APPENDIX B

COMSEARCH
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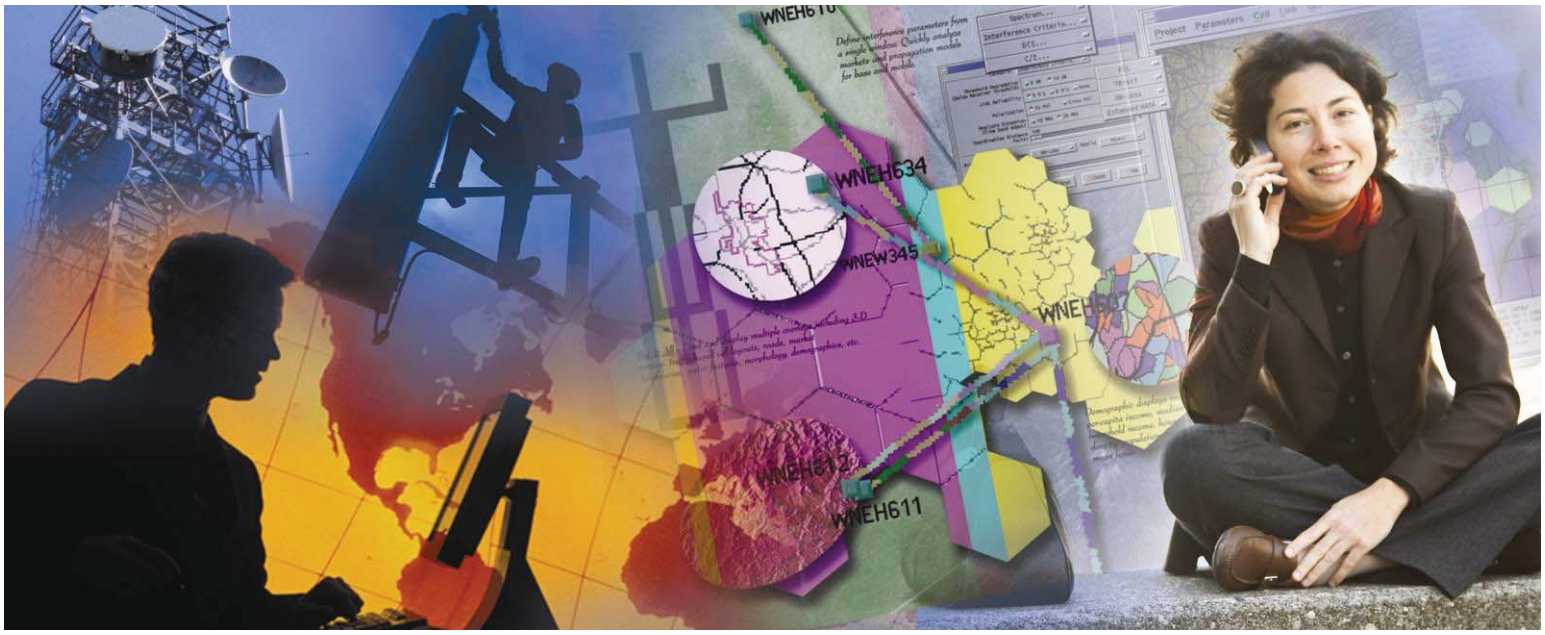

RADIO FREQUENCY MEASUREMENT REPORT

WMTS RF Measurements (608-614 MHz)

Prepared For

WMTS Coalition

January 2015

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APPENDIX 1

Pathloss Calculations

Executive Summary

Comsearch performed a series of Radio Frequency (RF) tests and measurements on behalf of the WMTS Coalition ("the Coalition") in the Alexandria, VA area within the vicinity of the INOVA Mount Vernon Hospital. The purpose of these measurements was to determine path loss values related to building losses, and to a lesser extent losses due to land clutter (foliage, buildings, man-made obstructions, etc). The tests were also performed to determine potential for interference into the GE Healthcare Systems ("GEHC") WMTS system in an attempt to characterize external interference into an installed and operative WMTS system. Comsearch worked with GEHC to identify candidate test sites and develop the test plan. In addition, we worked with GEHC to conduct the measurements, with GEHC taking independent measurement within the WMTS system.

The measurements were conducted by establishing a test transmit signal at nine locations between 338m and 2836m from the hospital. The locations were selected based upon access and the ability to see the hospital. Comsearch set up a spectrum analyzer at specific locations in the hospital close to WMTS receive antennas to capture receive signal level as close to the WMTS receive antenna as practical. The measurement results include line-of-sight profiles from each location to the hospital at the height within the hospital of the WMTS antennas. The test transmit signals included both CW and modulated waveforms that simulate typical transmissions from unlicensed devices.

The results indicated that path loss values could be measured that were between 0.2dB and 9.85 dB of calculated free space loss. In addition, when taken in conjunction with independent measurements performed by GEHC that it was possible to establish signals that could interfere with the WMTS system.

SECTION

ONE

SECTION 1

INTRODUCTION AND BACKGROUND

1.1 Introduction

Radio frequency tests and measurements were performed on behalf of the WMTS Coalition ("the Coalition") in the Alexandria, VA area within the vicinity of the Innova Mount Vernon Hospital. Comsearch worked with GE Healthcare Systems ("GEHC") to identify candidate test sites and develop the test plan. In addition, we worked with GEHC to conduct the measurements.

The purpose of these measurements was to determine path loss values related to building losses, and to a lesser extent losses due to land clutter (foliage, buildings, man-made obstructions, etc). Additionally, the tests were performed to determine potential interference into the GE Healthcare Systems WMTS system.

1.2 Background

Innova Mount Vernon is currently operating using frequencies in the WMTS Band, 608-614 MHz. This system is operational and has been for some time.

Comsearch has been tasked to perform path loss measurements and interference testing to determine the impact of adjacent transmitter systems operating in the same band.

GE Healthcare Systems was issued a Special Temporary Authority (STA) for this test under the call sign WI9XAF. This report documents the results of the field measurements.

1.3 Constraints

The analysis in this report is based on the following assumptions and constraints:

- The WMTS system being tested will not interfere with existing hospital operations.
- The WMTS system will be operational in a "test mode" simulating normal operating conditions.
- The test transmitter will generate power levels in accordance with FCC regulations. For each test site, Height Above Average Terrain (HAAT) will be determined and then referenced to a chart which indicates maximum permitted radiated power for that specific HAAT.

- Test sites in the area surrounding the hospital were selected to simulate various levels of path loss.

- Signal level measurements from inside the hospital will be measured in easily accessible areas, and not cause interruptions to hospital operations.

SECTION

TWO

SECTION 2

TEST PROCEDURE

2.1 Test Equipment

To generate the required signals for the test, a Rohde & Schwarz SMBV100A Vector Signal Generator was used. This signal generator allows for the generation of radio frequency (RF) test signals in either Continuous Wave (CW) or modulated modes. The test set is capable of generating up to +22 dBm. Prior to the on-site testing, a calibrated power meter was used to measure the output of the signal generator to ensure that the displayed power level on the signal generator matched the actual power level at the generator RF port.

The antenna used to transmit the signals generated by the R&S VSG was a Katherine-Scala CL-1469B. This antenna provides a nominal 10 dB of gain at 470-862 MHz. The antenna was mounted on a tripod to facilitate a centerline of 9 feet (2.7 meters) above ground level (AGL). Signal polarity for all tests was vertical.

The antenna for the spectrum analyzer test set used in the hospital was a Shure PA805SWB. This is a wide-band, log periodic style antenna with a nominal gain of 6.5 dBi in the frequency range of 470-952 MHz. The antenna was oriented so that it was vertically polarized.

2.2 Calibration

Figure 2.2-1 is the block diagram of the spectrum analyzer test set. All test equipment used was allowed a proper warm-up period prior to calibration. The calibrated reference signal (-40dBm) from the signal generator was then injected into the end of the coaxial cable of the test set at the point which normally connects to the test antenna. An Agilent FieldFox spectrum analyzer then measured the reference test signal level after passing through the test set. Upon completion of the calibration process, a known reference level was obtained for the measurements which correspond to a given set of spectrum analyzer display readings. Figure 2.2-2 shows the spectrum photograph of the described calibration procedure employed during the band sweep measurements.

The following formula is used to transform the measured signal level as read on the spectrum analyzer display (dBm) to an isotropic reference signal level (dBm_I) as seen at the point of test:

$$dBm_I = LI - GA$$

Where: dBm_I = Isotropic level in dBm

LI = Level (dBm) of injected signal

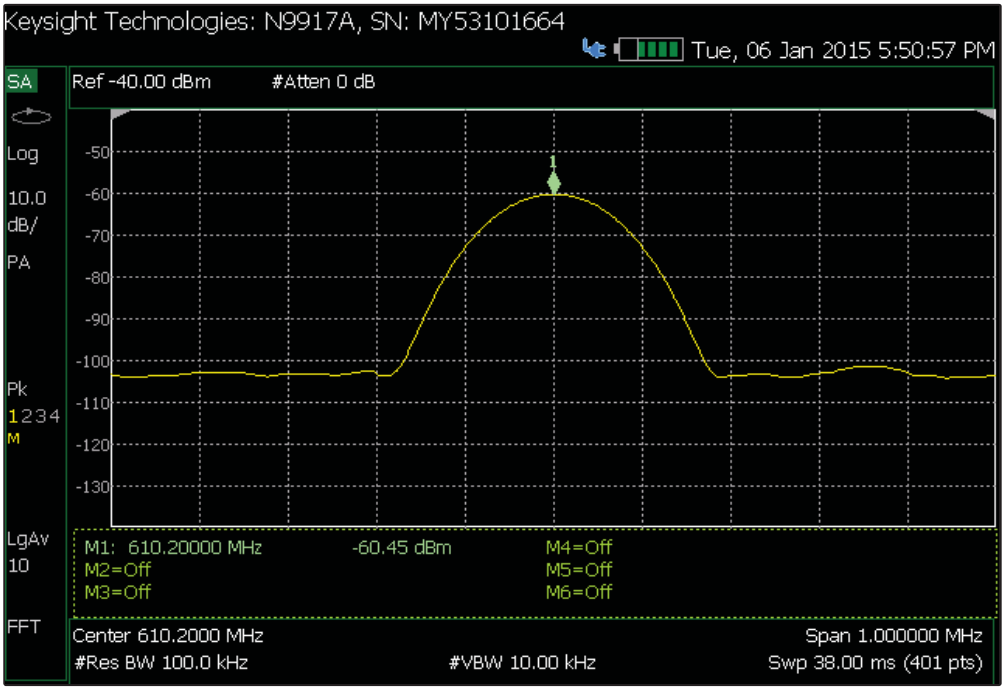
GA = Test antenna gain

at 610 MHz: $dBm_I = -60\ dBm - 6.5\ dB$

$= -66.5\ dBm_I$

In this instance, the spectrum analyzer displayed measured signal level of -60 dBm_I equates to an injected signal level of -60 dBm and represents an isotropic level of -66.5 dBm_I

Figure 2.2-1 600 MHz Receive Test Equipment



(A)

Res BW: 100 kHz
Video BW: 10 kHz

The -60 dBm, 610.200 MHz signal indication on the spectrum photograph represents a -60 dBm CW signal being injected into the point where the test cable connects to the output of the test antenna.

Figure 2.2-2 Spectrum Analyzer Calibration

2.3 Methodology

The purpose of these RF measurements is to show potential interference into WMTS (Wireless Medical Telemetry Systems) operations used by the hospital (INOVA Mt Vernon) from a transmitter operating in the WMTS frequencies of 608 to 614 MHz. GE had setup up a separate test network of four transmitters simulating devices used in actual operation at the hospital.

A potential interfering source was produced by setting up a test transmitter (Rohde & Schwarz SMBV100A) for use in the in the WMTS band. The test transmitter was set to frequencies designated by GE to ensure non-interference into existing WMTS operational frequencies at the hospital. The transmitter was connected to a directional antenna (Kathrein Scala CL-1469 B) with centerline of 9 feet above ground and pointed toward the hospital from each test point. At each test point the HAAT was calculated. Using the calculated HAAT, power density restrictions (FCC 14-144 para.42) and separation distance restrictions (FCC 14-144 para.112) power levels for the test transmitter were calculated for a 6 MHz modulated carrier. These power levels were then translated into values for a 100 kHz modulated carrier and then used to set the RF power level at the signal generator (see table below).

EIRP (dBm)		TX Power (dBm) (minus antenna gain)	Cable Loss (dB)	Conducted Power at Signal Generator (dBm)
in 6MHz	in 100kHz			
16	-1.404	-11.404	1.47	-9.93
20	2.596	-7.404	1.47	-5.93
24	6.596	-3.404	1.47	-1.93
28	10.596	0.596	1.47	2.07
32	14.596	4.596	1.47	6.07
36	18.596	8.596	1.47	10.07

The transmitter was powered up using a CW (carrier wave) signal at the frequency of 610.2000 MHz. The signal at 610.200 MHz was used because this was outside of the test signals used by the GE test network and would not be masked and therefore visible when powered on. RF measurements were performed inside the hospital using the receive test set describe in section 2.1 of the test signal which is external to the WMTS system used by the hospital as well as a RF monitoring unit (CRFS RF Eye Node) placed upon the rooftop of the hospital. Concurrently separate RF measurements were conducted by GE using the WMTS distributed antenna system installed in the hospital (GE is preparing a separate report for this effort). Upon direction from the GE team the CW signal was powered off and the transmitter was reconfigured to transmit a modulated (802.x – 64 QAM) 100 kHz signal at 610.200 kHz. The signal was powered on and RF measurements were then conducted of this test signal as previously described both external and internal to the hospital's WMTS system. Again upon direction from the GE team the modulated signal was powered off the transmitter was reconfigured to transmit a modulated (802.x – 64 QAM) 100 kHz signal at 610.3375 kHz. The signal at 610.3375 MHz was used as it overlaid the test signals used the GE test network. Once again the signal was powered on and RF measurements were then conducted of this test signal as previously described both external and internal to the hospital's WMTS system. This process was repeated for each test point.

SECTION

THREE

SECTION 3

Data Presentation

The following section contains street maps, aerial maps, and spectrum photographs pertaining to each test site location.

3.0 Hospital Site

- Figure 3.0-1 Street map of the Hospital location
- Figure 3.0-2 Aerial photograph of the Hospital location
- Figure 3.0-3 Street map of the Hospital and transmitter locations
- Figure 3.0-4 Aerial photograph of the Hospital and transmitter locations
- Figure 3.0-5 Street map of the Hospital and close-in transmitter locations
- Figure 3.0-6 Aerial photograph f the Hospital and close-in transmitter locations

3.1 Transmitter Site 1

- Figure 3.1-1 Street map of the transmitter location
- Figure 3.1-2 Aerial photograph of the transmitter location
- Figure 3.1-3 through Figure 3.1-5 Path views from transmitter test site location towards Inova Mount Vernon Hospital and reverse
- Figure 3.1-6 Receive Test Set in Inova Mount Vernon Hospital for Transmitter Site #1 location
- Figure 3.1-7 through Figure 3.1-11 RF spectrum photographs

3.2 Transmitter Site 2

- Figure 3.2-1 Street map of the transmitter location
- Figure 3.2-2 Aerial photograph of the transmitter location
- Figure 3.2-3 through Figure 3.2-6 Path views from transmitter test site location towards Inova Mount Vernon Hospital and reverse
- Figure 3.2-7 Receive Test Set in Inova Mount Vernon Hospital for Transmitter Site #2 location
- Figure 3.2-8 through Figure 3.2-12 RF spectrum photographs

3.3 Transmitter Site 4

- Figure 3.3-1 Street map of the transmitter location
- Figure 3.3-2 Aerial photograph of the transmitter location
- Figure 3.3-3 through Figure 3.3-6 Path views from transmitter test site location towards Inova Mount Vernon Hospital and reverse
- Figure 3.3-7 Receive Test Set in Inova Mount Vernon Hospital for Transmitter Site #4 location
- Figure 3.3-8 through Figure 3.3-10 RF spectrum photographs

3.4 Transmitter Site 4a

- Figure 3.4-1 Street map of the transmitter location
- Figure 3.4-3 through Figure 3.4-6 Path views from transmitter test site location towards Inova Mount Vernon Hospital and reverse
- Figure 3.4-7 Receive Test Set in Inova Mount Vernon Hospital for Transmitter Site #4a location
- Figure 3.4-8 RF spectrum photograph

3.5 Transmitter Site 4b

- Figure 3.5-1 Street map of the transmitter location
- Figure 3.5-2 Aerial photograph of the transmitter location
- Figure 3.5-3 through Figure 3.5-6 Path views from transmitter test site location towards Inova Mount Vernon Hospital and reverse
- Figure 3.5-7 Receive Test Set in Inova Mount Vernon Hospital for Transmitter Site #4b location
- Figure 3.5-8 through Figure 3.5-11 RF spectrum photographs

3.6 Transmitter Site 4c

- Figure 3.6-1 Street map of the transmitter location
- Figure 3.6-2 Aerial photograph of the transmitter location
- Figure 3.6-3 through Figure 3.6-6 Path views from transmitter test site location towards Inova Mount Vernon Hospital and reverse
- Figure 3.6-7 Receive Test Set in Inova Mount Vernon Hospital for Transmitter Site #4c location
- Figure 3.6-8 through Figure 3.6-11 RF spectrum photographs

3.7 Transmitter Site 4d

- Figure 3.7-1 Street map of the transmitter location
- Figure 3.7-2 Aerial photograph of the transmitter location
- Figure 3.7-3 through Figure 3.7-6 Path views from transmitter test site location towards Inova Mount Vernon Hospital and reverse
- Figure 3.7-7 Receive Test Set in Inova Mount Vernon Hospital for Transmitter Site #4d location
- Figure 3.7-8 through Figure 3.7-11 RF spectrum photographs

3.8 Transmitter Site 4e

- Figure 3.8-1 Street map of the transmitter location
- Figure 3.8-2 Aerial photograph of the transmitter location
- Figure 3.8-3 through Figure 3.8-6 Path views from transmitter test site location towards Inova Mount Vernon Hospital and reverse
- Figure 3.8-7 Receive Test Set in Inova Mount Vernon Hospital for Transmitter Site #4e location
- Figure 3.8-8 through Figure 3.8-11 RF spectrum photographs

3.9 Transmitter Site 5

- Figure 3.9-1 Street map of the transmitter location
- Figure 3.9-2 Aerial photograph of the transmitter location
- Figure 3.9-3 through Figure 3.9-6 Path views from transmitter test site location towards Inova Mount Vernon Hospital and reverse
- Figure 3.9-7 Receive Test Set in Inova Mount Vernon Hospital for Transmitter Site #5 location
- Figure 3.9-8 through Figure 3.9-11 RF spectrum photographs

