# Exhibit A
# Fixed Antenna Specifications

## 1 Parabolic Antenna Beamwidth

This application for an experimental license includes the use of a 1.22 meter (4 ft) parabolic antenna transmitting a CW signal at frequencies between 1668.4 and 18000 MHz. Antenna beamwidth is a function of wavelength or more practically the transmit frequency. Below is the formula used to determine the peak gain as a function of efficiency ($\eta$), diameter ($D$) and wavelength ($\lambda$):

$$G_{peak} = 10log\left[\eta\left(\frac{\pi D}{\lambda}\right)^2\right] \tag{1}$$

The peak gain of a parabolic antenna can also be calculated as a function of efficiency ($\eta$) and the half power beamwidth($\theta_{3dB}$):

$$G_{peak} = 10log\left[\eta\left(\frac{70\pi}{\theta_{3dB}}\right)^2\right] \tag{2}$$

Equating 1 and 2:

$$10log\left[\eta\left(\frac{\pi D}{\lambda}\right)^2\right] = 10log\left[\eta\left(\frac{70\pi}{\theta_{3dB}}\right)^2\right] \tag{3}$$

$$\eta\left(\frac{\pi D}{\lambda}\right)^2 = \eta\left(\frac{70\pi}{\theta_{3dB}}\right)^2$$

$$\left(\frac{D}{\lambda}\right)^2 = \left(\frac{70}{\theta_{3dB}}\right)^2$$

$$\theta_{3dB} = \left(\frac{70c}{Df}\right)$$

$$\theta_{3dB} = \left(\frac{20985472060}{Df}\right) \tag{4}$$

Figure 1 shows the relationship between frequency and beamwidth for a 4 ft (1.22 meter) parabolic antenna. Table 1 shows the beamwidth for the specific frequencies in the request for an experimental license.

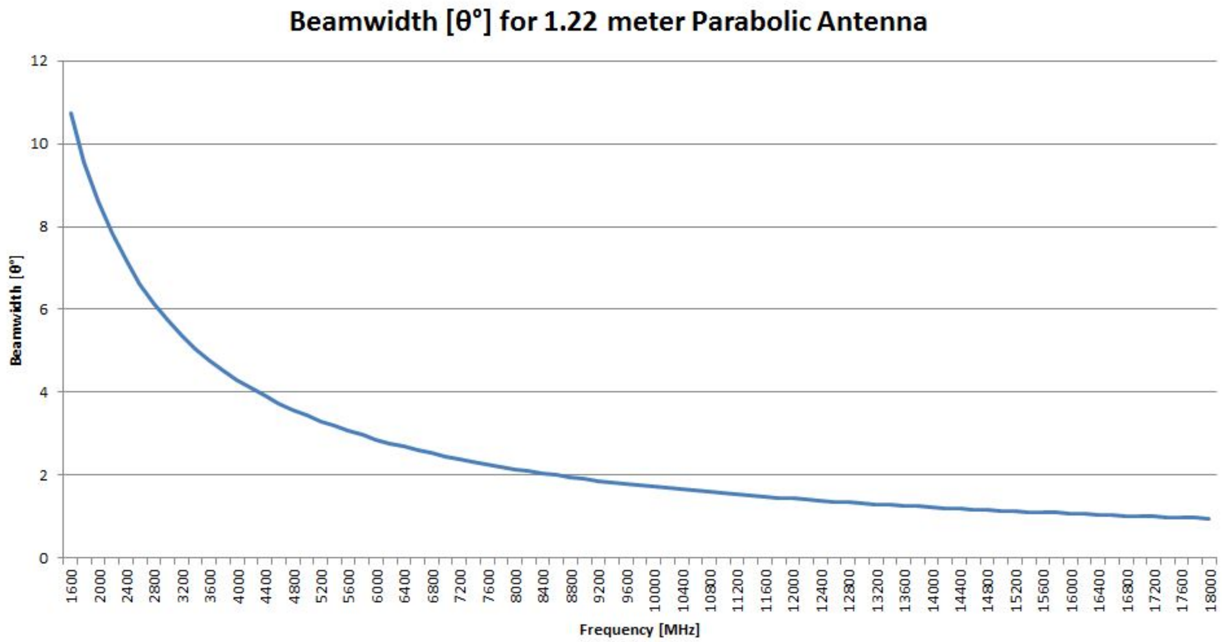


Figure 1: Beamwidth as a function of frequency [MHz]

