The Green Bank Observatory Interference Protection Group: Policies for RFI Management

PREPARED BY	ORGANIZATION	DATE
GBO IPG	Green Bank Observatory	8/25/25

APPROVALS (Name and Signature)	ORGANIZATION	DATE
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Change Record

VERSION	DATE	REASON
Rev. 0	11/15/05	original
Rev. 1	1/24/06	Changed zone 2 boundary to include the area up to the intersection of the airstrip and the airstrip access road, and bounded by those two features.
Rev. 2	5/29/14	Refined the definitions of Long Duty Cycle, Short Duty Cycle, and High Risk Equipment in Zone 2. Also Updated Signature Page Due to changes in Personnel.
Rev. 3	10/29/20	Changed Language to Reflect transition from NRAO to GBO, Updated formatting and document organization, minor clarifications.
Rev 4	05/23/22	Simplified Section 3.2 for clarity. Clarified exception authority in Sections 3.3 and 4.3. Clarified need for coordination with IPG for all exceptions, and noted that IPG is responsible for tracking exceptions. Noted that PR campaigns need director approval and coordination with public relations. Fixed page numbers. Note need for consultation with IPG for NRQZ exceptions. Updated director for signature
Rev 5	08/25/25	(Proposed) Revise Section 4 to include zones 2a (same as past zone 2) and 2b (allowing 2.4 GHz WiFi. Updated the map (Figure 1) to show the new zones. Removed line from Section 1 stating that enforcement for Zone 1 and 2 are in a different document, as not such document exists. Added map showing the boundaries of Zone 3 and 4. Added captions to figures. Minor grammer corrections. Changed wording to be consistent in the use of exceptions and waivers.

1 PURPOSE AND SCOPE

The fundamental goal of the Green Bank Observatory (GBO) Interference Protection Group (IPG) is to provide the best possible access to the spectrum for Observers at GBO. Our general philosophy regarding this task has been set forth in a previous document, "The Green Bank Interference Protection Group: Charge, Practices, and Policies". The tools we have at our disposal to accomplish this task are based on legal instruments as well as internal policies, which are variously applicable in different jurisdictions, or zones. In this document, we define five Zones of protection in which different policies for RFI mitigation apply. We also develop the internal policies applicable to Zones 1 and 2, which are on Observatory property. Defining and clarifying internal policies is important so that we can distinguish violations of policy from the variances due to the existence of two internal zones which are treated differently. The limits we voluntarily impose on Zones 1 and 2 are uniformly stricter than those applicable to Zones outside of Observatory property. Furthermore, we take a proactive approach to mitigation of all unintentional radiators in Zone 1 and for selective unintentional radiators in zone 2, whereas, outside of Observatory property, mitigation of unintentional radiators is interference driven. The policies applicable to Zones 3 and 4 have been defined by §37A-1 of the West Virginia code (the "Radio Astronomy Zoning Act"). In this paper, we define GBO's policy for exercising the provisions of this law. The policy applicable to Zone 5 was defined by the establishment of the National Radio Quiet Zone (NRQZ) in 1958 by the Federal Communications Commission (FCC) and the Interdepartmental Radio Advisory Committee (IRAC). The NRAO has followed consistent procedures for administering the NRQZ for many years; we will refer to this administrative process, but a detailed expansion is outside the scope of this document.

2 PHYSICAL DESCRIPTIONS OF THE ZONES

Zone 1: Radio Astronomical Instrument Zone
All Green Bank Observatory property except that designated as Zone 2 (Figure 1).

Zone 2: On-Site, housing, visitor and laboratory areas
The housing, visitor and laboratory areas on the Green Bank Observatory are defined as Zone 2 (Figure 1).