Figure 3.0-1 – Street Map – Hospital Location

Figure 3.0-2 – Aerial Map – Hospital Location

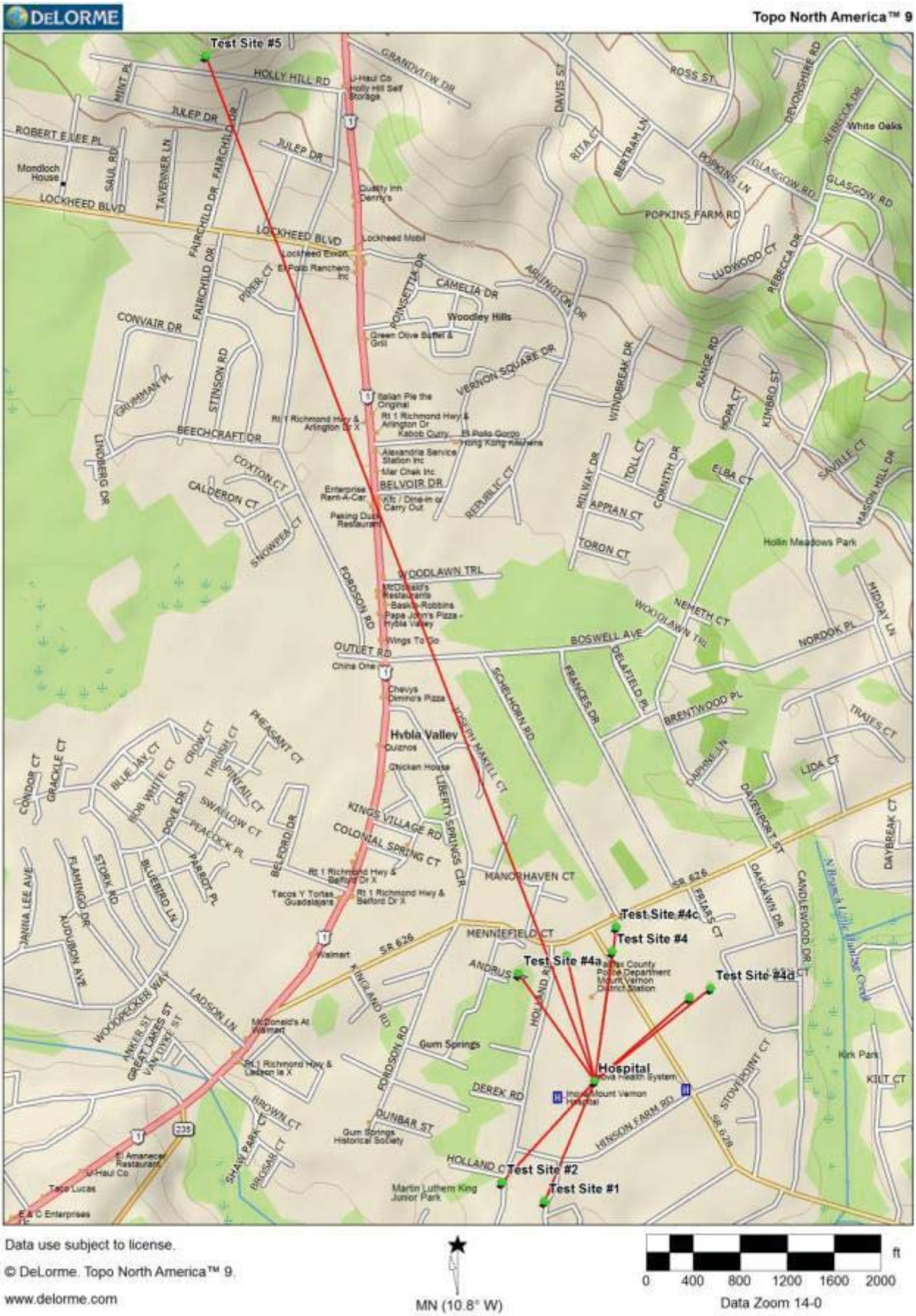


Figure 3.0-3 – Street Map – Test Site Locations

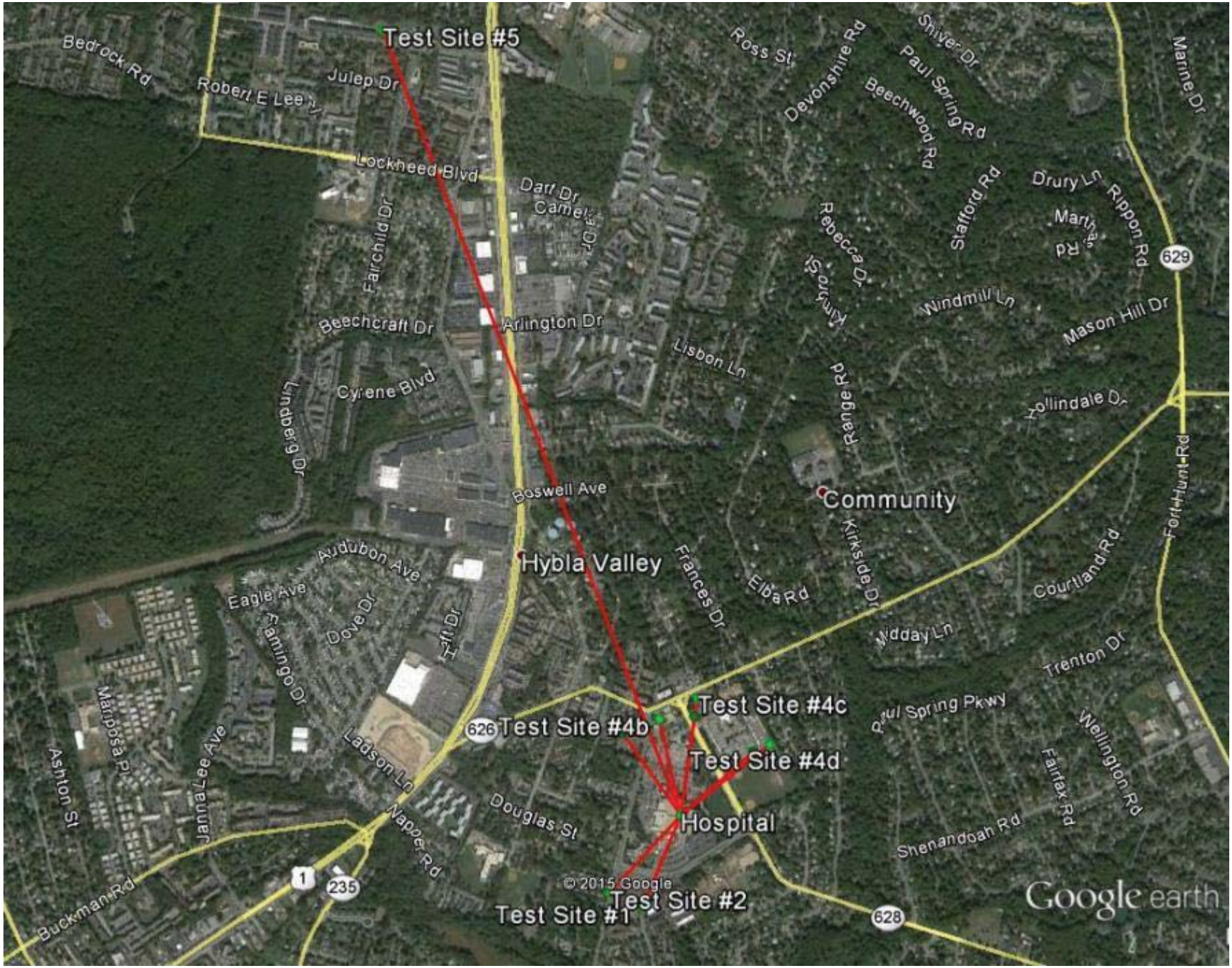


Figure 3.0-4 – Aerial Map – Test Site Locations

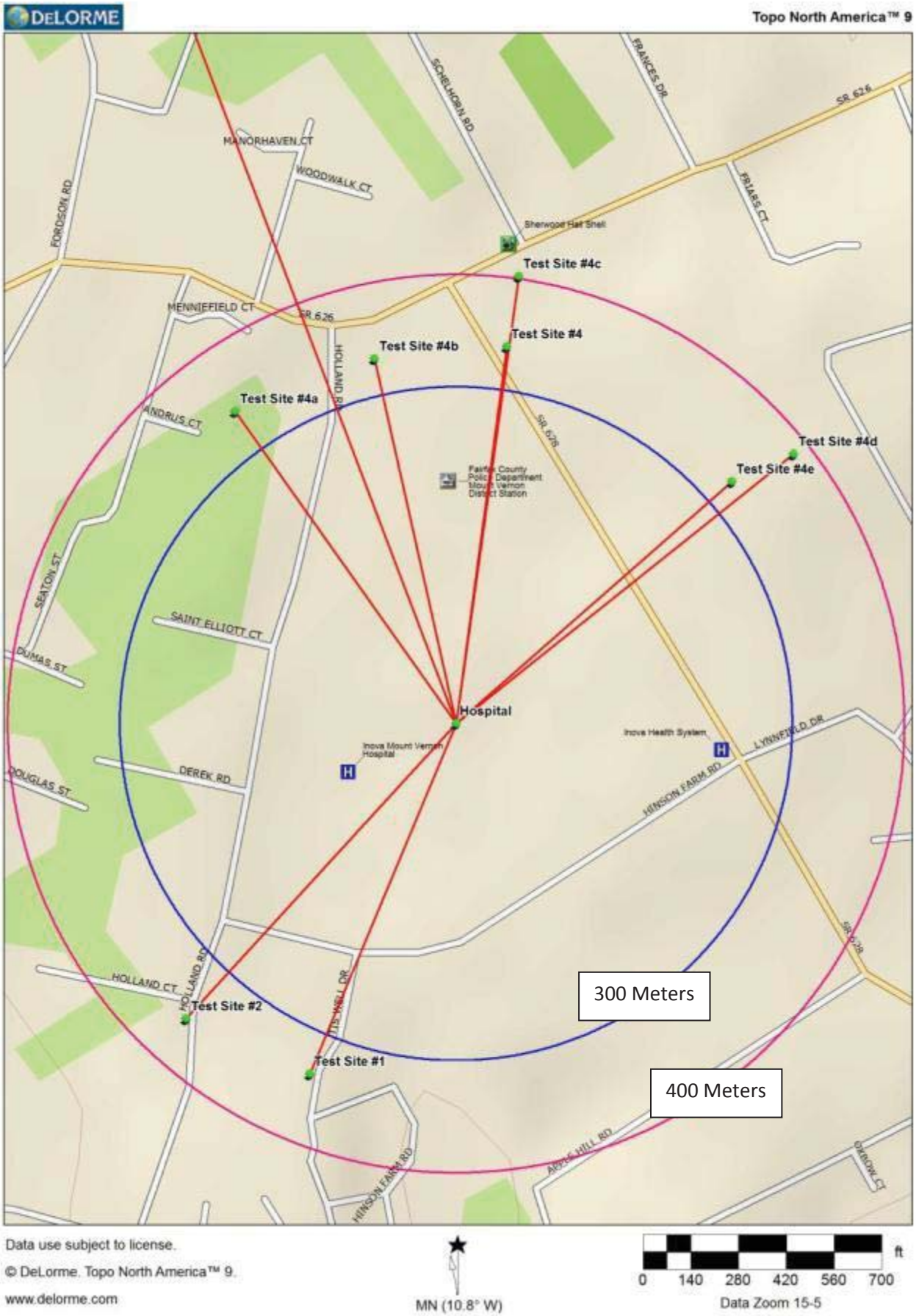


Figure 3.0-5 – Street Map – Close in Test Site Locations

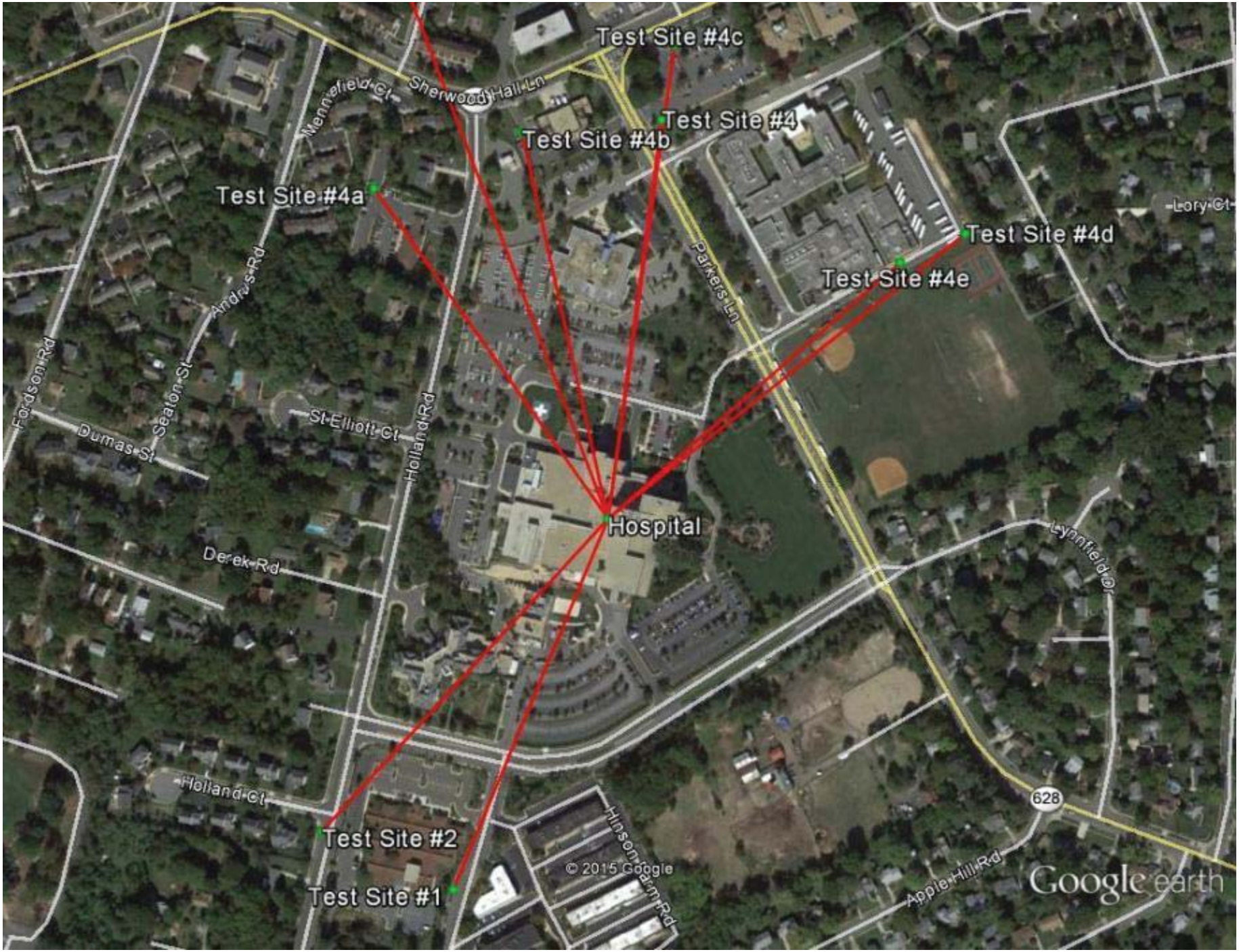


Figure 3.0-6 – Aerial Map – Close in Test Site Locations

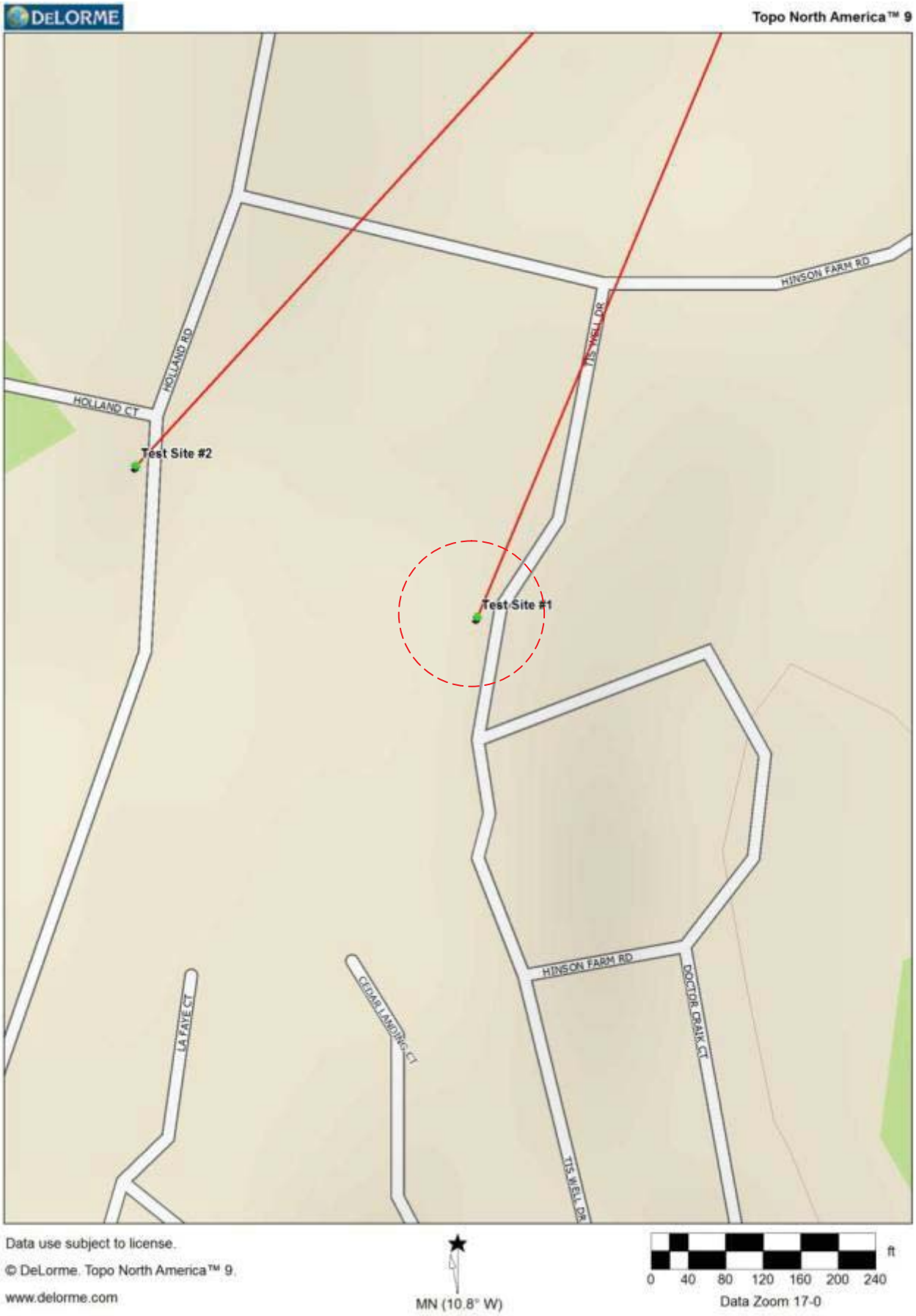


Figure 3.1-1 – Street Map – Test Site #1 Transmitter Location

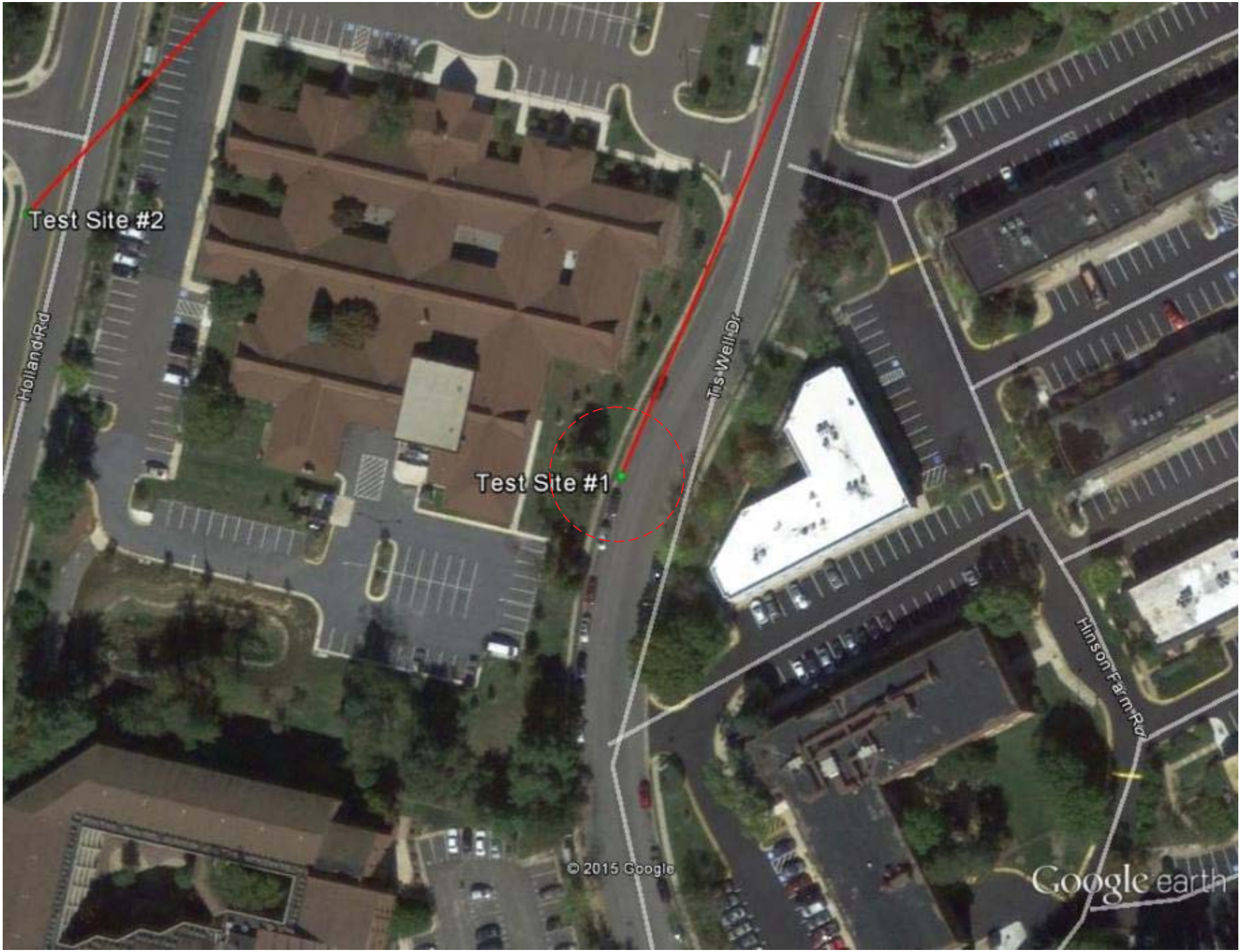


Figure 3.1-2 – Aerial Map – Test Site #1 Transmitter Location

Figure 3.1-3 – View toward Inova Mount Vernon Hospital from Test Site #1

Figure 3.1-4 – View toward Test Site #1 from inside Inova Mount Vernon Hospital 5th floor

Figure 3.1-5 – View toward Test Site #1 from inside Inova Mount Vernon Hospital 5th floor - Zoom

Figure 3.1-6 – Receive Test Set in Inova Mt Vernon Hospital on 5th floor exterior room – for Test Site #1

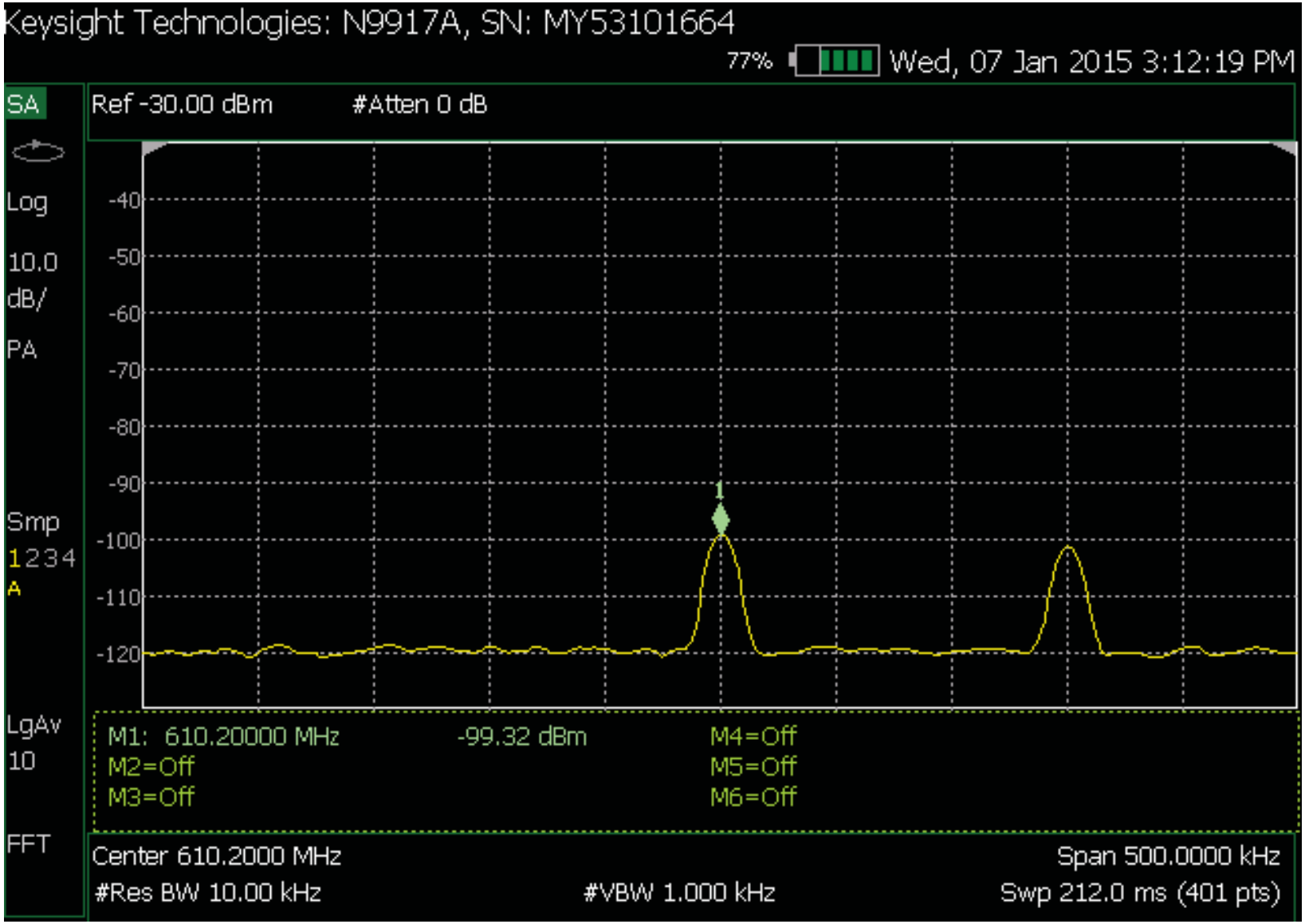


Figure 3.1-7 – Test Site #1 – Spectrum analyzer capture at 10 kHz RBW CW signal
Spectrum analyzer located on 5th floor exterior room approximately 338 meters from the street level Test Site #1
Average recorded level -99.32 dBm (610.200 MHz) Marker 1 – isotropic value -105.82 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

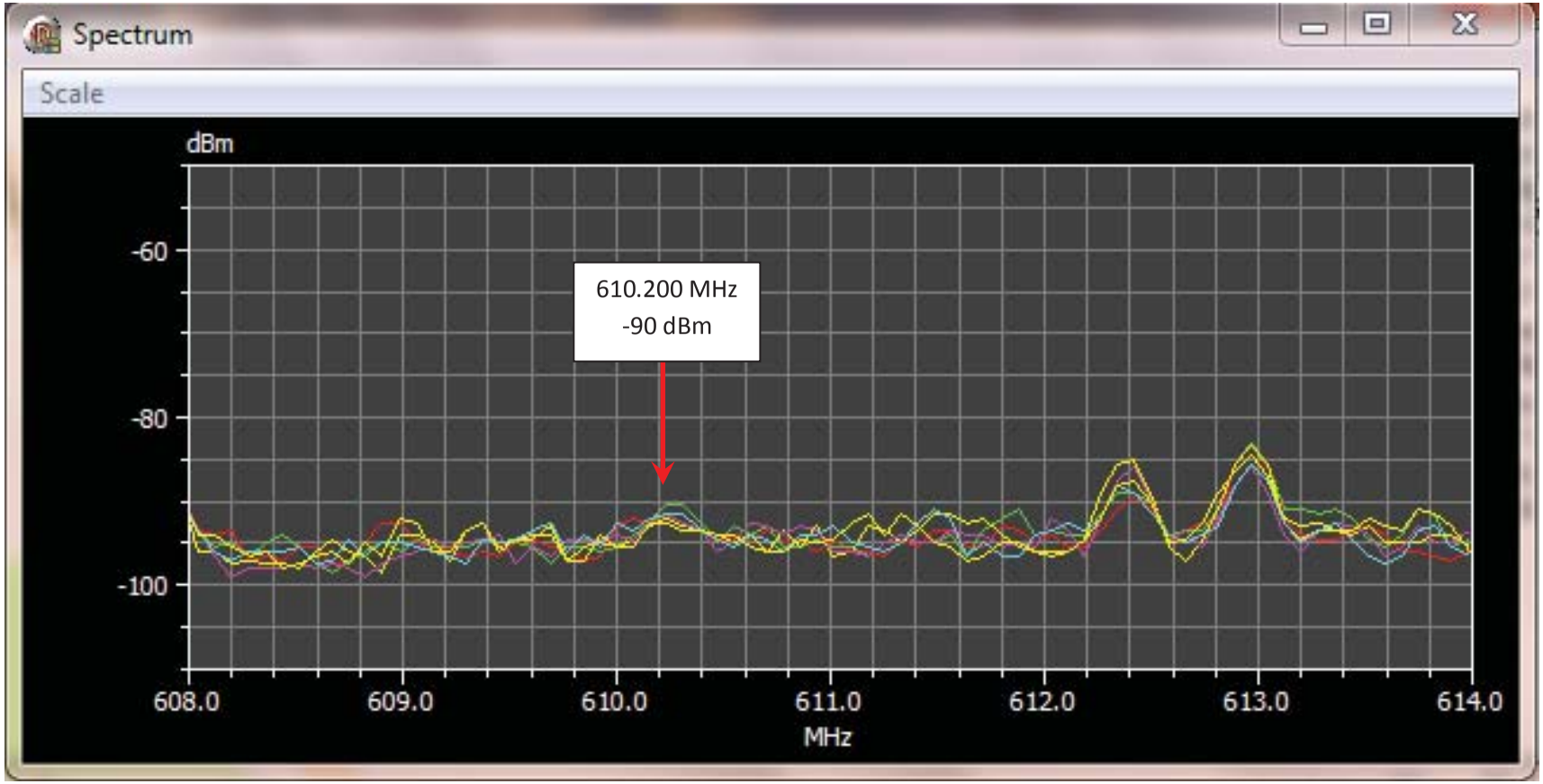


Figure 3.1-8 – Test Site #1 – Spectrum capture from rooftop
Spectrum Monitor located on rooftop approximately 338 meters from the street level Test Site #1
Maximum recorded level -90 dBm (610.200 MHz) Marker 1
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)

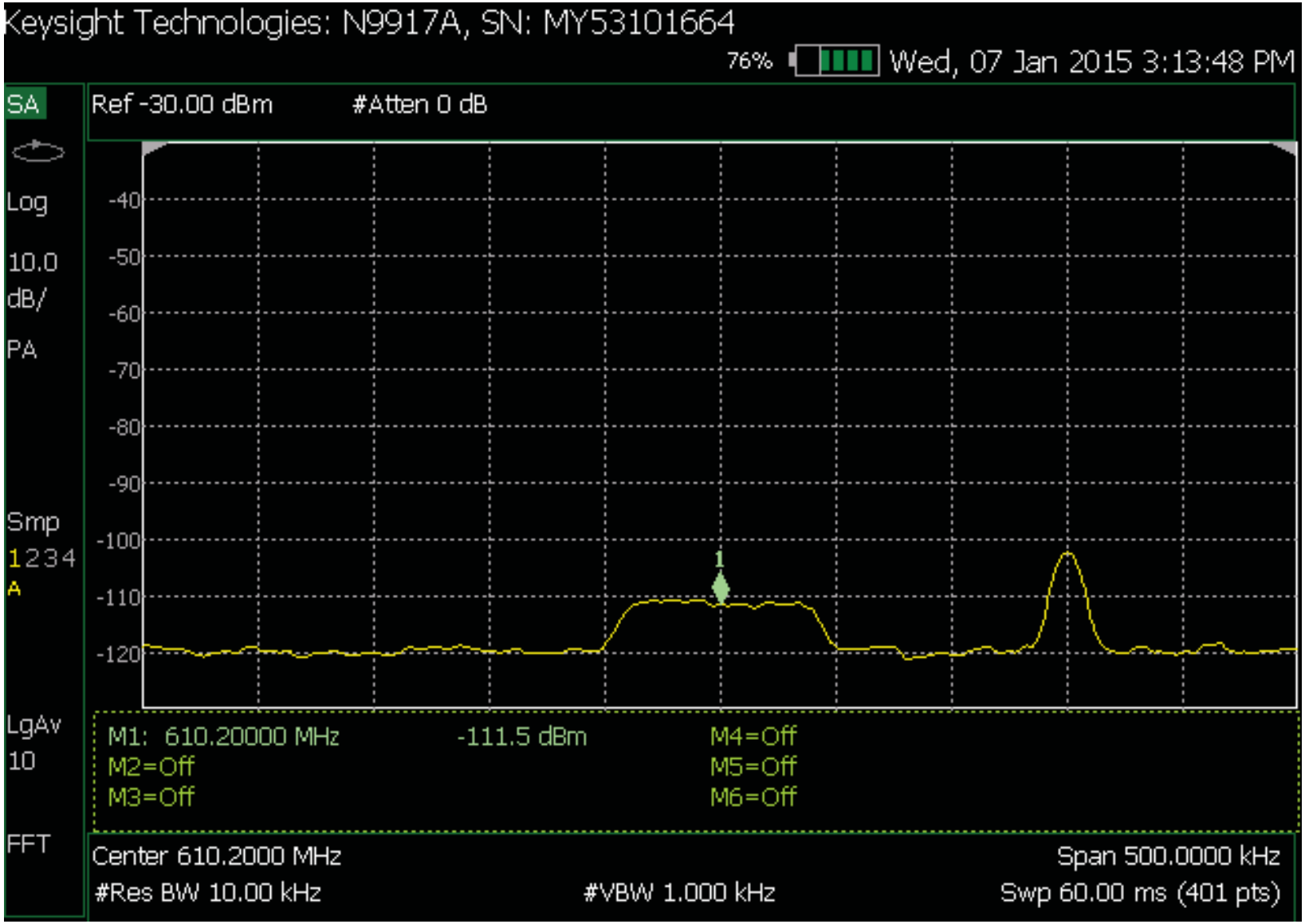


Figure 3.1-9 – Test Site #1 – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 5th floor exterior room approximately 338 meters from the street level Test Site #1
Average recorded level -111.5 dBm (610.200 MHz) Marker 1 – isotropic value --118 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

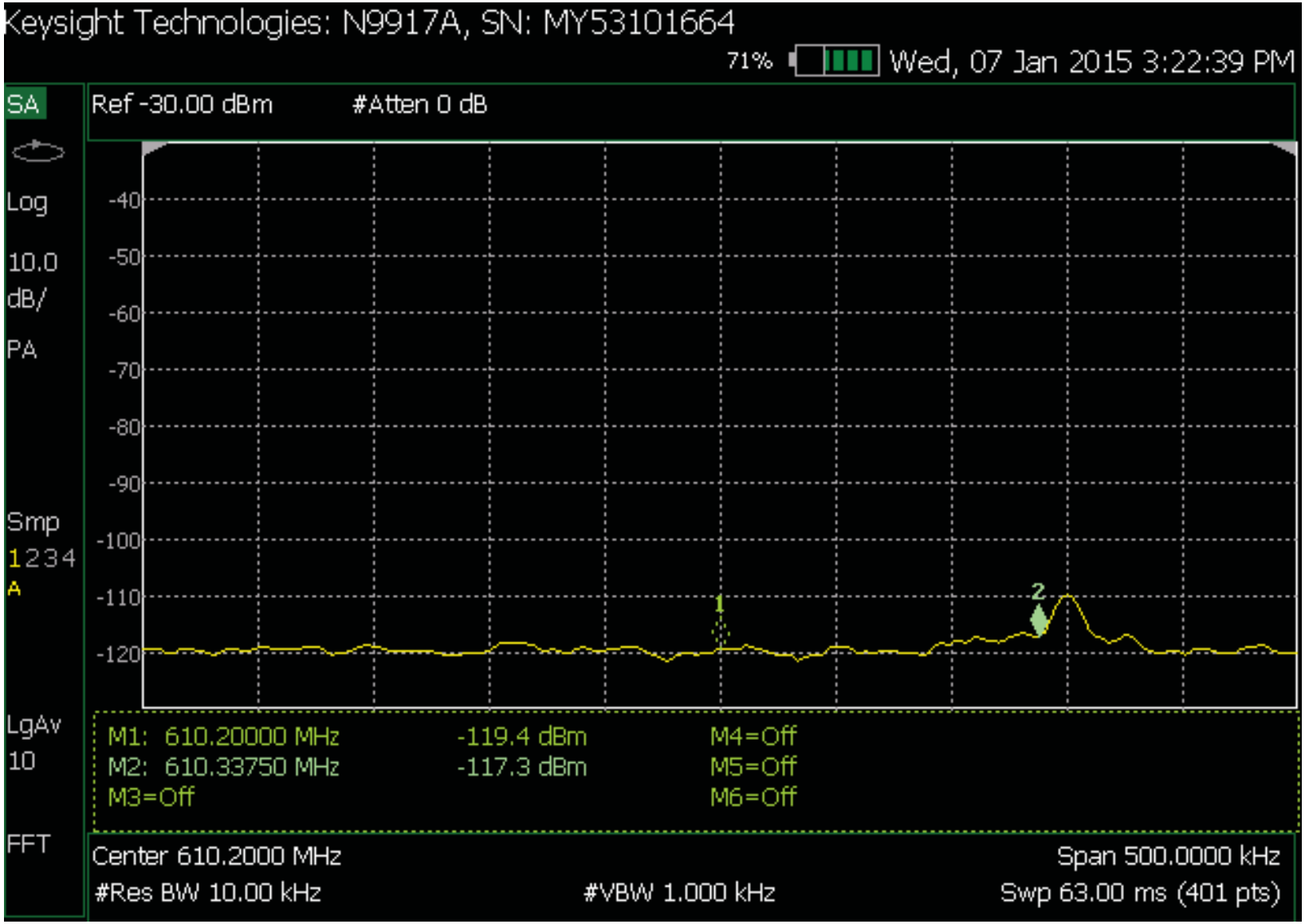


Figure 3.1-10 – Test Site #1 – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 5th floor exterior room approximately 338 meters from the street level Test Site #1
Average recorded level -117.3 dBm (610.3375 MHz) Marker 2 – isotropic value –123.8 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

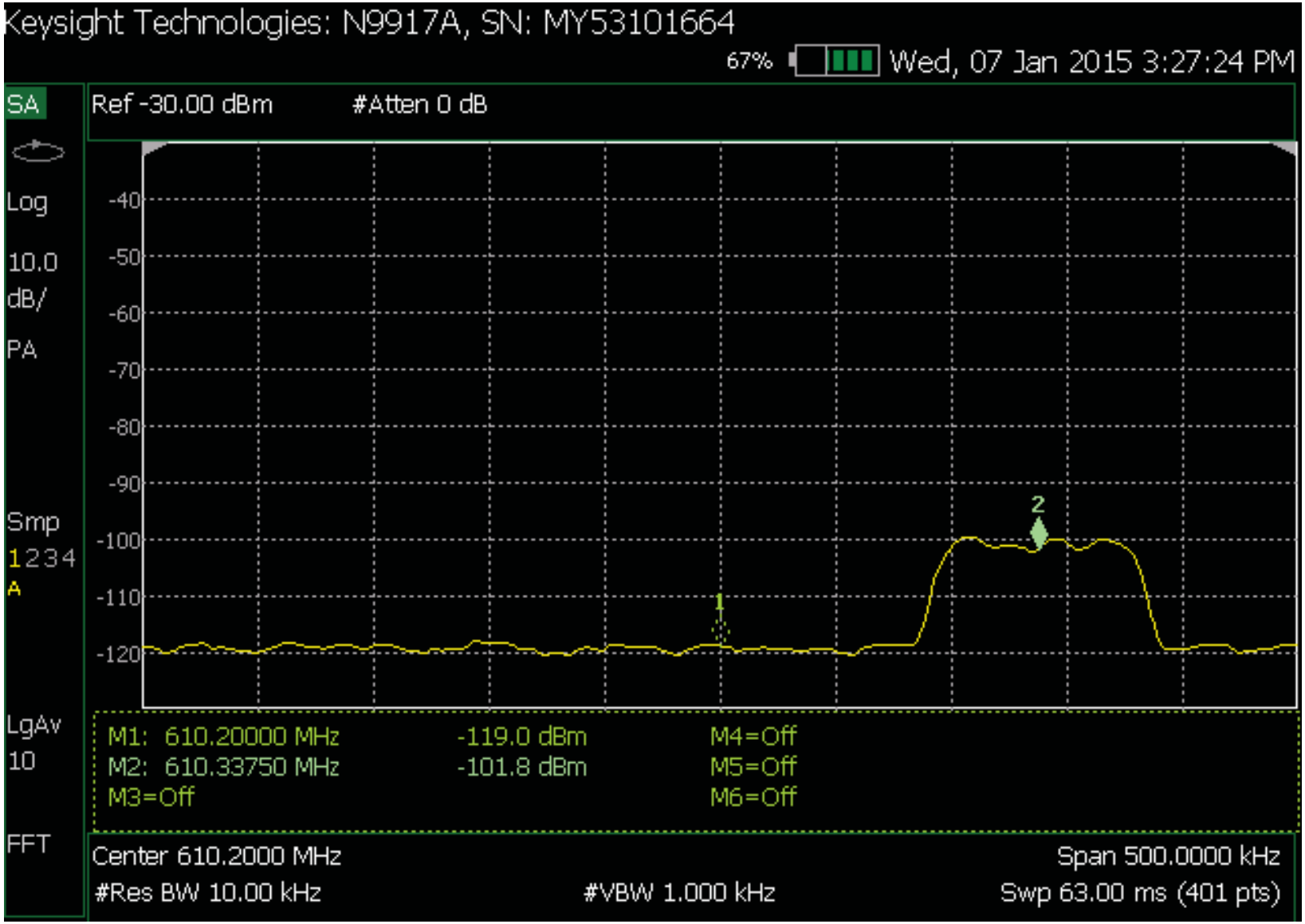


Figure 3.1-11 – Test Site #1 – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 5th floor exterior room approximately 338 meters from the street level Test Site #1
Average recorded level -101.8 dBm (610.3375 MHz) Marker 2 – isotropic value –108.3 dBm
Transmitter EIRP +11.46 dBm (Signal Generator set to +2.93 dBm) – This is 12.86 dBm above the PSD limit for 6 MHz carrier

Figure 3.2-1 – Street Map – Test Site #2 Transmitter Location

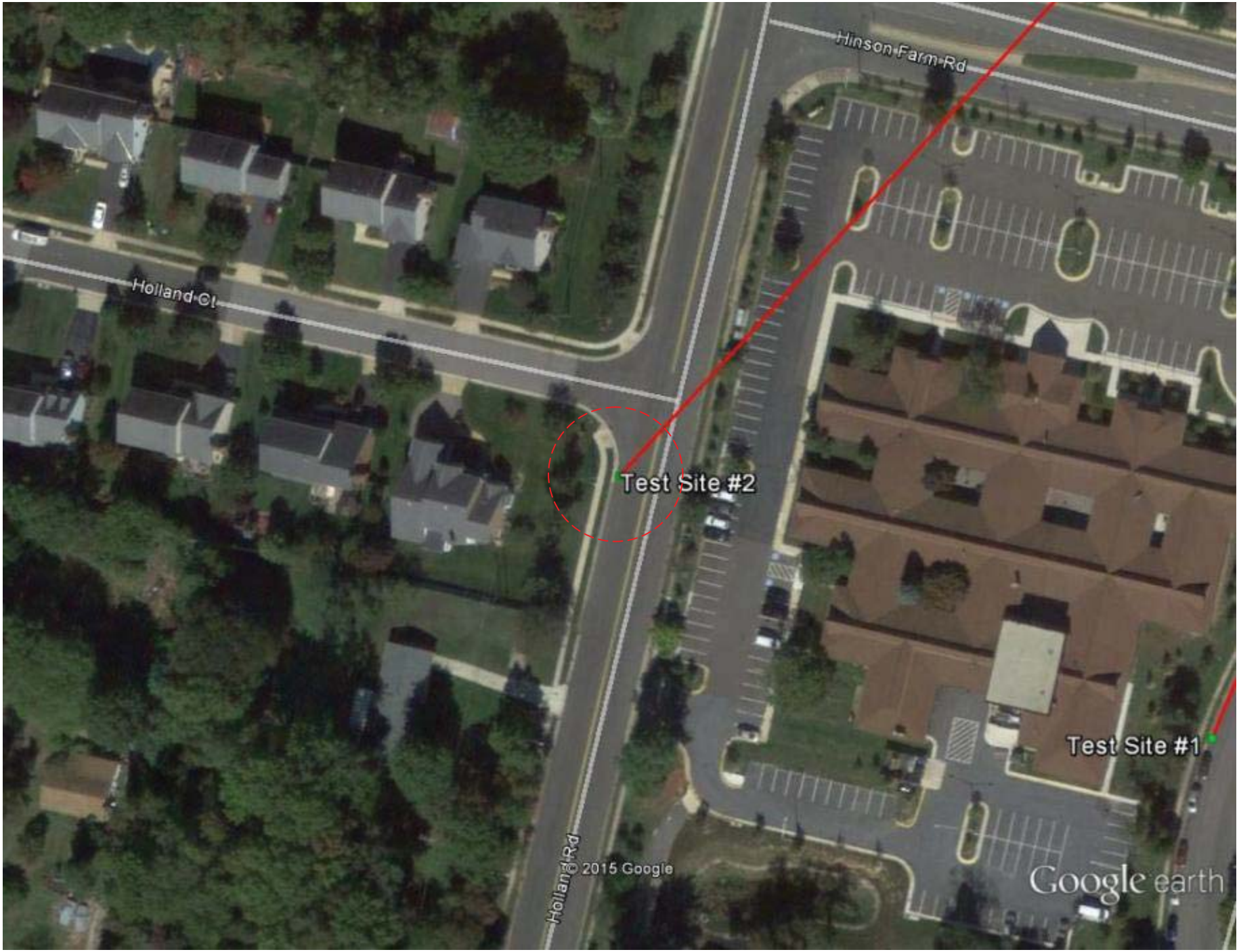


Figure 3.2-2 – Aerial Map – Test Site #2 Transmitter Location

Figure 3.2-3 – View toward Inova Mount Vernon Hospital from Test Site #2

Figure 3.2-4 – View toward Inova Mount Vernon Hospital from Test Site #2 - Zoom

Figure 3.2-5 –Test Site #2 – Transmitter

Figure 3.2-6 – View toward Test Site #2 from inside Inova Mount Vernon Hospital 5th floor

Figure 3.2-7 – Receive Test Set in Inova Mt Vernon Hospital on 5th floor exterior room – for Test Site #2

