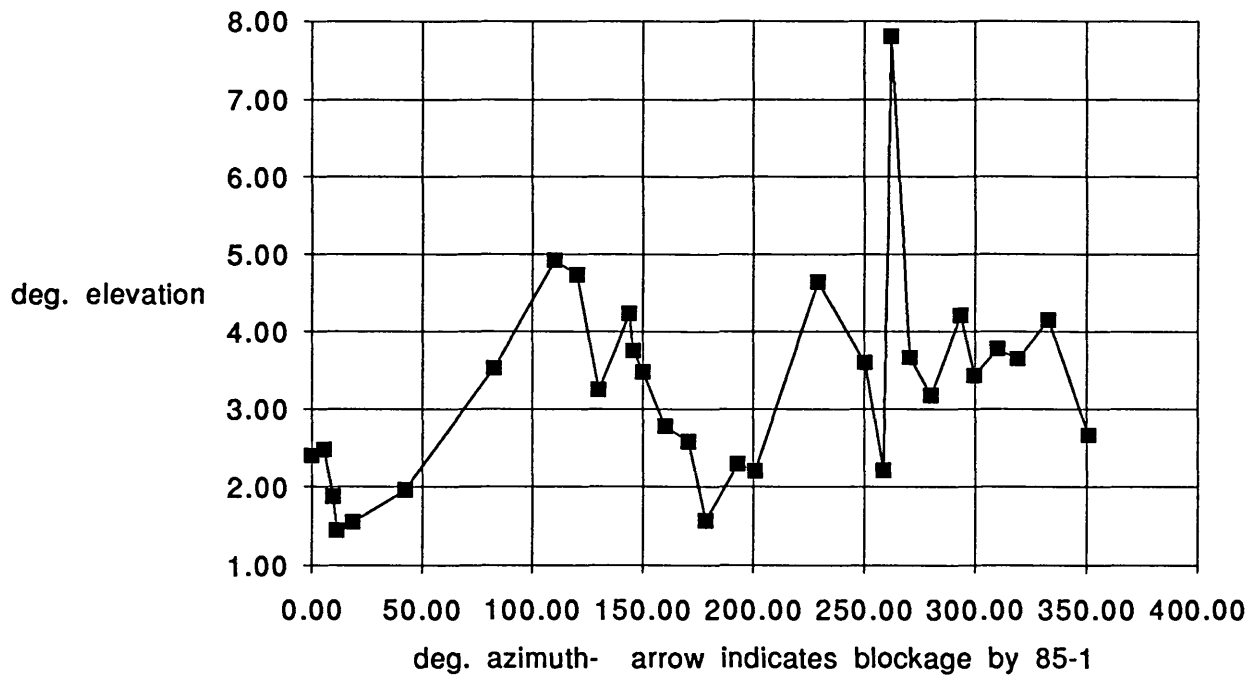
Fork

Back

### GBT Site 3 Elevation of Horizon Data

[illegible]