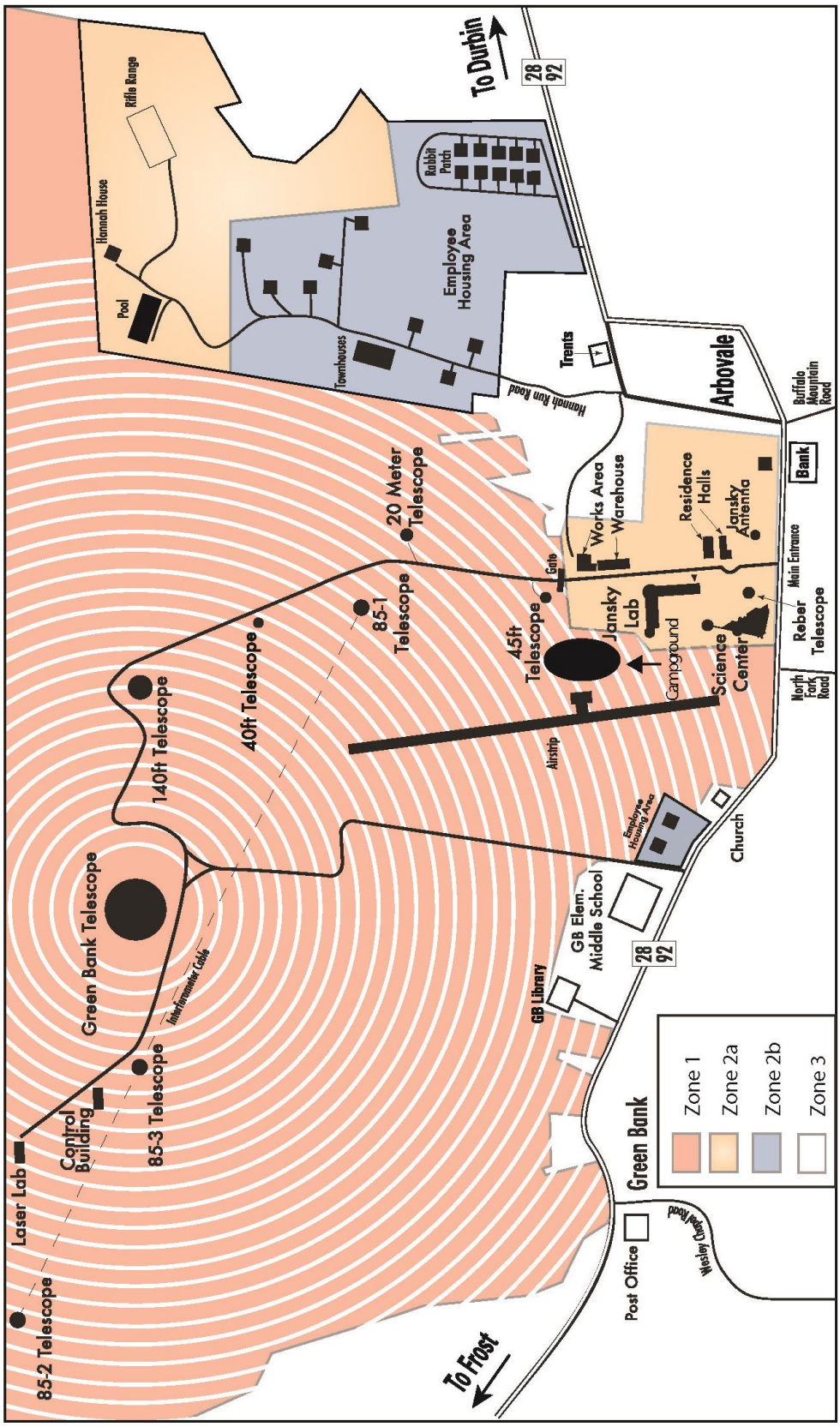

Figure 1. Map depicting radio astronomy zones for all Observatory property.

Zone 3: 2-Mile Radius
A circle of two miles radius drawn with the GBT pintle bearing as the center point (yellow circle in map, Figure 2)

Zone 4: 10-Mile Radius
A circle of ten miles radius drawn with the GBT pintle bearing as the center point, excepting the circle described by Zone 3. This defines the edge of the WVRAZ. (Red circle in map. Figure 2; note that the eastern edge is defined by the Virginia state line and not the circle.)