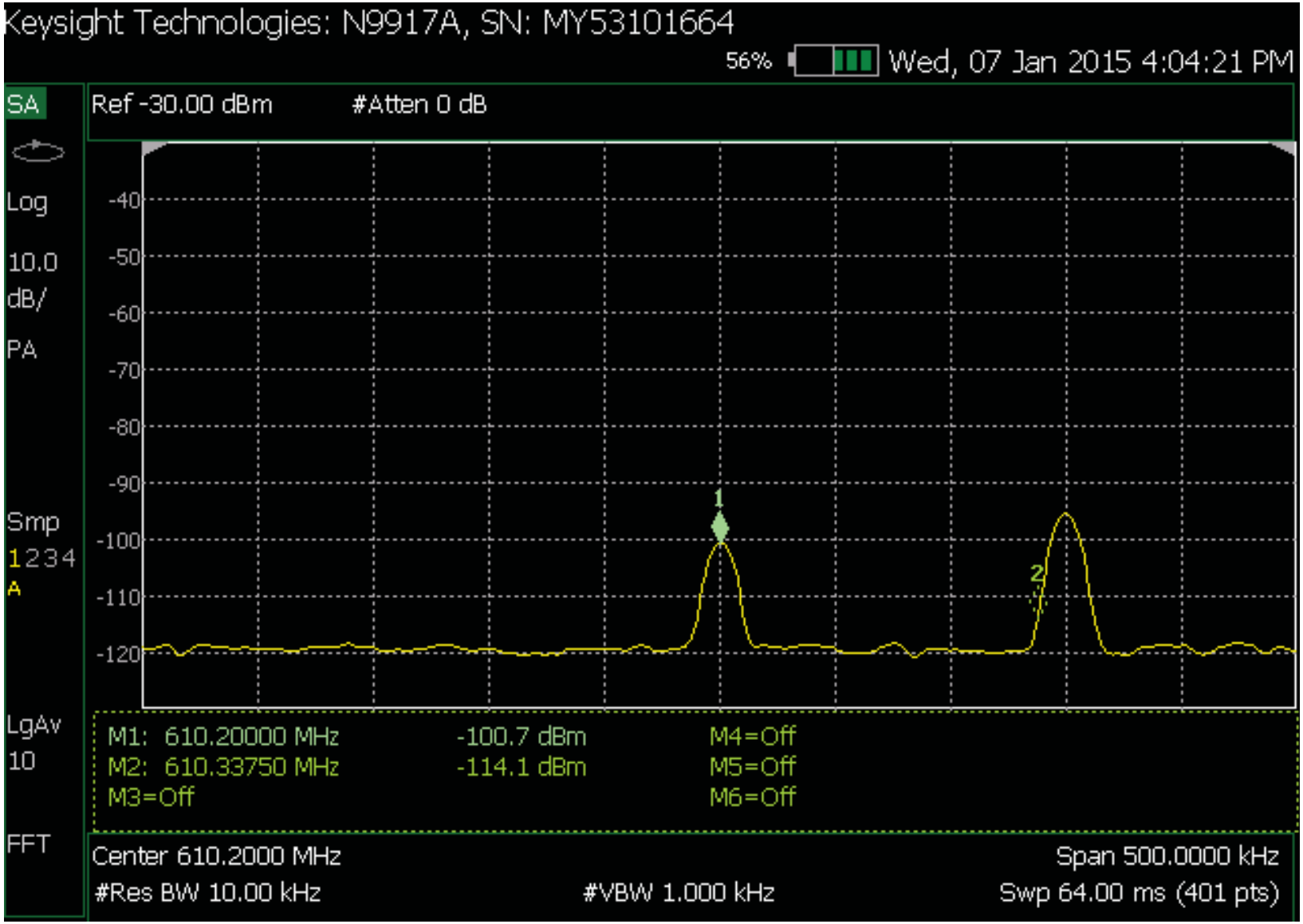


Figure 3.2-8 – Test Site #2 – Spectrum analyzer capture at 10 kHz RBW CW signal
Spectrum analyzer located on 5th floor exterior room approximately 357 meters from the street level Test Site #2
Average recorded level -100.7 dBm (610.200 MHz) Marker 1 – isotropic value -107.2 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

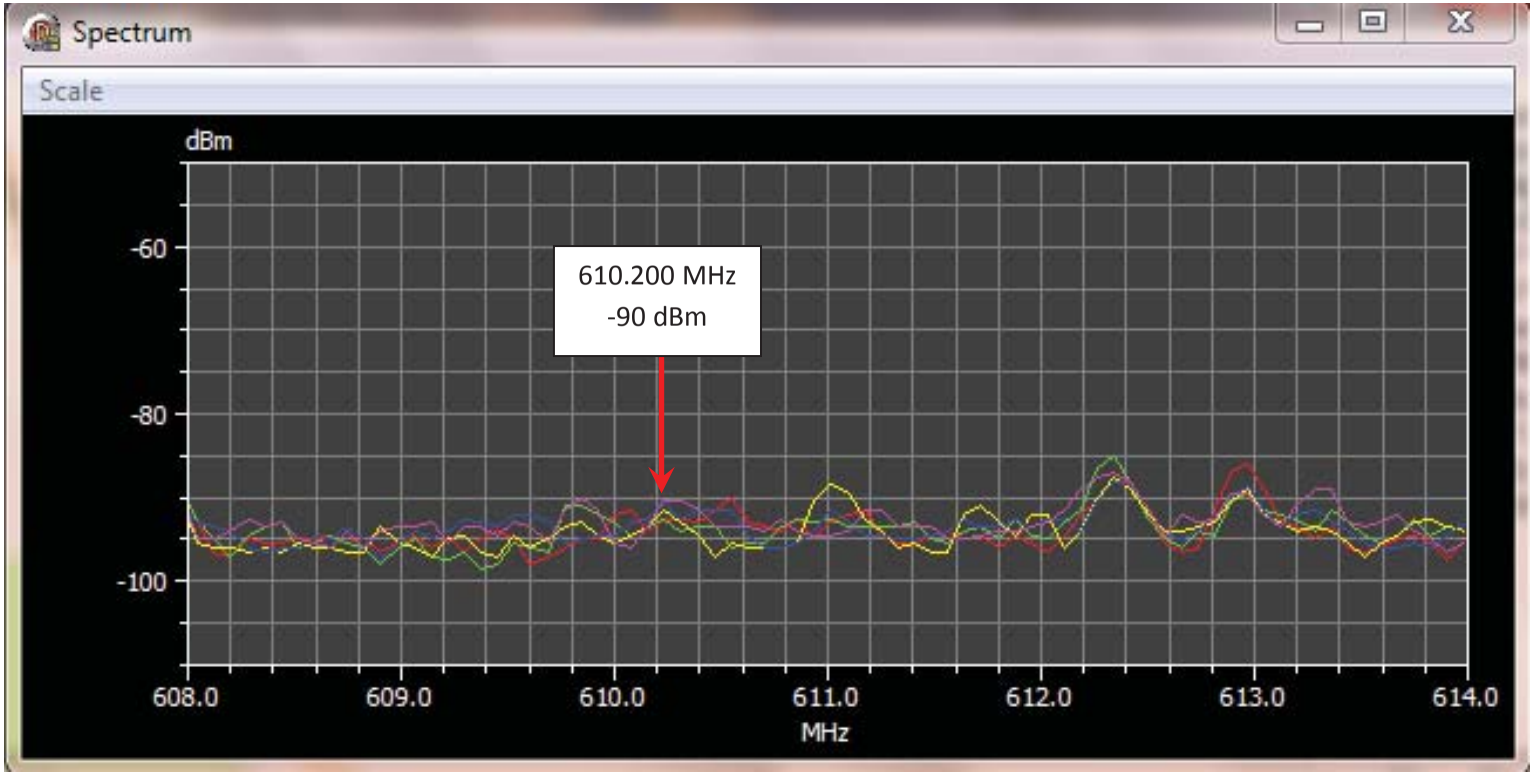


Figure 3.2-9 – Test Site #2 – Spectrum capture from rooftop
Spectrum Monitor located on rooftop approximately 357 meters from the street level Test Site #2
Maximum recorded level -90 dBm (610.200 MHz) Marker 1
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)

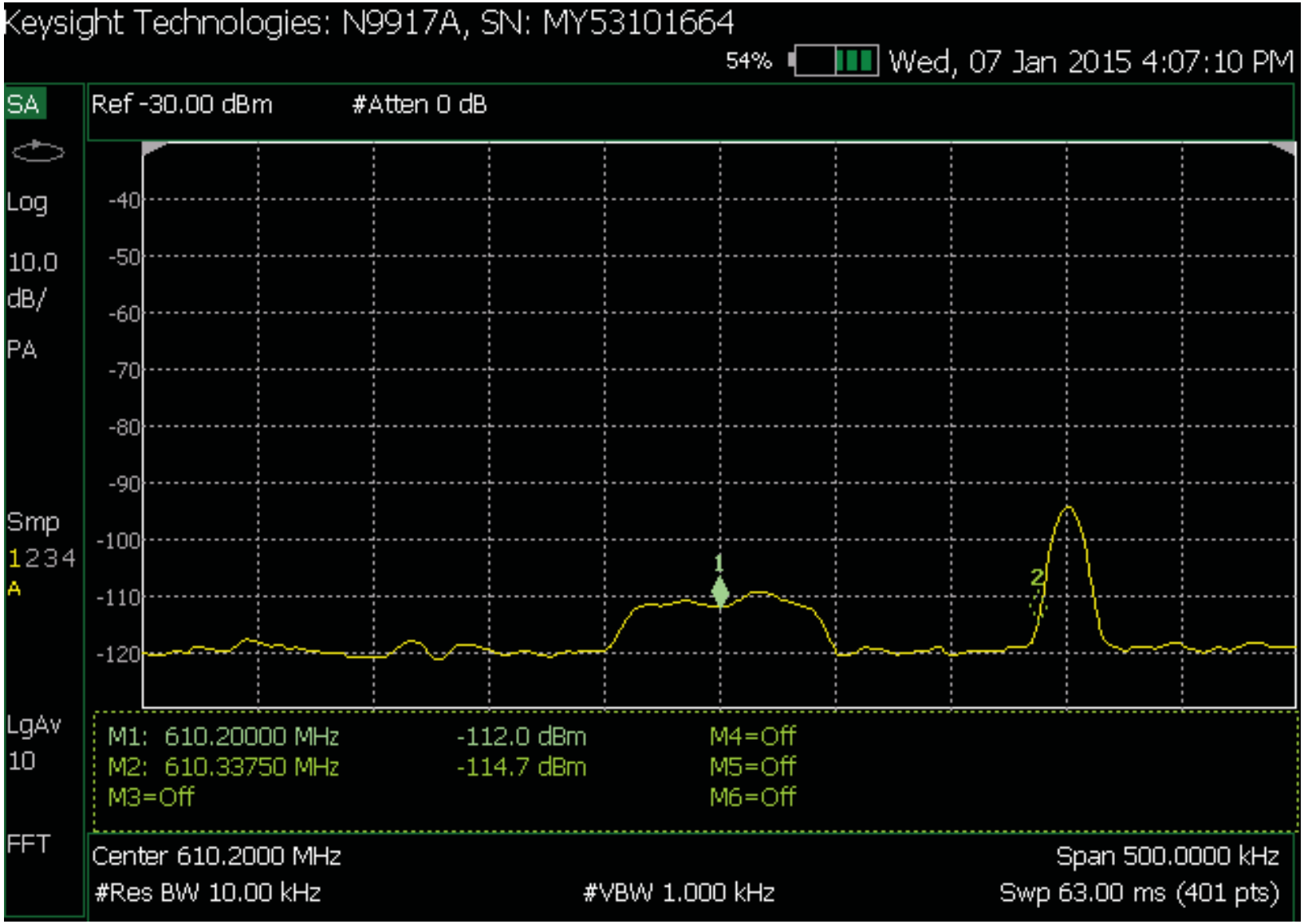


Figure 3.2-10 – Test Site #2 – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 5th floor exterior room approximately 357 meters from the street level Test Site #2
Average recorded level -112.0 dBm (610.200 MHz) Marker 1 – isotropic value -118.5 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

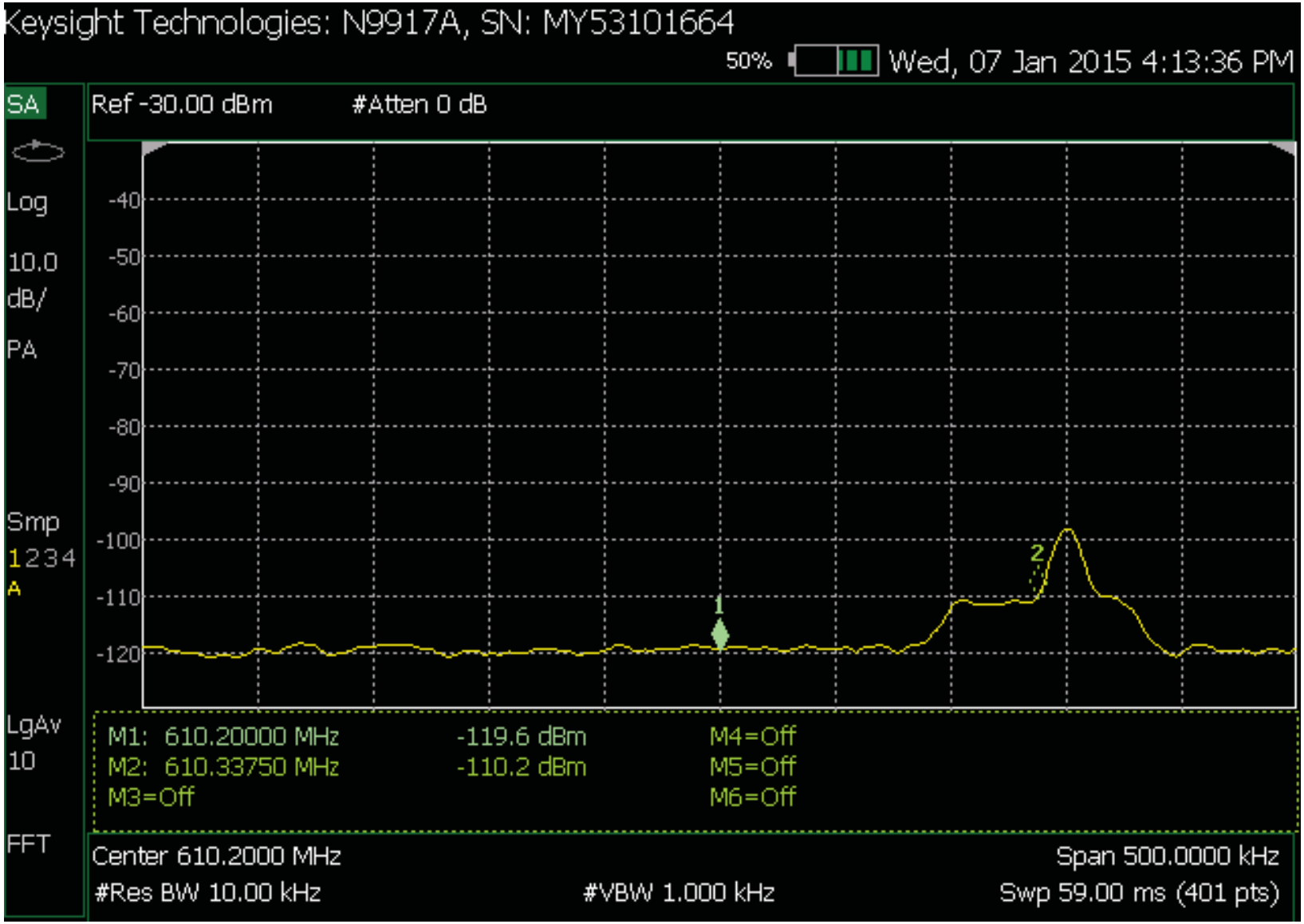


Figure 3.2-11 – Test Site #2 – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 5th floor exterior room approximately 357 meters from the street level Test Site #2
Average recorded level -110.2 dBm (610.3375 MHz) Marker 2 – isotropic value -116.7 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

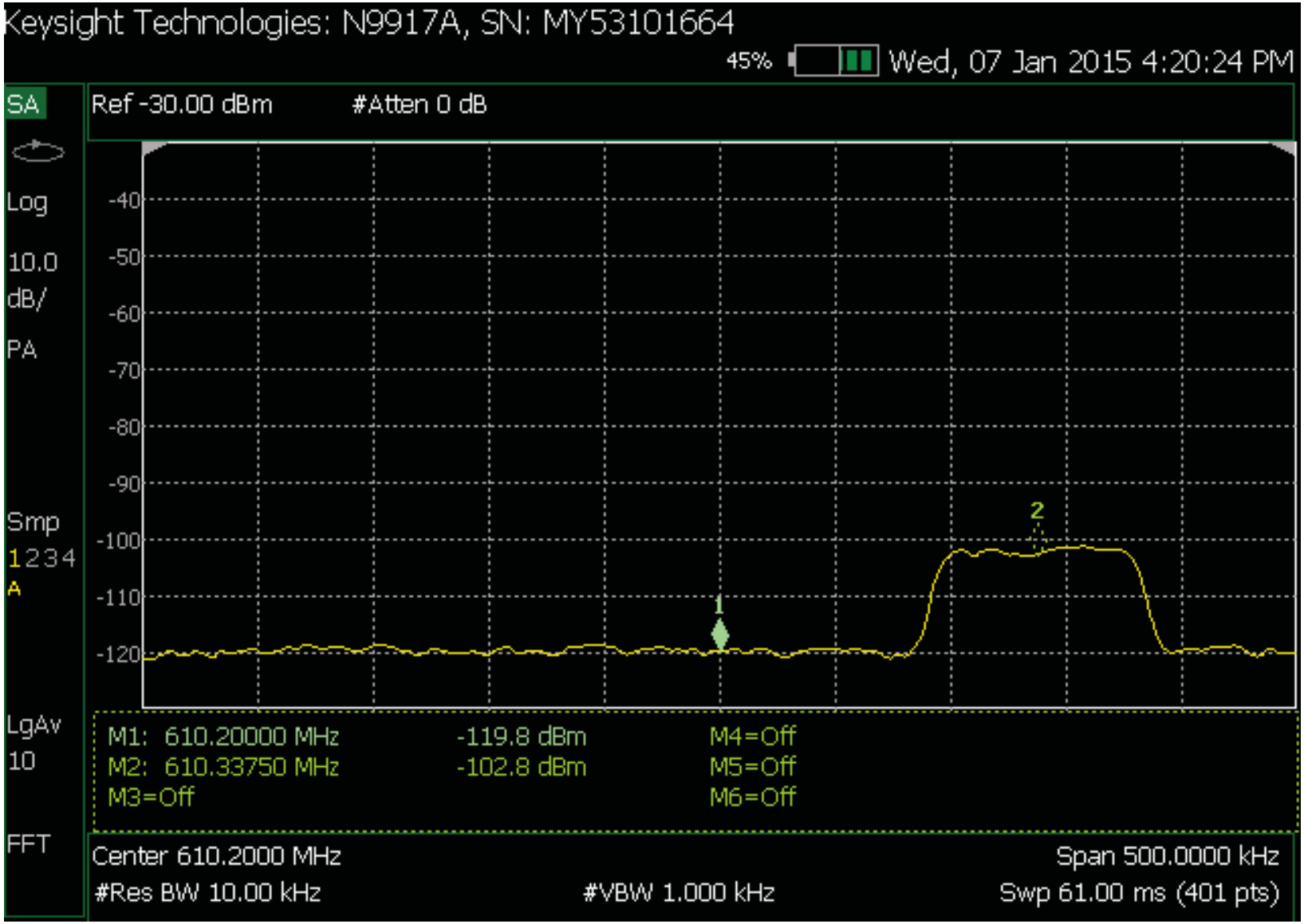


Figure 3.2-12 – Test Site #2 – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 5th floor exterior room approximately 357 meters from the street level Test Site #2
Average recorded level -102.8 dBm (610.3375 MHz) Marker 2 – isotropic value –109.3 dBm
Transmitter EIRP +11.46 dBm (Signal Generator set to +2.93 dBm) – This is 12.86 dBm above the PSD limit for 6 MHz carrier

Figure 3.3-1 – Street Map – Test Site #4 Transmitter Location

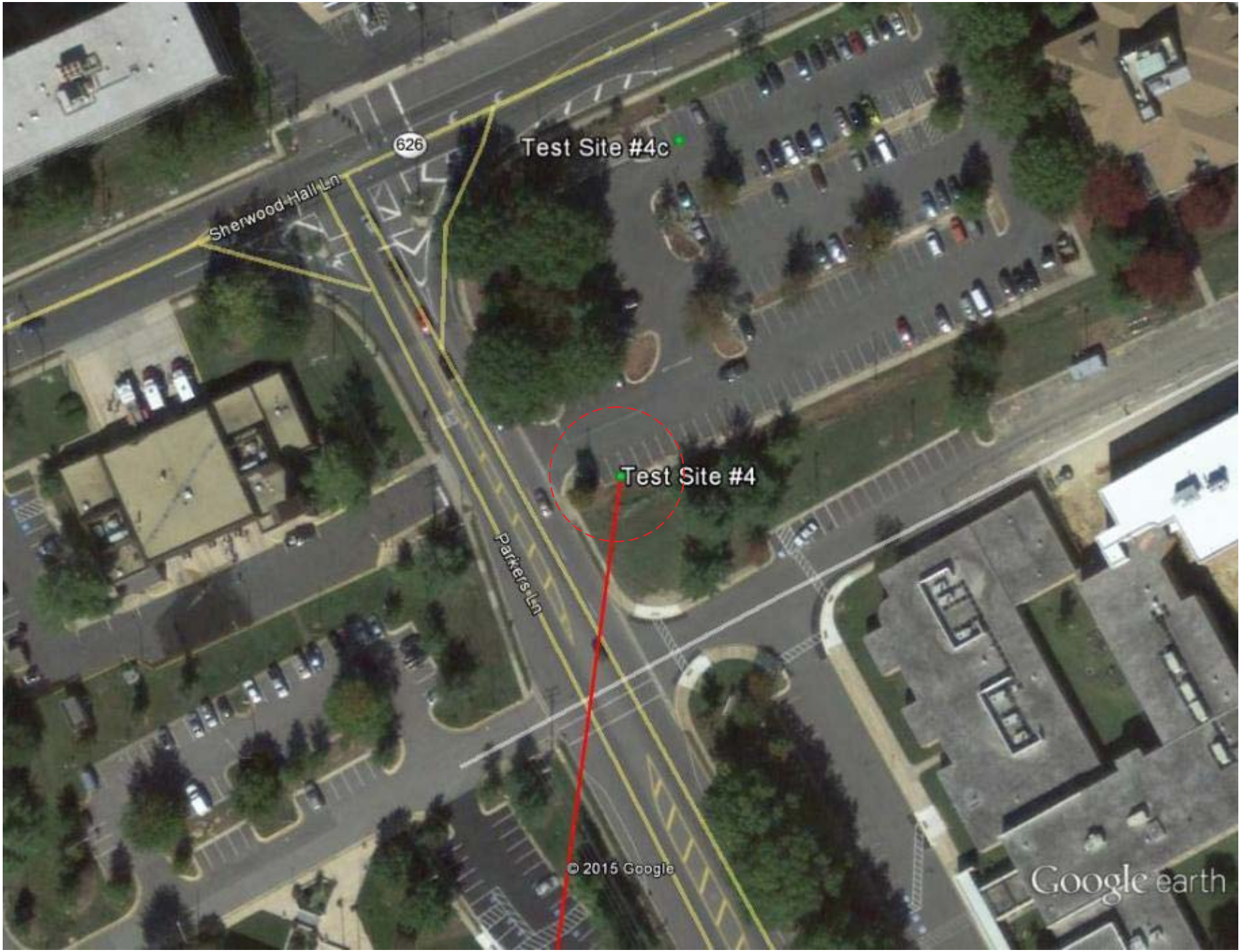


Figure 3.3-2 – Aerial Map – Test Site #4 Transmitter Location

Figure 3.3-3 – View toward Inova Mount Vernon Hospital from Test Site #4

Figure 3.3-4 – View toward Inova Mount Vernon Hospital from Test Site #4 - Zoom

Figure 3.3-5 –Test Site #4 – Transmitter

Figure 3.3-6 – View toward Test Site #4 from inside Inova Mount Vernon Hospital 6th floor

Figure 3.3-7 – Receive Test Set in Inova Mt Vernon Hospital on 6th floor exterior hallway – for Test Site #4

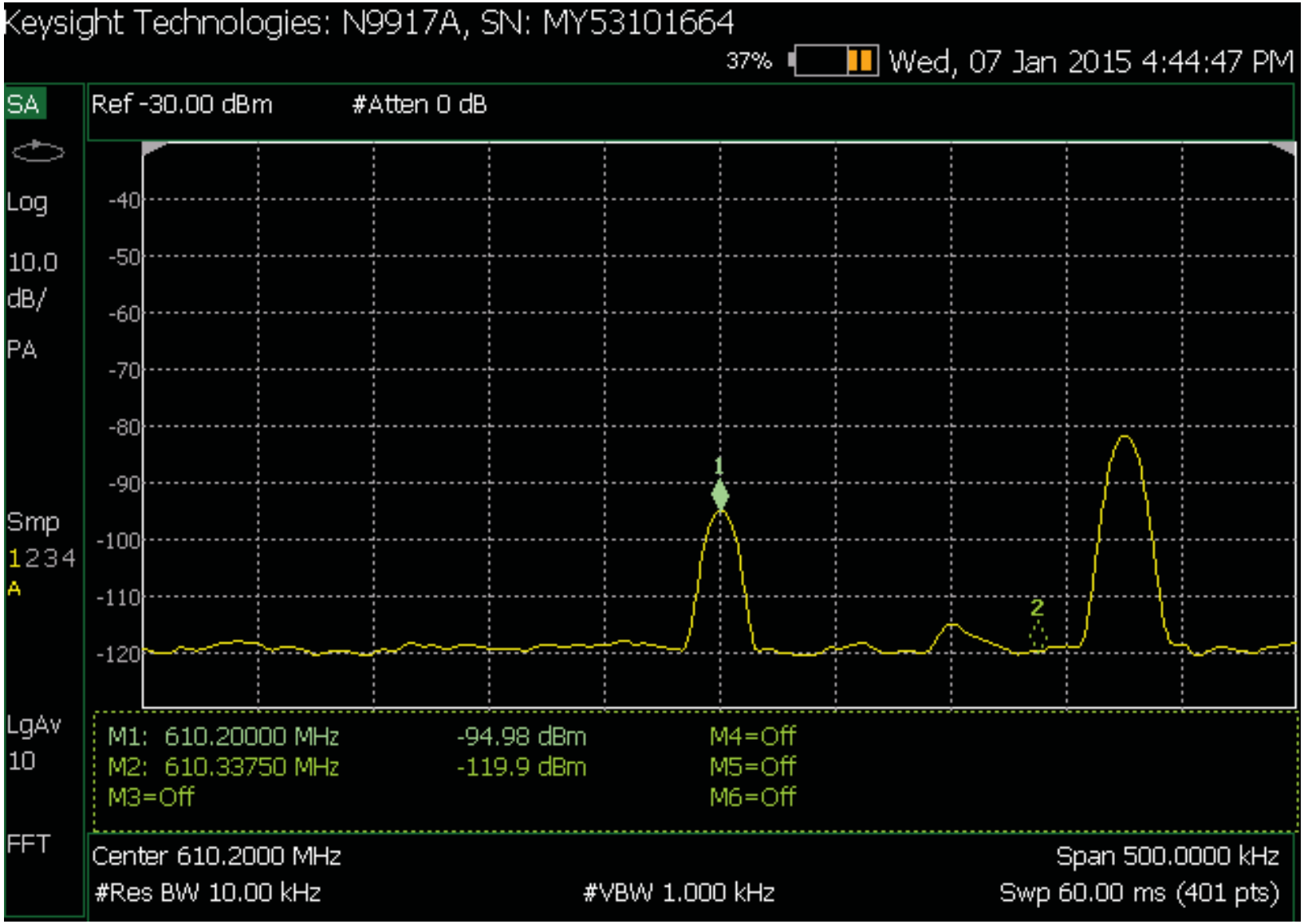


Figure 3.3-8 – Test Site #4 – Spectrum analyzer capture at 10 kHz RBW CW signal
Spectrum analyzer located on 6th floor exterior hallway approximately 338 meters from the street level Test Site #4
Average recorded level -94.98 dBm (610.200 MHz) Marker 1 – isotropic value -100.48 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

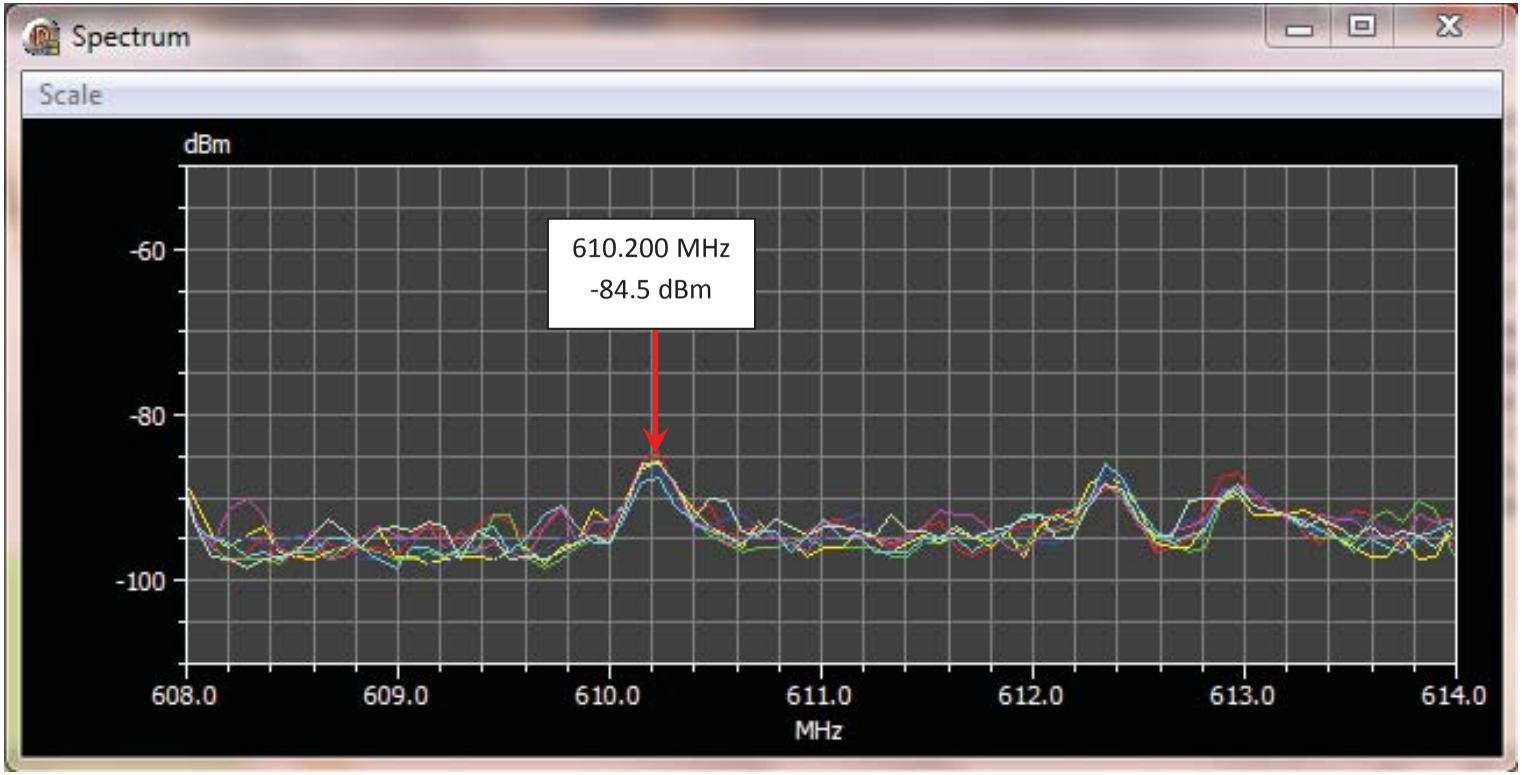


Figure 3.3-9 – Test Site #4 – Spectrum capture from rooftop
Spectrum Monitor located on rooftop approximately 338 meters from the street level Test Site #4
Maximum recorded level -84.5 dBm (610.200 MHz) Marker 1
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)

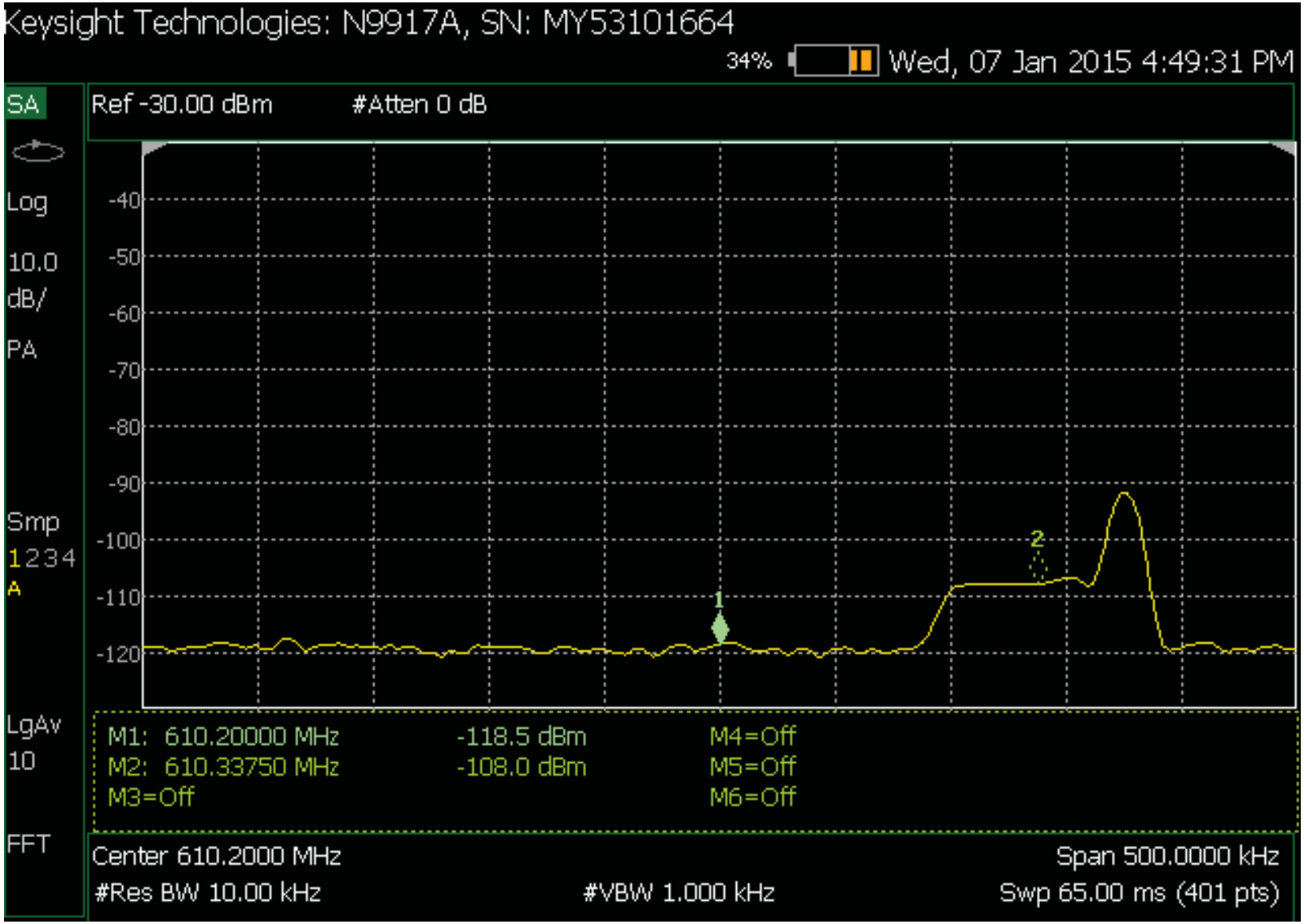


Figure 3.3-10 – Test Site #4 – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 6th floor exterior hallway approximately 338 meters from the street level Test Site #4
Average recorded level -108.0 dBm (610.3375 MHz) Marker 2 – isotropic value -114.5 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