| **Frequency [MHz]** | **Beamwidth [°]** |
|---|---|
| 1747 | 9.88 |
| 2200 | 7.82 |
| 2250 | 7.64 |
| 3649 | 4.71 |
| 4200 | 4.10 |
| 8900 | 1.93 |
| 12700 | 1.35 |
| 18000 | 0.96 |

Table 1: Relationship between frequency and beamwidth.

# 2 Orientation of Beam

The transmit antenna located at 33° 57′ 48” N by 84° 6′ 51” W is orientated in the horizontal plane 91.50° from true North and in the vertical plane $-1.7°$ from the horizontal plane. Figure 2 shows the elevation profile of the path between the transmit and receive antennas.

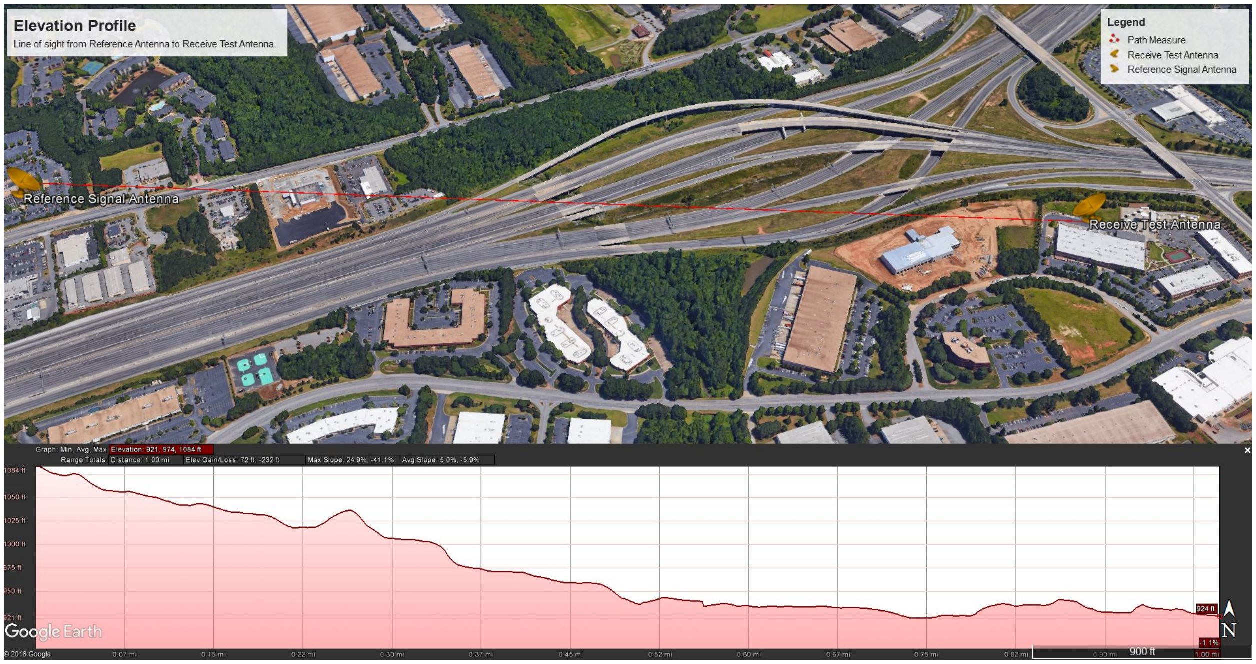


Figure 2: Beamwidth as a function of frequency [MHz]

Calculation of the vertical orientation of the beam is shown below:

$$tan(\theta) = \frac{1084ft - 927ft}{5280ft} \tag{5}$$

$$= \frac{157}{5280}$$

$$\theta_{3dB} = arctan\left(\frac{157}{5280}\right)$$

$$= 1.7^{\circ} \tag{6}$$