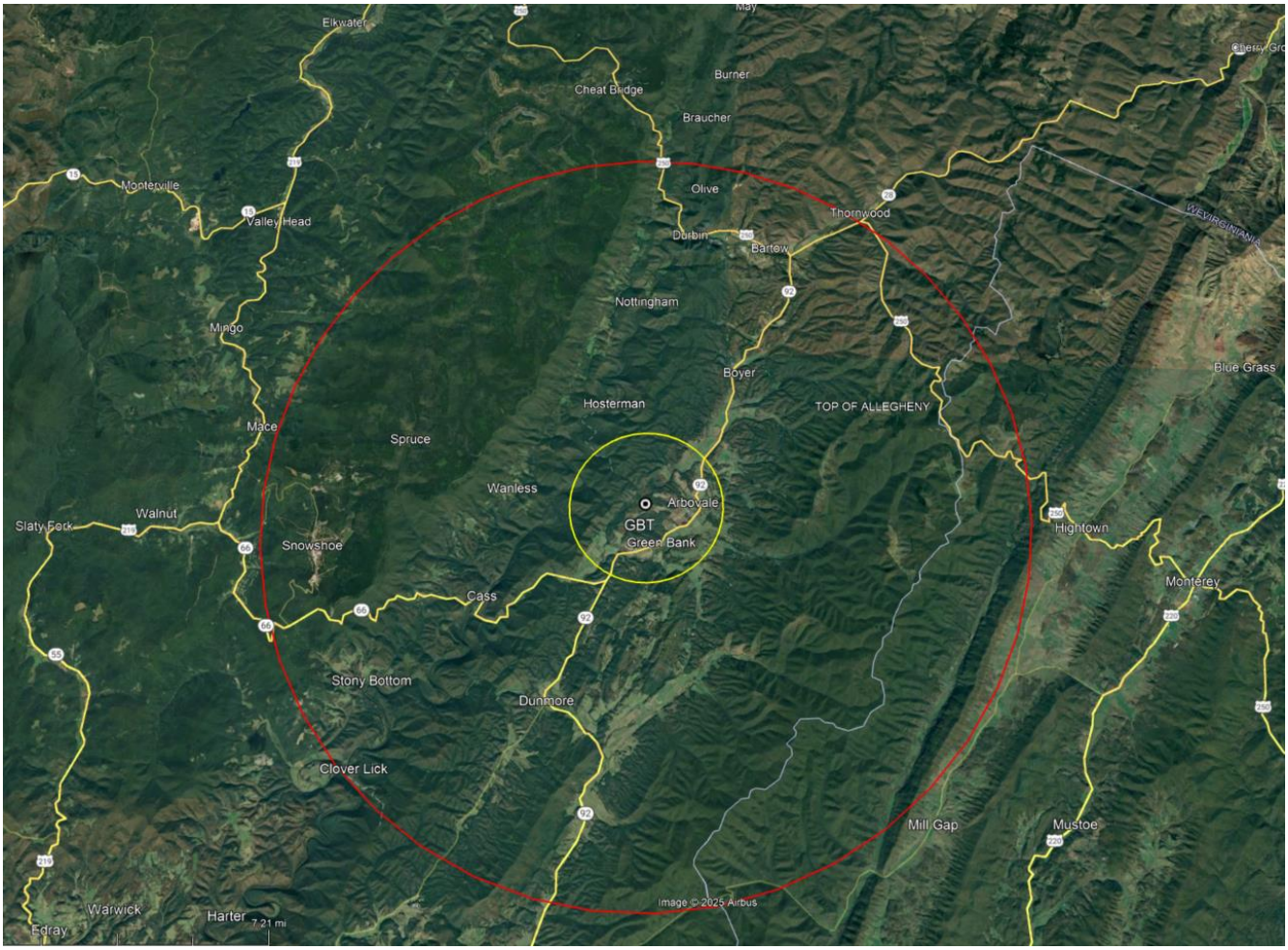

Figure 2. The 2-mile (yellow) and 10-mile (red) radius for the WVRAZ. Note that the Virginia state line (grey) denoted the eastern edge of much of the WVRAZ, rather than the red circle.

Zone 5: The National Radio Quiet Zone (NRQZ)
The NRQZ, as defined by Section 1.924, Title 47 of the Code of Federal Regulations, is bounded by NAD-83 meridians of longitude at 78d 29m 59.0s Wand 80d 29m 59.2s Wand latitudes of 37d 30m 0.4s N and 39d 15m 0.4s N, and encloses a land area of approximately 13,000 square miles near the state borders of Virginia, West Virginia, and Maryland, as illustrated in Figure 3.