Figure 3.4-1 – Street Map – Test Site #4a Transmitter Location

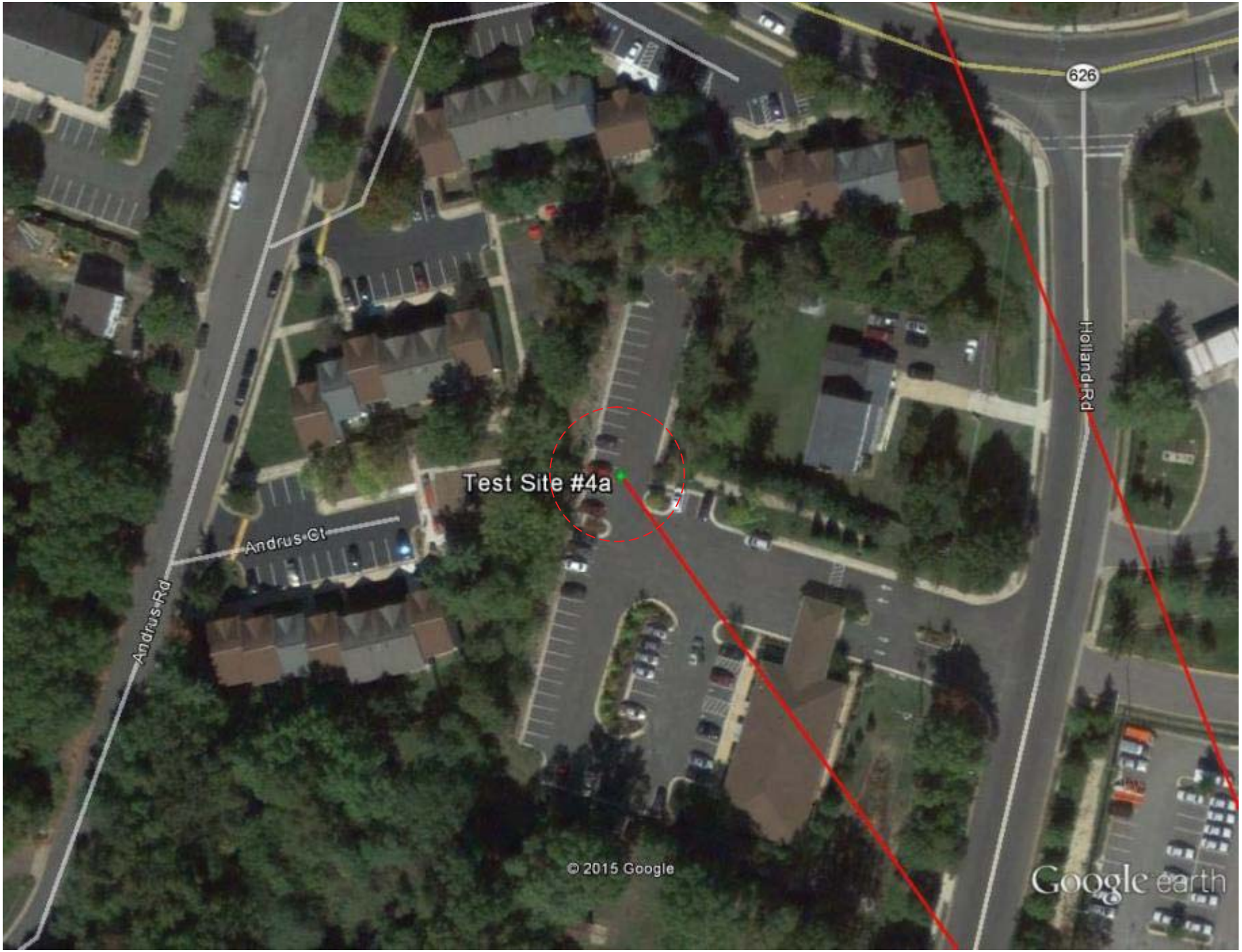


Figure 3.4-2 – Aerial Map – Test Site #4a Transmitter Location

Figure 3.4-3 – View toward Inova Mount Vernon Hospital from Test Site #4a

Figure 3.4-4 – View toward Inova Mount Vernon Hospital from Test Site #4a - Zoom

Figure 3.4-5 –Test Site #4a – Transmitter

Figure 3.4-6 – View toward Test Site #4a from inside Inova Mount Vernon Hospital 5th floor

Figure 3.4-7 – Receive Test Set in Inova Mt Vernon Hospital on 5th floor exterior hallway – for Test Site #4a

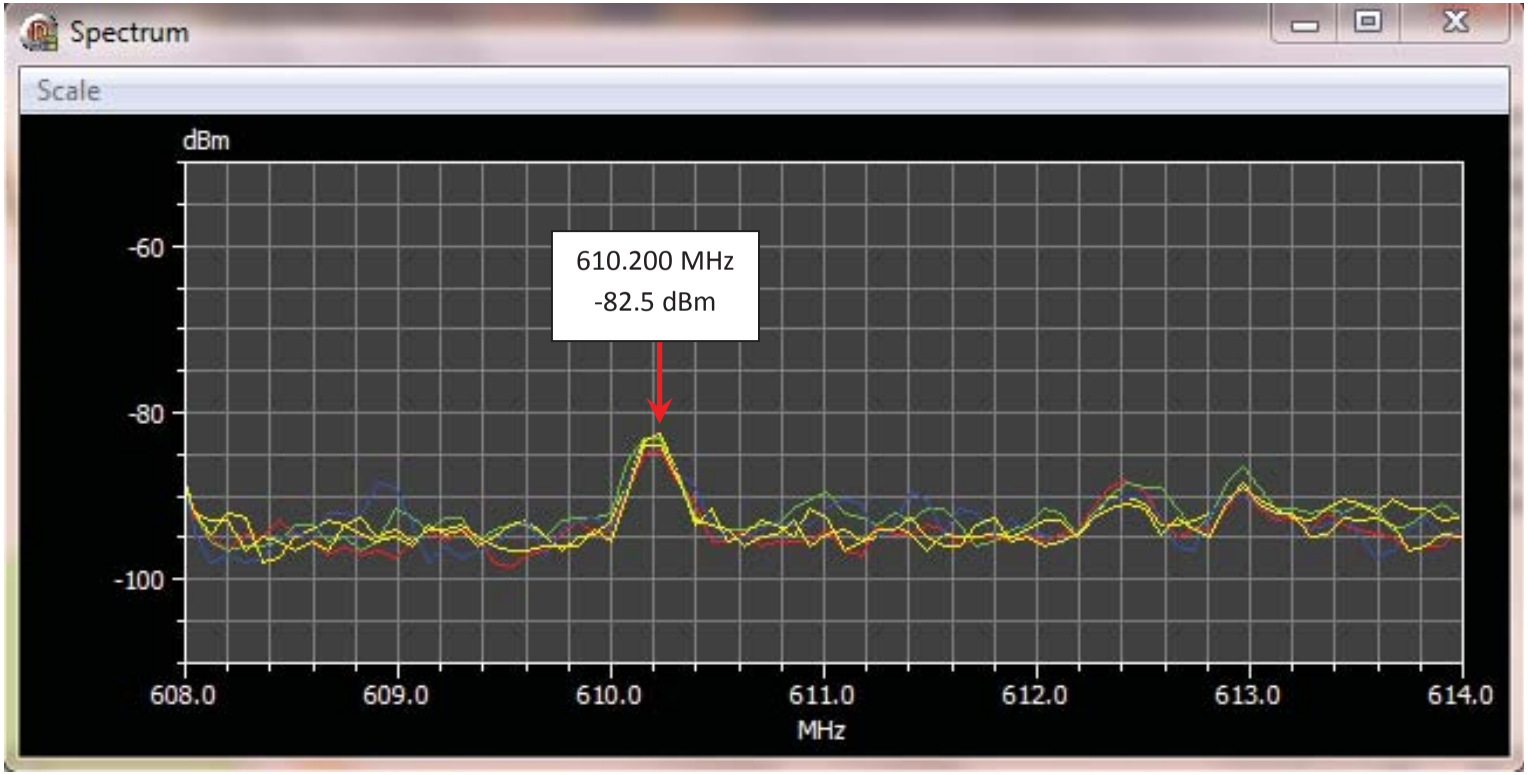


Figure 3.4-9 – Test Site #4a – Spectrum capture from rooftop
Spectrum Monitor located on rooftop approximately 341 meters from the street level Test Site #4a
Maximum recorded level –82.5 dBm (610.200 MHz) Marker 1
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)
Inside Spectrum Measurements were not saved for this test site.

Figure 3.5-1 – Street Map – Test Site #4b Transmitter Location

Figure 3.5-2 – Aerial Map – Test Site #4b Transmitter Location

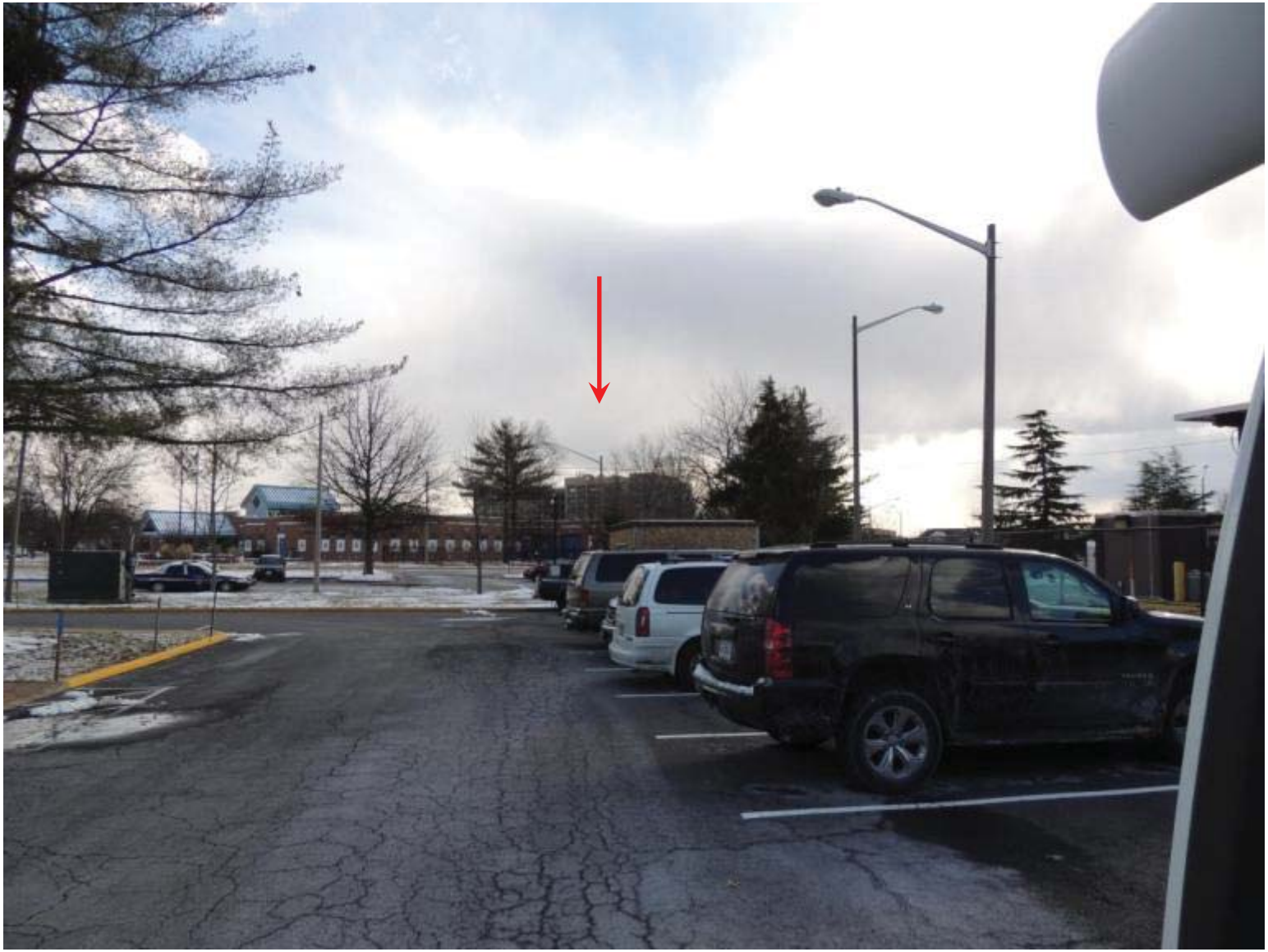


Figure 3.5-3 – View toward Inova Mount Vernon Hospital from Test Site #4b

Figure 3.5-4 – View toward Inova Mount Vernon Hospital from Test Site #4b - Zoom

Figure 3.5-5 –Test Site #4b – Transmitter

Figure 3.5-6 – View toward Test Site #4b from inside Inova Mount Vernon Hospital 6th floor

Figure 3.5-7 – Receive Test Set in Inova Mt Vernon Hospital on 6th floor exterior hallway – for Test Site #4b

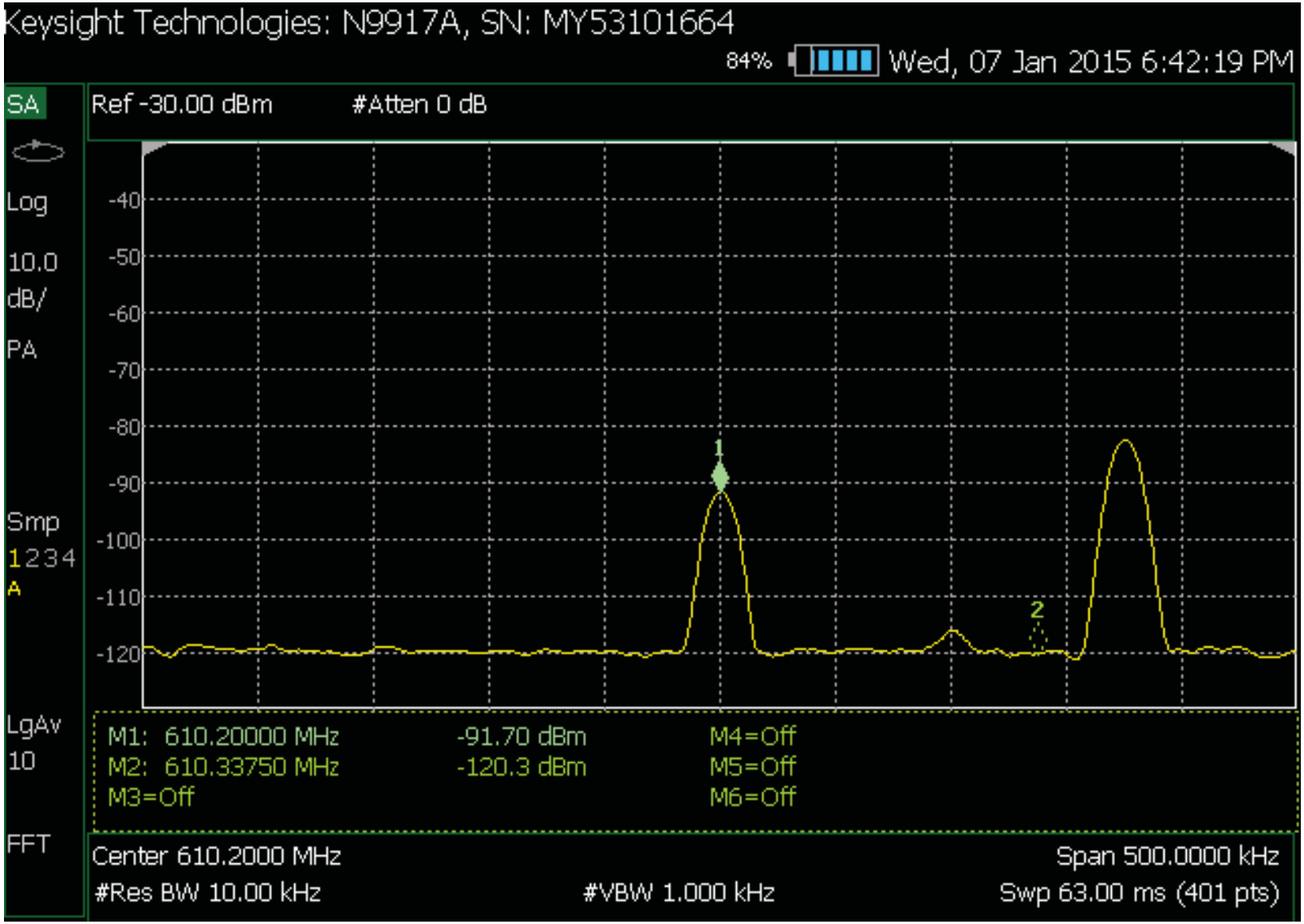


Figure 3.5-8 – Test Site #4b – Spectrum analyzer capture at 10 kHz RBW CW signal
Spectrum analyzer located on 6th floor exterior hallway approximately 332 meters from the street level Test Site #4b
Average recorded level -91.7 dBm (610.200 MHz) Marker 1 – isotropic value –98.2 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

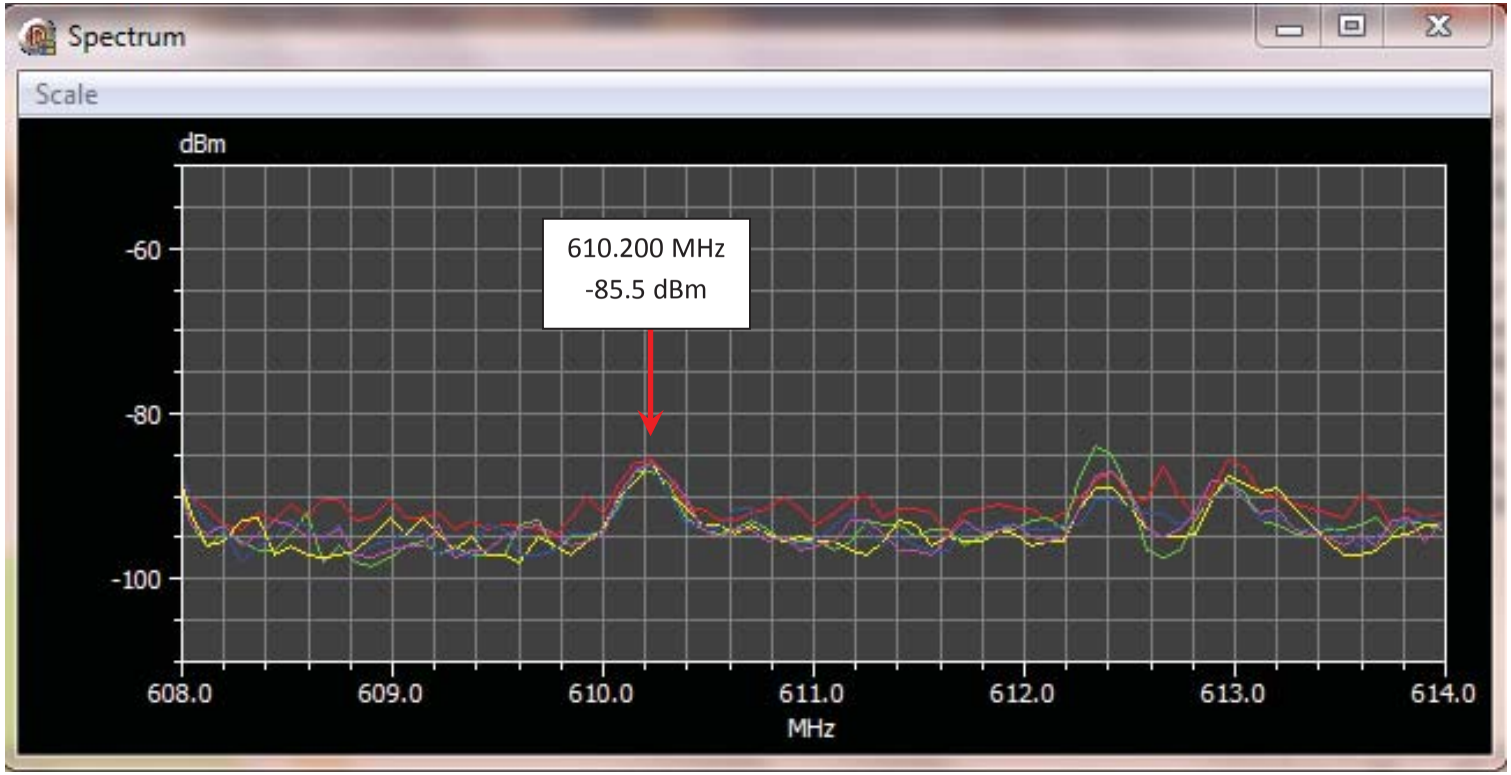


Figure 3.5-9 – Test Site #4b – Spectrum capture from rooftop
Spectrum Monitor located on rooftop approximately 332 meters from the street level Test Site #4b
Maximum recorded level -85.5 dBm (610.200 MHz) Marker 1
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)

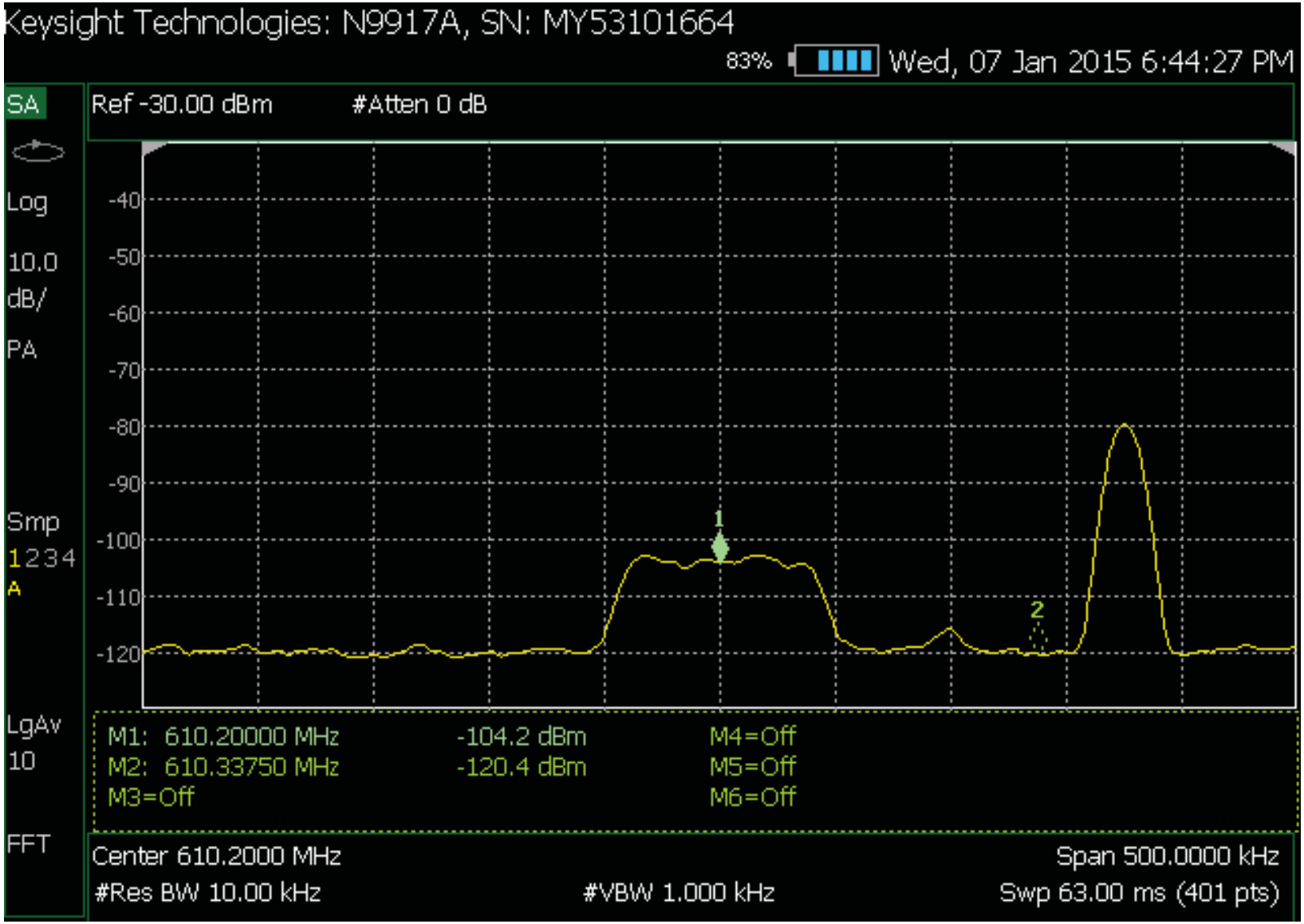


Figure 3.5-10 – Test Site #4b – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 6th floor exterior hallway approximately 332 meters from the street level Test Site #4b
Average recorded level -104.2 dBm (610.200 MHz) Marker 1 – isotropic value -110.7 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

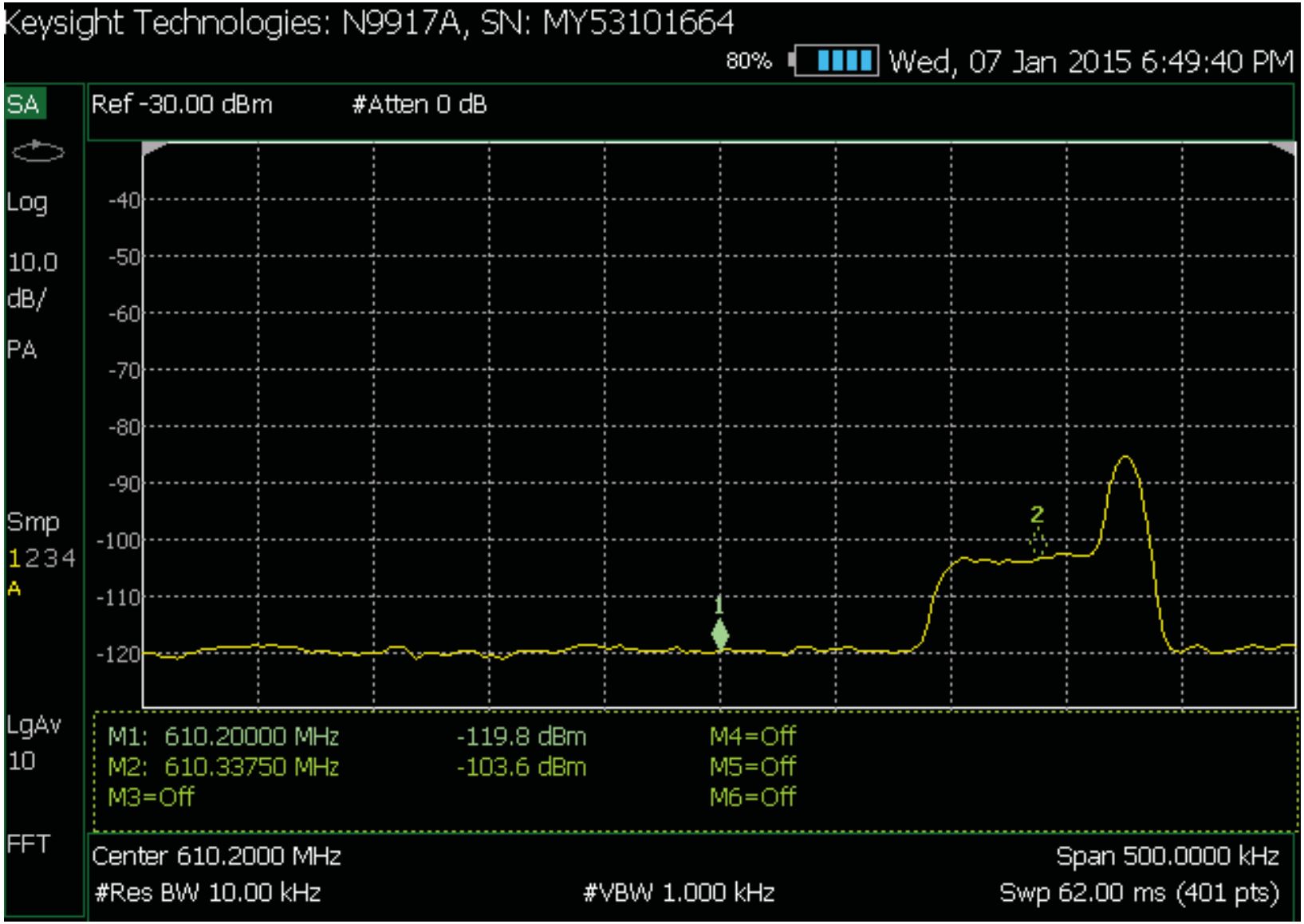


Figure 3.5-11 – Test Site #4b – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 6th floor exterior hallway approximately 332 meters from the street level Test Site #4b
Average recorded level -110.2 dBm (610.3375 MHz) Marker 2 – isotropic value -116.7 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

Figure 3.6-1 – Street Map – Test Site #4c Transmitter Location

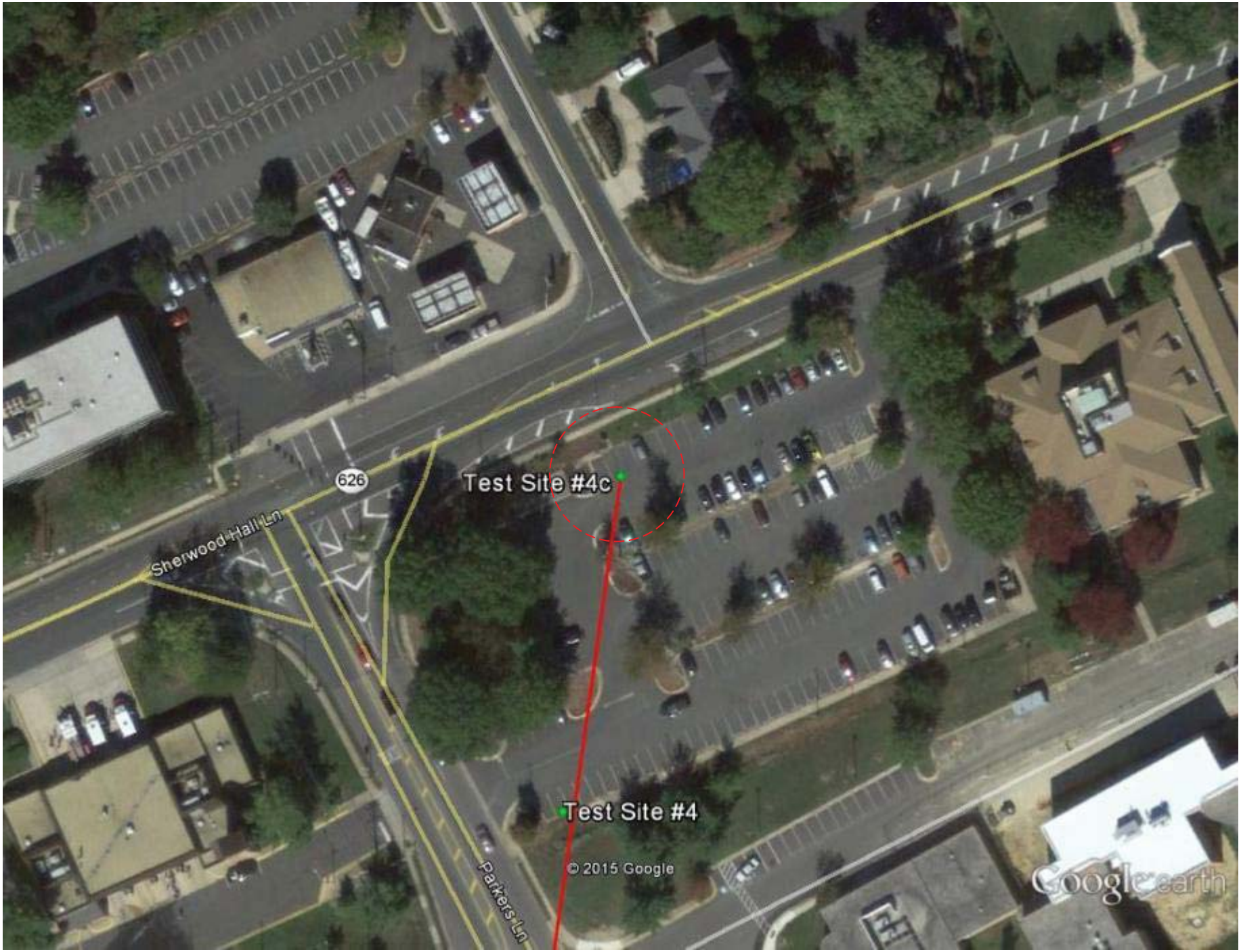


Figure 3.6-2 – Aerial Map – Test Site #4c Transmitter Location

Figure 3.6-3 – View toward Inova Mount Vernon Hospital from Test Site #4c

Figure 3.6-4 – View toward Inova Mount Vernon Hospital from Test Site #4c - Zoom

Figure 3.6-5 –Test Site #4c – Transmitter

Figure 3.6-6 – View toward Test Site #4c from inside Inova Mount Vernon Hospital 6th floor

Figure 3.6-7 – Receive Test Set in Inova Mt Vernon Hospital on 6th floor exterior hallway – for Test Site #4c