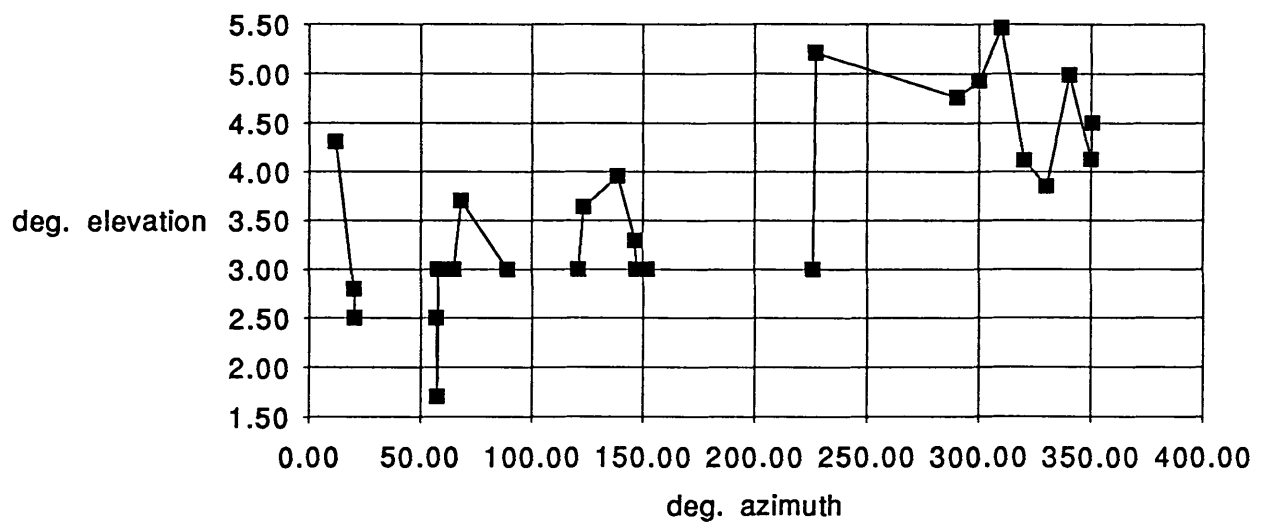
GBT Site 3 elevation of horizon



GBT Site 4 Elevation of Horizon Data

GBT Site 4		
Elevation of Horizon		
Az deg	Elev deg	Comments
11.54	4.30	west lip 140 in service pos
20.09	2.80	
20.17	2.50	local trees <2.5 deg
57.00	2.50	local trees <2.5 deg
57.48	1.70	
58.00	3.00	local trees <3 deg
65.00	3.00	
68.08	3.70	85-1 fp 0ha +23dec
89.00	3.00	local trees <3 deg
121.00	3.00	local trees <3 deg
123.38	3.64	
138.57	3.96	
146.44	3.29	
147.00	3.00	local trees <3 deg
152.00	3.00	local trees <3 deg
226.00	3.00	local trees <3 deg
227.08	5.21	
290.13	4.76	
300.07	4.93	
310.07	5.46	
320.04	4.12	
330.05	3.85	Cheat mtn- Slavin hollow
340.15	4.99	
350.01	4.12	
350.56	4.50	

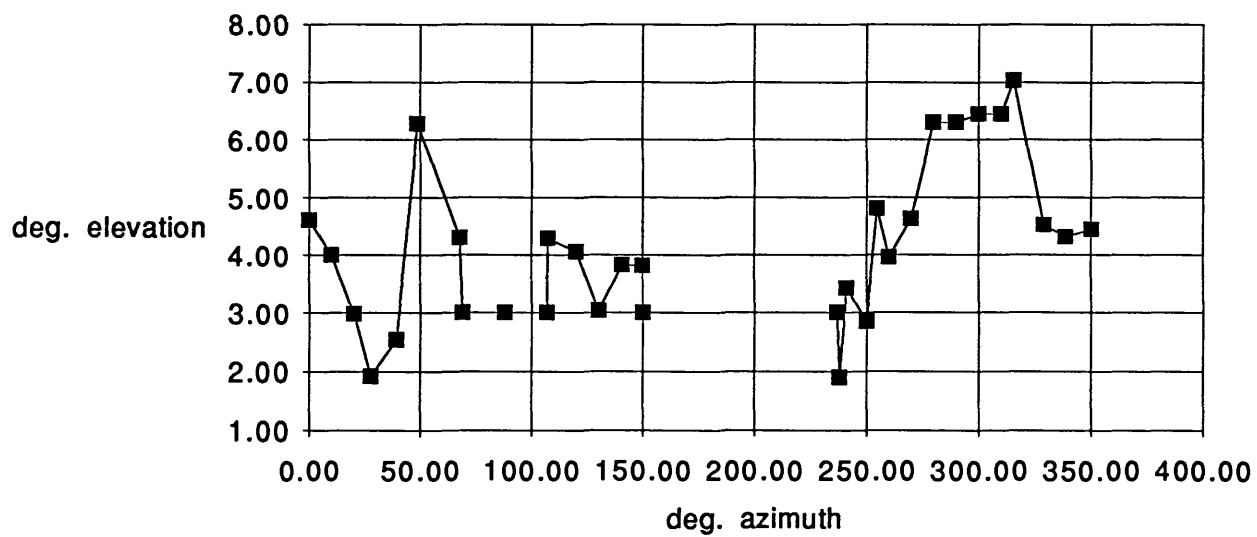
GBT Site 4 Elevation of Horizon Data



# GBT Site 5 Elevation of Horizon Data

GBT Site 5		
Elevation of Horizon		
Az deg	Elev deg	Comments
0.00	4.60	
10.06	4.00	
20.16	2.98	
28.08	1.92	
39.41	2.54	
48.94	6.28	140 fp 2ha +25dec
67.84	4.30	
69.00	3.00	69-107 az, el <3deg
88.00	3.00	"-----"
107.00	3.00	Local trees
107.50	4.29	
120.06	4.05	
130.02	3.04	
140.75	3.83	
150.01	3.81	
150.00	3.00	Local trees <=3 deg
237.00	3.00	Local trees <=3 deg
237.99	1.90	
241.23	3.42	85-3fp 0ha +25dec
250.08	2.84	
254.63	4.81	150 ft microwave tower
260.03	3.95	
270.04	4.63	
280.06	6.31	
290.03	6.31	
300.01	6.44	
310.20	6.44	
315.43	7.03	
329.06	4.51	
338.81	4.31	Cht Mtn Slaven Hollow
350.14	4.45	

GBT Site 5 Elevation of Horizon



**GBT Site 6 Elevation of Horizon Data**

<b>GBT Site 6</b>		
<b>Elevation of Horizon</b>		
<b>Az deg</b>	<b>Elev deg</b>	<b>Comments</b>
0.00	4.49	
10.01	4.10	
20.03	2.86	
30.15	2.86	
40.02	0.91	
50.10	1.19	
54.27	2.87	
61.41	1.78	140 @5h west +21.9dec
67.05	1.63	
70.58	1.91	
76.02	6.99	
77.82	2.95	85-3 @0h +22deg
78.00	4.80	
101.00	4.80	local trees
101.85	4.01	local trees
108.21	3.62	
202.67	3.97	
234.38	2.18	
240.15	1.79	
257.34	5.45	
265.30	7.05	
271.05	7.05	
286.02	9.27	
299.76	10.12	
319.96	9.12	
330.05	8.20	
340.13	6.74	
350.08	5.11	



GBT Site 6 Elevation of Horizon