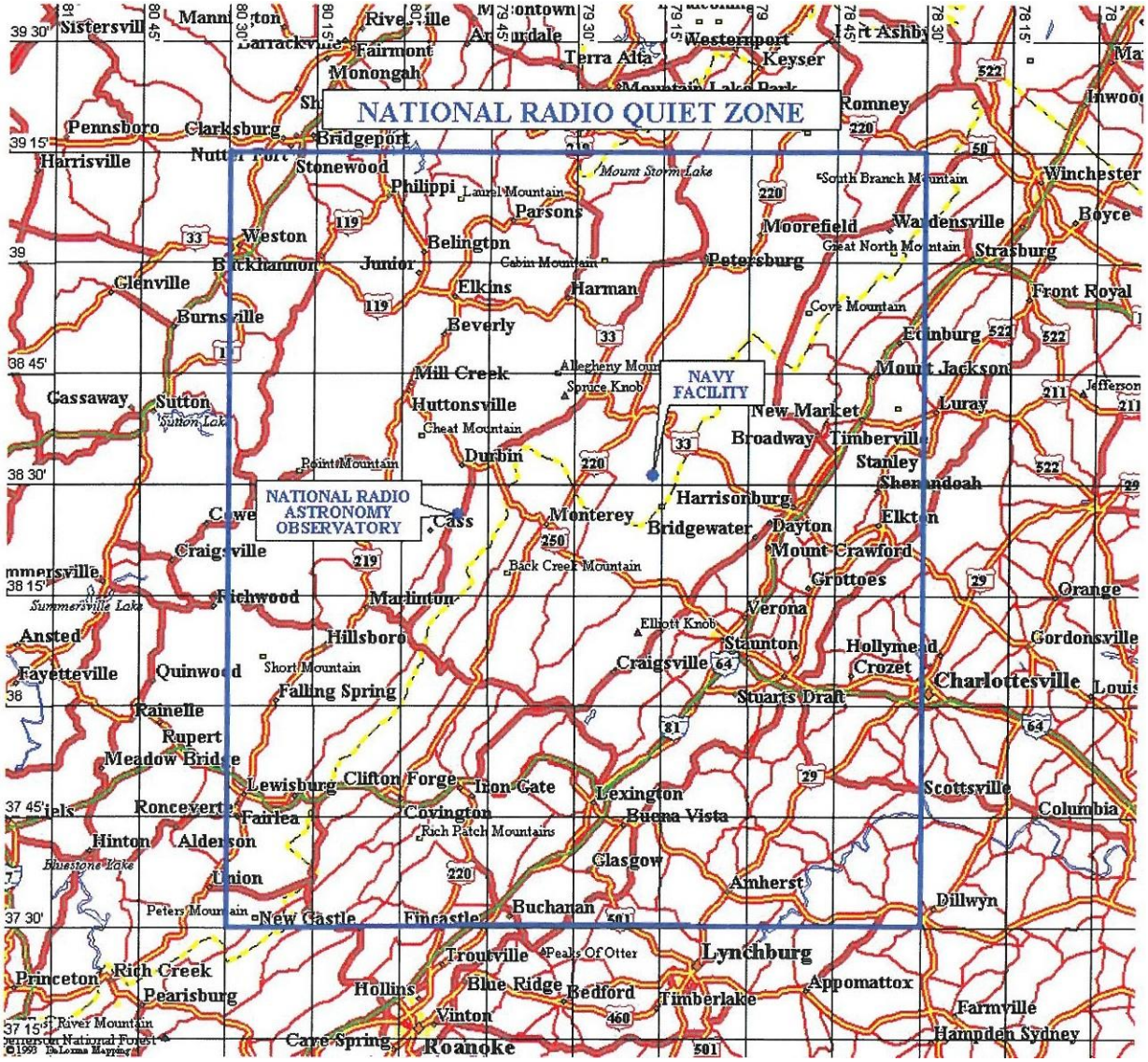

Figure 3. The NRQZ boundaries.

3 ZONE I POLICY

3.1 Authority

While the GBO Site Director is the final authority in determining RFI suppression policy on site, and granting waivers to that policy, the responsibility of developing the policy and recommending the approval/disapproval of waivers has been delegated to the IPG. All requests for waivers should be made to the IPG lead for evaluation and recommendation to the Site Director, who provides final approval/rejection.

3.2 Philosophy

The general philosophy for interference mitigation in Zone I is a preventative, proactive approach; interference potential is assessed through testing, and equipment is shielded, filtered, etc. as necessary **before** installation(or use). By policy, we do not install equipment first and then mitigate it if it happens to cause interference.

3.3 Equipment Classes

- Intentional Radiators:

  Intentional radiators are banned from this zone with the exception of those the deemed **essential** for the operation of the facility and given a waiver. A comprehensive list of those waivers, their frequencies of operation and dates, is maintained by the IPG.