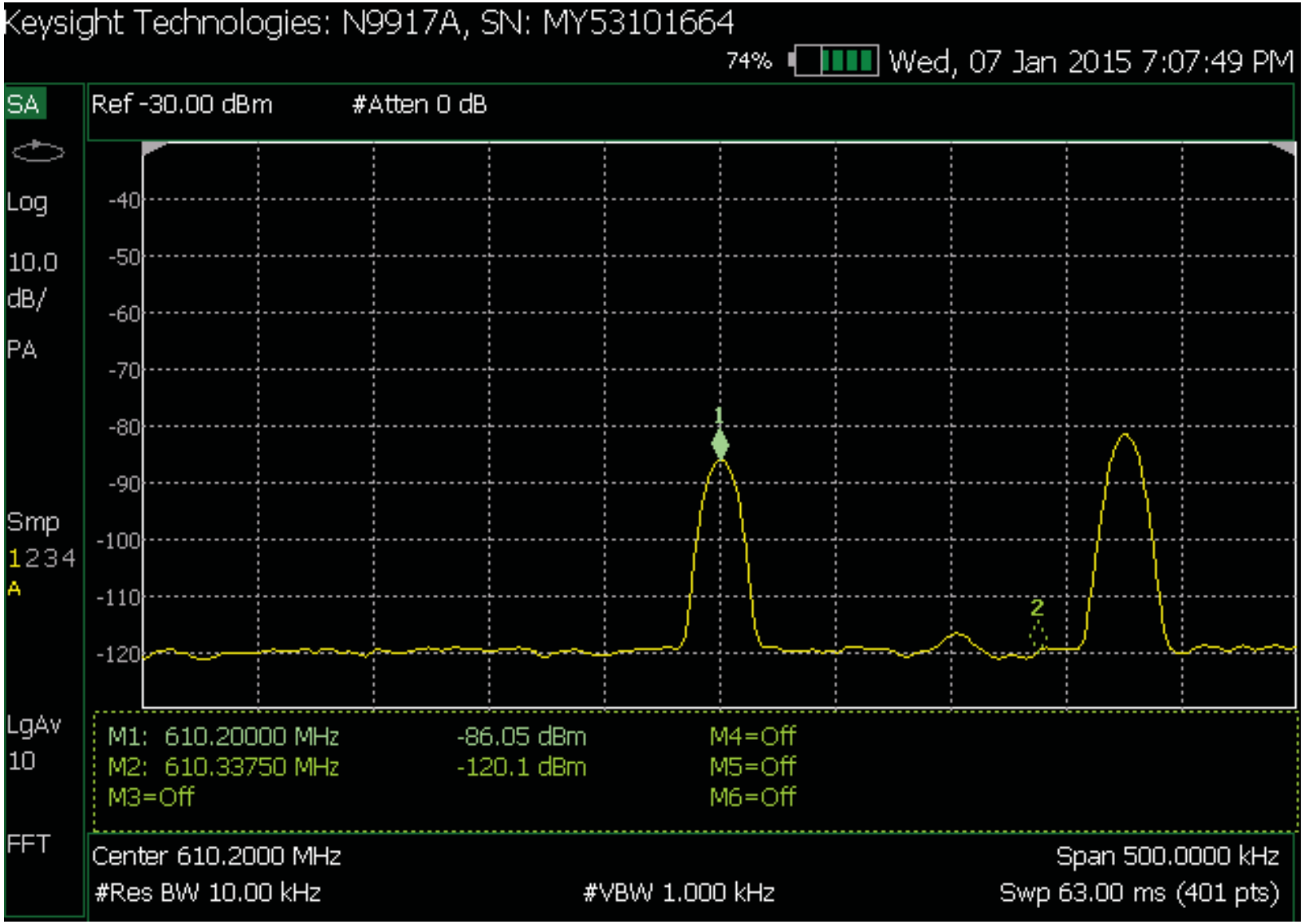


Figure 3.6-8 – Test Site #4c – Spectrum analyzer capture at 10 kHz RBW CW signal
Spectrum analyzer located on 6th floor exterior hallway approximately 402 meters from the street level Test Site #4c
Average recorded level –86.05 dBm (610.200 MHz) Marker 1 – isotropic value –92.55 dBm
Transmitter EIRP +2.60 dBm (Signal Generator set to -5.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

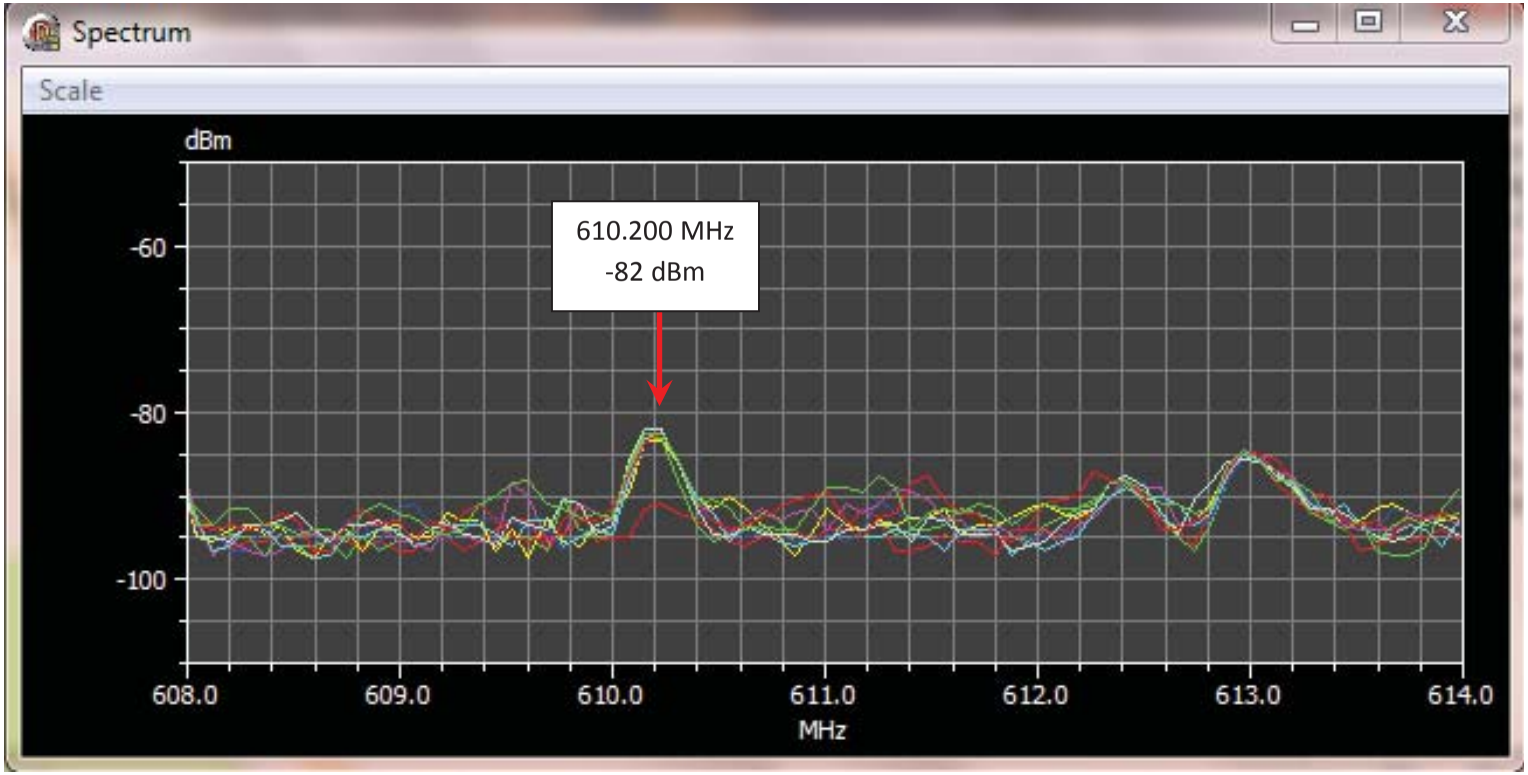


Figure 3.6-9 – Test Site #4c – Spectrum capture from rooftop
Spectrum Monitor located on rooftop approximately 402 meters from the street level Test Site #4c
Maximum recorded level -82 dBm (610.200 MHz) Marker 1
Transmitter EIRP +2.60 dBm (Signal Generator set to -5.93 dBm)

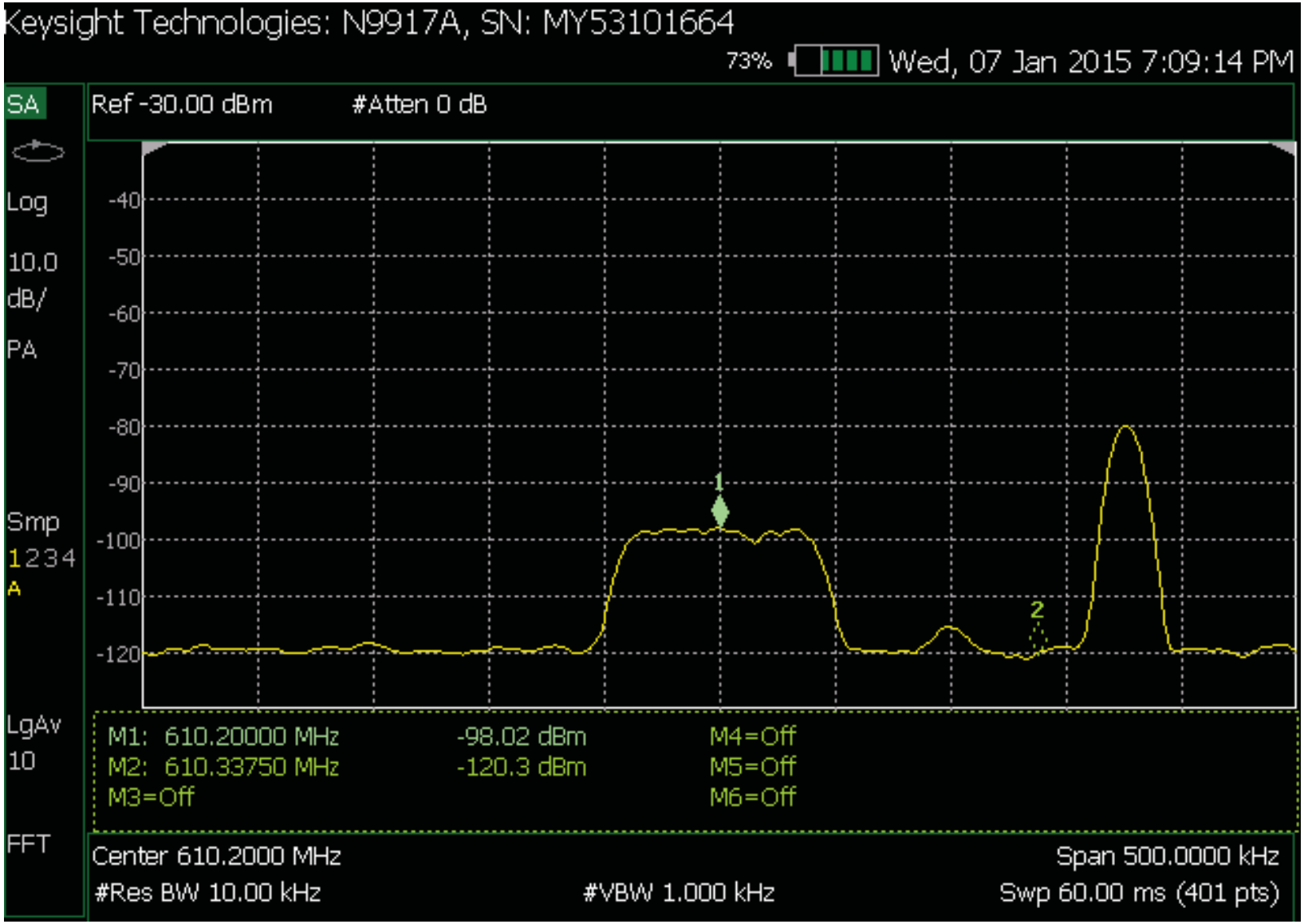


Figure 3.6-10 – Test Site #4c – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 6th floor exterior hallway approximately 402 meters from the street level Test Site #4c
Average recorded level -98.02 dBm (610.200 MHz) Marker 1 – isotropic value -104.52 dBm
Transmitter EIRP +2.60 dBm (Signal Generator set to -5.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

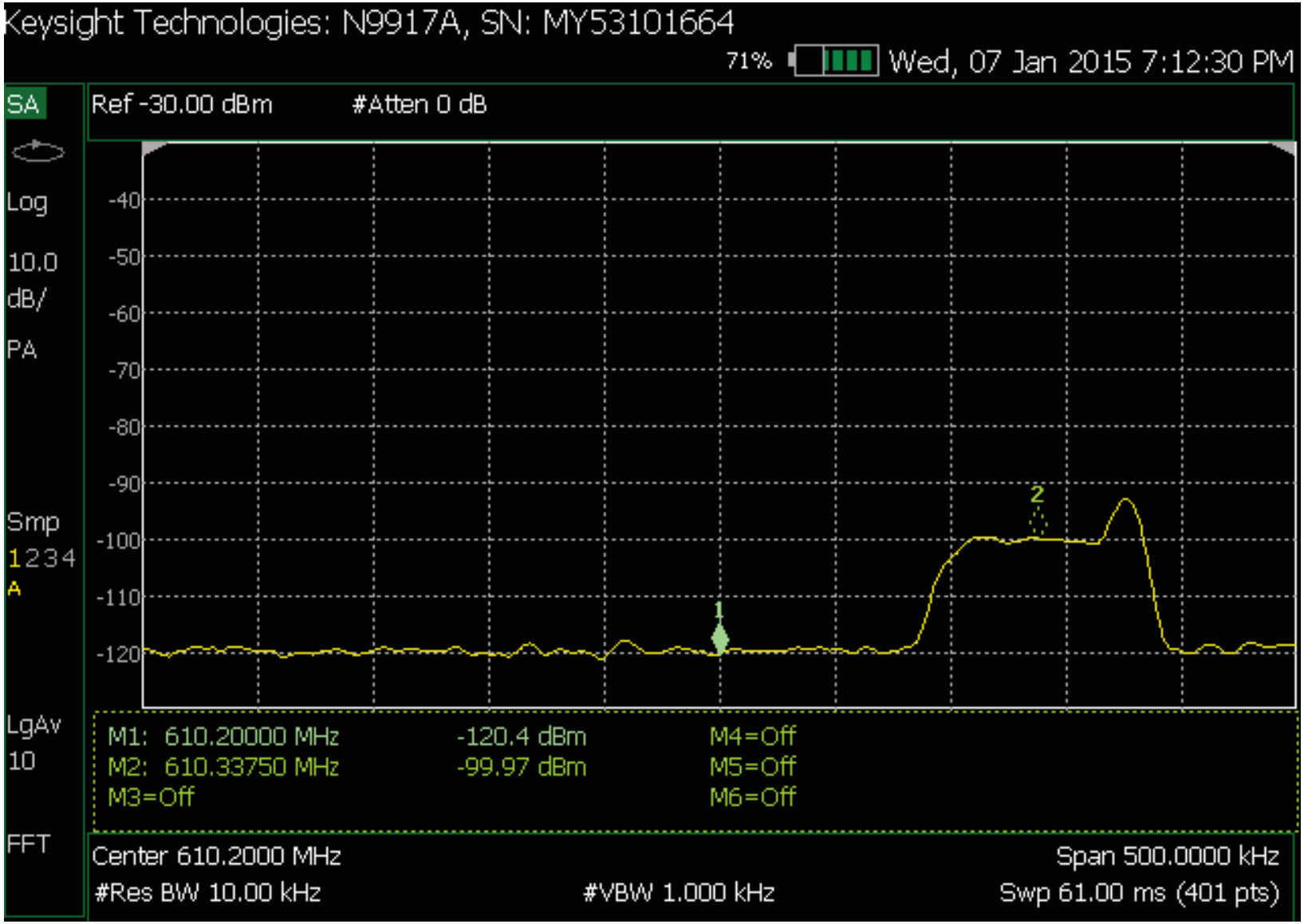


Figure 3.6-11 – Test Site #4c – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 6th floor exterior hallway approximately 402 meters from the street level Test Site #4c
Average recorded level -99.97 dBm (610.3375 MHz) Marker 2 – isotropic value -106.47 dBm
Transmitter EIRP +2.60 dBm (Signal Generator set to -5.93 dBm)

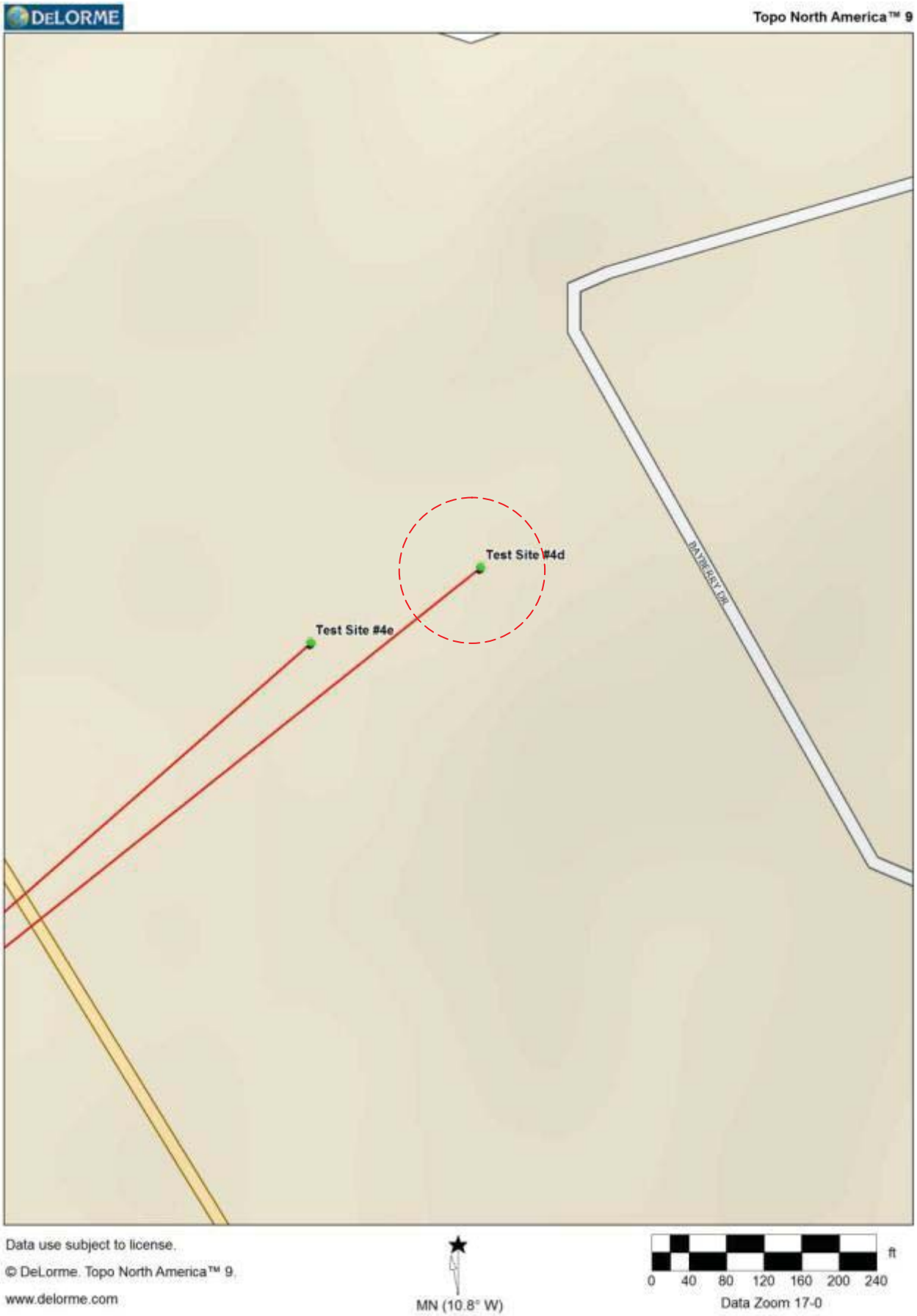


Figure 3.7-1 – Street Map – Test Site #4d Transmitter Location

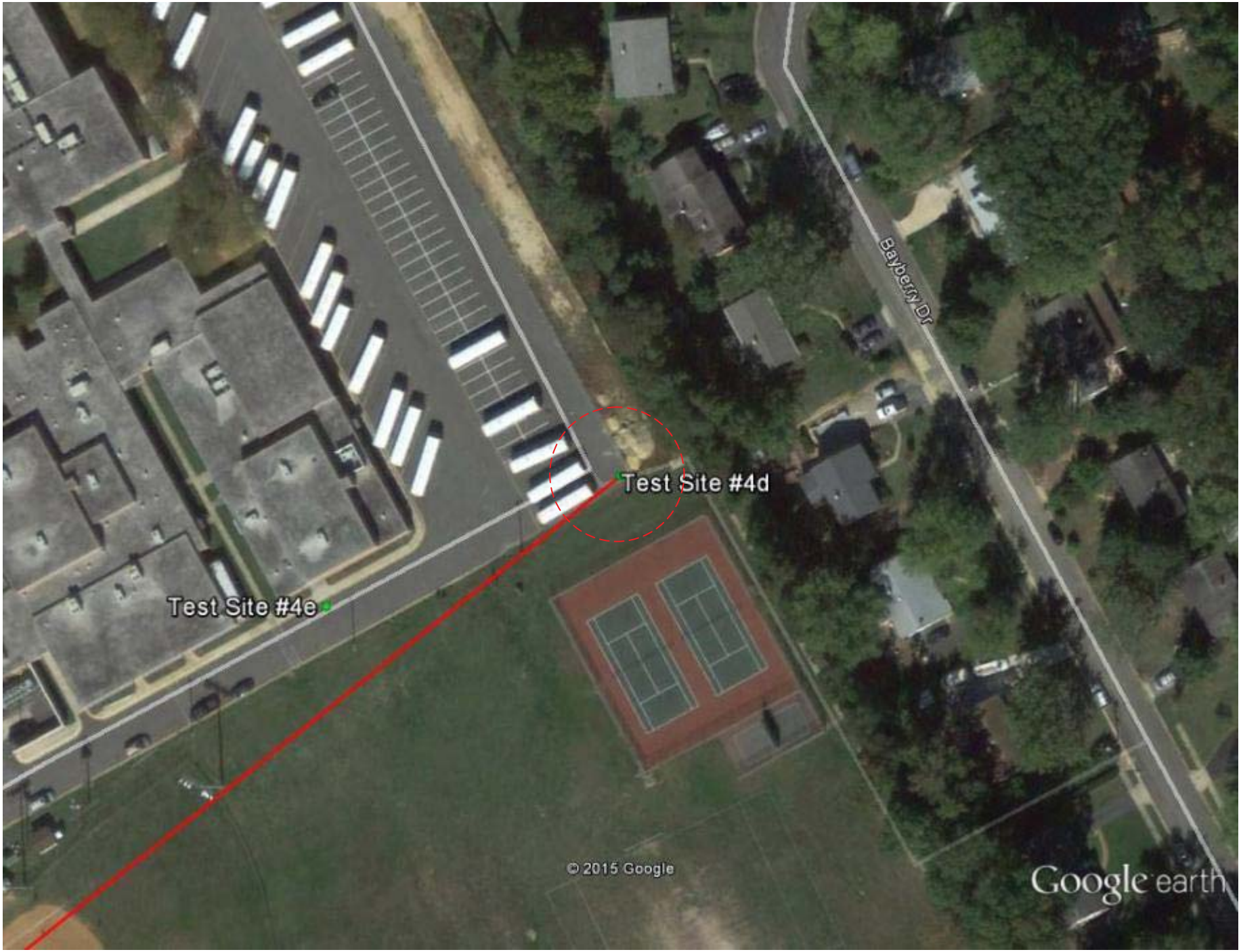


Figure 3.7-2 – Aerial Map – Test Site #4d Transmitter Location

Figure 3.7-3 – View toward Inova Mount Vernon Hospital from Test Site #4d

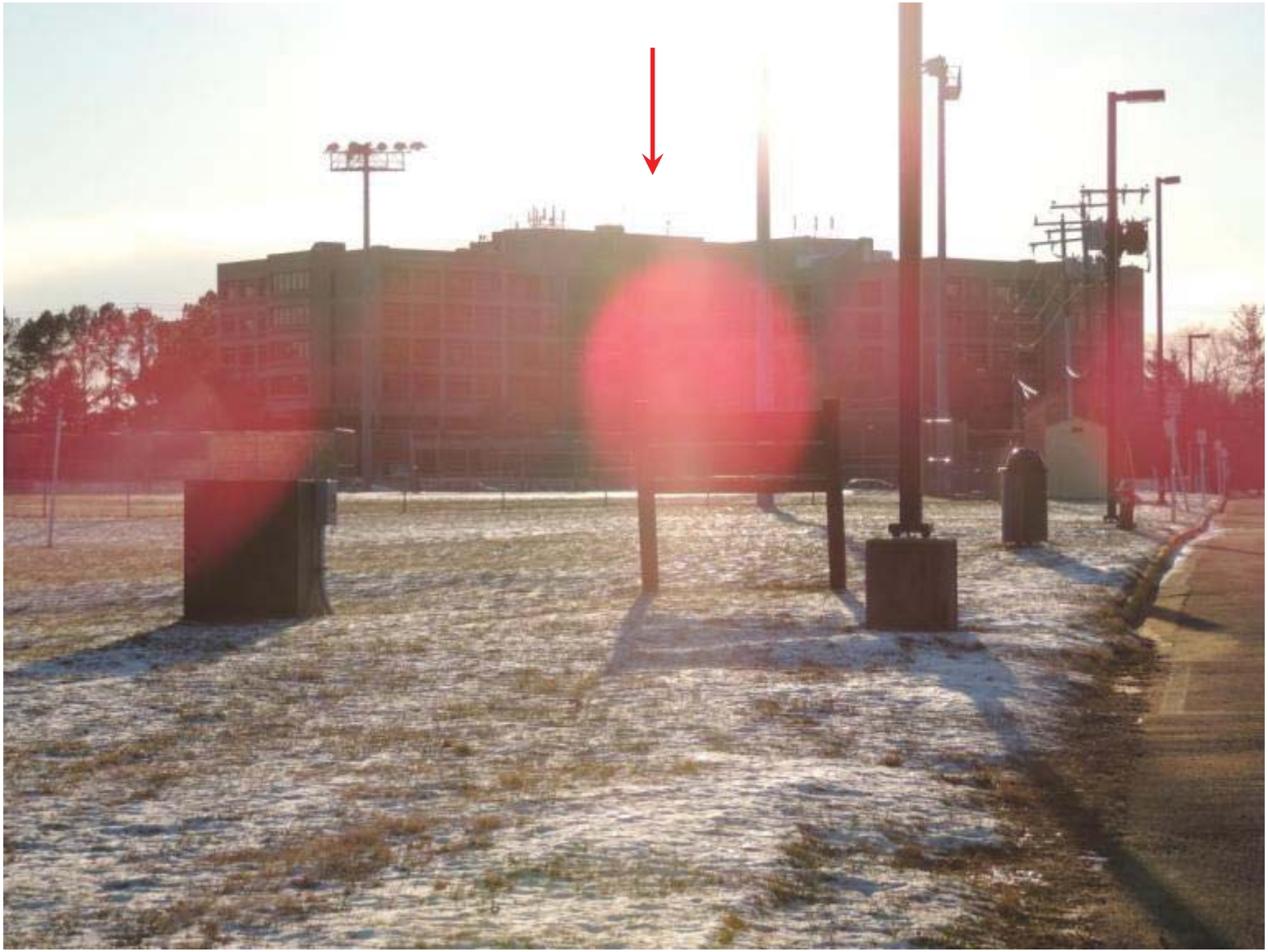


Figure 3.7-4 – View toward Inova Mount Vernon Hospital from Test Site #4d - Zoom

Figure 3.7-5 –Test Site #4d – Transmitter

Figure 3.7-6 – View toward Test Site #4d from inside Inova Mount Vernon Hospital 6th floor

Figure 3.7-7 – Receive Test Set in Inova Mt Vernon Hospital on 6th floor exterior hallway – for Test Site #4d

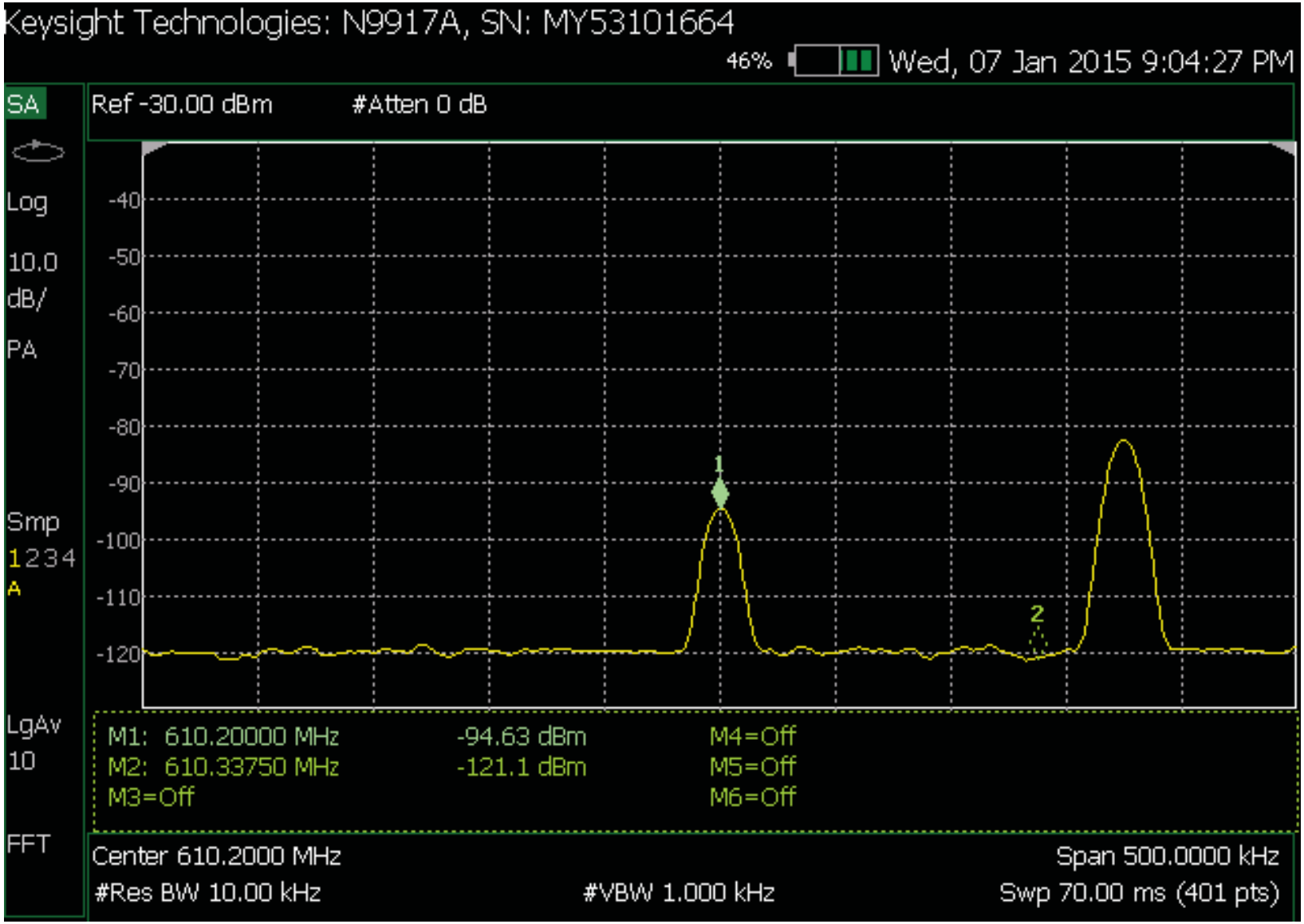


Figure 3.7-8 – Test Site #4d – Spectrum analyzer capture at 10 kHz RBW CW signal
Spectrum analyzer located on 6th floor exterior hallway approximately 385 meters from the street level Test Site #4d
Average recorded level -94.63 dBm (610.200 MHz) Marker 1 – isotropic value -101.13 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

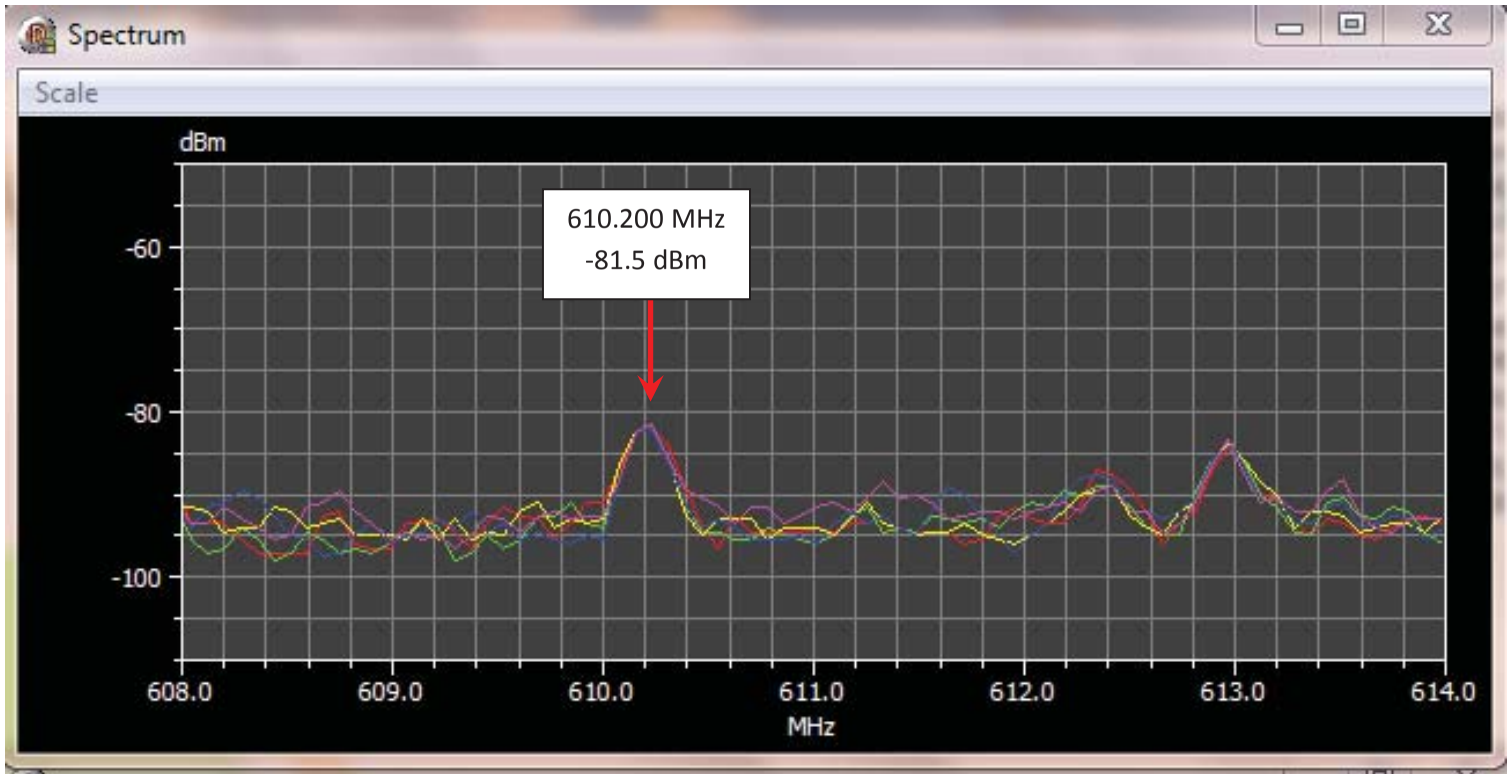


Figure 3.7-9 – Test Site #4d – Spectrum capture from rooftop
Spectrum Monitor located on rooftop approximately 385 meters from the street level Test Site #4d
Maximum recorded level –81.5 dBm (610.200 MHz) Marker 1
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)

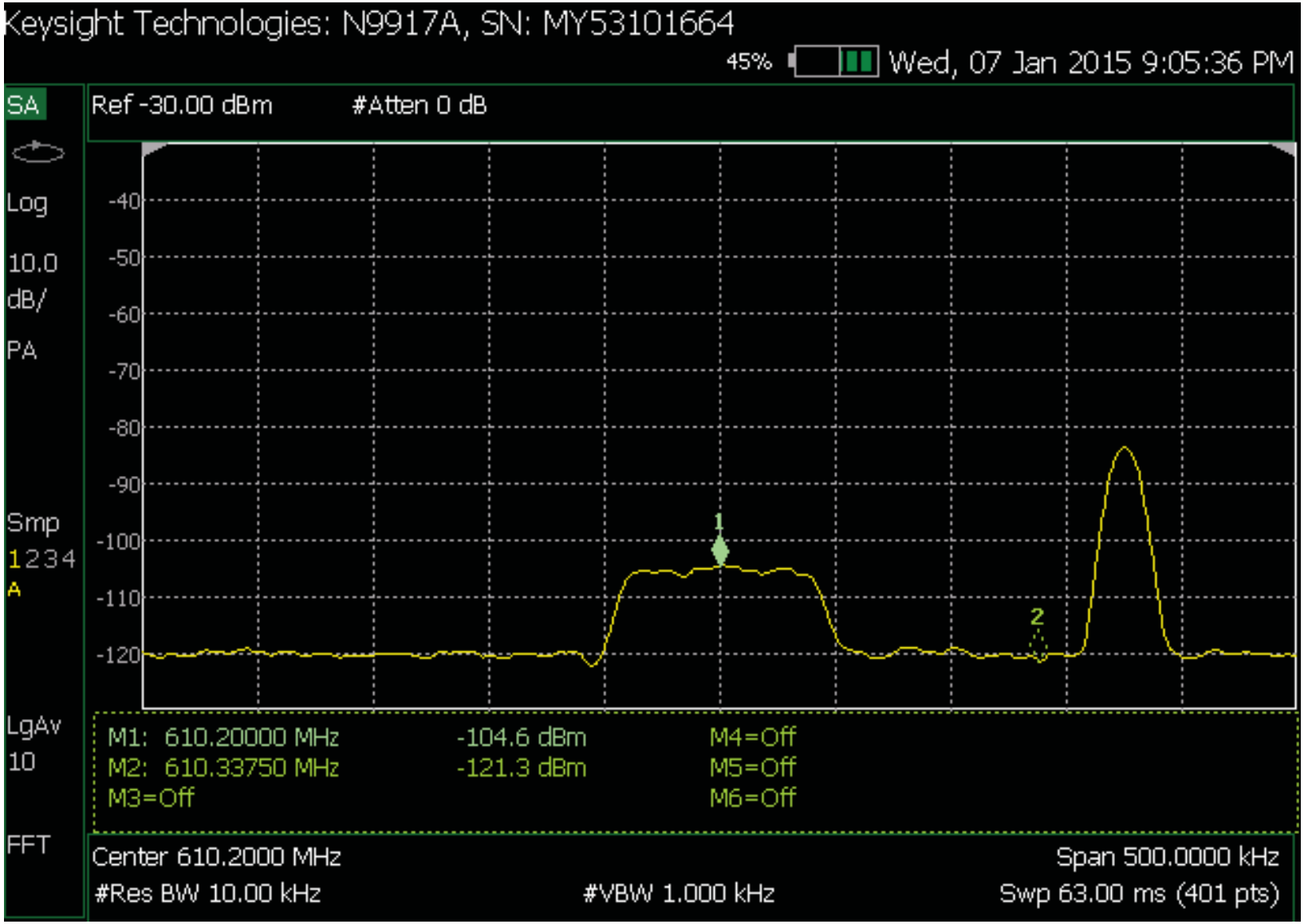


Figure 3.7-10 – Test Site #4d – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 6th floor exterior hallway approximately 385 meters from the street level Test Site #4d
Average recorded level -104.6 dBm (610.200 MHz) Marker 1 – isotropic value -111.1 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

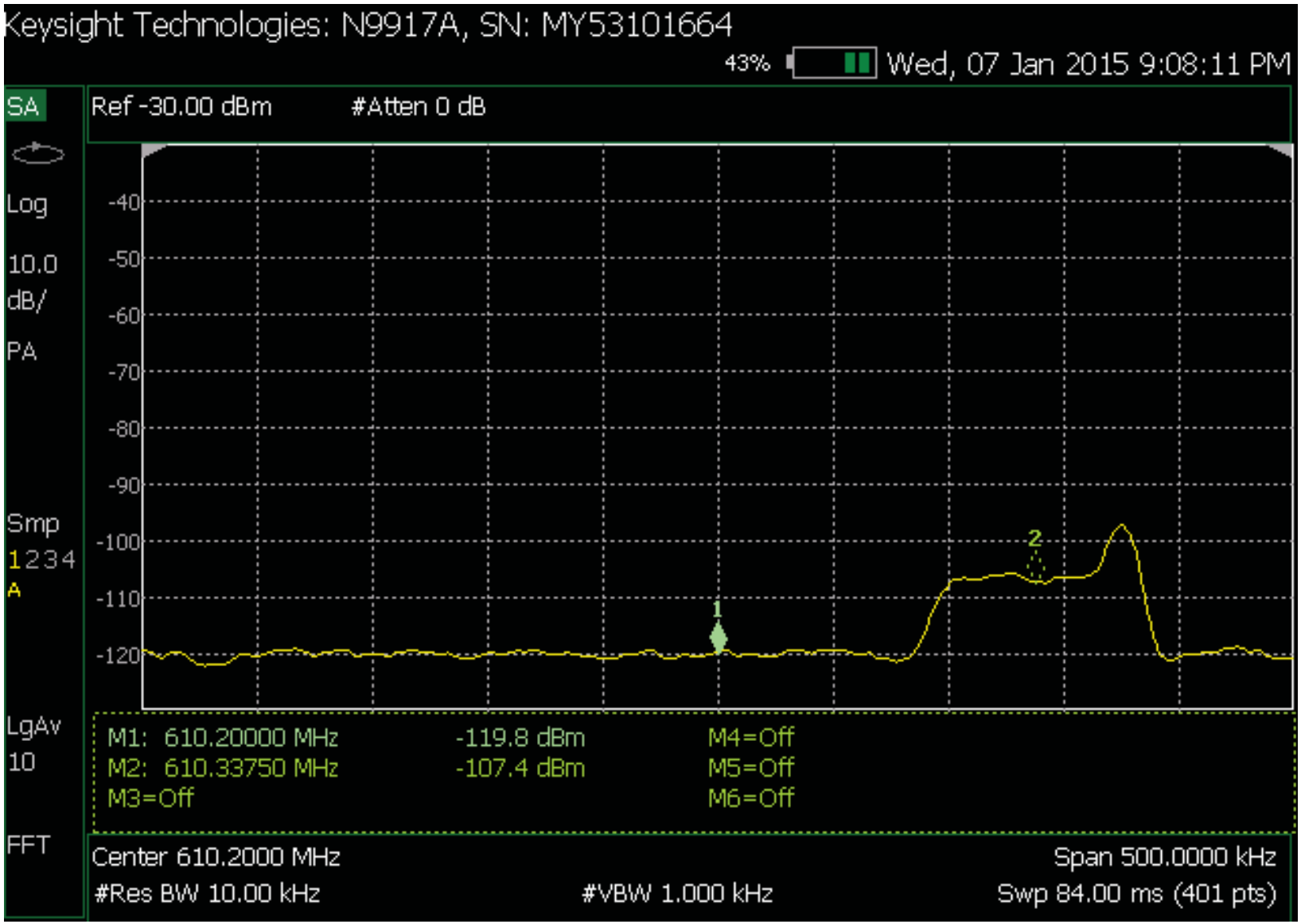


Figure 3.7-11 – Test Site #4d – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 6th floor exterior hallway approximately 385 meters from the street level Test Site #4d
Average recorded level -107.4 dBm (610.3375 MHz) Marker 2 – isotropic value -113.9 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)

Figure 3.8-1 – Street Map – Test Site #4e Transmitter Location

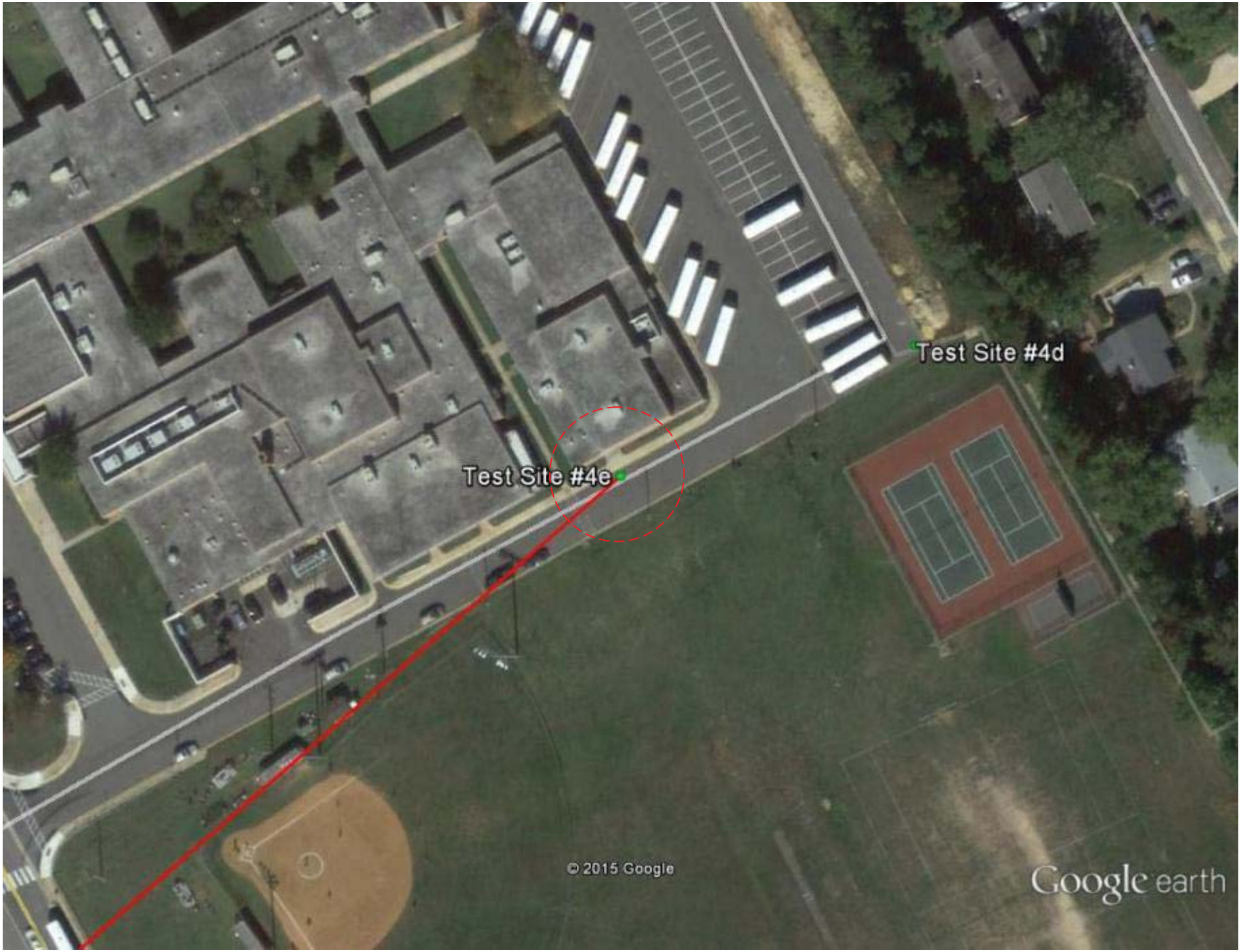


Figure 3.8-2 – Aerial Map – Test Site #4e Transmitter Location

Figure 3.8-3 – View toward Inova Mount Vernon Hospital from Test Site #4e

Figure 3.8-4 – View toward Inova Mount Vernon Hospital from Test Site #4e - Zoom

Figure 3.8-5 –Test Site #4e – Transmitter

Figure 3.8-6 – View toward Test Site #4e from inside Inova Mount Vernon Hospital 6th floor

Figure 3.8-7 – Receive Test Set in Inova Mt Vernon Hospital on 6th floor exterior hallway – for Test Site #4e

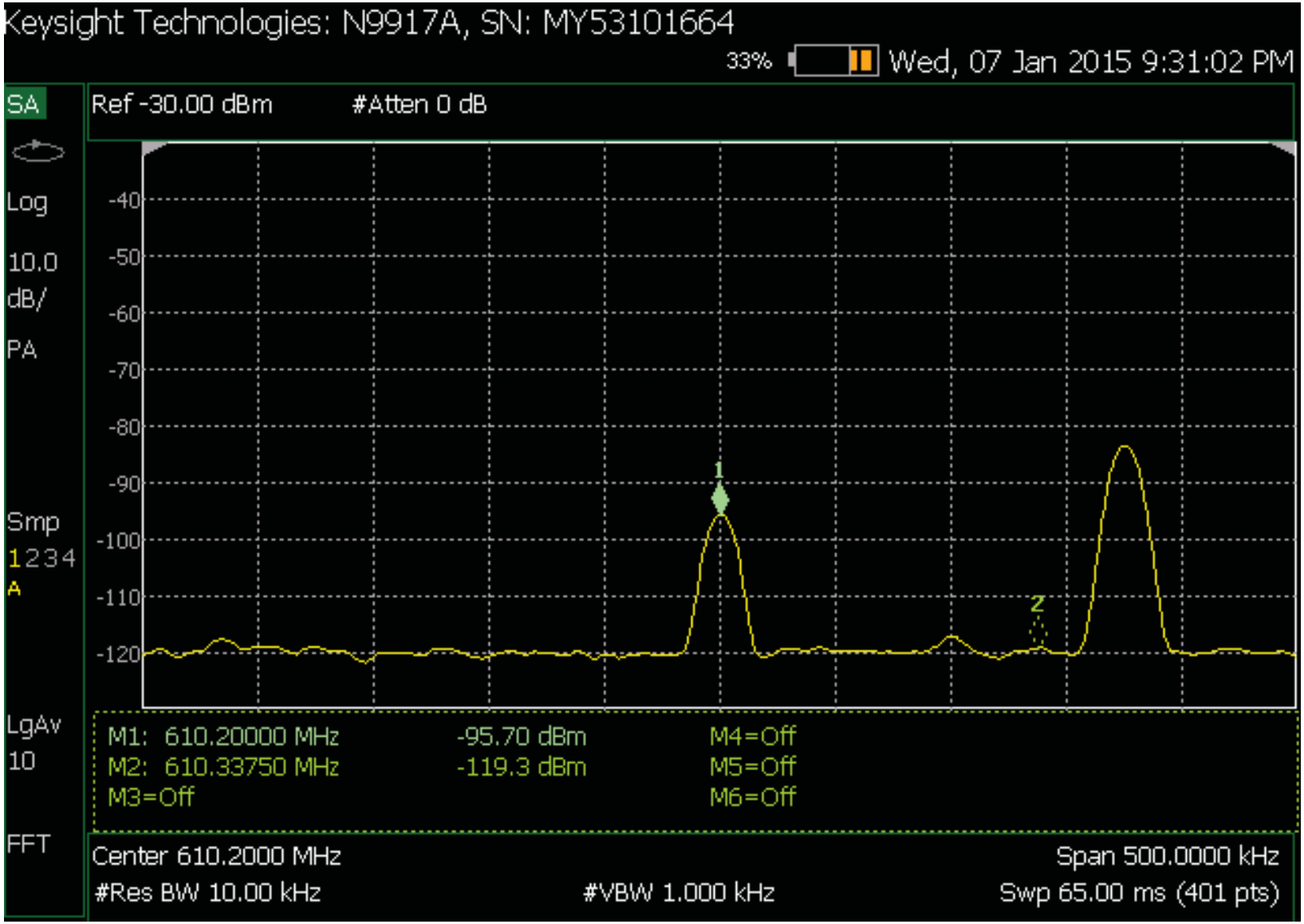


Figure 3.8-8 – Test Site #4e – Spectrum analyzer capture at 10 kHz RBW CW signal
Spectrum analyzer located on 6th floor exterior hallway approximately 327 meters from the street level Test Site #4e
Average recorded level -95.70 dBm (610.200 MHz) Marker 1 – isotropic value -102.5 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

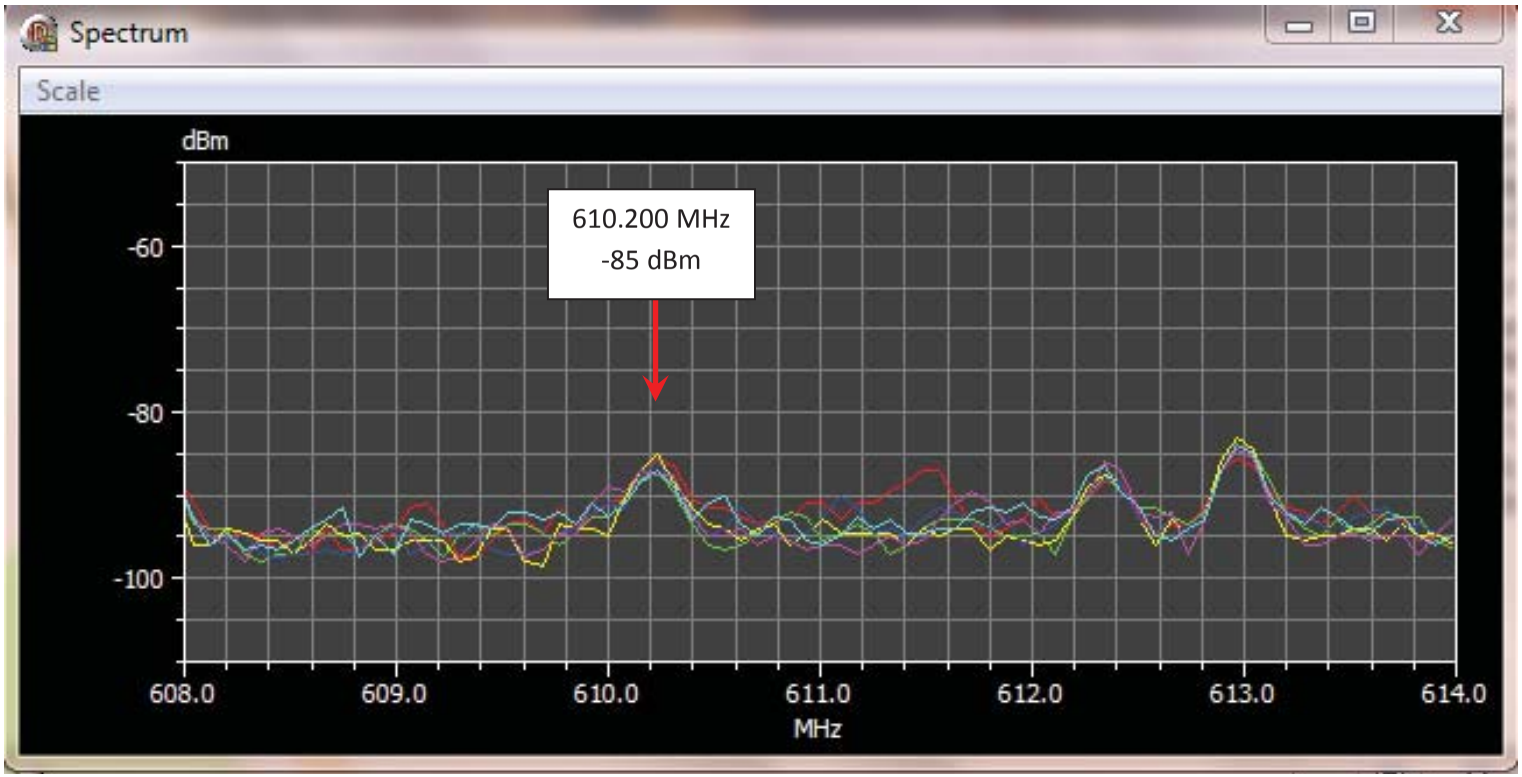


Figure 3.8-9 – Test Site #4e – Spectrum capture from rooftop
Spectrum Monitor located on rooftop approximately 327 meters from the street level Test Site #4e
Maximum recorded level –85 dBm (610.200 MHz) Marker 1
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)

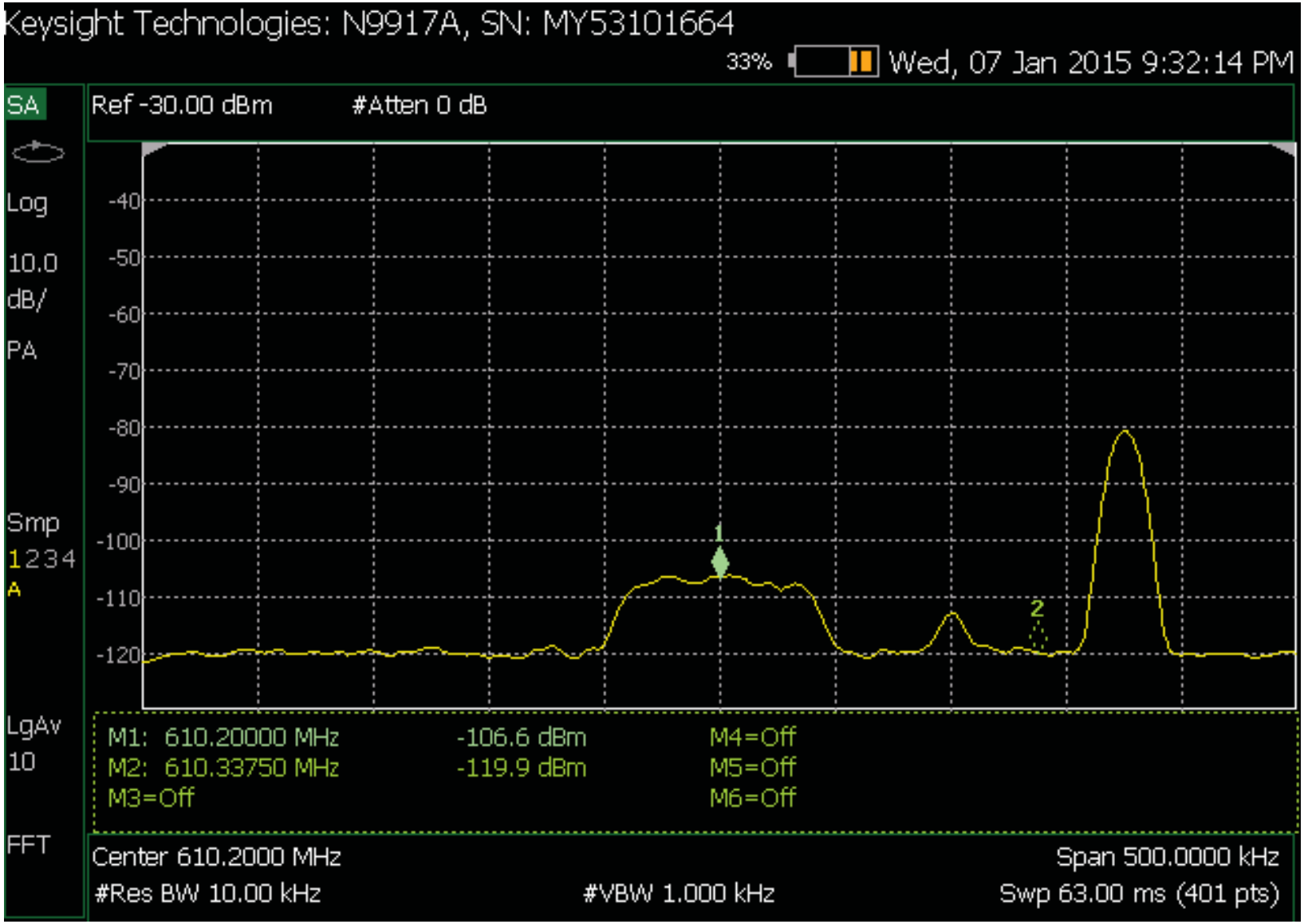


Figure 3.8-10 – Test Site #4e – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 6th floor exterior hallway approximately 327 meters from the street level Test Site #4e
Average recorded level -106.6 dBm (610.200 MHz) Marker 1 – isotropic value -113.1 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

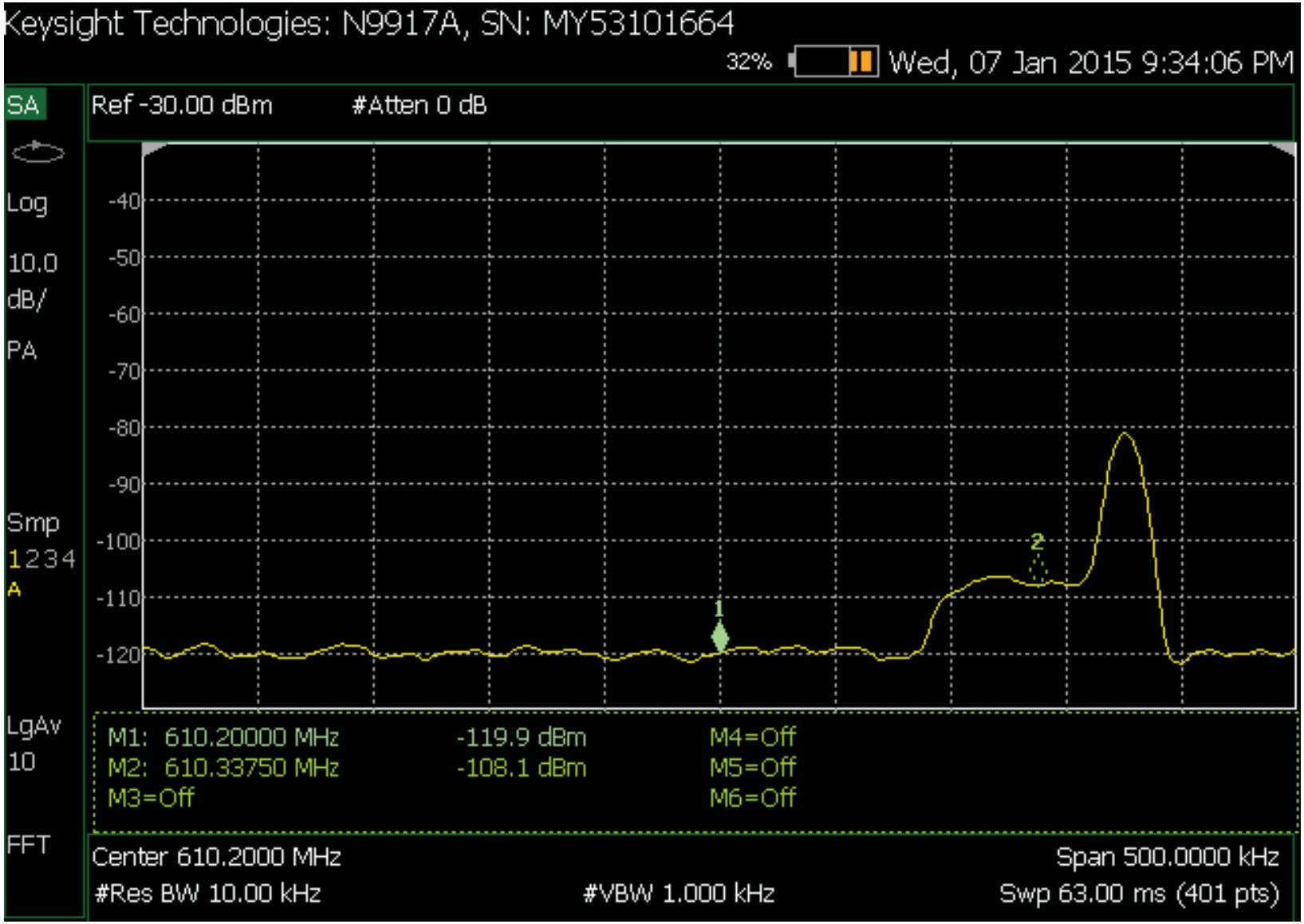


Figure 3.8-11 – Test Site #4e – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 6th floor exterior hallway approximately 327 meters from the street level Test Site #4e
Average recorded level -108.1 dBm (610.3375 MHz) Marker 2 – isotropic value -114.6 dBm
Transmitter EIRP -1.40 dBm (Signal Generator set to -9.93 dBm)

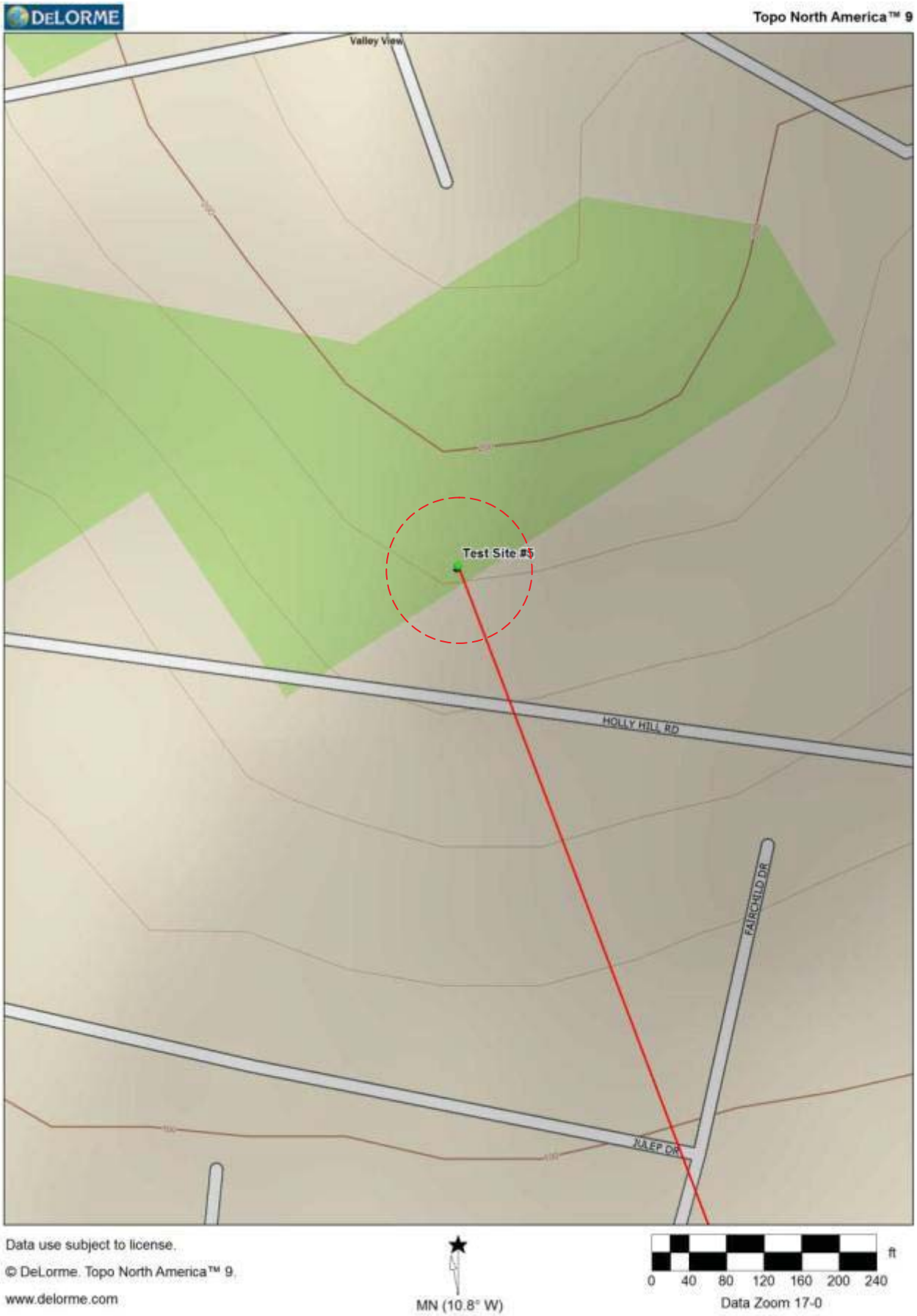


Figure 3.9-1 – Street Map – Test Site #5 Transmitter Location

Figure 3.9-2 – Aerial Map – Test Site #5 Transmitter Location

Figure 3.9-3 – View toward Inova Mount Vernon Hospital from Test Site #5

Figure 3.9-4 – View toward Inova Mount Vernon Hospital from Test Site #5 - Zoom

Figure 3.9-5 –Test Site #5 – Transmitter

Figure 3.9-6 – View toward Test Site #5 from inside Inova Mount Vernon Hospital 6th floor