- Unintentional Radiators:

  - Installed Equipment:

    Any and all electrical equipment installed in Zone 1 is subject to the limits set forth in J. R. Fisher's 1997 paper titled "RFI Radiation Limits in The Vicinity of GBT". These limits are consistent with the ITU-R RA.769 limits, which are used worldwide as a basis for protecting Radio Astronomy instruments from harmful RFI. The IPG will use the distance from the installed equipment to the focal point of the primary instrument on site (at this writing, that would be the GBT) in evaluating

the allowable emissions. The limit is so strict that, in practice, other instruments on site are effectively protected as well. Procedural controls, that is, controls by which non-compliant equipment would be powered down during the operation of a RA instrument, are not to be used. Waivers can be granted (by the Director after recommendation by the IPG), through granting waivers, for automated systems (e.g. turret rotator controller, LASSI system) and a list of this equipment is maintained by the IPG.

- Non-installed equipment:

  Automobiles: Only specified GBO site vehicles are permitted to drive in Zone 1. These vehicles have been, and will continue to be, selected to include a minimum of interference-causing features. They will be diesel vehicles and will lack collision avoidance radar, wireless connectivity features, and any other known and intentional radiators. Any exceptions to this will require a waiver.

  Test, maintenance, and construction equipment: Non-compliant, portable equipment used for testing, maintenance, and construction is permitted for the duration of the test, maintenance, or construction. This equipment may not be left to operate unattended, however, and its use must be coordinated with the IPG, site telescope schedules and maintenance periods. A schedule of this coordination is maintained by the IPG.

  Other portable equipment: All portable electronic equipment (e.g. athletic trackers, digital cameras, phones, etc.) other than that used for testing, construction and maintenance may not be operated in Zone 1.

4 ZONE 2 POLICY

4.1 Authority

While the GBO Site Director is the final authority in determining RFI suppression policy on site, and granting waivers to that policy, the responsibility of developing the policy and recommending the approval/disapproval of waivers has been delegated the IPG. All requests for waivers should be made to the IPG lead for evaluation and recommendation to the Site Director, who provides final

approval/rejection.

4.2 Philosophy

The general philosophy for interference mitigation in Zone 2 is a risk assessment approach, balanced by practical concerns, unlike the blanket compliance requirements for Zone 1. While the same limit applies for interference assessment, the preventative, proactive mitigation approach is reserved for equipment that would be difficult to power off in the event that it is identified as an actual interference source, or equipment whose emissions are very strong and therefore likely to interfere.

4.3 Equipment Classes

- Intentional Radiators

  Intentional radiators are banned from this zone with the exception of those deemed **essential** for the operation of the facility and given a waiver. A waiver to this rule has been granted by the GBO Director to allow 2.4 GHz WiFi (802.11b/g/n/ax/be) in the Zone 2b (Figure 1). Zone 2a does not allow for this exception.

- Unintentional Radiators

  - Installed Equipment

    In Zone 2, installed equipment falls into three categories:

    1. Long Duty Cycle Equipment

       Long Duty Cycle Equipment is defined as equipment that emits RFI in excess of the ITU-R RA.769 limit for a period in excess of 8 hours out of 24, in other words, having a duty cycle greater than 1/3. This includes equipment that runs continuously, and equipment that is vital to the operation of the facility, for example, equipment responsible for the climate control of the buildings, security equipment, lighting of common areas such as hallways and stairwells, etc. This category also includes equipment used to operate and take data from the RA instruments, the LAN equipment, plus any other equipment that is intentionally, or in practice, left running continuously. Personal computers are not included in this category; see (c). This category of electrical equipment is subject to the same limits as equipment in Zone 1, and must be contained in a filtered, shielded enclosure which provides sufficient attenuation of its emissions to bring it into

compliance with these limits.

2. High-Risk Equipment

   Equipment that is not Long Duty Cycle but has emissions in excess of the FCC Part 15 Class B Limit must be contained in a filtered, shielded enclosure which provides sufficient attenuation of its emissions to bring it into compliance with the Zone 1 limits. Microwave Ovens (FCC Part 18) are one example in this category, any FCC Part 15 Class A equipment is another.

3. Short Duty Cycle Equipment

   Short Duty Cycle Equipment is defined as equipment that emits RF in excess of the ITU-R RA.769 limit for a period less than or equal to 8 hours out of 24, in other words, having a duty cycle less than or equal to 1/3, and typically operated during normal business hours. Since the emissions of a typical PC located in the Jansky Laboratory exceed the ITU-R RA.769 limit relative to the GBT, the staff of GBO must power down their PCs and other office equipment on a daily basis when they leave work, unless this equipment is located inside a shielded area. The basic idea is to provide the lowest RFI risk to observing outside of regular business hours. Equipment that is used in this manner and which complies with the FCC Class B Limit may be used in Zone 2 with no special mitigation measures. It is acknowledged that FCC Class B electronics are likely to be used in the housing after business hours, however these, too, should be powered down when not in use.