Figure 3.9-7 – Receive Test Set in Inova Mt Vernon Hospital on 6th floor exterior hallway – for Test Site #5

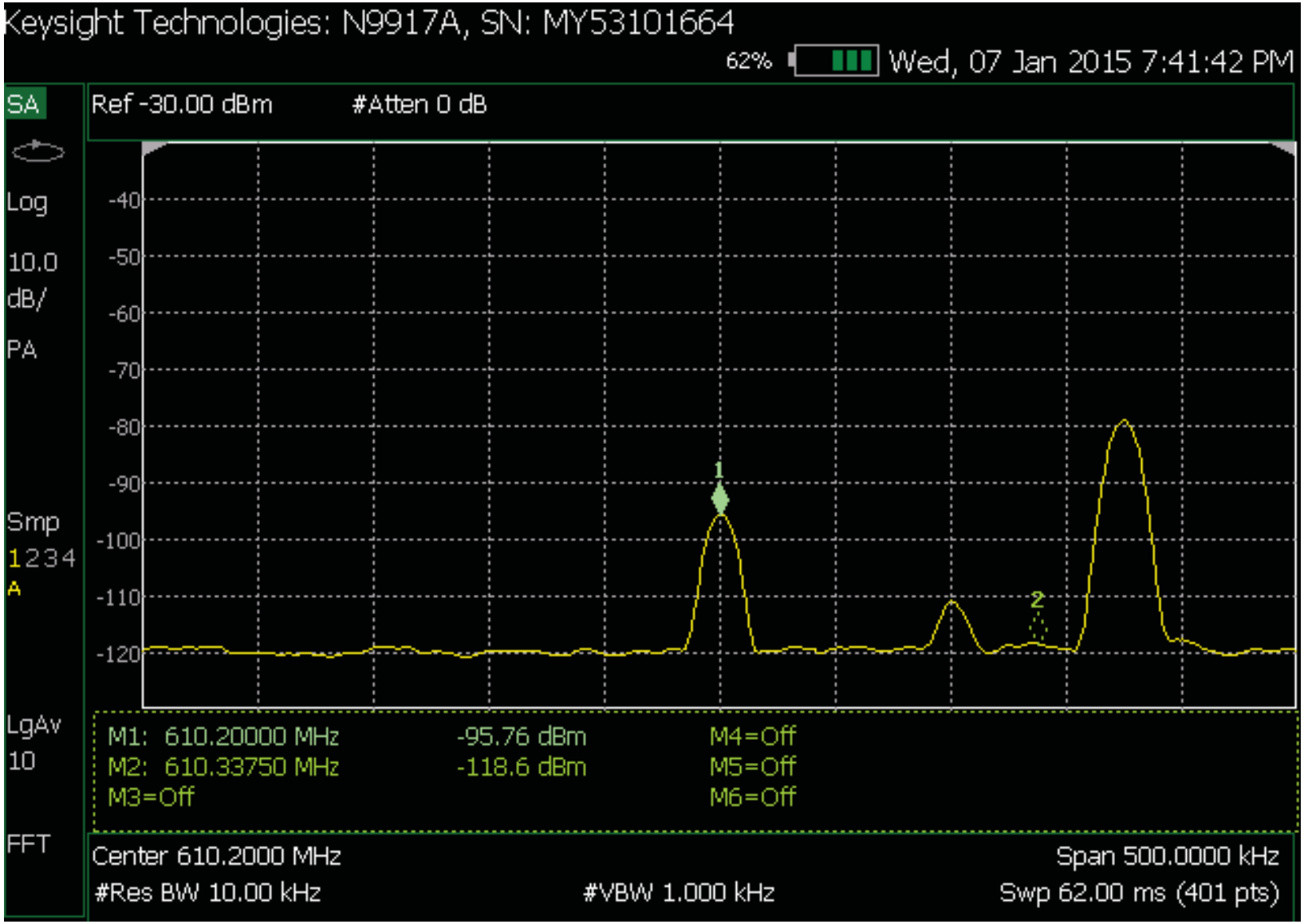


Figure 3.9-8 – Test Site #5 – Spectrum analyzer capture at 10 kHz RBW CW signal
Spectrum analyzer located on 6th floor exterior hallway approximately 2836 meters from the street level Test Site #5
Average recorded level -95.76 dBm (610.200 MHz) Marker 1 – isotropic value -102.26 dBm
Transmitter EIRP +14.60 dBm (Signal Generator set to +6.07 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

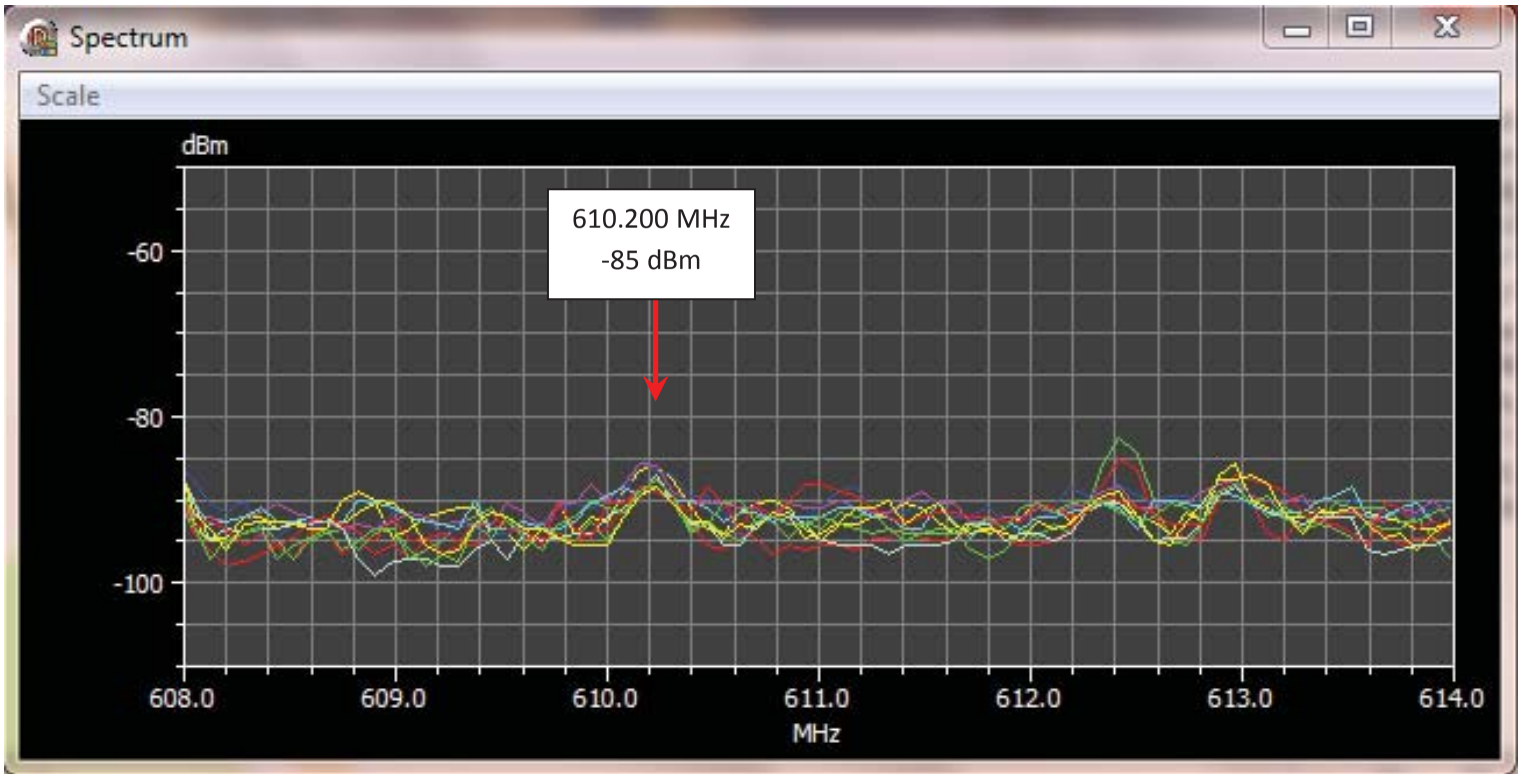


Figure 3.9-9 – Test Site #5 – Spectrum capture from rooftop
Spectrum Monitor located on rooftop approximately 2836 meters from the street level Test Site #5
Maximum recorded level –81.5 dBm (610.200 MHz) Marker 1
Transmitter EIRP +14.60 dBm (Signal Generator set to +6.07 dBm)

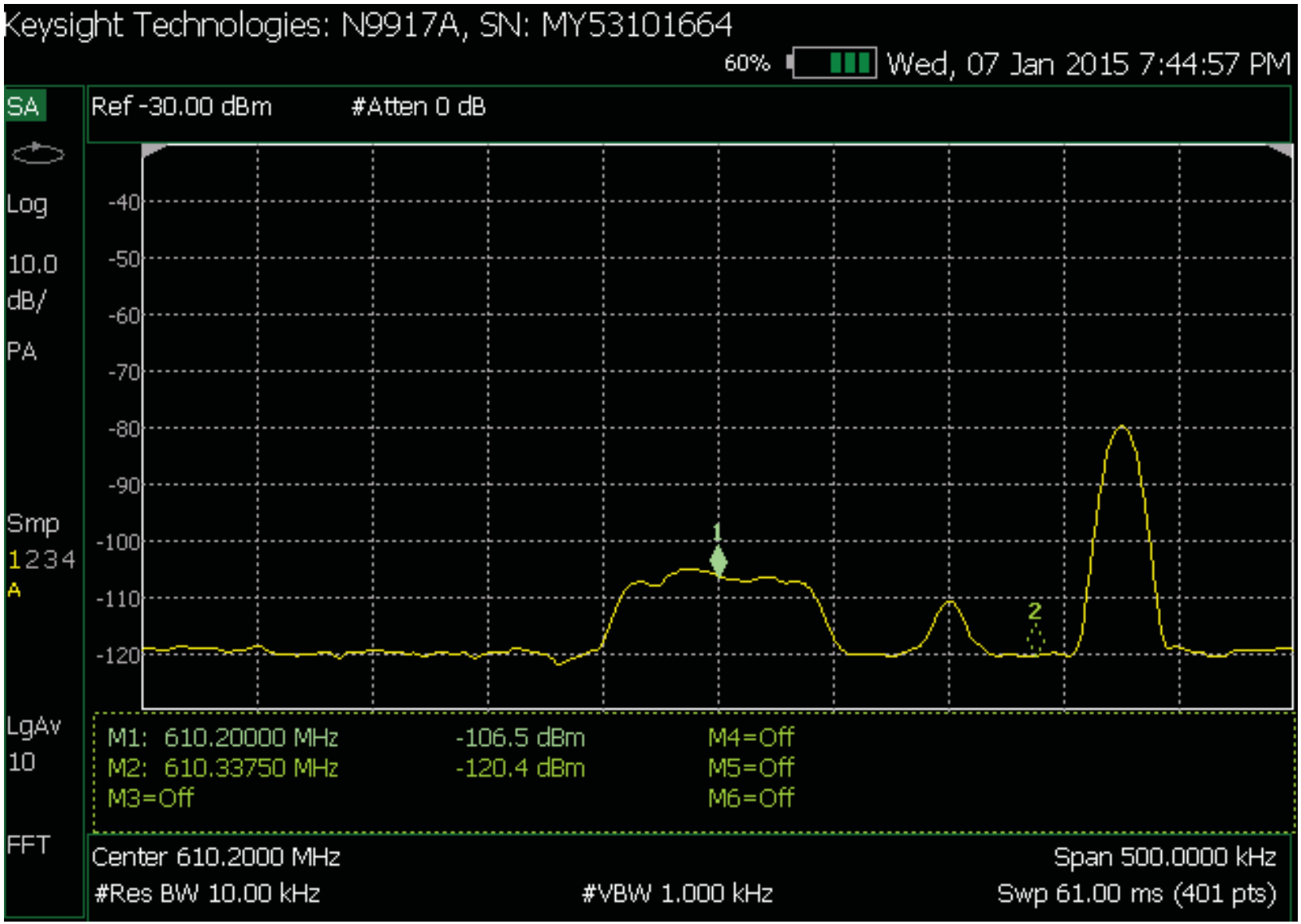


Figure 3.9-10 – Test Site #5 – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 6th floor exterior hallway approximately 2836 meters from the street level Test Site #5
Average recorded level -106.5 dBm (610.200 MHz) Marker 1 – isotropic value -113.0 dBm
Transmitter EIRP +14.60 dBm (Signal Generator set to +6.07 dBm)
NOTE: Adjacent signal seen is generated by the G.E. WMTS Test System

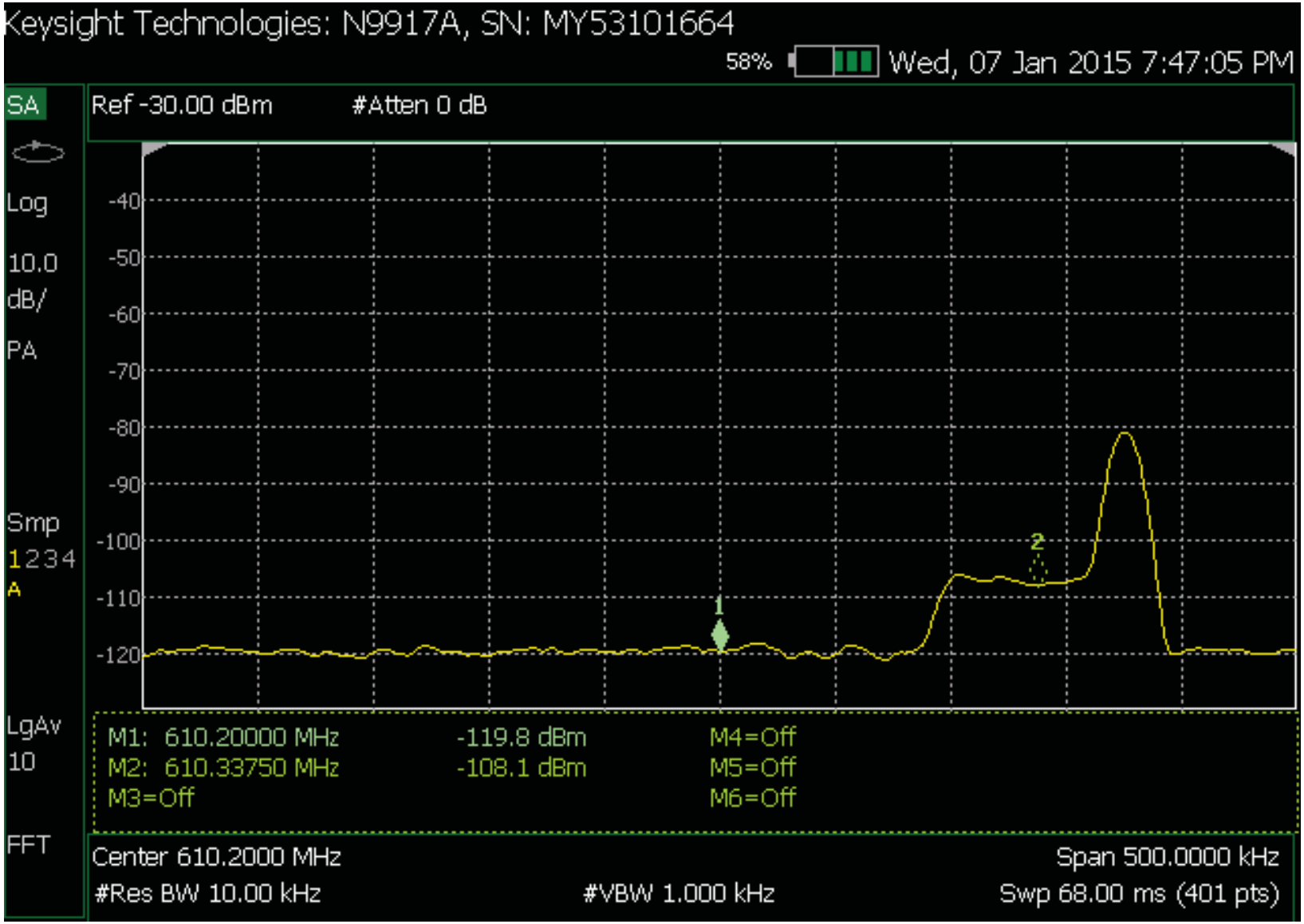


Figure 3.9-11 – Test Site #5 – Spectrum analyzer capture at 10 kHz RBW modulated signal (100 kHz BW)
Spectrum analyzer located on 6th floor exterior hallway approximately 2836 meters from the street level Test Site #5
Average recorded level -108.1 dBm (610.3375 MHz) Marker 2 – isotropic value -114.6 dBm
Transmitter EIRP +14.60 dBm (Signal Generator set to +6.07 dBm)

SECTION

FOUR

SECTION 4

SUMMARY OF RESULTS

The results of the measurements performed at each site location in the Alexandria, VA area are presented in this section.

4.1 RF Measurements

- There were measurements made in nine (9) locations within the Inova Mount Vernon Hospital.

- Signals were observed at various levels at all locations.

- Table 4.1-1 contains the values of the measured signals from inside the Inova Mount Vernon Hospital. These values are in isotropic levels.

RF Measurements Summary Results Table										
Site	**Hospital**	**Test Site #1**	**Test Site #2**	**Test Site #4**	**Test Site #4a**	**Test Site #4b**	**Test Site #4c**	**Test Site #4d**	**Test Site #4e**	**Test Site #5**
Latitude	38 44 22.96N	38 44 12.86N	38 44 14.45N	38 44 33.83N	38 44 31.96N	38 44 33.48N	38 44 35.86N	38 44 30.73N	38 44 29.94N	38 45 48.9N
Longitude	77 04 36.55W	77 04 41.96W	77 04 46.55W	77 04 34.67W	77 04 44.73W	77 04 39.56W	77 04 34.22W	77 04 24.05W	77 04 26.33W	77 05 18.4W
Distance to Hospital (m)	-	338	357	338	341	332	402	385	327	2836
Azimuth to Test Site	-	202.76	222.63	7.71	324.56	347.37	8.05	51.56	48.91	339.13
Azimuth to Hospital	-	22.76	42.63	187.71	144.56	167.37	188.05	231.56	228.91	159.12
Gound Elevation (m)	9.49	10.52	9.7	11.13	10.71	10.92	11.07	11.14	11.13	54.65
TX Antenna HAAT (m)	-	-23	-24	-23	-23	-23	-23	-23	-23	18
MAX EIRP Allowed (dBm)	-	16	16	16	16	16	20	16	16	32
TX Power at Signal Generator (dBm)	-	-9.93	-9.93	-9.93	-9.93	-9.93	-5.93	-9.93	-9.93	6.07
TX Antenna Gain (dBm)	-	10	10	10	10	10	10	10	10	10
TX Cable Loss (dBm)	-	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47
EIRP(dBm)	-	-1.40	-1.40	-1.40	-1.40	-1.40	2.60	-1.40	-1.40	14.60
Calculated Free Space Loss (dB)+	-	78.75	79.22	78.82	78.80	78.60	80.26	79.90	78.48	97.23
Predicted CW RSL on Roof (dBm)*	-	-80.15	-80.63	-80.16	-80.23	-80.01	-77.66	-81.30	-79.88	-82.64
Isotropic CW RSL on Roof (dBm)**	-	-90.00	-90.00	-84.50	-82.50	-85.50	-82.00	-81.50	-85.00	-85.00
Isotropic CW RSL in Building (dBm)	-	-105.82	-107.20	-100.48	-	-98.20	-92.55	-101.13	-102.50	-102.26
Measured Outside Pathloss (dB)***	-	88.60	88.60	83.10	81.10	84.10	84.60	80.10	83.60	99.60
Measured Inside Pathloss (dB)	-	104.42	105.80	99.08	-	96.80	95.15	99.73	101.10	116.86

+ FSPL(dB) = 20 log (d) + 20 Log (f) + 32.45 (where d, f in km and MHz)

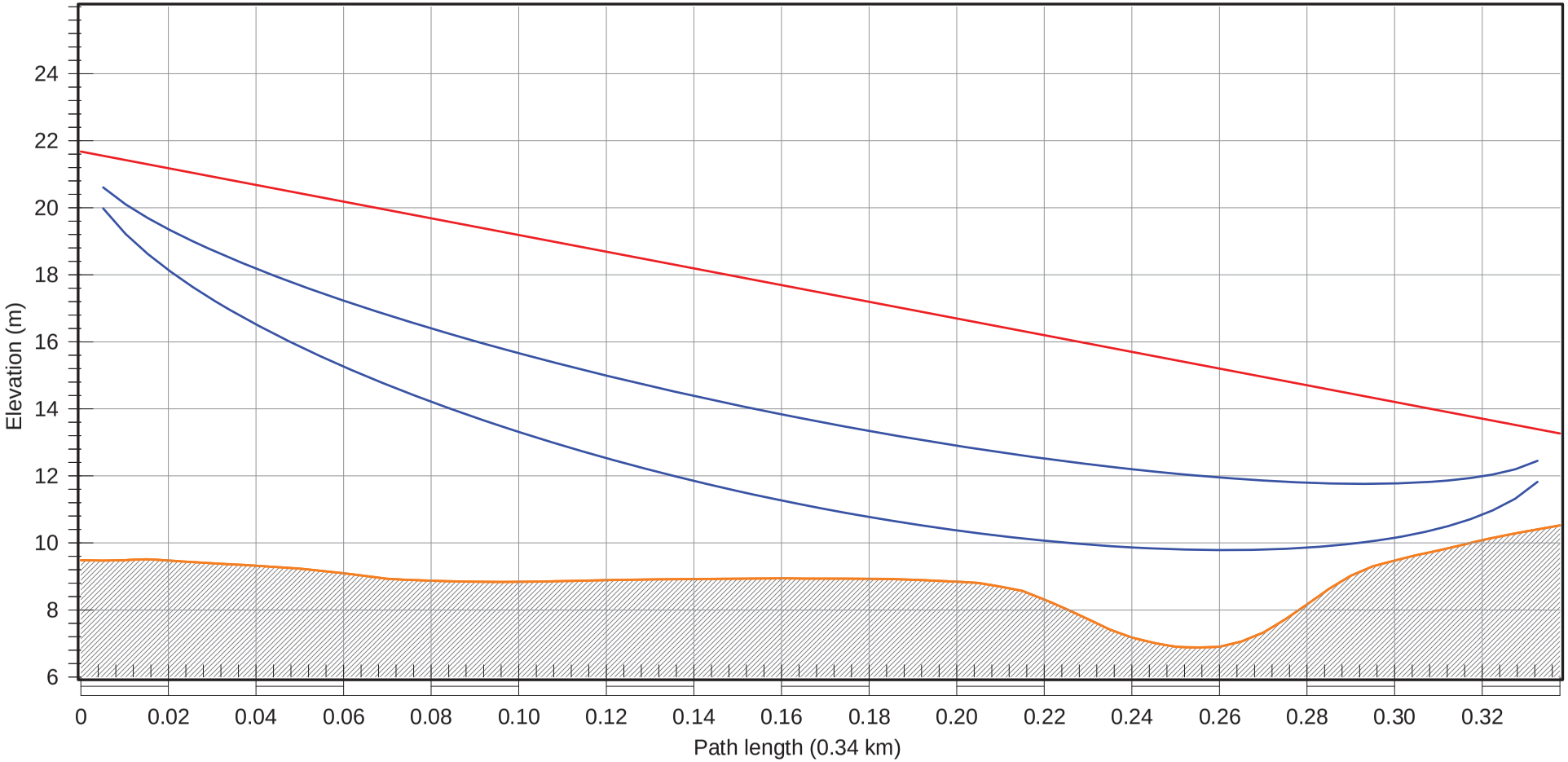
*** Predicted CW RSL on Roof = EIRP - Free Space Loss**

**** RF signal level as measured on the roof of the Hospital**

***** Difference in the EIRP and Isotropic CW RSL on Roof**

Table 4.1-1

APPENDIX



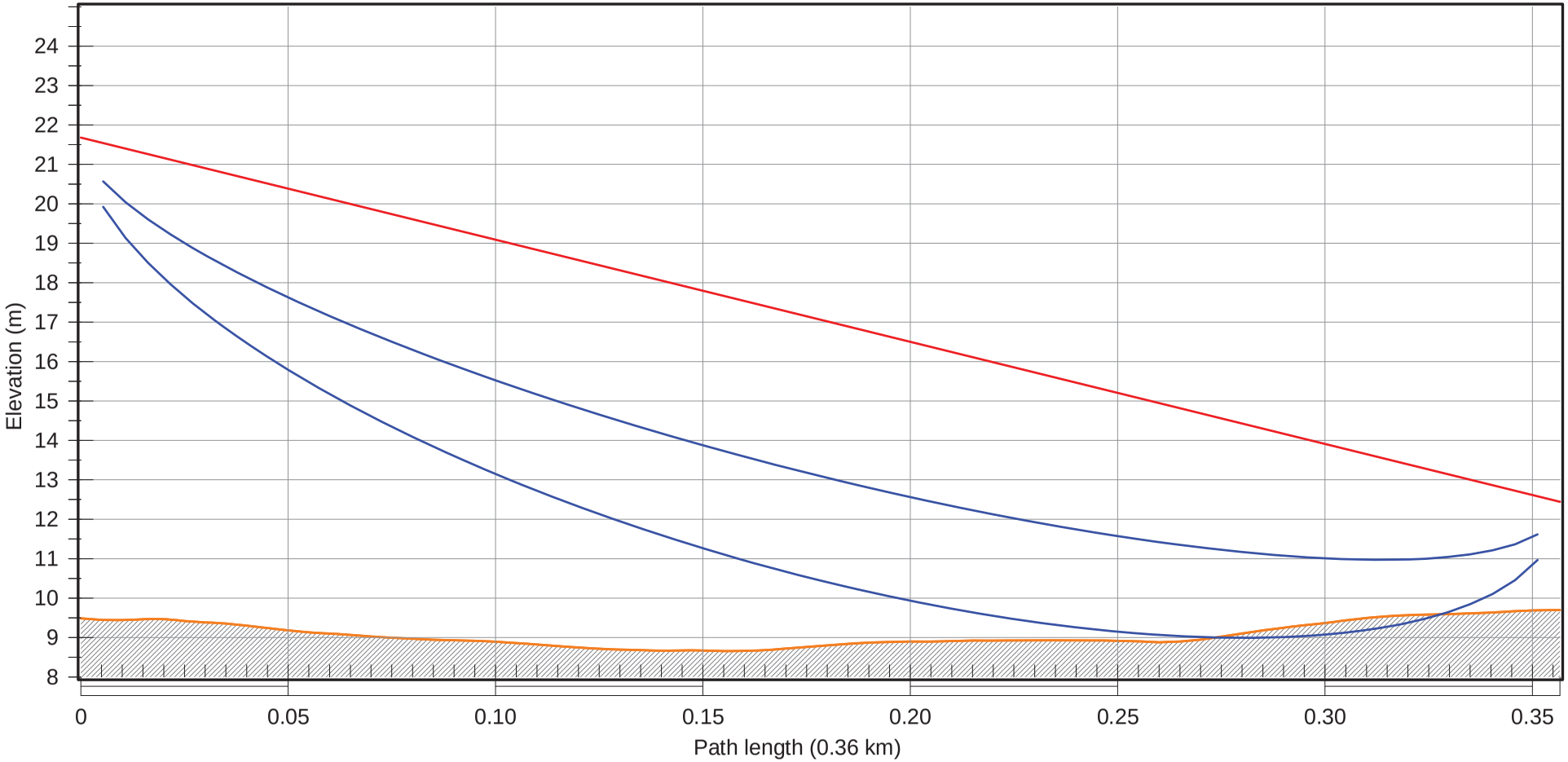
Hospital	
Latitude	38 44 22.96 N
Longitude	077 04 36.55 W
Azimuth	202.76°
Elevation	9 m ASL
Antenna CL	12.2 m AGL

Frequency (MHz) = 610.2
K = 1.33
%F1 = 100.00, 60.00

Test Site #1	
Latitude	38 44 12.86 N
Longitude	077 04 41.96 W
Azimuth	22.76°
Elevation	11 m ASL
Antenna CL	2.7 m AGL

	Hospital	Test Site #1
Latitude	38 44 22.96 N	38 44 12.86 N
Longitude	077 04 36.55 W	077 04 41.96 W
True azimuth (°)	202.76	22.76
Vertical angle (°)	-1.43	1.43
Elevation (m)	9.49	10.52
Antenna gain (dBi)	0.00	10.00
Antenna height (m)	12.19	2.74
TX line loss (dB)		1.47
Frequency (MHz)	610.20	
Polarization	Vertical	
Path length (km)	0.34	
Free space loss (dB)	78.75	
Atmospheric absorption loss (dB)	0.00	
Net path loss (dB)	70.22	70.22
TX power (dBm)		-9.93
EIRP (dBm)		-1.40
Receive signal (dBm)	-80.15	
Thermal fade margin (dB)		
Dispersive fade occurrence factor	1.00	
Climatic factor	1.00	
Terrain roughness (m)	6.10	
C factor	3.29	
Average annual temperature (°C)	12.35	
Fade occurrence factor (Po)	4.645E-008	
Polarization	Vertical	
Rain region	Washington, District Of Columbia	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane



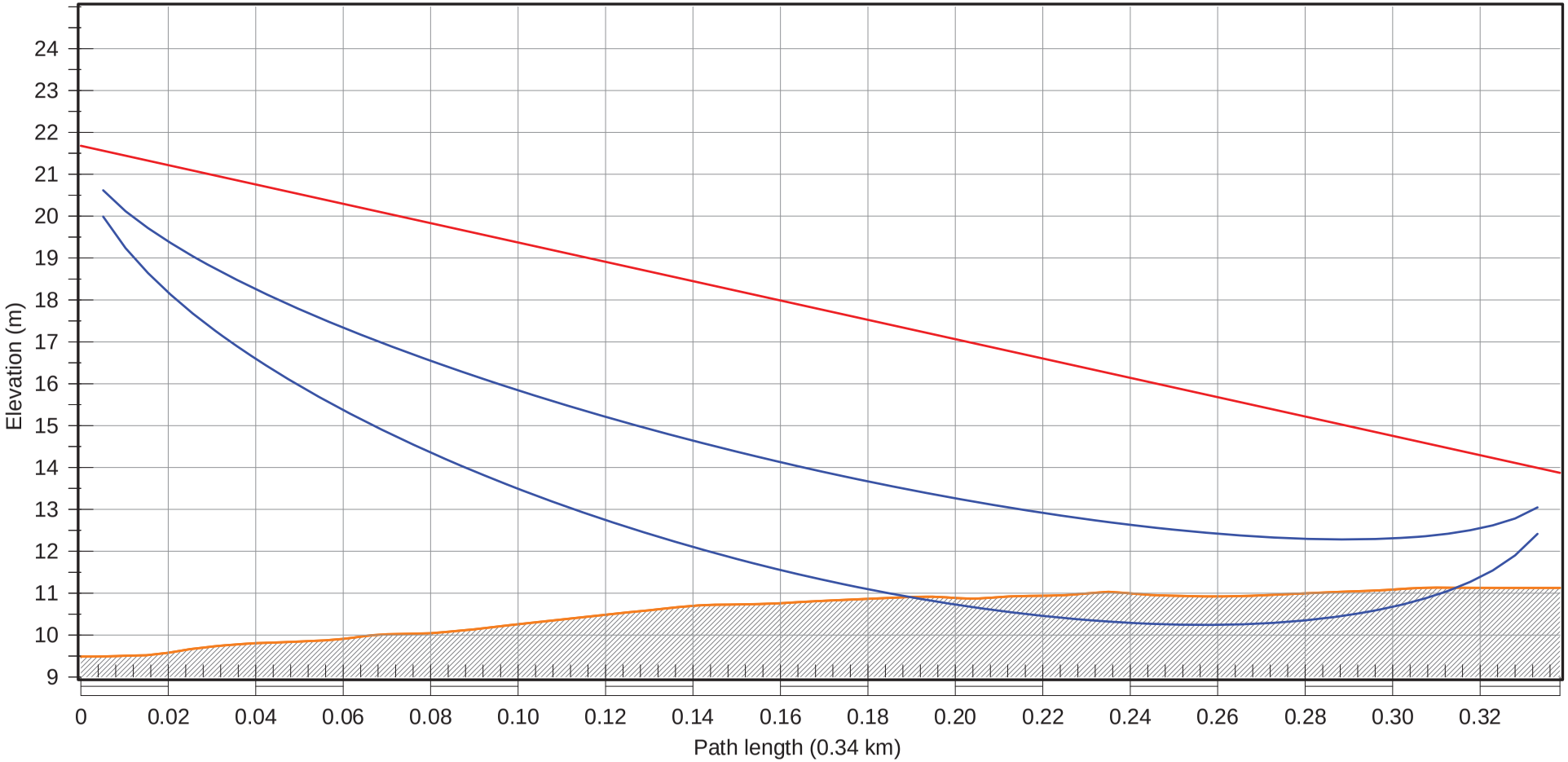
Hospital	
Latitude	38 44 22.96 N
Longitude	077 04 36.55 W
Azimuth	222.63°
Elevation	9 m ASL
Antenna CL	12.2 m AGL

Frequency (MHz) = 610.2
K = 1.33
%F1 = 100.00, 60.00

Test Site #2	
Latitude	38 44 14.45 N
Longitude	077 04 46.55 W
Azimuth	42.62°
Elevation	10 m ASL
Antenna CL	2.7 m AGL