- Non-installed equipment:

  Automobiles, and portable unintentional radiators are not regulated in Zone 2, except by the regulations of Zone 3.

5 ZONE 3 (THE WEST VIRGINIA RADIO ASTRONOMY ZONE, 0-2 MILE RADIUS) POLICY

Applicable Rules/Enforcement Authority

The limits set forth in §37A-1-2 of the West Virginia Code (The Radio Astronomy

Zoning Act; Restrictions - Within two miles of the facility), apply in Zone 3. Let it be noted that these restrictions also apply in zones 1 and 2. While it is the responsibility of GBO to initiate enforcement of these rules in the procedure set forth in this document under "IPG Policy, Zone 3", according to §37A-1-6, the Pocahontas County Prosecuting Attorney, or the WV State Attorney General is the enforcement authority responsible for levying the fines described in §37A-1-5.

The IPG may engage in a public education campaign to raise awareness of local RFI issues using brochures, informational spots in the local paper, discussions/ interviews on the local radio station, etc. The purpose of this campaign is to heighten local awareness of the value of the work done at the Observatory, and its vulnerability to RFI, as well as a reminder of our obligation to mitigate local interference. We believe that a heightened awareness will facilitate voluntary cooperation. Such campaigns will be coordinated with GBO public relations and undertaken only with approval of the GBO Director.

Enforcement must be driven by "interference to observations" according to the Act, so enforcement should proceed as follows:

- Document the interference in Radio Astronomy data; with time, date and (sky) frequency information.
- Locate source of interference. In certain cases (WIFI example) several sources may be producing interference on the same frequency. In order to get quiet spectra, ALL sources must be located and quieted.
- Visit personally with owner of offending equipment and deliver the "please cooperate" letter. The letter shall state:
    - How the interference harms us
    - Our legal authority for requesting that the equipment be turned off
    - What we are/aren't willing to do to help them comply
    - What further action will be taken if they don't comply
- Contact the county prosecuting attorney if they don't comply. Prosecuting attorney can provide "injunctive relief' as described in §37A-1-6.

Any request for a waiver to this policy should be submitted to the GBO IPG who will provide a recommendation to the GBO Director. The GBO Director (only) can grant waivers.

A waiver has been granted in this zone by the GBO director to allow 2.4 GHz WiFi (802.11b/g/n/ax/be) (only).

6 ZONE 4 (THE WEST VIRGINIA RADIO ASTRONOMY ZONE, 2-10 MILE RADIUS) POLICY

Applicable Rules/Enforcement Authority

The limits set forth in §37A-1-3 of the West Virginia Code (The Radio Astronomy Zoning Act; Restrictions - Within ten miles of the facility), apply in Zone 4. While it is the responsibility of GBO to initiate enforcement of these rules in the procedure set forth in this document under "IPG Policy, Zone 4", according to §37A-1-6, the Pocahontas County Prosecuting Attorney, or the WV State Attorney General is the enforcement authority responsible for levying the fines described in §37A-1-5.

The IPG policy for enforcement in Zone 4 is the same as for Zone 3, however, instead of adhering to the (stricter) limit set forth in §37A-1-3, we will enforce the more lenient NRQZ limit; experience has shown that the NRQZ limit has been effective in protecting our observations.

Any request for a waiver to this policy should be submitted to the GBO IPG who will provide a recommendation to the GBO Director. The GBO Director (only) can grant waivers.

A waiver has been granted in this zone by the GBO director to allow 2.4 GHz WiFi (802.11b/g/n/ax/be) (only).

7 ZONE 5 (THE NATIONAL RADIO QUIET ZONE) POLICY

Applicable Rules/Enforcement Authority

The National Radio Quiet Zone (NRQZ) was established by the Federal Communications Commission (FCC) in Docket No. 11745 (November 19, 1958) and by the Interdepartmental Radio Advisory Committee (IRAC) in Document 3867/2 (March 26, 1958) to minimize possible harmful interference to the National Radio Astronomy Observatory (NRAO) in Green Bank, WV and the Sugar Grove Research Station in Sugar Grove, WV. The administration of the NRQZ is the responsibility of the NRAO's NRQZ Administrator. The FCC is the enforcement authority in the event of a violation of the rules.

Policies related to NRQZ management are at the discretion of the NRQZ Administrator. While not required, all waivers to the NRQZ limits will be made in consultation and agreement with the GBO IPG.