	Hospital	Test Site #2
Latitude	38 44 22.96 N	38 44 14.45 N
Longitude	077 04 36.55 W	077 04 46.55 W
True azimuth (°)	222.63	42.62
Vertical angle (°)	-1.48	1.48
Elevation (m)	9.49	9.70
Antenna gain (dBi)	0.00	10.00
Antenna height (m)	12.19	2.74
TX line loss (dB)		1.47
Frequency (MHz)	610.20	
Polarization	Vertical	
Path length (km)	0.36	
Free space loss (dB)	79.22	
Atmospheric absorption loss (dB)	0.00	
Net path loss (dB)	70.70	70.70
TX power (dBm)		-9.93
EIRP (dBm)		-1.40
Receive signal (dBm)	-80.63	
Thermal fade margin (dB)		
Dispersive fade occurrence factor	1.00	
Climatic factor	1.00	
Terrain roughness (m)	6.10	
C factor	3.29	
Average annual temperature (°C)	12.35	
Fade occurrence factor (Po)	5.469E-008	
Polarization	Vertical	
Rain region	Washington, District Of Columbia	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane



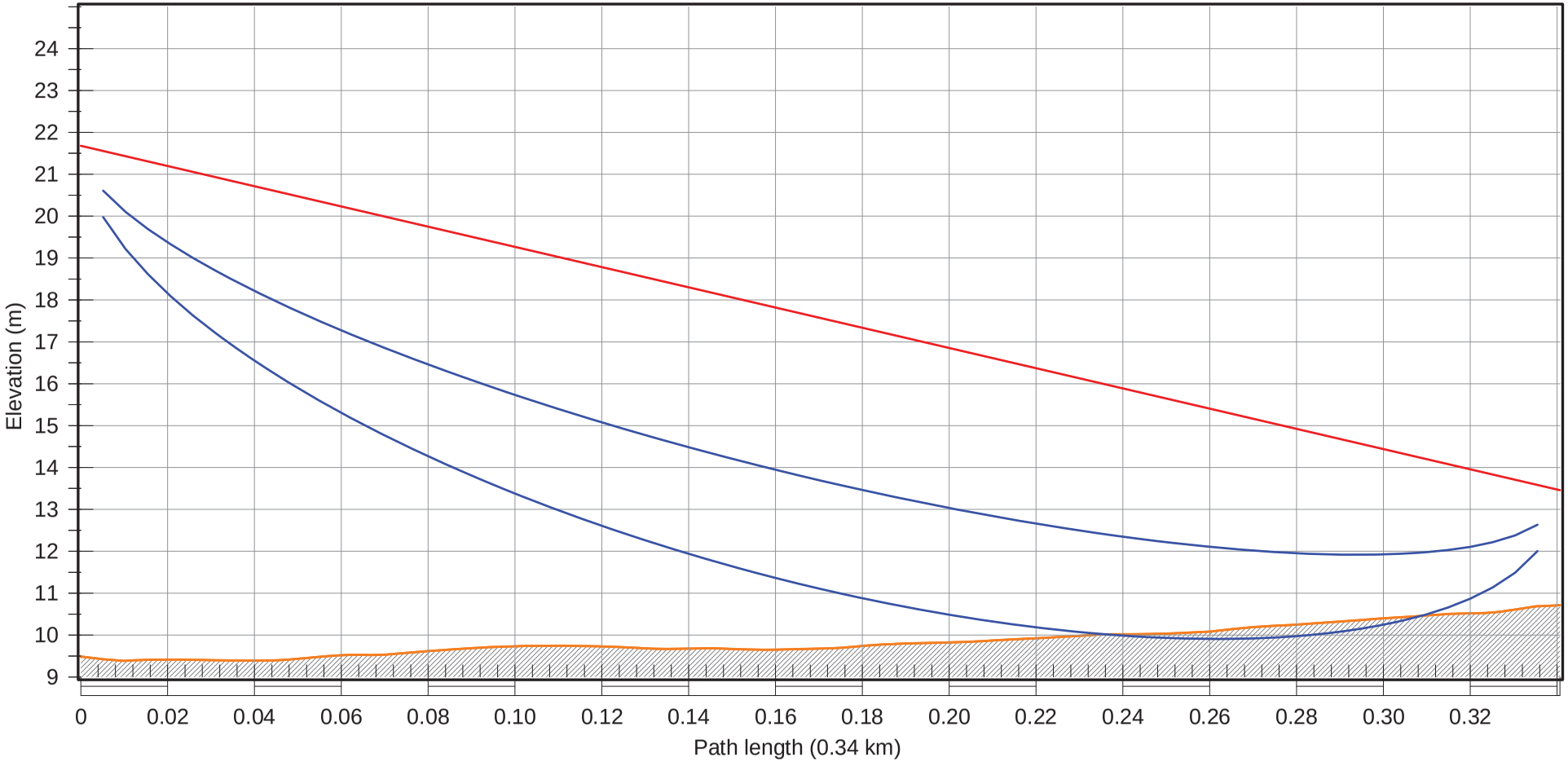
Hospital	
Latitude	38 44 22.96 N
Longitude	077 04 36.55 W
Azimuth	7.71°
Elevation	9 m ASL
Antenna CL	12.2 m AGL

Frequency (MHz) = 610.2
K = 1.33
%F1 = 100.00, 60.00

Test Site #4	
Latitude	38 44 33.83 N
Longitude	077 04 34.67 W
Azimuth	187.71°
Elevation	11 m ASL
Antenna CL	2.7 m AGL

	Hospital	Test Site #4
Latitude	38 44 22.96 N	38 44 33.83 N
Longitude	077 04 36.55 W	077 04 34.67 W
True azimuth (°)	7.71	187.71
Vertical angle (°)	-1.32	1.32
Elevation (m)	9.49	11.13
Antenna gain (dBi)	0.00	10.00
Antenna height (m)	12.19	2.74
TX line loss (dB)		1.47
Frequency (MHz)	610.20	
Polarization	Vertical	
Path length (km)	0.34	
Free space loss (dB)	78.76	
Atmospheric absorption loss (dB)	0.00	
Net path loss (dB)	70.23	70.23
TX power (dBm)		-9.93
EIRP (dBm)		-1.40
Receive signal (dBm)	-80.16	
Thermal fade margin (dB)		
Dispersive fade occurrence factor	1.00	
Climatic factor	1.00	
Terrain roughness (m)	6.10	
C factor	3.29	
Average annual temperature (°C)	12.35	
Fade occurrence factor (Po)	4.664E-008	
Polarization	Vertical	
Rain region	Washington, District Of Columbia	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane



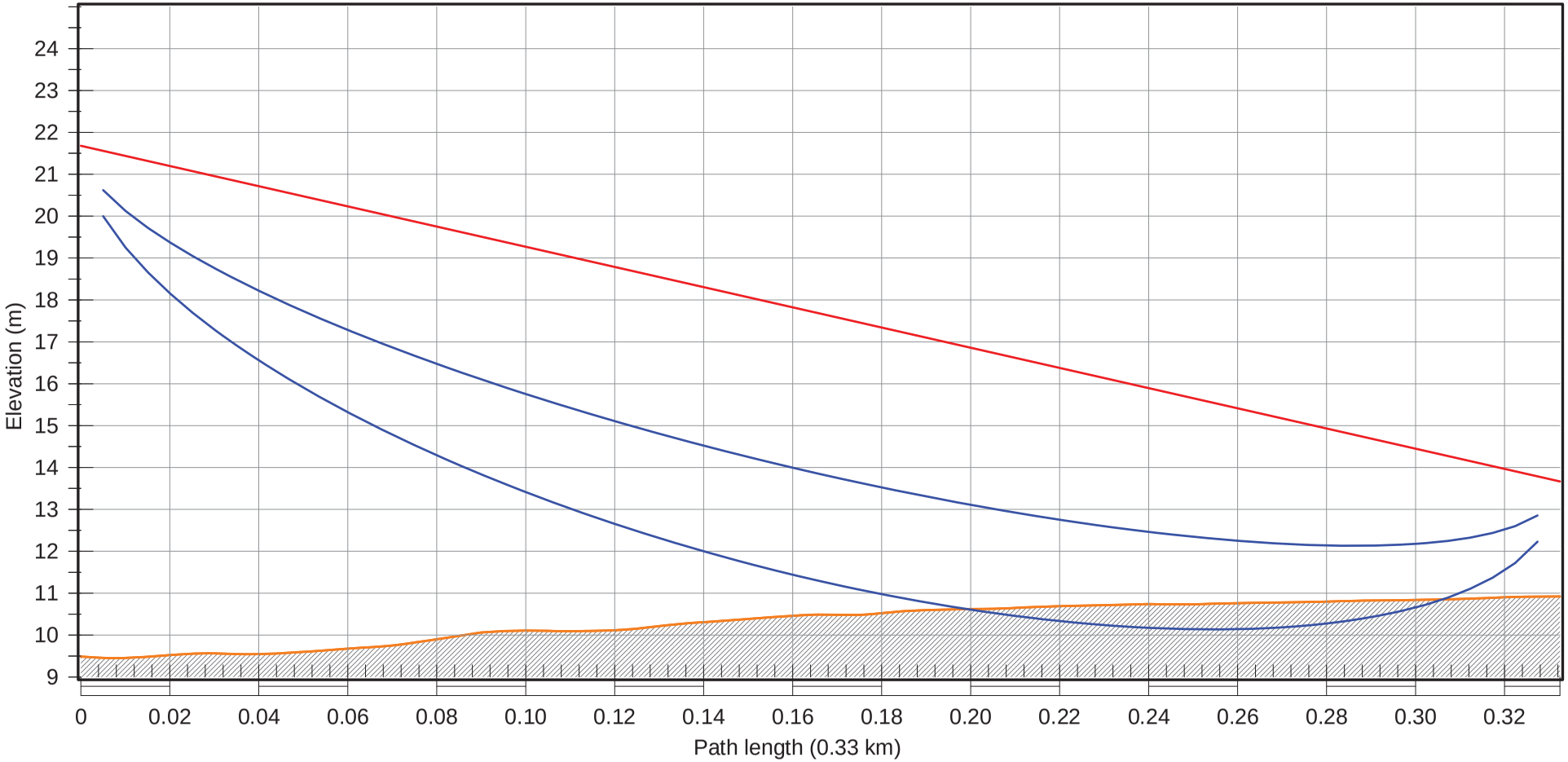
Hospital	
Latitude	38 44 22.96 N
Longitude	077 04 36.55 W
Azimuth	324.56°
Elevation	9 m ASL
Antenna CL	12.2 m AGL

Frequency (MHz) = 610.2
K = 1.33
%F1 = 100.00, 60.00

Test Site #4a	
Latitude	38 44 31.96 N
Longitude	077 04 44.73 W
Azimuth	144.56°
Elevation	11 m ASL
Antenna CL	2.7 m AGL

	Hospital	Test Site #4a
Latitude	38 44 22.96 N	38 44 31.96 N
Longitude	077 04 36.55 W	077 04 44.73 W
True azimuth (°)	324.56	144.56
Vertical angle (°)	-1.38	1.38
Elevation (m)	9.49	10.71
Antenna gain (dBi)	0.00	10.00
Antenna height (m)	12.19	2.74
TX line loss (dB)		1.47
Frequency (MHz)	610.20	
Polarization	Vertical	
Path length (km)	0.34	
Free space loss (dB)	78.83	
Atmospheric absorption loss (dB)	0.00	
Net path loss (dB)	70.30	70.30
TX power (dBm)		-9.93
EIRP (dBm)		-1.40
Receive signal (dBm)	-80.23	
Thermal fade margin (dB)		
Dispersive fade occurrence factor	1.00	
Climatic factor	1.00	
Terrain roughness (m)	6.10	
C factor	3.29	
Average annual temperature (°C)	12.35	
Fade occurrence factor (Po)	4.766E-008	
Polarization	Vertical	
Rain region	Washington, District Of Columbia	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane



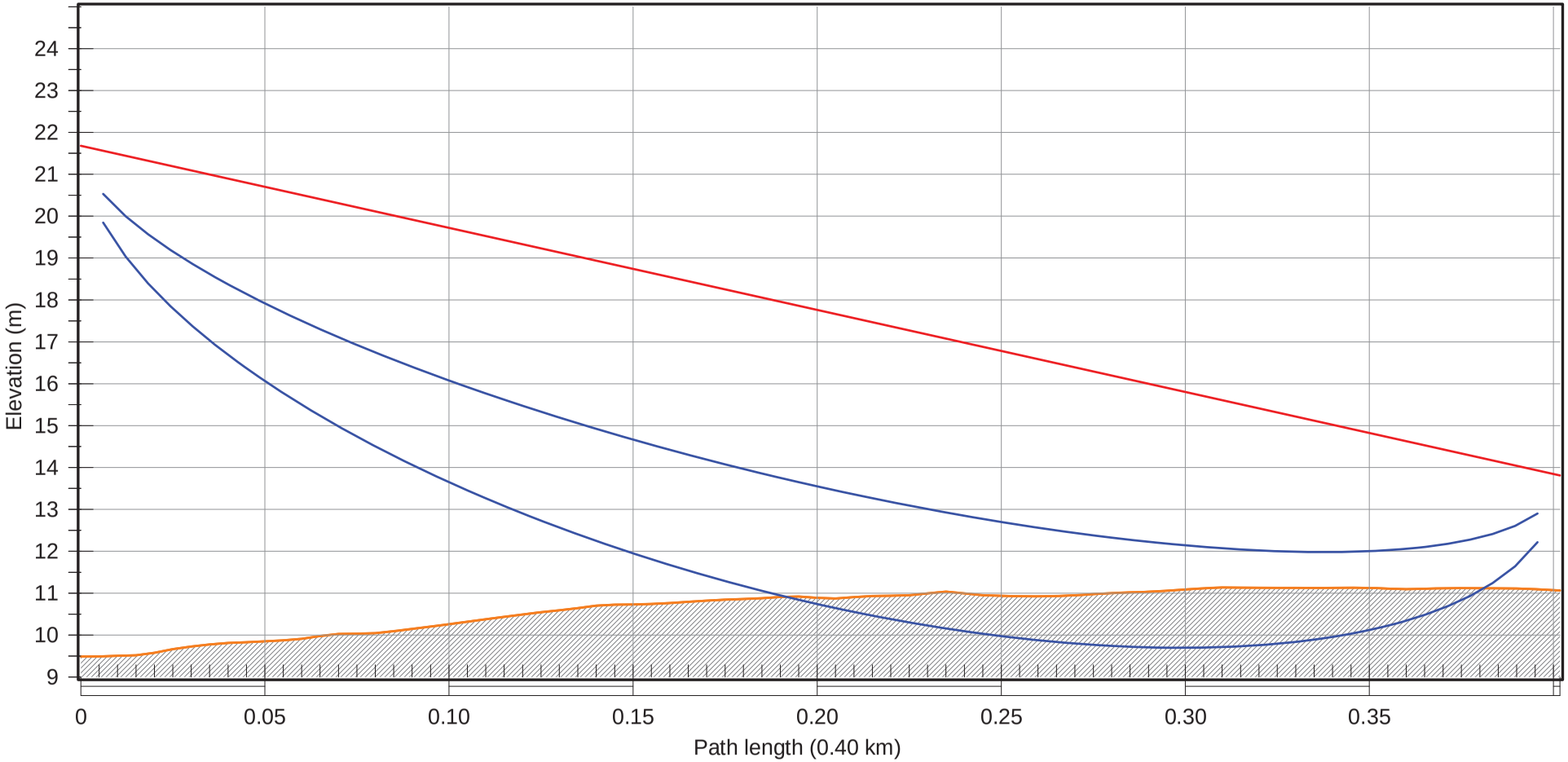
Hospital	
Latitude	38 44 22.96 N
Longitude	077 04 36.55 W
Azimuth	347.37°
Elevation	9 m ASL
Antenna CL	12.2 m AGL

Frequency (MHz) = 610.2
K = 1.33
%F1 = 100.00, 60.00

Test Site #4b	
Latitude	38 44 33.48 N
Longitude	077 04 39.56 W
Azimuth	167.37°
Elevation	11 m ASL
Antenna CL	2.7 m AGL

	Hospital	Test Site #4b
Latitude	38 44 22.96 N	38 44 33.48 N
Longitude	077 04 36.55 W	077 04 39.56 W
True azimuth (°)	347.37	167.37
Vertical angle (°)	-1.38	1.38
Elevation (m)	9.49	10.92
Antenna gain (dBi)	0.00	10.00
Antenna height (m)	12.19	2.74
TX line loss (dB)		1.47
Frequency (MHz)	610.21	
Polarization	Vertical	
Path length (km)	0.33	
Free space loss (dB)	78.61	
Atmospheric absorption loss (dB)	0.00	
Net path loss (dB)	70.08	70.08
TX power (dBm)		-9.93
EIRP (dBm)		-1.40
Receive signal (dBm)	-80.01	
Thermal fade margin (dB)		
Dispersive fade occurrence factor	1.00	
Climatic factor	1.00	
Terrain roughness (m)	6.10	
C factor	3.29	
Average annual temperature (°C)	12.35	
Fade occurrence factor (Po)	4.428E-008	
Polarization	Vertical	
Rain region	Washington, District Of Columbia	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane



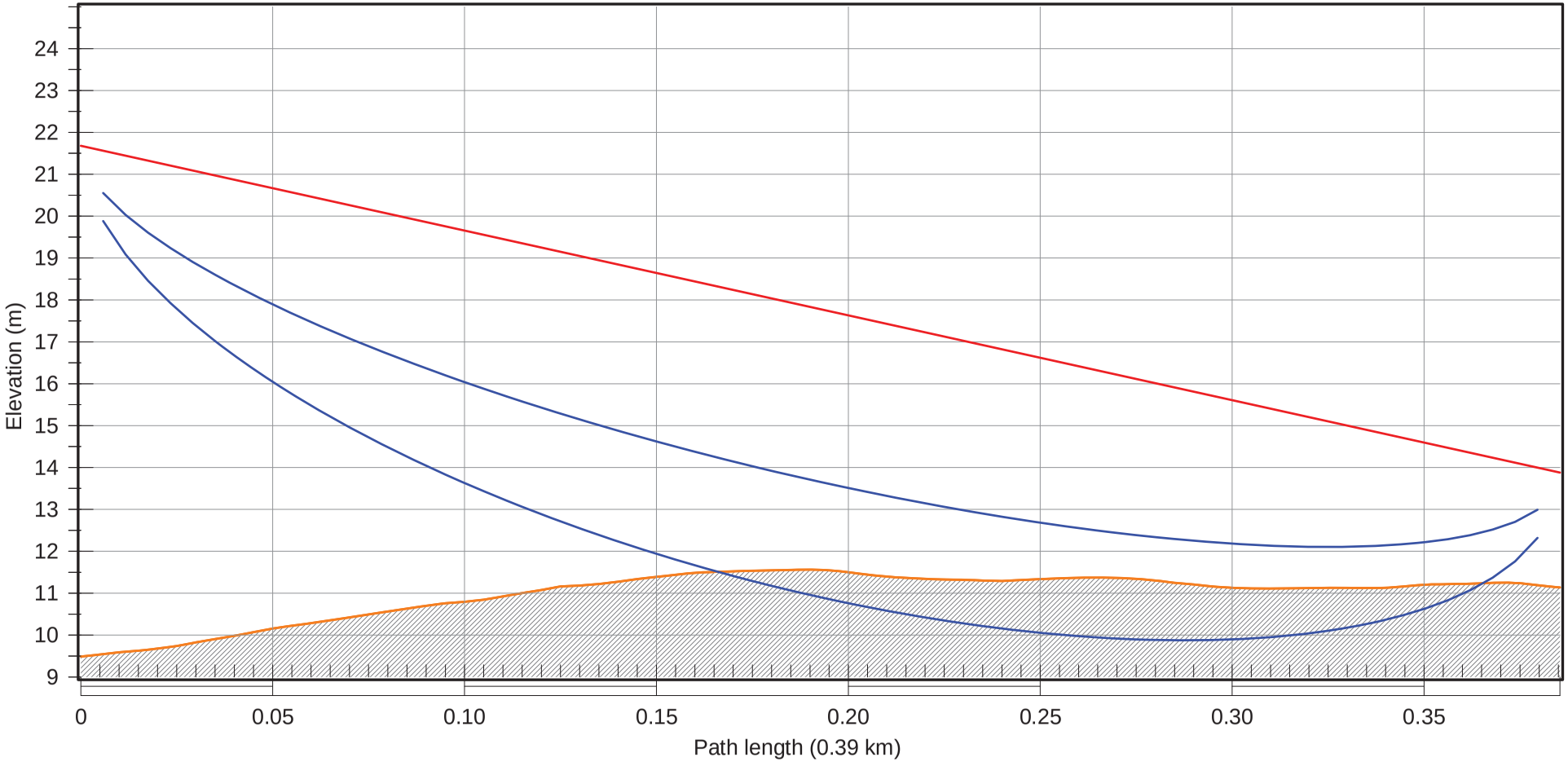
Hospital	
Latitude	38 44 22.96 N
Longitude	077 04 36.55 W
Azimuth	8.05°
Elevation	9 m ASL
Antenna CL	12.2 m AGL

Frequency (MHz) = 610.2
K = 1.33
%F1 = 100.00, 60.00

Test Site #4c	
Latitude	38 44 35.86 N
Longitude	077 04 34.22 W
Azimuth	188.05°
Elevation	11 m ASL
Antenna CL	2.7 m AGL

	Hospital	Test Site #4c
Latitude	38 44 22.96 N	38 44 35.86 N
Longitude	077 04 36.55 W	077 04 34.22 W
True azimuth (°)	8.05	188.05
Vertical angle (°)	-1.12	1.12
Elevation (m)	9.49	11.07
Antenna gain (dBi)	0.00	10.00
Antenna height (m)	12.19	2.74
TX line loss (dB)		1.47
Frequency (MHz)	610.20	
Polarization	Vertical	
Path length (km)	0.40	
Free space loss (dB)	80.26	
Atmospheric absorption loss (dB)	0.00	
Net path loss (dB)	71.73	71.73
TX power (dBm)		-5.93
EIRP (dBm)		2.60
Receive signal (dBm)	-77.66	
Thermal fade margin (dB)		
Dispersive fade occurrence factor	1.00	
Climatic factor	1.00	
Terrain roughness (m)	6.10	
C factor	3.29	
Average annual temperature (°C)	12.35	
Fade occurrence factor (Po)	7.813E-008	
Polarization	Vertical	
Rain region	Washington, District Of Columbia	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane



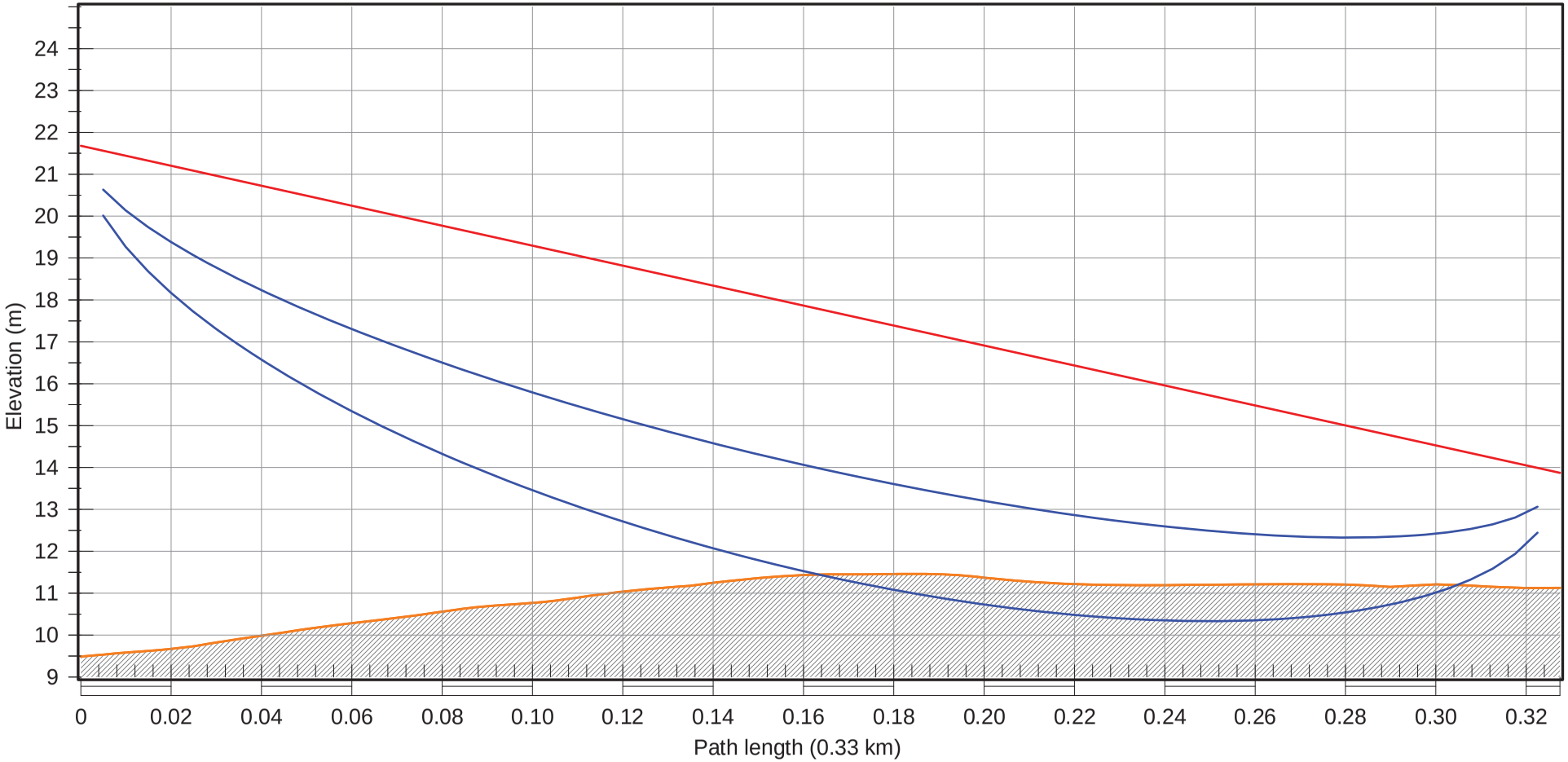
Hospital	
Latitude	38 44 22.96 N
Longitude	077 04 36.55 W
Azimuth	51.56°
Elevation	9 m ASL
Antenna CL	12.2 m AGL

Frequency (MHz) = 610.2
K = 1.33
%F1 = 100.00, 60.00

Test Site #4d	
Latitude	38 44 30.73 N
Longitude	077 04 24.05 W
Azimuth	231.56°
Elevation	11 m ASL
Antenna CL	2.7 m AGL

	Hospital	Test Site #4d
Latitude	38 44 22.96 N	38 44 30.73 N
Longitude	077 04 36.55 W	077 04 24.05 W
True azimuth (°)	51.56	231.56
Vertical angle (°)	-1.16	1.16
Elevation (m)	9.49	11.14
Antenna gain (dBi)	0.00	10.00
Antenna height (m)	12.19	2.74
TX line loss (dB)		1.47
Frequency (MHz)	610.20	
Polarization	Vertical	
Path length (km)	0.39	
Free space loss (dB)	79.90	
Atmospheric absorption loss (dB)	0.00	
Net path loss (dB)	71.37	71.37
TX power (dBm)		-9.93
EIRP (dBm)		-1.40
Receive signal (dBm)	-81.30	
Thermal fade margin (dB)		
Dispersive fade occurrence factor	1.00	
Climatic factor	1.00	
Terrain roughness (m)	6.10	
C factor	3.29	
Average annual temperature (°C)	12.35	
Fade occurrence factor (Po)	6.898E-008	
Polarization	Vertical	
Rain region	Washington, District Of Columbia	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane



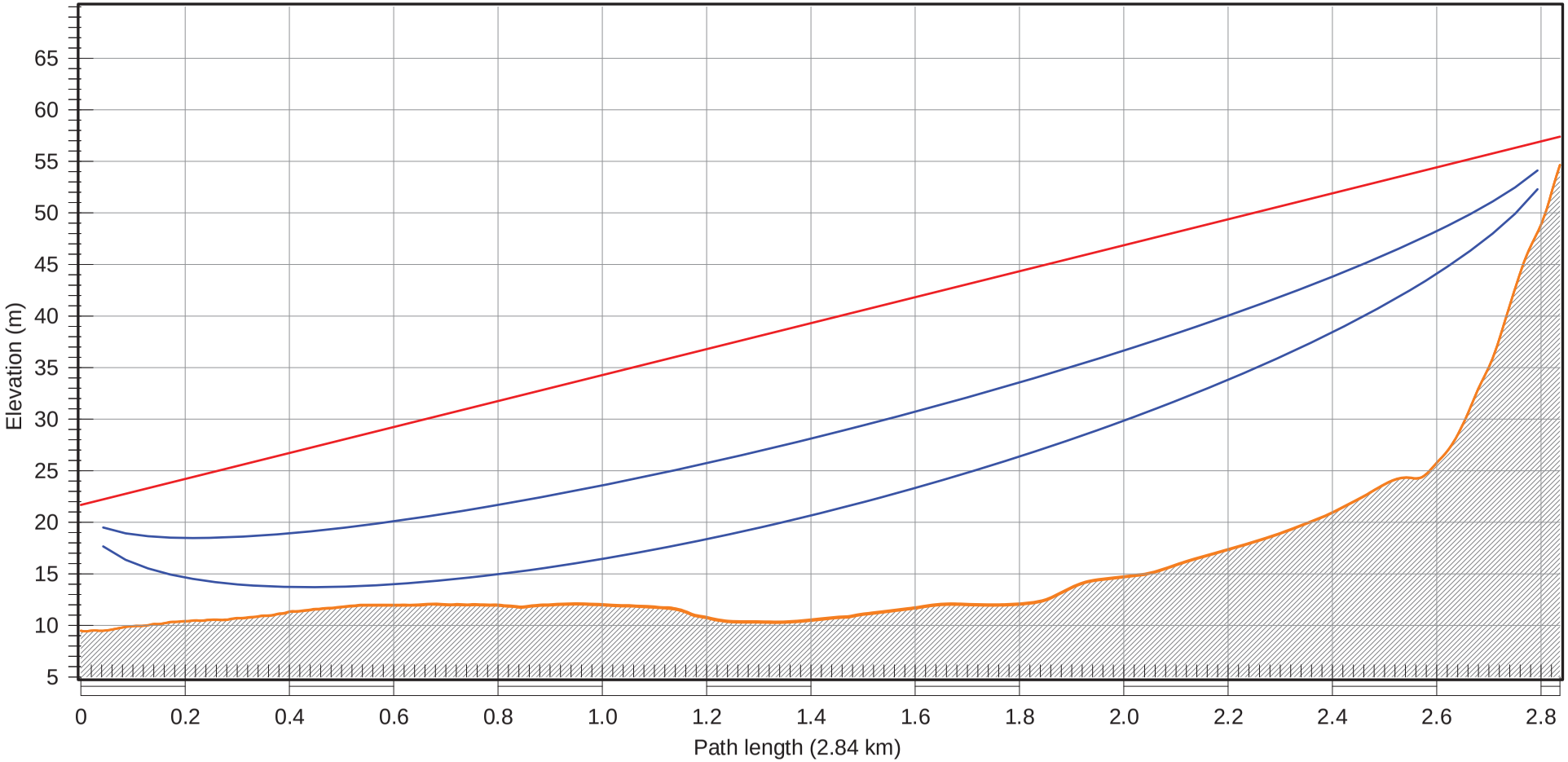
Hospital	
Latitude	38 44 22.96 N
Longitude	077 04 36.55 W
Azimuth	48.91°
Elevation	9 m ASL
Antenna CL	12.2 m AGL

Frequency (MHz) = 610.2
K = 1.33
%F1 = 100.00, 60.00

Test Site #4e	
Latitude	38 44 29.94 N
Longitude	077 04 26.33 W
Azimuth	228.91°
Elevation	11 m ASL
Antenna CL	2.7 m AGL

	Hospital	Test Site #4e
Latitude	38 44 22.96 N	38 44 29.94 N
Longitude	077 04 36.55 W	077 04 26.33 W
True azimuth (°)	48.91	228.91
Vertical angle (°)	-1.37	1.36
Elevation (m)	9.49	11.13
Antenna gain (dBi)	0.00	10.00
Antenna height (m)	12.19	2.74
TX line loss (dB)		1.47
Frequency (MHz)	610.20	
Polarization	Vertical	
Path length (km)	0.33	
Free space loss (dB)	78.48	
Atmospheric absorption loss (dB)	0.00	
Net path loss (dB)	69.95	69.95
TX power (dBm)		-9.93
EIRP (dBm)		-1.40
Receive signal (dBm)	-79.88	
Thermal fade margin (dB)		
Dispersive fade occurrence factor	1.00	
Climatic factor	1.00	
Terrain roughness (m)	6.10	
C factor	3.29	
Average annual temperature (°C)	12.35	
Fade occurrence factor (Po)	4.233E-008	
Polarization	Vertical	
Rain region	Washington, District Of Columbia	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane



Hospital	
Latitude	38 44 22.96 N
Longitude	077 04 36.55 W
Azimuth	339.13°
Elevation	9 m ASL
Antenna CL	12.2 m AGL

Frequency (MHz) = 610.2
K = 1.33
%F1 = 100.00, 60.00

Test Site #5	
Latitude	38 45 48.90 N
Longitude	077 05 18.40 W
Azimuth	159.12°
Elevation	55 m ASL
Antenna CL	2.7 m AGL

	Hospital	Test Site #5
Latitude	38 44 22.96 N	38 45 48.90 N
Longitude	077 04 36.55 W	077 05 18.40 W
True azimuth (°)	339.13	159.12
Vertical angle (°)	0.71	-0.73
Elevation (m)	9.49	54.65
Antenna gain (dBi)	0.00	10.00
Antenna height (m)	12.19	2.74
TX line loss (dB)		1.47
Frequency (MHz)	610.2	
Polarization	Vertical	
Path length (km)	2.84	
Free space loss (dB)	97.23	
Atmospheric absorption loss (dB)	0.01	
Net path loss (dB)	88.71	88.71
TX power (dBm)		6.07
EIRP (dBm)		14.60
Receive signal (dBm)	-82.64	
Thermal fade margin (dB)		
Dispersive fade occurrence factor	1.00	
Climatic factor	1.00	
Terrain roughness (m)	6.10	
C factor	3.29	
Average annual temperature (°C)	12.33	
Fade occurrence factor (Po)	2.749E-005	
Polarization	Vertical	
Rain region	Washington, District Of Columbia	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane