

ViaSat, Inc.

Frequency Coordination Study for Proposed EESS Uplink near Pendergrass, Georgia

July 22, 2016

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Statement of Hammett & Edison, Inc., Consulting Engineers

Hammett & Edison, Inc., Consulting Engineers, has been retained by ViaSat, Inc. to conduct a frequency coordination study for a proposed 2,056 MHz Earth Exploration Satellite Service (EESS) uplink near Pendergrass, Georgia. This work has been undertaken pursuant to ViaSat Consultant Services Agreement Number CSA-HE-20160602.

Proposed EESS Uplink Facilities

As shown by the attached Figure 1, the proposed EESS uplink would be located at a site 1.3 km NNE of Pendergrass, Jackson County, Georgia. The site coordinates are 34° 10' 29" N, 83° 40' 19" West, NAD83 datum. The site elevation is 748 feet AMSL. A 5.4-meter diameter parabolic dish transmitting antenna with a main beam gain of 38.1 dBi would be used, with an effective center-of-radiation (C.O.R.) height of 15 feet AGL. The attached Figure 2 shows the azimuth and elevation patterns for this antenna. The transmitter power would be 32.5 watts (45.1 dBm), and the main beam equivalent isotropic radiated power (EIRP) would be 83.2 dBm, with 1M31F1D emission. The uplink signal would be used for tracking, telemetry and control (TT&C) of up to 200 non-geosynchronous low earth orbit (NGSO LEO) satellites operated by Planet Labs Inc., pursuant to satellite license S2912. This constellation will be used for Earth imaging applications.¹

An earlier application by ViaSat, FCC File No. E110157, for an EESS uplink at Duluth, Gwinnett County, Georgia, was withdrawn after it became apparent that the uplink would cause interference to Atlanta-area 2 GHz TV Broadcast Auxiliary Services (BAS) operations. At 2,025–2,110 MHz Part 74, Subpart F, TV BAS stations are primary, and EESS uplinks are secondary. Therefore, an EESS uplink must demonstrate protection of co-channel TV BAS operations, used primarily by mobile TV Pickup stations for electronic news gathering (ENG) applications. By selecting the more remote Pendergrass site, 81.5 km from Atlanta versus just 46.0 km from Atlanta for the now abandoned Duluth uplink site, ViaSat surmised that there might be sufficient separation and terrain obstruction to ensure that there would be no impact to ENG operations.

¹ According to Planet Lab's Exhibit 43 to its S2912 satellite authorization, FCC File Number SAT-MOD-20150802-00053, dated June 15, 2016, although as many as 600 Cubesat satellites may be built over the next ten years, only 200 Cubesats will be in use at any one time. Also according to the S2912 Exhibit 43, low-cost and expendable Cubesats will be transported to the International Space Station (ISS) aboard a cargo resupply mission and ejected from the ISS to an altitude between 380 and 410 km. As the orbit naturally decays the Cubesat will be allowed to burn up, and the constellation will be maintained by regularly deploying new Cubesats.

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Atlanta Area 2 GHz TV BAS Stations

To ensure identifying all 2 GHz Part 74 TV BAS licensees, the FCC Universal Licensing System (ULS) was searched for 200 km of Atlanta; a total of 47 records were returned, of which 44 were TV Pickup stations, one was a fixed-link TV STL, and two were fixed-link Inter City Relay (ICR) stations. These stations are shown in the attached Figures 3A and 3B. Because of their separation distances and favorable path geometries, and because the fixed-link stations would be neither co-channel nor adjacent-channel to the proposed Pendergrass uplink,² the uplink was not judged to be an interference threat to any of the 2 GHz fixed-link TV BAS stations. However, as shown by Figure 3C, the Pendergrass uplink would be inside the operational areas of all five of the Atlanta TV stations with 2 GHz TV Pickup licenses. Cable News Network (CNN) also holds an Atlanta-area TV Pickup license, but the Pendergrass site falls just outside that station's operational area.

TV stations typically install multiple ENG receive-only (ENG-RO) sites in their operational area, with receiving antennas near the top of a tall tower or building, or on a mountain. Directional dish receive antennas that can be steered in real time are commonly used, along with sensitive receivers. The goal is to have a sufficient number of ENG-RO sites so that no matter where a news event occurs in the TV station's market, an ENG truck at the news event site will be able to establish a path back to at least one of the receive sites. The incoming ENG feed is then relayed back to the TV station's studio by a fixed-link 7 or 13 GHz ICR, or in some cases by fiber optic cable.

Although the FCC has allowed TV Pickup licensees to voluntarily add their ENG-RO sites to a TV Pickup license since 2008, only one of the Atlanta TV stations had properly done so. Another Atlanta TV station had added their ENG-RO sites to their TV Pickup license, but incorrectly showed the C.O.R. heights of their receiving antennas as just 6.1 m (20 feet) AGL, when in fact the receiving antennas were at far greater heights. Three of the Atlanta TV stations, and CNN, had failed to add any ENG-RO sites to their TV Pickup licenses. It was determined that WUPA(TV) has no ENG-RO sites, and the ENG-active stations were not aware of any CNN ENG-RO sites. Thus, it is believed that CNN, like WUPA(TV), has no high-elevation, high-sensitivity ENG receive sites that could potentially receive interference from an EESS uplink at Pendergrass. However, this still left four stations with ENG operations and multiple ENG-RO sites:

WGCL-TV, D19 (V56), CBS, Atlanta; TV Pickup Station KC62919

WAGA-TV, D27 (V05), FOX, Atlanta; TV Pickup Station KC25976

² The STL and ICR stations are on TV BAS Channels A1 (2,025.5–2,037.5 MHz), A5 (2,073.5–2,085.5 MHz) and A6 (2,085.5–2,097.5 MHz), whereas 2,056 MHz falls in TV BAS Channel A3 (2,049.5–2,061.5 MHz).

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WXIA-TV, D10 (V11), NBC, Atlanta; TV Pickup Station KA74886

WSB-TV, D39 (V02), ABC, Atlanta; TV Pickup Station KR9903

These stations were contacted and technical details for their ENG-RO sites obtained, and then evaluated for their susceptibility to interference from a Pendergrass uplink on 2,056 MHz, as described below.

Interference Criteria

As opposed to fixed-link paths, because the transmitting location of an ENG platform is often not known in advance, it is similarly not possible to know in advance the relative path geometries between an incoming ENG feed and a potentially interfering co-channel station. Because of this, it is the noise threshold of the ENG receiver that needs to be protected, to ensure that an ENG truck at the periphery of an ENG-RO site's effective coverage will not suffer interference. Because ENG-RO sites use either an omnidirectional receiving antenna, or a remotely controlled steerable-in-real-time directional receiving antenna, and further are usually polarization agile, no receiving antenna pattern or polarization discrimination should be assumed. Central receive site receivers used for incoming ENG feeds have a typical sensitivity of -87 dBm. A 64QAM incoming ENG signal needs a threshold-to-interference ratio of at least 18 dB,³ meaning that the protected signal level is -105 dBm.

For a noise-like digital ENG signal, the criteria specified in EIA/TIA Technical Service Bulletin 10F (TSB-10F) is a noise threshold degradation of no greater than 1 dB.⁴ However, an even stricter 0.5 dB noise threshold degradation benchmark was recognized by the FCC in the ET Docket 00-258 Seventh Report & Order (R&O), which allowed Department of Defense (DoD) to use 2,025–2,110 MHz for its Space Ground Link System (SGLS) uplinks at up to eleven (and only eleven⁵) fixed sites, but with the obligation to protect incumbent co-channel TV BAS operations.⁶ This interference criteria was then adopted in a formal April 30, 2009, Memorandum of Understanding (MOU) between the Society of Broadcast Engineers, Inc. and the DoD. Thus, it is appropriate to use the more stringent 0.5 dB noise threshold degradation criteria rather than the TSB-10F 1 dB noise threshold degradation criteria.

To not degrade a noise threshold of -105 dBm by more than 0.5 dB means that an undesired EESS signal must not exceed -114 dBm at the receiver input; that is, -114 dBm plus -105 dBm gives -104.5 dBm, a 0.5 dB degradation. However, a bandwidth factor may be applied if the undesired

³ See Figure 2.13.5 of the 2016 *SBE Broadcast Engineering Handbook*.

⁴ TSB-10F Section 2.5.5.

⁵ Specified in US Government Footnote 346 (US346) to the FCC Section 2.106 *Table of Allotments*.

⁶ See Footnote 63 to the October 21, 2004, ET Docket 00-258 Seventh R&O.



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signal has a bandwidth that is different from the 12 MHz ENG channel bandwidth (or 6 MHz, if in a TV market that uses split-channel operation).

Terrain Obstruction Model

The Longley-Rice Irregular Terrain Model (ITM) was used for calculating terrain obstruction losses at 2 GHz. This model was selected because it is the same model mandated by the National Telecommunications and Information Administration (NTIA) for commercial mobile radio service (CMRS) licensees entering the 1.8 GHz L-band. In General Docket 13-185 the FCC opened the federal government L-band to CMRS use, but since some federal government and DoD use of 1.8 GHz will remain, newcomer CMRS stations are required to demonstrate protection of these remaining federal operations. The Longley-Rice ITM is used for these calculations with the following parameters:⁷

Surface refractivity	= 301 N-units
Ground conductivity	= 0.005 Siemens/meter
Ground dielectric constant	= 15
Radio climate	= continental temperate
Terrain database	= USGS 3-second
Reliability	= 50%
Confidence	= 50%

Further, no additional losses for clutter or building attenuation are to be used.

No allowance for foliage losses was taken, because foliage losses can be seasonal, or intervening trees may end up being cut down. Further, Weissberger's modified exponential decay model suggests that foliage attenuation is not orders-of-magnitude like terrain obstruction, but rather is likely to be only a few decibels. For example, at 2 GHz the Weissberger model predicts only 5.5 dB of loss for 10 meters of tree blockage. Thus, foliage losses are conservatively treated as a safety margin against interference rather than relied upon to protect against interference, as is done for terrain obstruction losses.

Protection of WGCL-TV KC62919 ENG-RO Sites

As shown by Figure 4A, WGCL-TV has five ENG-RO sites: Fox Tower, Blackjack Tower, Richland Tower, Westin Plaza Hotel, and Newnan Tower. As shown by Figures 4B through 4D, all of the sites have terrain obstruction to the proposed Pendergrass uplink. As shown by Figure 4E, for the Blackjack, Richard, Westin and Newnan Tower sites this terrain obstruction is sufficient to cause the worse case undesired uplink receive signal level to be -114 dBm or weaker based on a minimum

⁷ From the November 25, 2013, NTIA *ex parte* comments to GN Docket 13-185, at page 86.

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uplink dish elevation angle of 10° (an uplink dish for an NGSO LEO satellite needs to track the satellite across the sky as it first becomes visible over one horizon and until losing visibility over the opposite horizon; this means that, over time, the uplink dish will paint out a wide swath of azimuth and elevation angles). For the Fox Tower site, protection will be assured by a $252.4^\circ \pm 3^\circ$ notch out for the uplink dish azimuth. ViaSat reports that the tracking hardware for the uplink antenna can be programmed to automatically inhibit transmissions at specified azimuth and elevation angles.

Protection of WAGA-TV KC25976 ENG-RO Sites

As shown by Figures 5A and 5B, WAGA-TV has four ENG-RO sites: Midtown, Fairplay, Gainesville and WAGA. As shown by Figures 5C and 5D, Midtown, Fairplay, and WAGA have substantial terrain obstructions, but Gainesville (aka Fox Tower, aka Flowery Branch) has no terrain obstruction because the WAGA-TV receive dish is near the top of the tower, versus about mid-tower for the WGCL-TV receive dish. Figure 5E shows the calculation results: Midtown, Fairplay, and WAGA would be protected, but Gainesville fails the -114 dBm RSL criteria by 37 dB, even with an azimuth pattern notch out of $252.4^\circ \pm 3^\circ$.

Protection of WXIA-TV KA74886 ENG-RO Sites

As shown by Figure 6A, WXIA-TV has six ENG-RO sites: Fox Tower, Westin Plaza Hotel, WXIA Xmtr, Fairplay, Sweat Mountain, and WXIA studios.⁸ As shown by Figures 6B through 6D, all of the sites have terrain obstruction to the proposed Pendergrass uplink. As shown by Figure 6E, for the Westin Plaza Hotel, WXIA Xmtr, Sweat Mountain, and WXIA studios sites this terrain obstruction is sufficient to cause the worse case undesired uplink receive signal level to be -114 dBm or weaker based on a minimum uplink dish elevation angle of 10° . For the Fox Tower site, protection will again be assured by a $252.4^\circ \pm 3^\circ$ notch out for the uplink dish azimuth.

Protection of WUPA(TV) KB55329 ENG-RO Sites

As shown by Figure 7, although the proposed Pendergrass uplink is inside the KB55329 operational area of record, WUPA reports that it has no fixed, high-elevation ENG-RO sites, and is thus unlikely to receive interference from a Pendergrass uplink using portable, itinerant 2 GHz ENG facilities.

⁸ The receive site at the WXIA-TV studios is unusual, in that it is an Andrew Model KP6F-19 6-foot diameter grid parabolic dish; such an antenna is normally used for fixed, point-to-point links rather than as an ENG-RO receiving antenna. The antenna is vertically polarized, with a locked-down azimuth of 270° and a 10° depression angle (the bearing from the WXIA-TV studios ENG-RO site to the proposed Pendergrass uplink is 57.6° , therefore the receive dish is not aimed towards the proposed uplink). The terrain obstruction losses between the proposed Pendergrass uplink and the WXIA-TV studios ENG receiving antenna ensure, however, that even if this antenna were to be changed to a remotely steerable ENG receive dish with 25 dBi gain, the undesired EESS uplink signal would still be below the -114 dBm RSL threshold.

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Protection of CNN KQ5670 ENG-RO Sites

As shown by Figure 8, the CNN KQ5670 TV Pickup license has no ENG-RO sites of record, and the other Atlanta area TV stations report that they are not aware of regular ENG operations by CNN. Further, CNN did not respond to an e-mail request for information, and CNN does not show up on the Atlanta home channel plan. Therefore, like WUPA, it is considered unlikely to receive interference from a Pendergrass uplink.

Protection of WSB-TV KR9903 ENG-RO Sites

As shown by Figures 9A and 9B, WSB-TV has eight ENG-RO sites:

- Remote 1, Westin Plaza Hotel
- Remote 2, WSB-TV studio
- Remote 3, Stone Mountain
- Remote 4, Sweat Mountain
- Remote 5, Newnan
- Remote 6, Flowery Branch
- Remote 7, Willoughby Way Atlanta
- Remote 8, Buchanan

As shown by Figures 9C through 9F, all of the ENG-RO sites except Flowery Branch (aka Fox Tower, aka Gainesville) have sufficient terrain obstruction to ensure no interference from a Pendergrass uplink. However, the Flowery Branch receive dish again lacks terrain obstruction due to its placement near the top of the tower. As shown by Figure 9G, the Flowery Branch ENG-RO site fails the protection criteria by 37 dB.

Need For Shielding Berm

Because the higher-elevation receiving antennas on the Fox Tower would have line-of-sight to the proposed Pendergrass uplink, and fail the -114 dBm RSL protection criteria by 37 dB, even with the uplink dish azimuth pattern notch out, the additional attenuation could be provided by a shielding berm to block the look angles to the Fox Tower ENG receiving antennas. The berm would need to be centered on an azimuth of 252.4°T from the proposed Pendergrass site and would need to block at least elevation angles of zero to 1.6 degrees above the horizontal.⁹ According to an IEEE paper, *Site Shielding of Earth-Station Antennas*,¹⁰ a shielding wall lined with microwave-absorbing material can have a site-shielding factor (SSF) of in excess of 40 dB.¹¹ A SSF of 37 dB or greater, combined with a

⁹ The elevation angles from the C.O.R. of the proposed Pendergrass uplink dish to the ENG receiving antennas on the Fox Tower range from 0.92° for WGCL-TV to 1.51° for WSB-TV and WAGA-TV.

¹⁰ See IEEE Antennas and Propagation Magazine, Volume 37, Number 1, February, 1995.

¹¹ Ibid, at Figure 6.

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252.4°T±3.0° azimuth pattern notch out and a minimum elevation angle of 10° for the uplink transmitting antenna, would ensure protection of the ENG receiving antennas near the top of the Fox Tower, even for worst case conditions; that is,

1. Operation on TV BAS Channel A3 (2,049.5–2,061.5 MHz)
2. ENG receive dish aimed towards Pendergrass (*i.e.*, no receiving antenna pattern discrimination)
3. ENG receive dish using same polarization (*i.e.*, no receiving antenna polarization discrimination)
4. Weak ENG signal (if a strong signal, a favorable desired-to-undesired (D/U) signal ratio would likely ensure no interference)
5. Uplink transmitting at same time as incoming ENG feed.

Thus, several worst case situations would have to occur before interference would be caused, even without the benefit of a shielding berm. However, given that news events are generally unscheduled and at locations not known in advance, and given that Planet Labs reports it ultimately will deploy up to 200 Cubesats, prudence requires that no reliance be made on the lack of simultaneous co-channel use of 2,056 MHz (falling in TV BAS Channel A3).

It is recommended that interference testing be conducted on the top-most mounted ENG receiving antennas (*i.e.*, the WSB-TV KR9903 receive dish and the WAGA-TV KC25976 receive dish), with the Pendergrass uplink dish at full power, aimed at either 249.4°T or 255.4°T (*i.e.*, ±3° from the Pendergrass-to-Fox Tower bearing) and with the minimum elevation angle of 10°, to confirm that the shielding berm has at least 37 dB of attenuation to those non-terrain obstructed ENG receiving antennas.

Conclusion

An EESS uplink with 83.2 dBm EIRP using a 5.4-meter diameter tracking uplink dish at the Pendergrass site would protect all Atlanta-area ENG-RO sites with an azimuth preclusion (notch out) of 252.4°T±3.0°, a minimum elevation angle of 10°, and a shielding berm with at least 37 dB of attenuation at 2 GHz for elevation angles of zero to 1.6° towards 252.4°T. It is believed that a berm lined with microwave absorbing material could achieve this level of shielding.

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List of Figures

In carrying out these engineering studies, the following figures were prepared under my direct supervision:

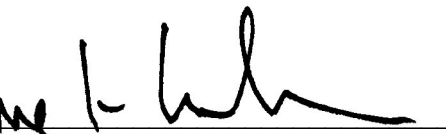
1. Maps of proposed uplink site
2. Uplink dish azimuth and elevation patterns
3. Maps showing 2 GHz TV BAS station locations
4. WGCL-TV KC62919 ENG-RO sites
5. WAGA-TV KC25976 ENG-RO sites
6. WXIA-TV KA74886 ENG-RO sites
7. WUPA(TV) KB55329 operational area
8. CNN KQ5670 operational area
9. WSB-TV KR9903 ENG-RO sites.

Authorship

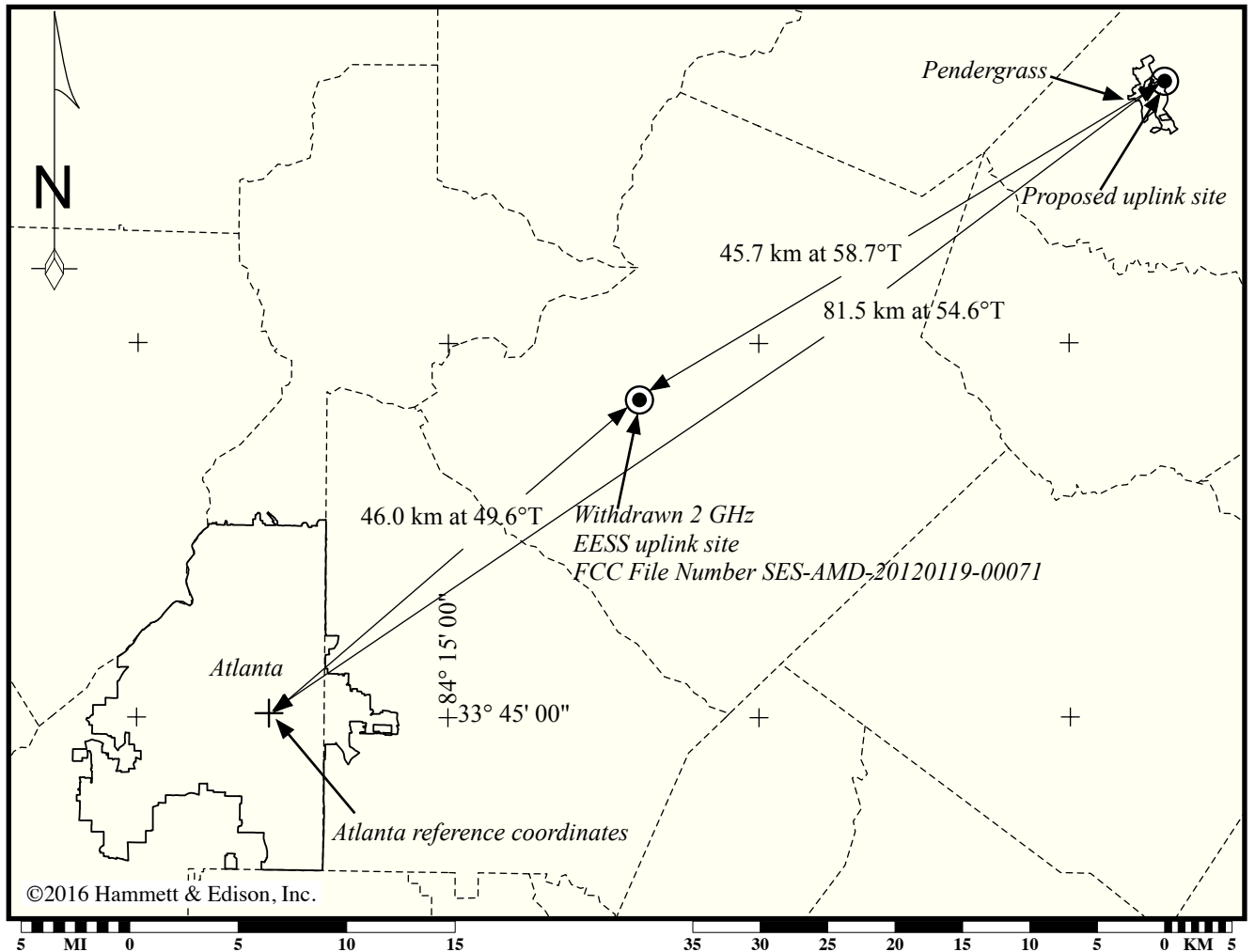
The undersigned author of this statement is a qualified Professional Engineer, holding California Registration No. E-11654, which expires on September 30, 2016. This work has been carried out under his direction, and all statements are true and correct of his own knowledge except, where noted, when data has been supplied by others, which data he believes to be correct.

July 22, 2016




Dane E. Ericksen, P.E.

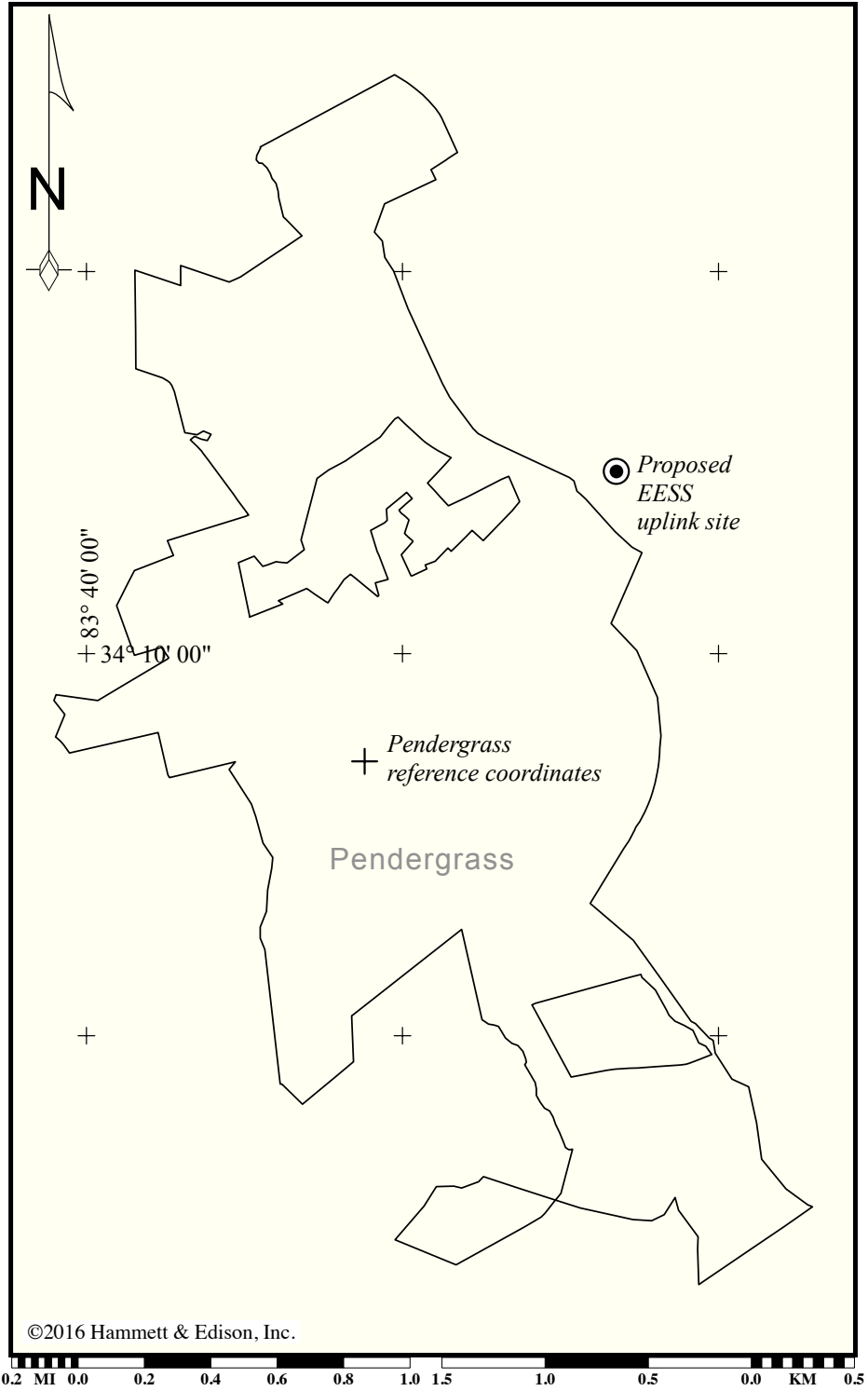
Proposed 2 GHz EESS Uplink near
Pendergrass, Georgia



Lambert conformal conic map projection. Geographic coordinate marks shown at 15-minute increments. City limits shown taken from U.S. Census Bureau TIGER/Line 2010 data.

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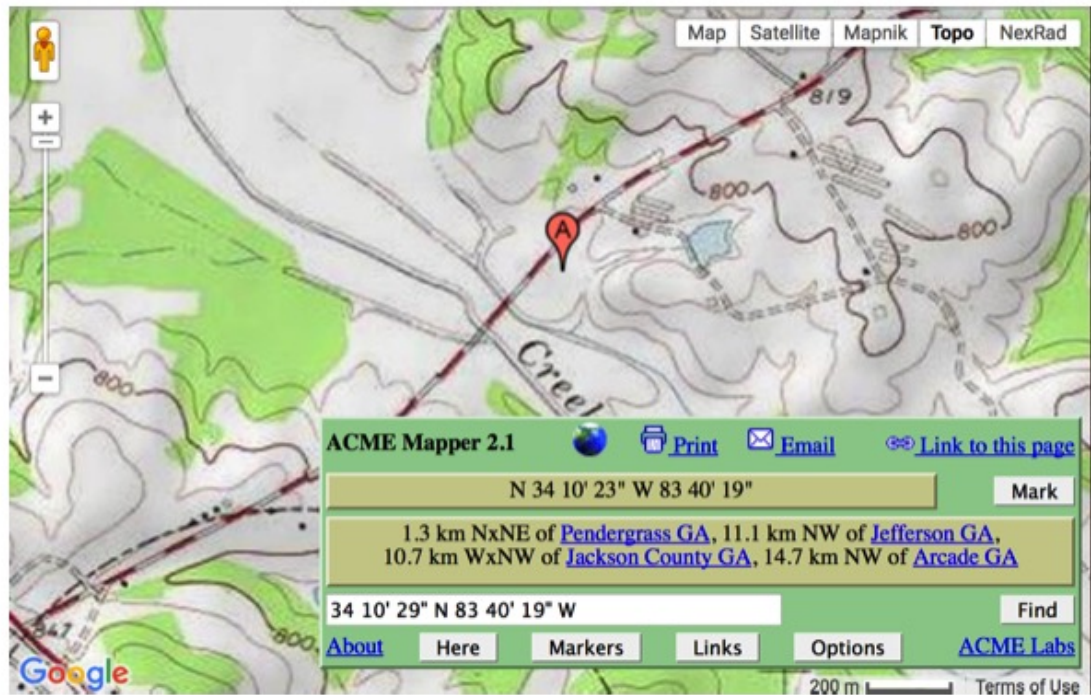
Proposed 2 GHz EESS Uplink near
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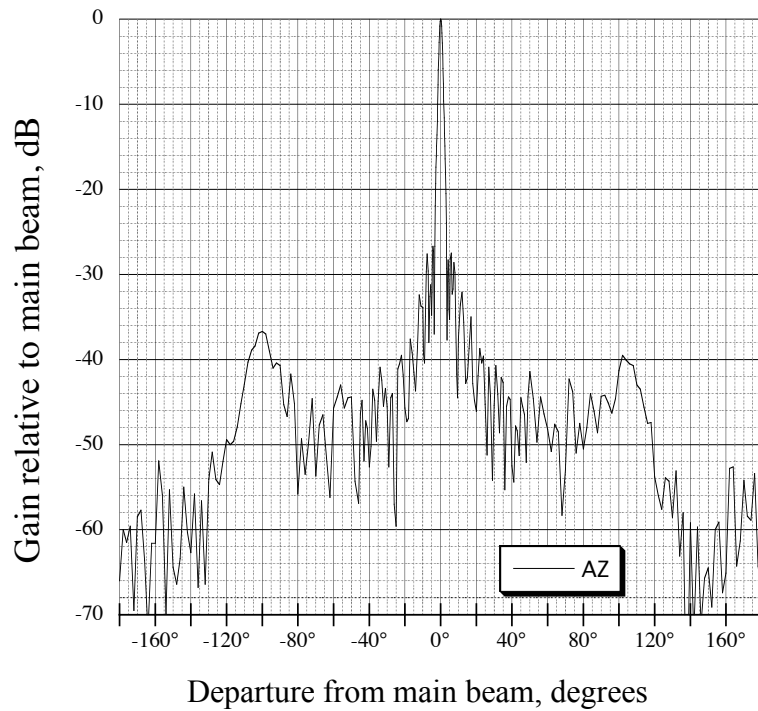
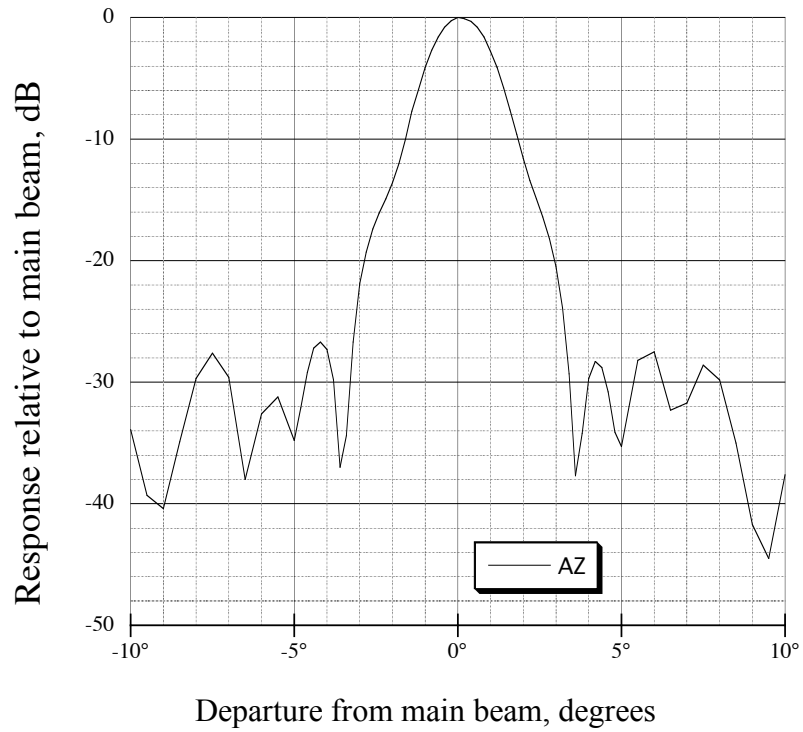
Lambert conformal conic map projection. Geographic coordinate marks shown at 1-minute increments. City limits shown taken from U.S. Census Bureau TIGER/Line 2010 data.

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Proposed 2 GHz EESS Uplink near
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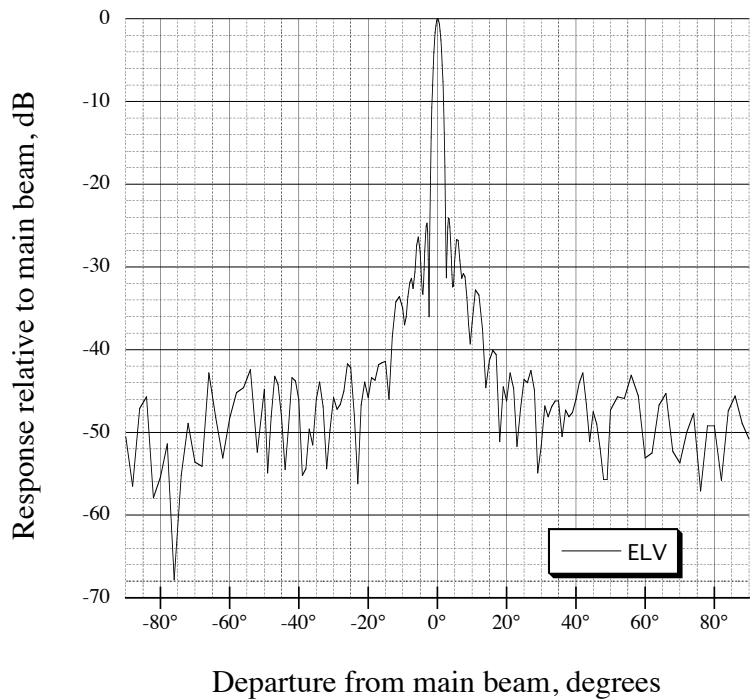
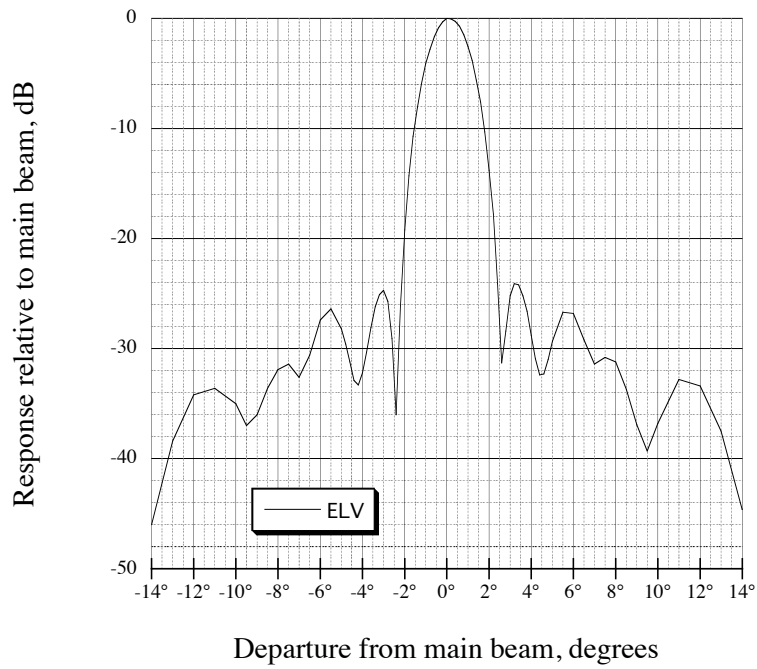


5.4-meter Uplink Dish Azimuth Pattern



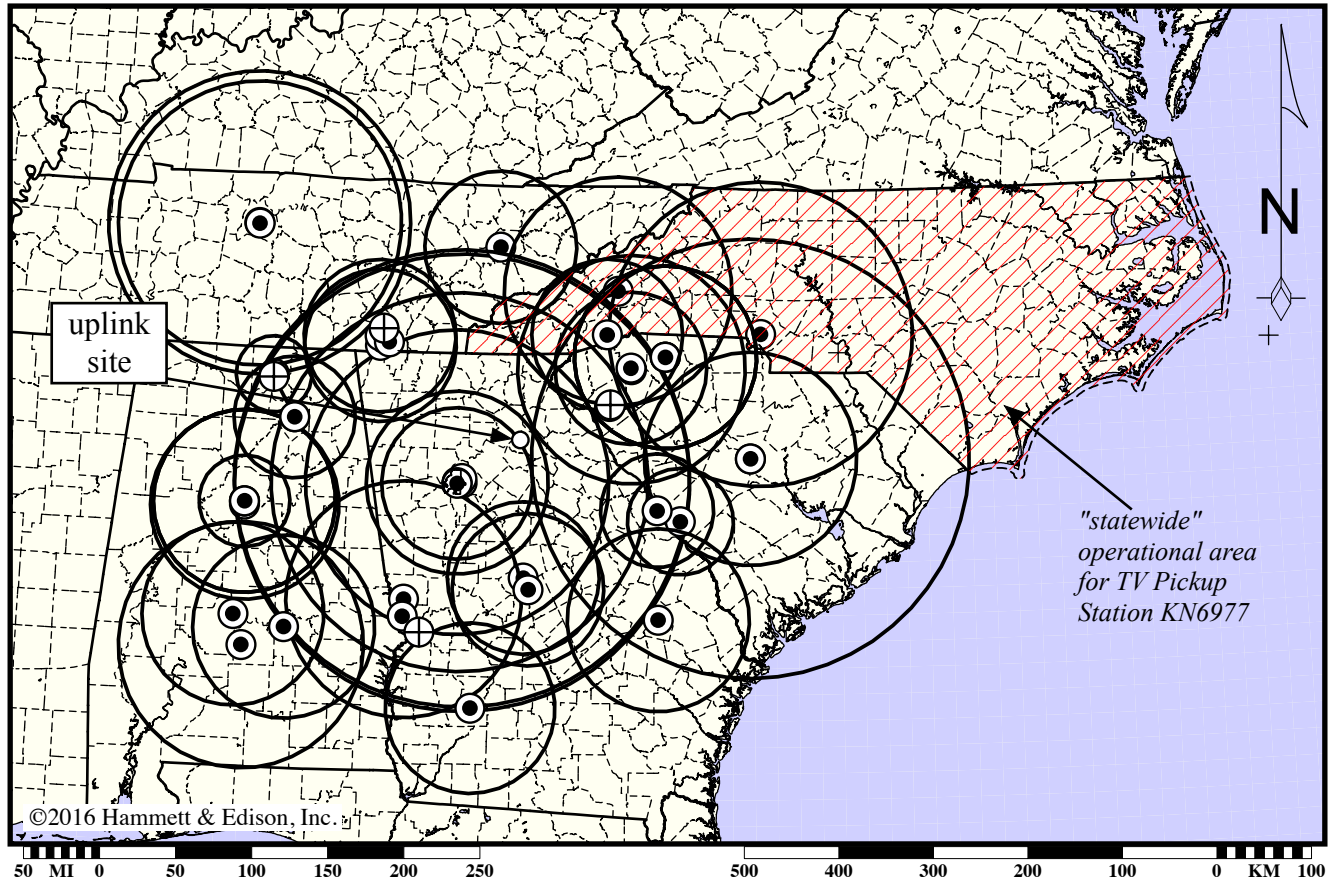
Based on data provided by ViaSat.

5.4-meter Uplink Dish Elevation Pattern



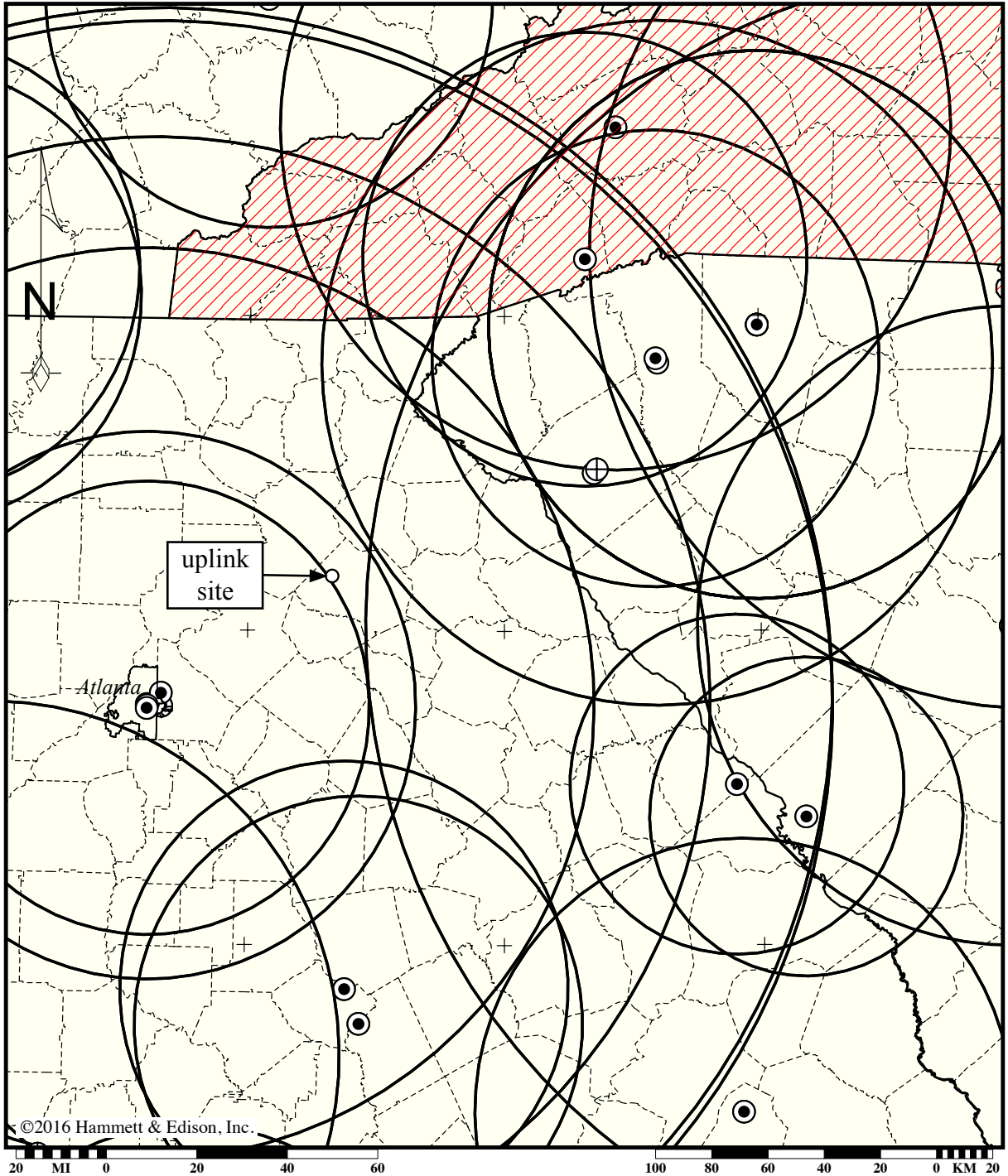
Based on data provided by ViaSat.

**2 GHz TV Broadcast Auxiliary Service
Stations within 200 km of Atlanta, Georgia
44 TV Pickup stations, 1 TV STL station, and 2 TV ICR stations**



- ⊙ = TV Pickup station operational area center point or transmit location for fixed-link STL/ICR
- ⊕ = Receive end of STL/ICR
- = Proposed 2 GHz EESS uplink, near Pendergrass, Georgia
- = Operational area boundaries

**2 GHz TV Broadcast Auxiliary Service
Stations within 200 km of Atlanta, Georgia
44 TV Pickup stations, 1 TV STL station, and 2 TV ICR stations**



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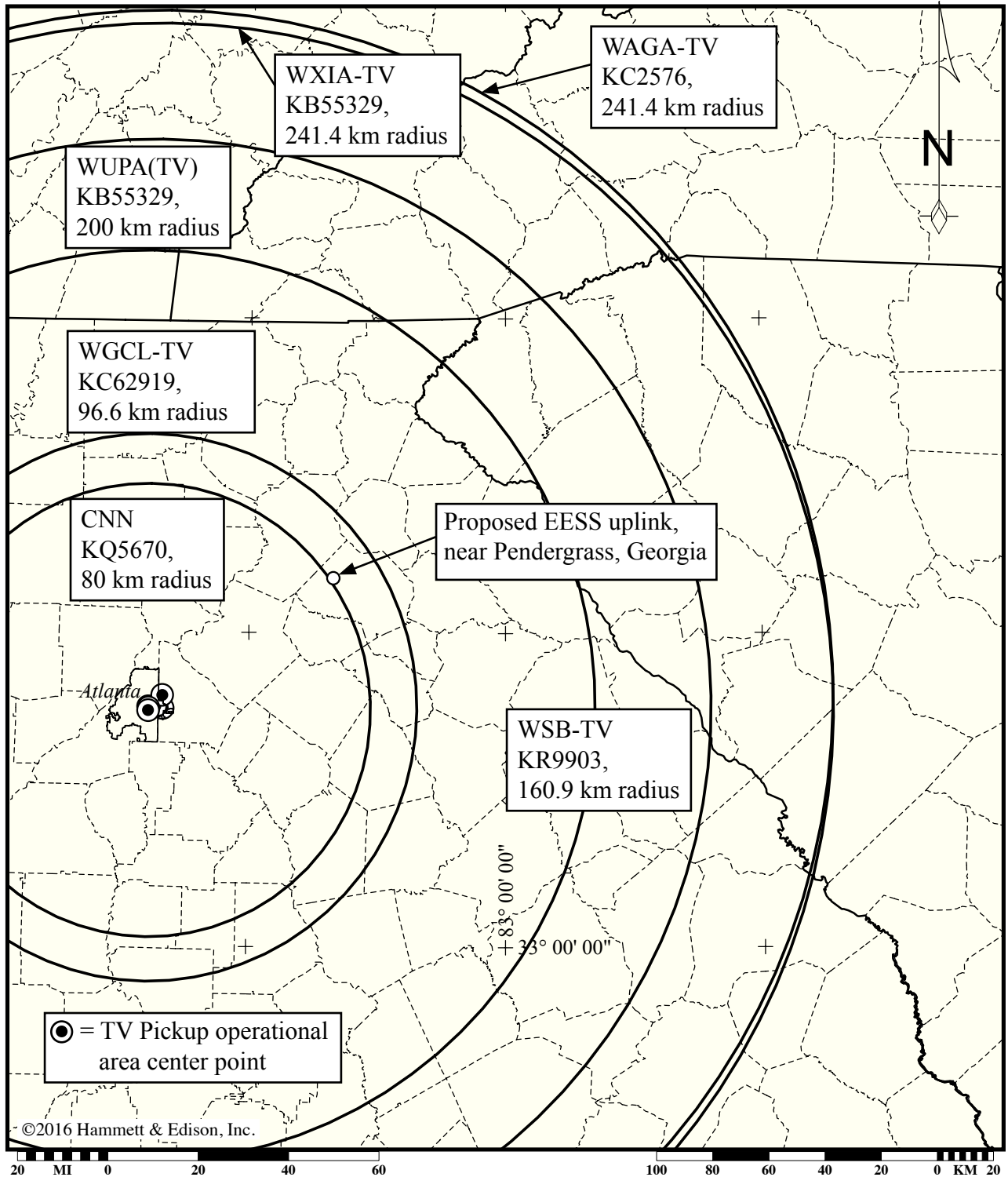
20 MI 0 20 40 60 100 80 60 40 20 0 KM 20

⊙ = TV Pickup station operational area center point or transmit location for fixed-link STL/ICR

⊕ = Receive end of STL/ICR

○ = Proposed 2 GHz EESS uplink, near Pendergrass, Georgia

Atlanta TV Pickup Stations



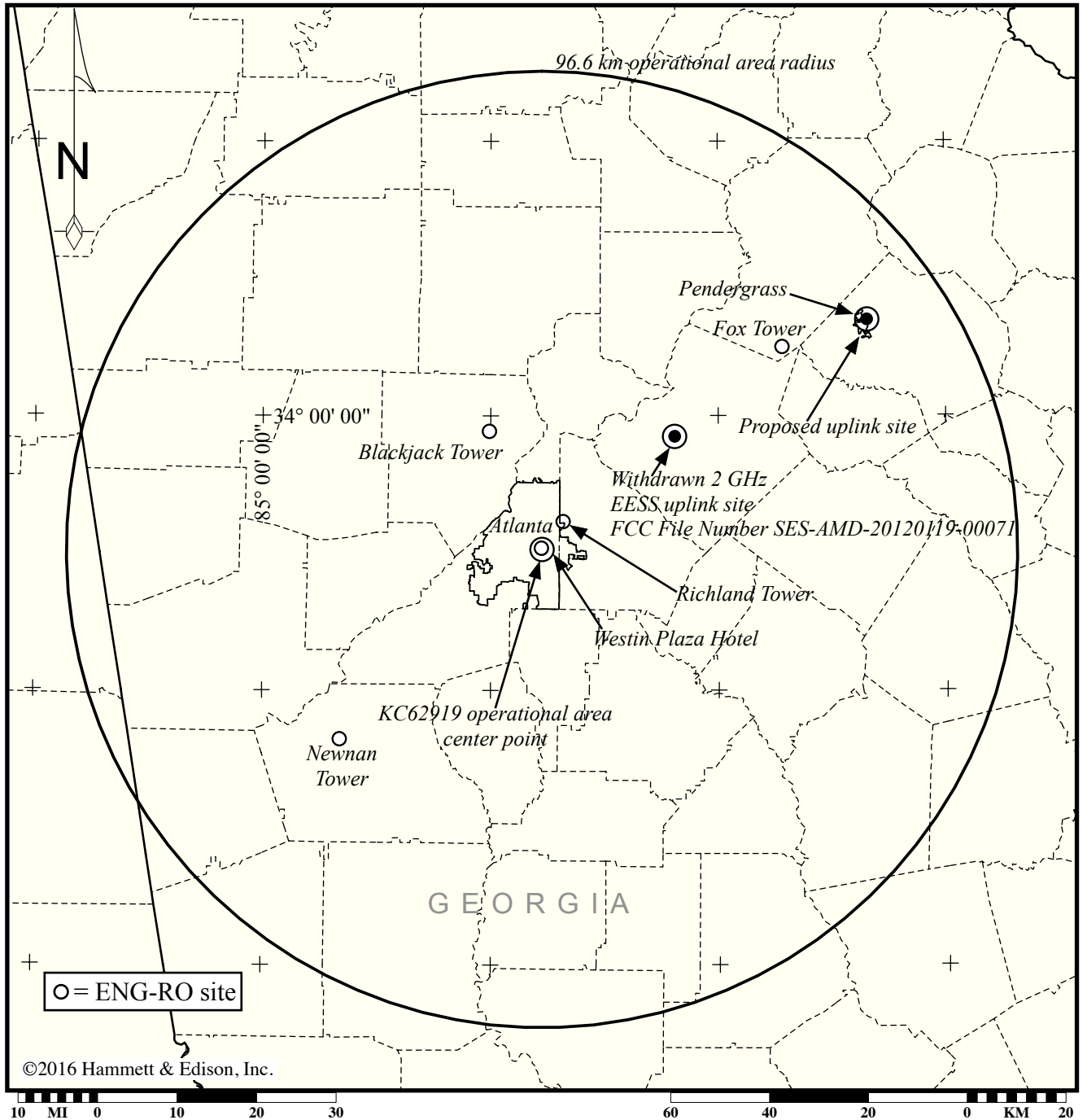
Lambert conformal conic map projection. Map data taken from Sectional Aeronautical Charts, published by the National Ocean Survey. Geographic coordinate marks shown at 60-minute increments. State, county, and city limits shown taken from U.S. Census Bureau TIGER/Line 2010 data.

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WGCL-TV KC62919 ENG-RO Sites

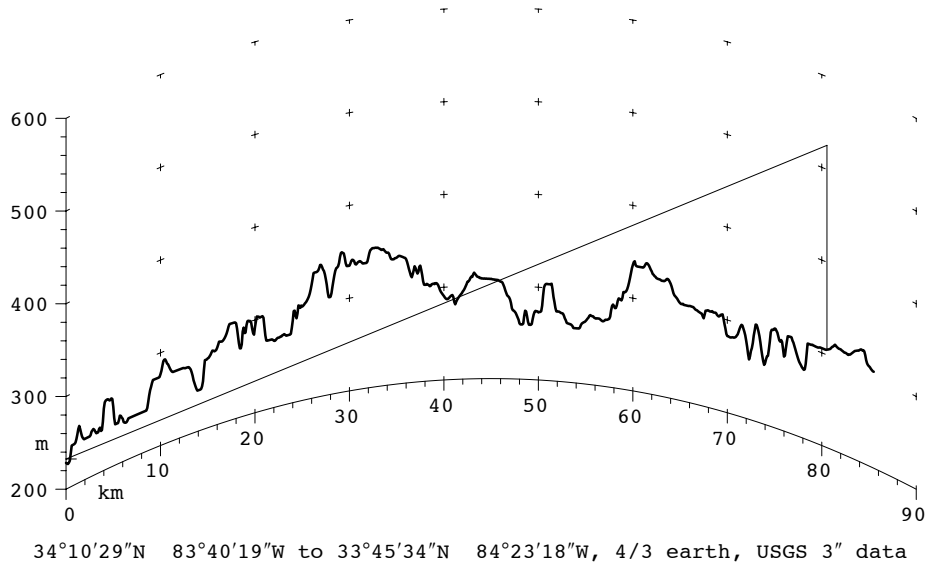
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Proposed Pendergrass EESS Uplink

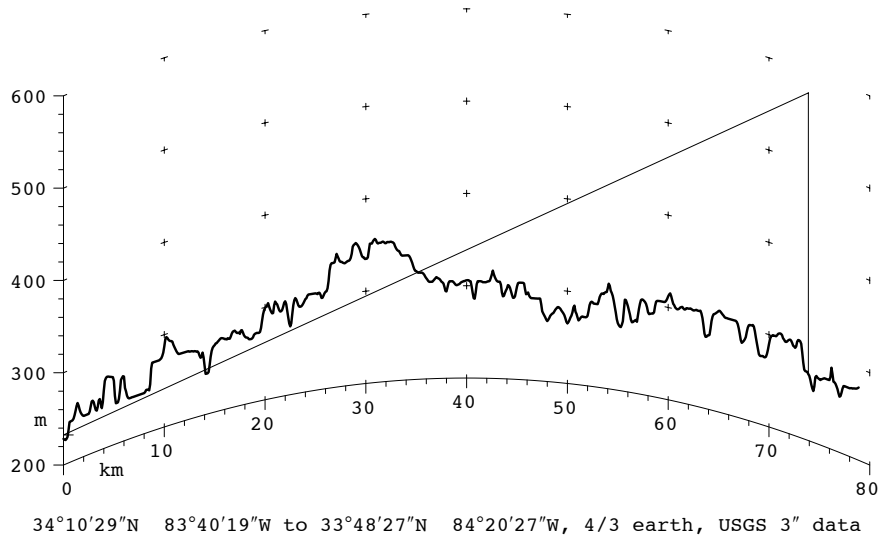


Lambert conformal conic map projection. Map data taken from Sectional Aeronautical Charts, published by the National Ocean Survey. Geographic coordinate marks shown at 30-minute increments. City and county limits shown taken from U.S. Census Bureau TIGER/Line 2000 data.

**Terrain Profile from Proposed Pendergrass EESS Uplink to
WGCL-TV TV Pickup Station KC62919 Westin Plaza Hotel and Richland Tower
Electronic News Gathering Receive-Only (ENG-RO) Sites**

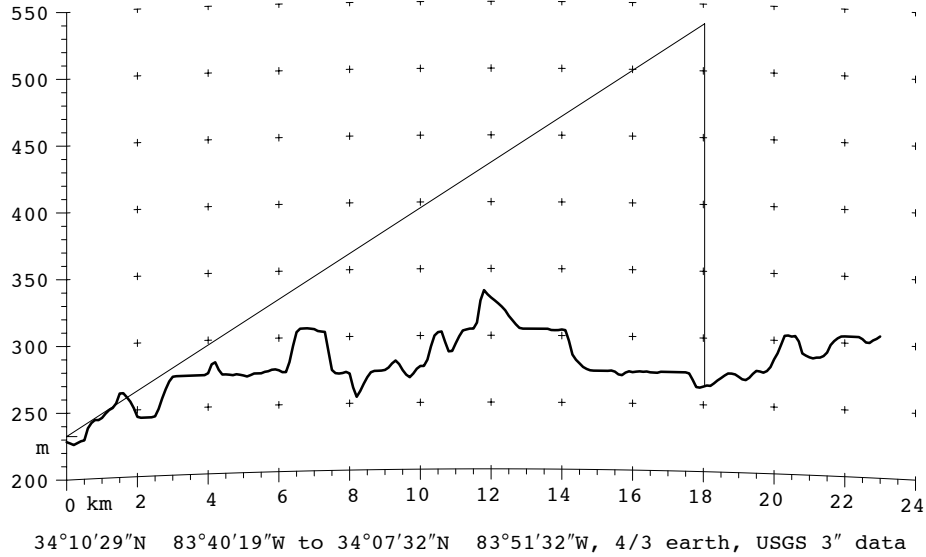


C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of MRC QuadSector array ENG receive antennas on Westin Plaza Hotel = 220.4 m AGL/545.0 m AMSL.

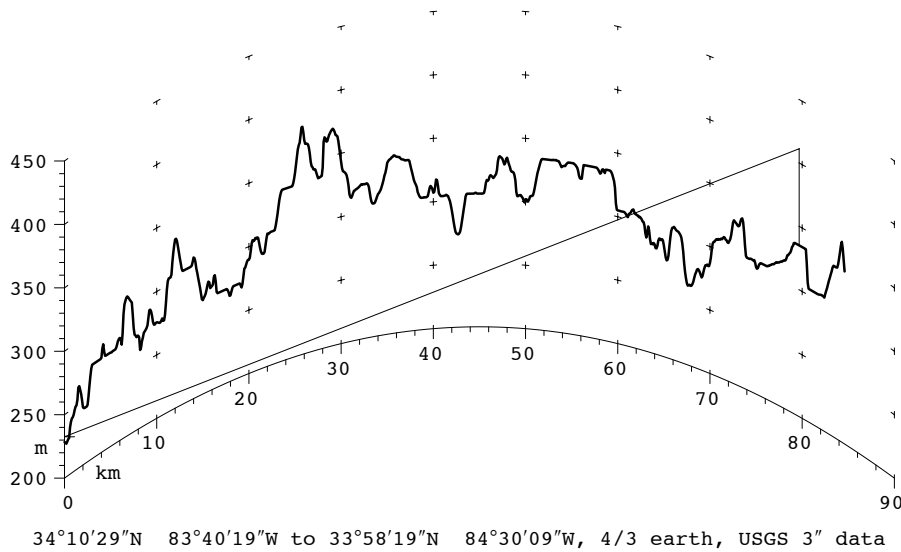


C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of MRC UltraScan ENG receive dish on Richland Tower = 304.8 m AGL/571.5 m AMSL.

**Terrain Profile from Proposed Pendergrass EESS Uplink to
WGCL-TV TV Pickup Station KC62919 Fox Tower and Blackjack Tower
Electronic News Gathering Receive-Only (ENG-RO) Sites**



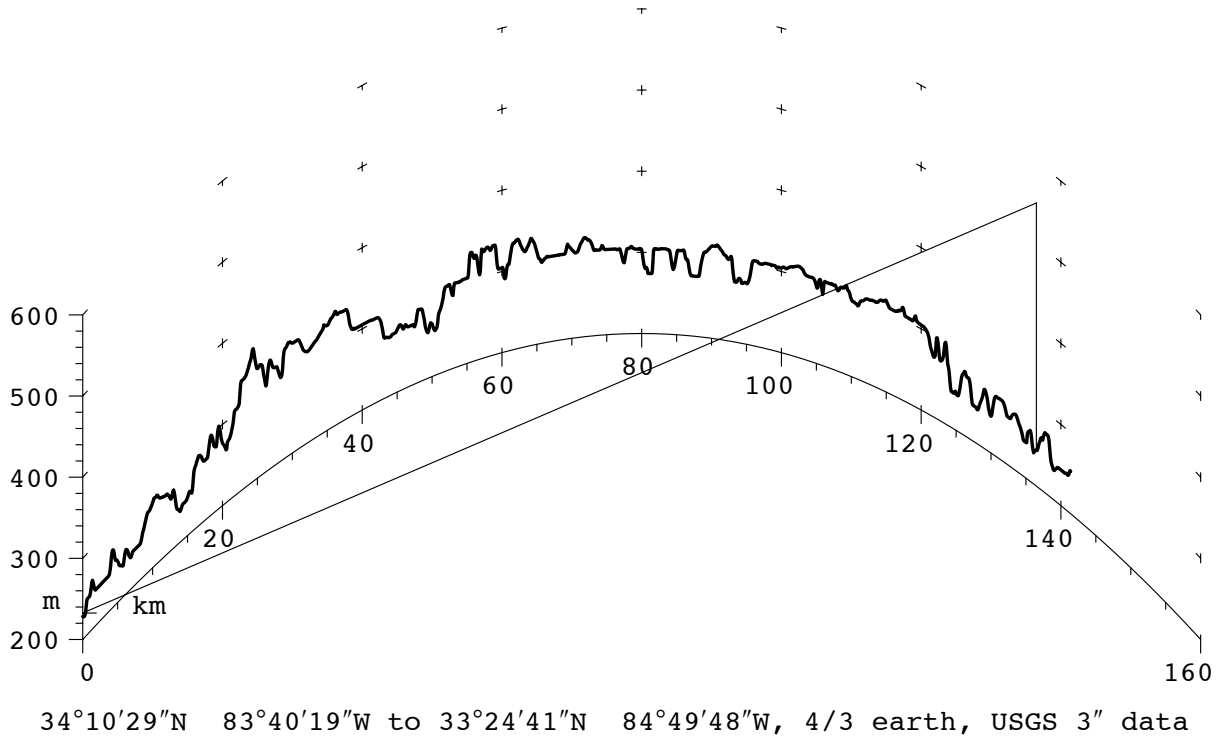
C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of MRC UltraScan receive dish on Fox Tower = 271.3 m AGL/542.5 m AMSL.



C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of MRC MicroScan receive dish on Blackjack Tower = 76.2 m AGL/462.4 m AMSL.

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Terrain Profile from Proposed Pendergrass EESS Uplink to
WGCL-TV TV Pickup Station KC62919 "Newnan Tower"
Electronic News Gathering Receive-Only (ENG-RO) Site



C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of UltraScan ENG receive dish on "Newnan Tower" = 304.8 m AGL/561.7 m AMSL.



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Calculation Results for WGCL-TV KC62919 ENG-RO Sites

ENG-RO site	Uplink Elevation Pattern*	Uplink Azimuth Pattern	Free Space Path Loss	Terrain Obstruction	ENG-RO Dish Gain	Predicted RSL†
Westin Plaza Hotel	-35 dB	0 dB	-137 dB	-71 dB	20 dBi	-151 dBm
Richland Tower	-35	0	-124	-69	20	-132
Fox Tower‡	-36	-21§	-124	-33	20	-118
Blackjack Tower	-35	0	-137	-71	20	-147
Newnan Tower	-35	0	-141	-75	20	-155

* Based on minimum uplink dish elevation angle of 10°.

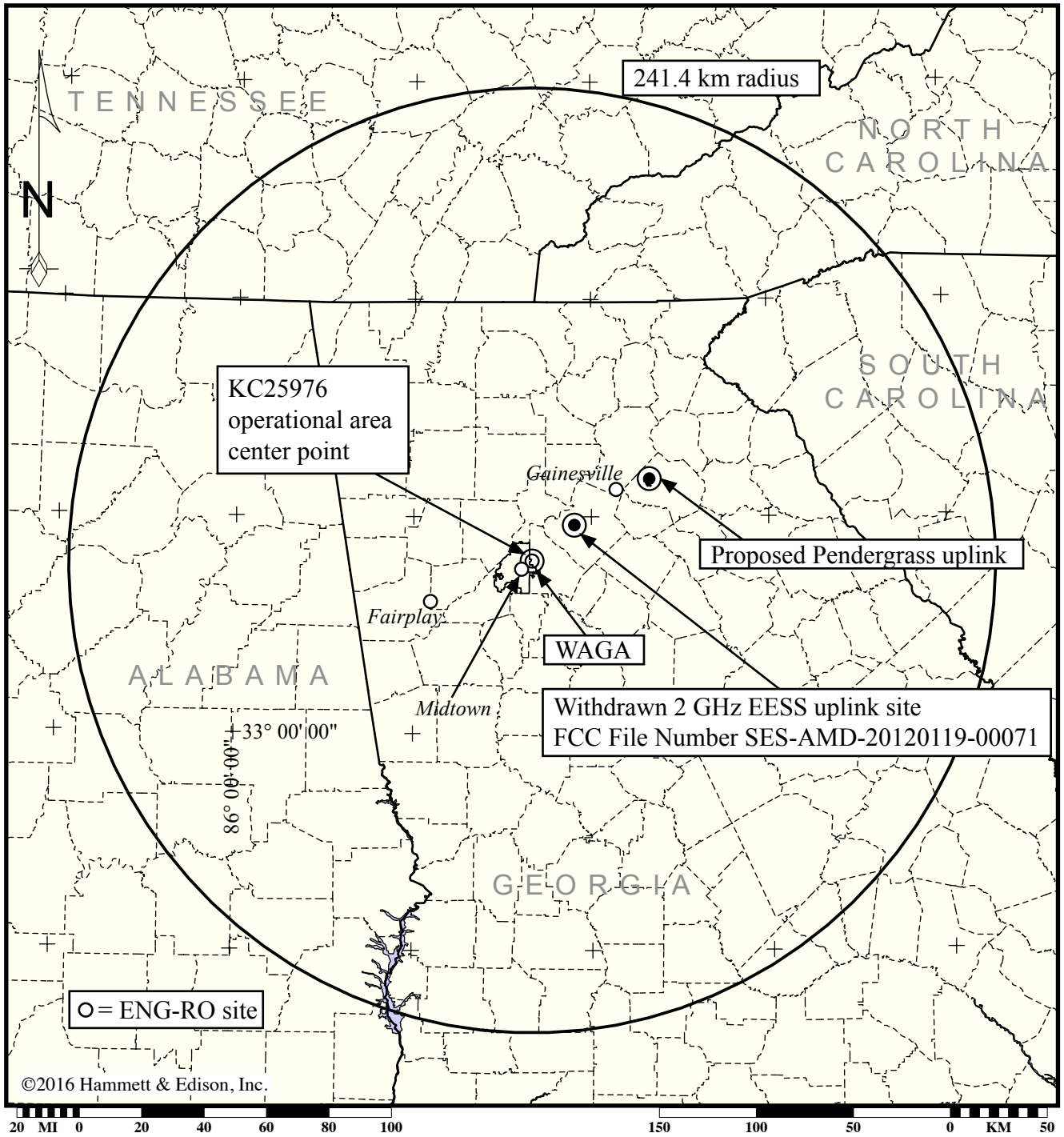
† Based on 83.2 dBm EIRP for main beam of EESS uplink, with a -7 dB allowance for bandwidth; that is, $10\log(1.31 \text{ MHz}/6 \text{ MHz})$. A 6 MHz ENG bandwidth was used rather than a 12 MHz ENG bandwidth because the Atlanta market reportedly sometimes uses split channel ENG.

‡ Also known as “Gainesville” and “Flowery Branch.”

§ Based on azimuth notch out of $252.4^\circ \pm 3^\circ$.



**WAGA-TV KC25976 ENG-RO Sites
vs.
Proposed Pendergrass EESS Uplink**

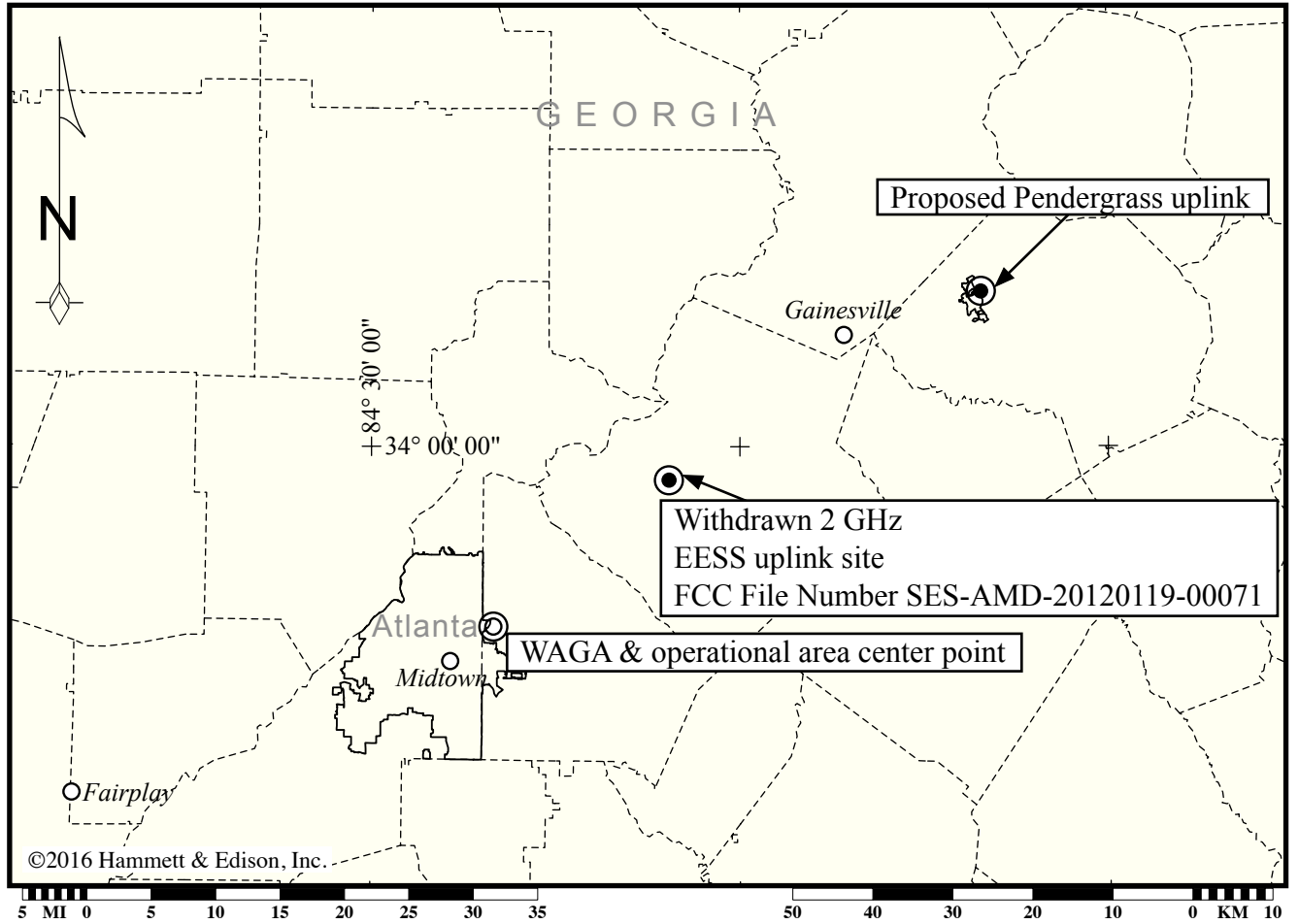


Lambert conformal conic map projection. Map data taken from Sectional Aeronautical Charts, published by the National Ocean Survey. Geographic coordinate marks shown at 60-minute increments. State, county, and city limits shown taken from U.S. Census Bureau TIGER/Line 2010 data.



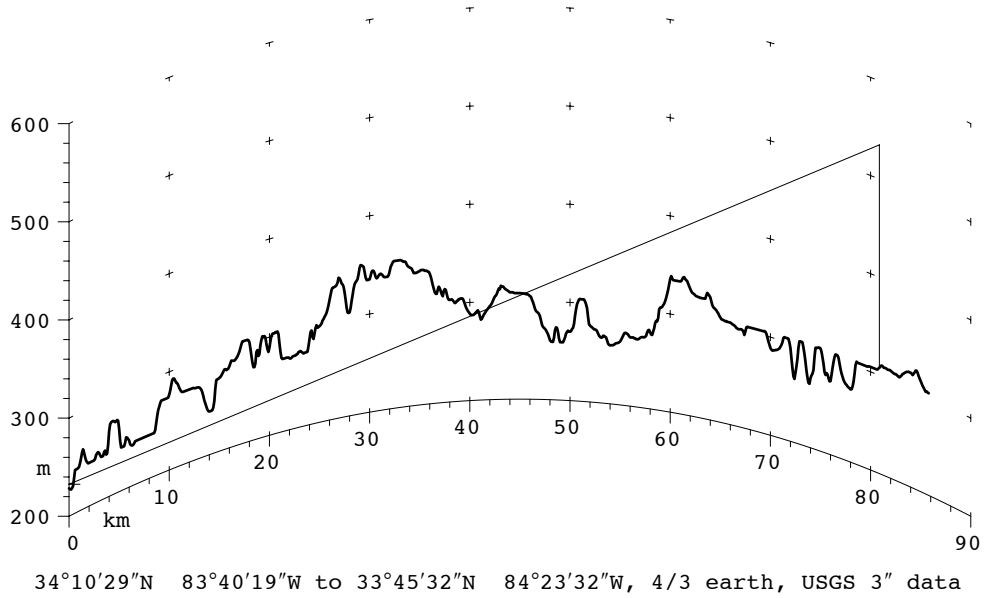
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**WAGA-TV KC25976 ENG-RO Sites
vs.
Proposed Pendergrass EESS Uplink**

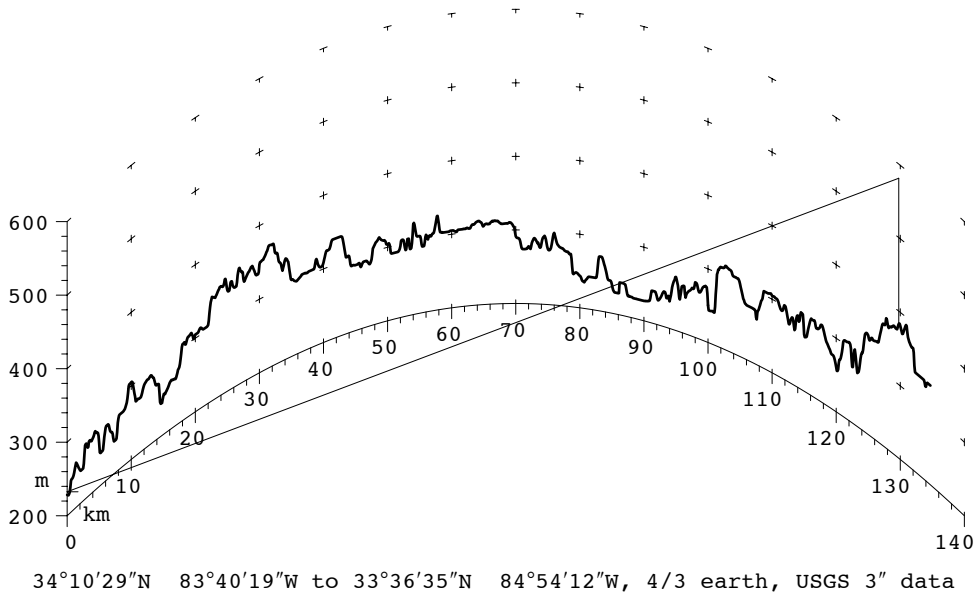


Lambert conformal conic map projection. Map data taken from Sectional Aeronautical Charts, published by the National Ocean Survey. Geographic coordinate marks shown at 30-minute increments. City and county limits shown taken from U.S. Census Bureau TIGER/Line 2010 data.

**Terrain Profile from Proposed Pendergrass EESS Uplink to
WAGA-TV TV Pickup Station KC25976 Midtown and Fairplay
Electronic News Gathering Receive-Only (ENG-RO) Sites**

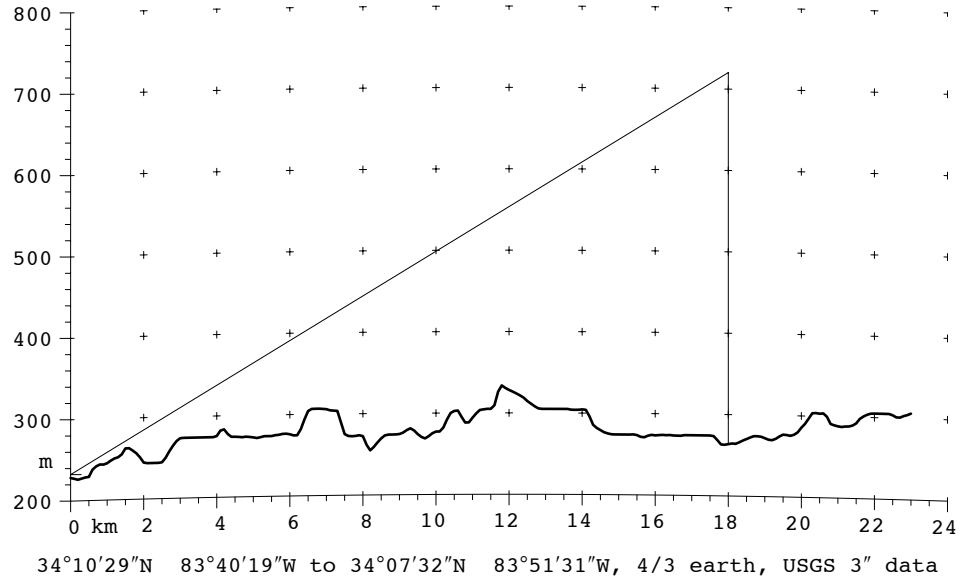


C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of NSI Superquad ENG receive dish at Midtown site = 227.1 m AGL/550.2 m AMSL.

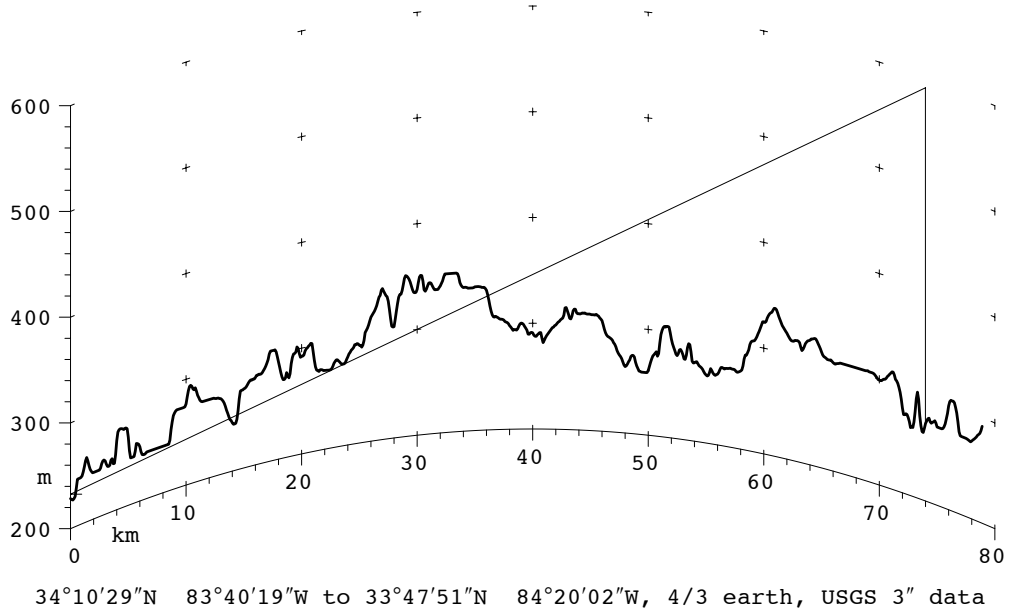


C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of NSI Superquad ENG receive dish on Fairplay Tower = 198.2 m AGL/460.3 m AMSL.

**Terrain Profile from Proposed Pendergrass EESS Uplink to
WAGA-TV TV Pickup Station KC25976 Gainesville Tower and WAGA
Electronic News Gathering Receive-Only (ENG-RO) Sites**



C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of NSI Superquad ENG receive dish on Gainesville tower = 456.6 m AGL/727.8 m AMSL.



C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of NSI Superquad ENG receive dish on WAGA tower = 317.9 m AGL/593.9 m AMSL.

ViaSat, Inc.

Calculation Results for WAGA-TV KC25976 ENG-RO Sites

ENG-RO site	Uplink Elevation Pattern*	Uplink Azimuth Pattern	Free Space Path Loss	Terrain Obstruction	ENG-RO Dish Gain	Predicted RSL†
Midtown	-35 dB	0 dB	-137 dB	-71 dB	25 dBi	-142 dBm
Fairplay	-35	0	-141	-73	25	-148
Gainesville‡	-33	-21§	-124	0	25	-77
WAGA	-35	0	-136	-68	225	-138

“Gainesville” ENG-RO fails -114 dBm received signal level (RSL) protection criteria by 37 dB, even with a main beam azimuth pattern notch out of $252.4^{\circ}T \pm 3^{\circ}$.

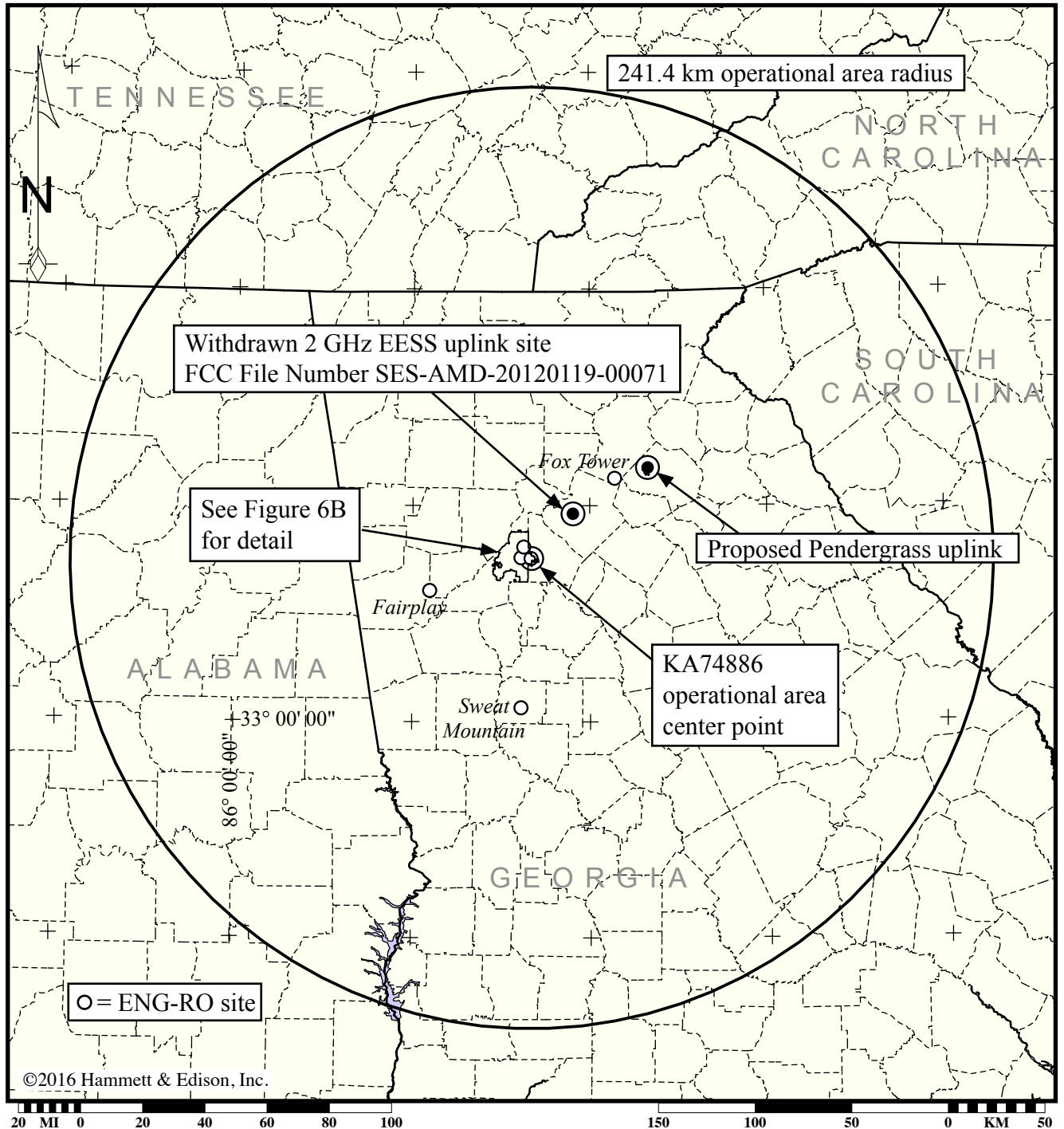
* Based on minimum uplink dish elevation angle of 10° .

† Based on 83.2 dBm EIRP for main beam of EESS uplink, with a -7 dB allowance for bandwidth; that is, $10\log(1.31 \text{ MHz}/6 \text{ MHz})$. A 6 MHz ENG bandwidth was used rather than a 12 MHz ENG bandwidth because the Atlanta market reportedly sometimes uses split channel ENG.

‡ Also known as “Fox Tower” and as “Flowery Branch.”

§ Based on transmit dish azimuth notch out of $252.4^{\circ}T \pm 3^{\circ}$.

**WXIA-TV TV Pickup Station KA74886
vs.
Proposed Pendergrass EESS Uplink**



Lambert conformal conic map projection. Map data taken from Sectional Aeronautical Charts, published by the National Ocean Survey. Geographic coordinate marks shown at 60-minute increments. State, county, and city limits shown taken from U.S. Census Bureau TIGER/Line 2010 data.

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Calculation Results for WXIA-TV KA74886 ENG-RO Sites

ENG-RO site	Uplink Elevation Pattern*	Uplink Azimuth Pattern	Free Space Path Loss	Terrain Obstruction	ENG-RO Dish Gain	Predicted RSL†
Fox Tower‡	-36 dB	-21§ dB	-124 dB	-30 dB	20 dBi	-115 dBm
Westin Hotel	-35	0	-137	-71	16	-151
WXIA-TV	-35	0	-136	-68	26	-137
Fairplay	-35	0	-141	-72	20	-152
Sweat Mountain	-35	0	-142	-66	20	-147
WXIA-TV studios	-35	0	-136	-68	30	-133

* Based on minimum uplink dish elevation angle of 10°.

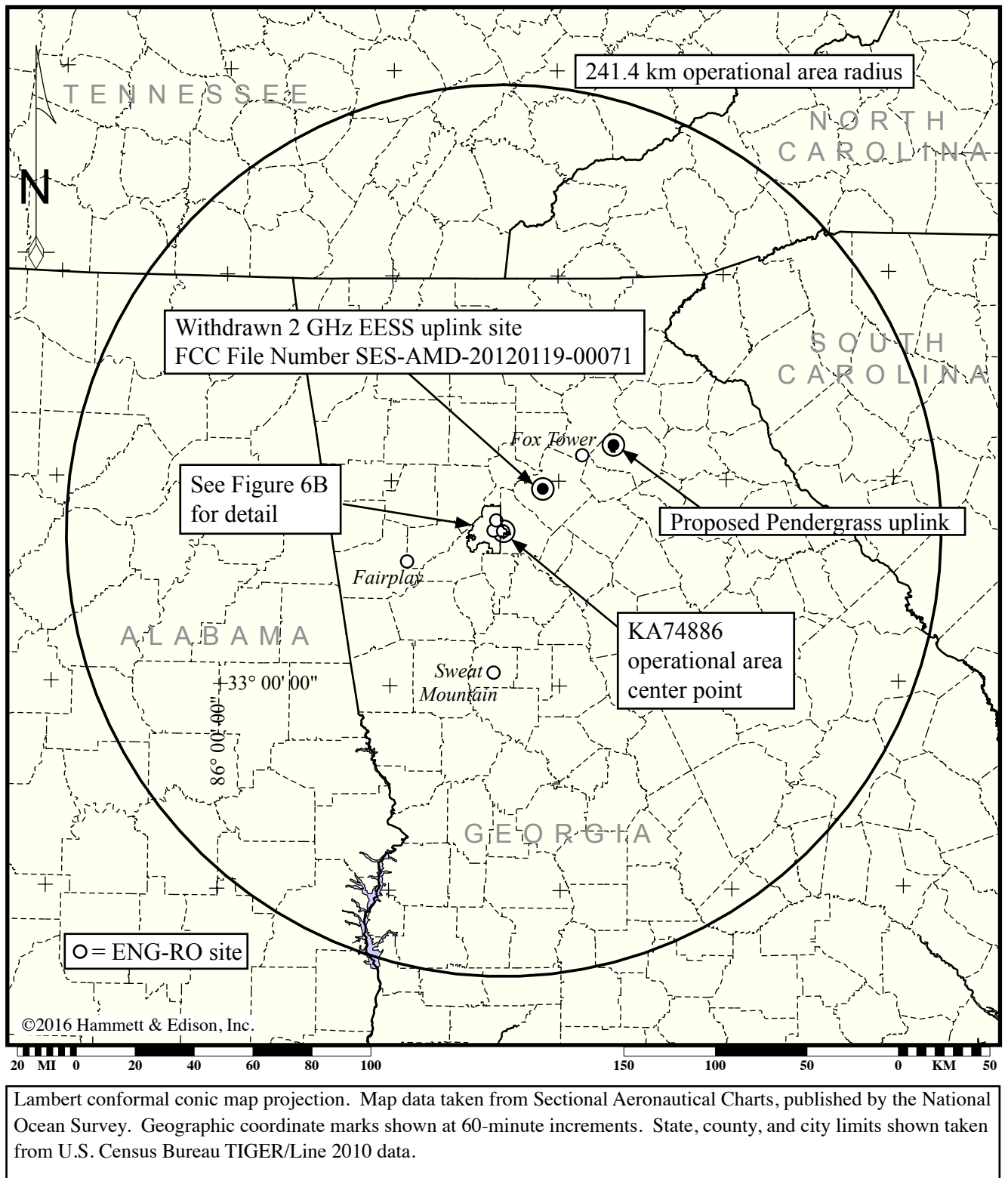
† Based on 83.2 dBm EIRP for main beam of EESS uplink, with a -7 dB allowance for bandwidth; that is, $10\log(1.31 \text{ MHz}/6 \text{ MHz})$. A 6 MHz ENG bandwidth was used rather than a 12 MHz ENG bandwidth because the Atlanta market reportedly sometimes uses split channel ENG.

‡ Also known as “Gainesville” and “Flowery Branch.”

§ Based on azimuth notch out of $252.4^\circ \pm 3^\circ$.



**WXIA-TV TV Pickup Station KA74886
vs.
Proposed Pendergrass EESS Uplink**

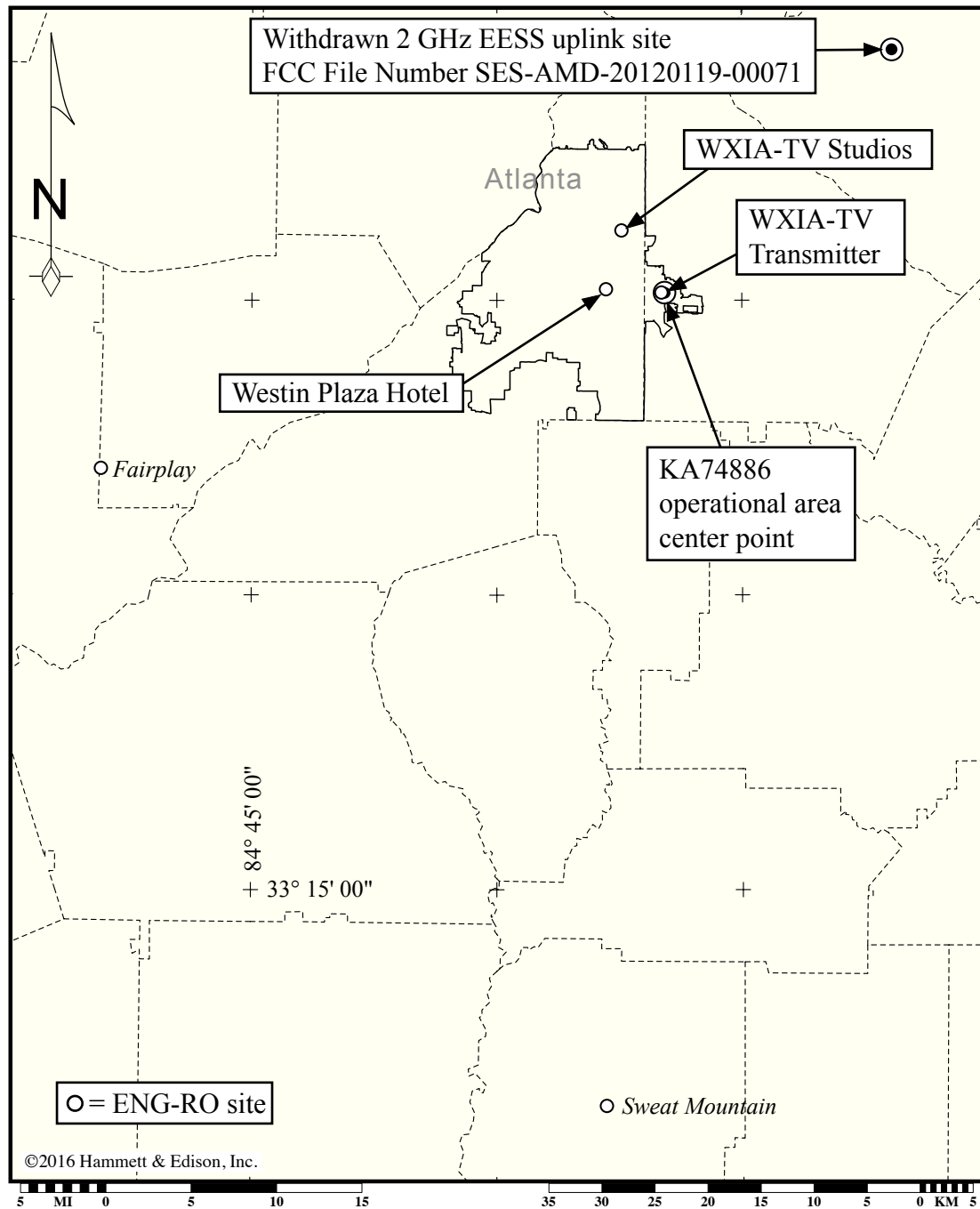


ViaSat, Inc.

WXIA-TV TV Pickup Station KA74886

vs.

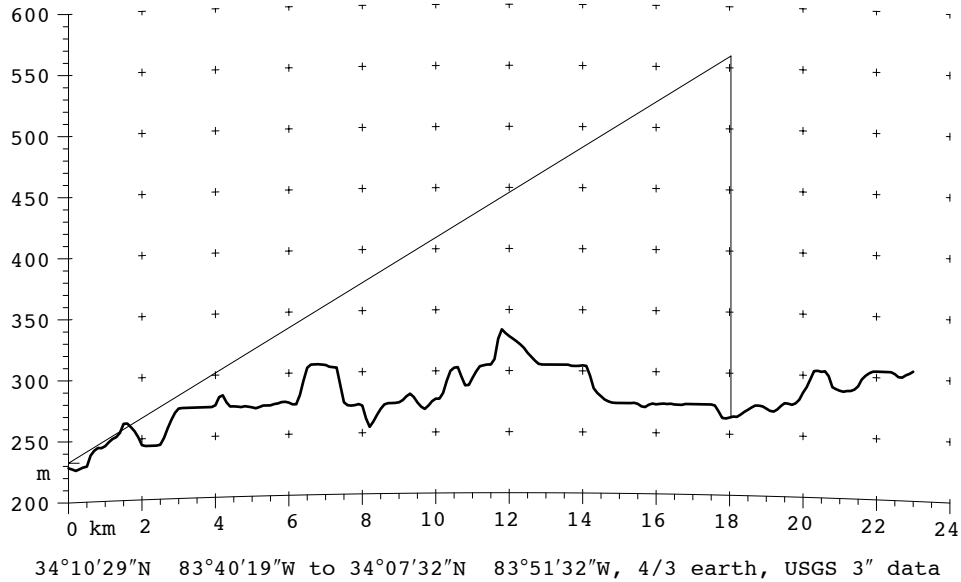
Proposed Pendergrass EESS Uplink



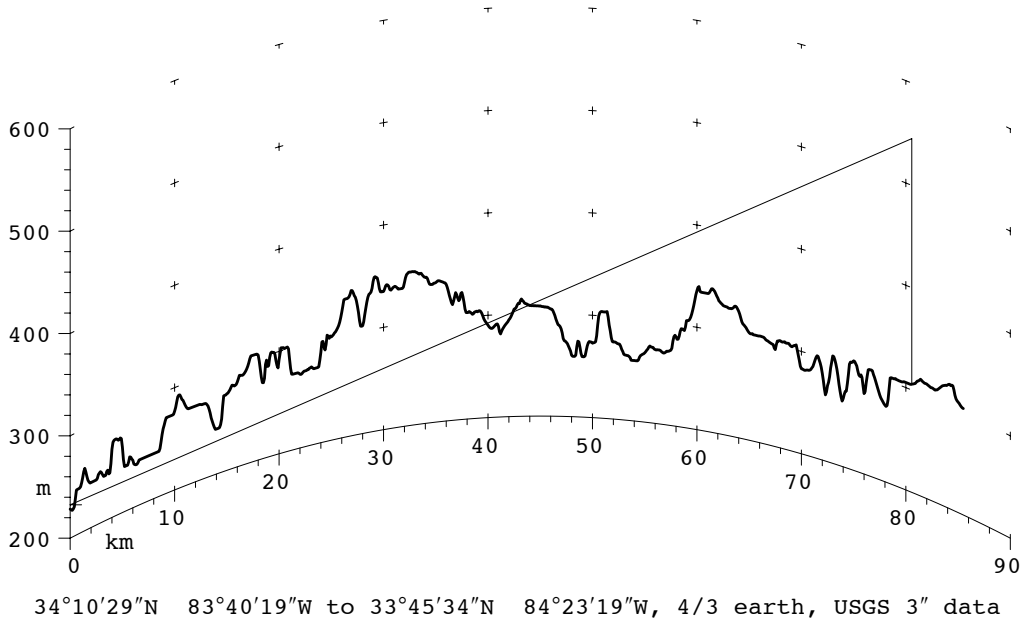
Lambert conformal conic map projection. Geographic coordinate marks shown at 15-minute increments. City limits shown taken from U.S. Census Bureau TIGER/Line 2010 data.

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**Terrain Profile from Proposed Pendergrass EESS Uplink to
WXIA-TV TV Pickup Station KA74886 Fox Tower and Westin Hotel
Electronic News Gathering Receive-Only (ENG-RO) Sites**

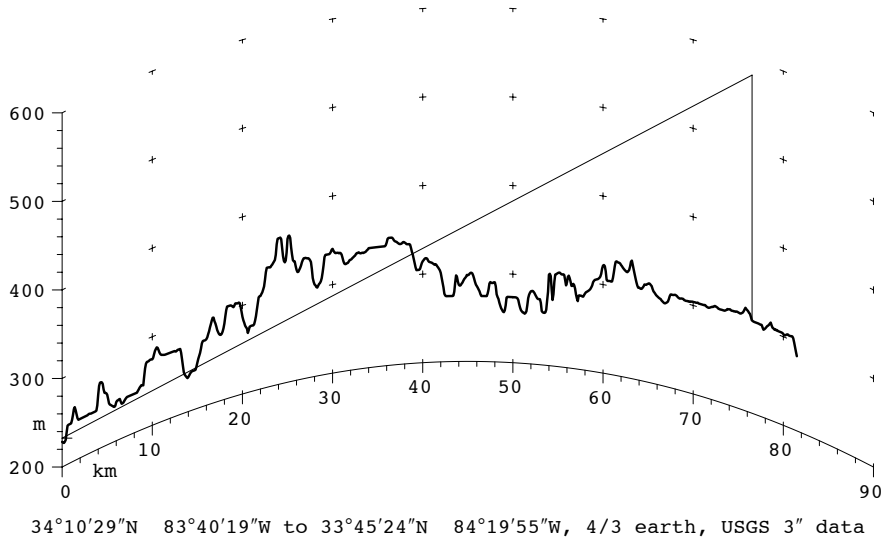


C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of Ultrascan ENG receive dish on Fox Tower = 295.7 m AGL/566.9 m AMSL.

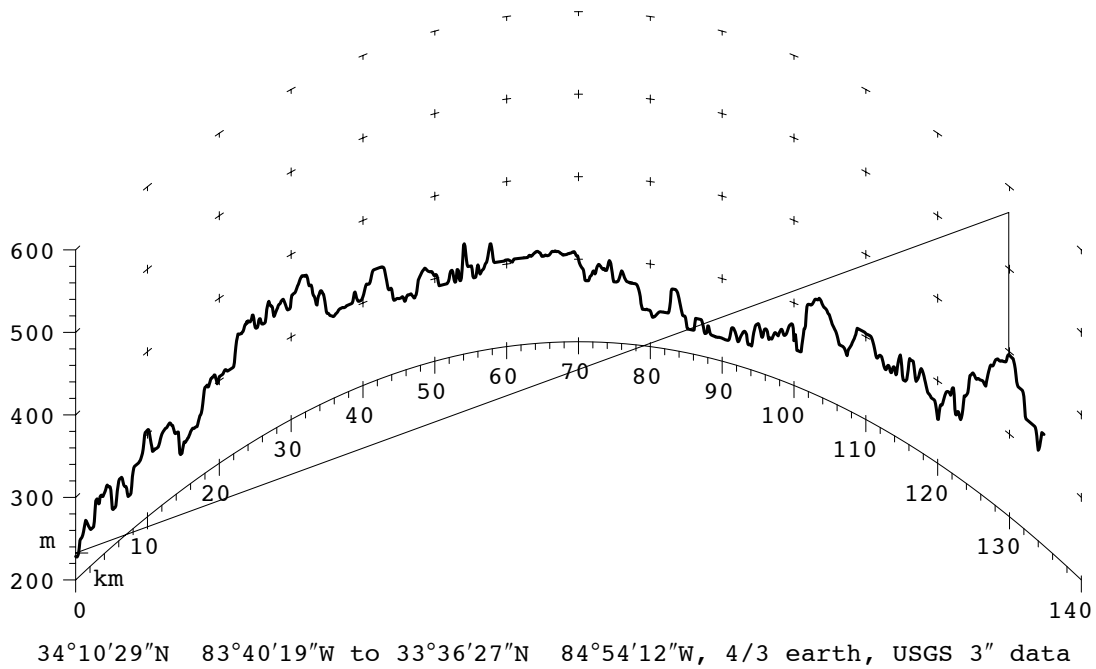


C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of NSI quad horns ENG receive antennas on Westin Hotel = 240.0 m AGL/565.8 m AMSL.

**Terrain Profile from Proposed Pendergrass EESS Uplink to
WXIA-TV TV Pickup Station KA74886 WXIA Xmtr and Fairplay
Electronic News Gathering Receive-Only (ENG-RO) Sites**



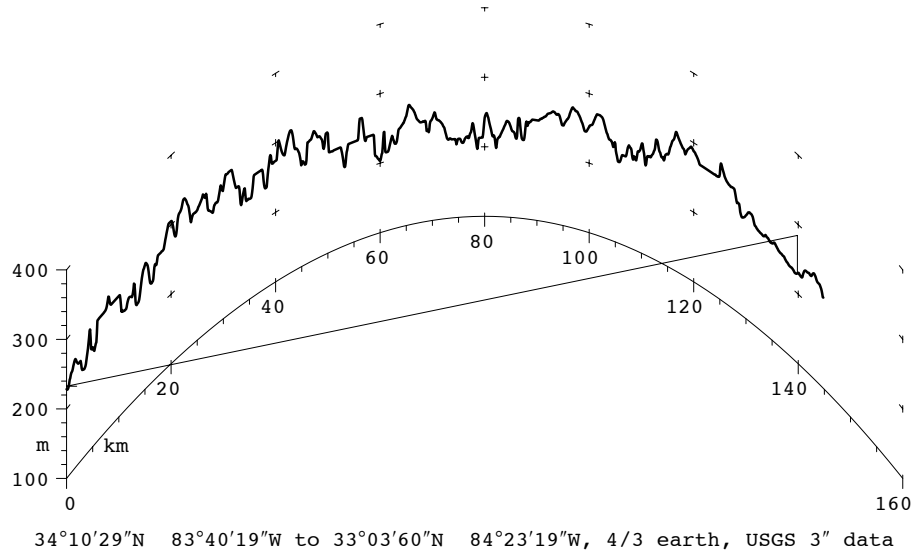
C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of ProScan 3 ENG receive dish on WXIA Xmtr tower = 277.1 m AGL/854.0 m AMSL.



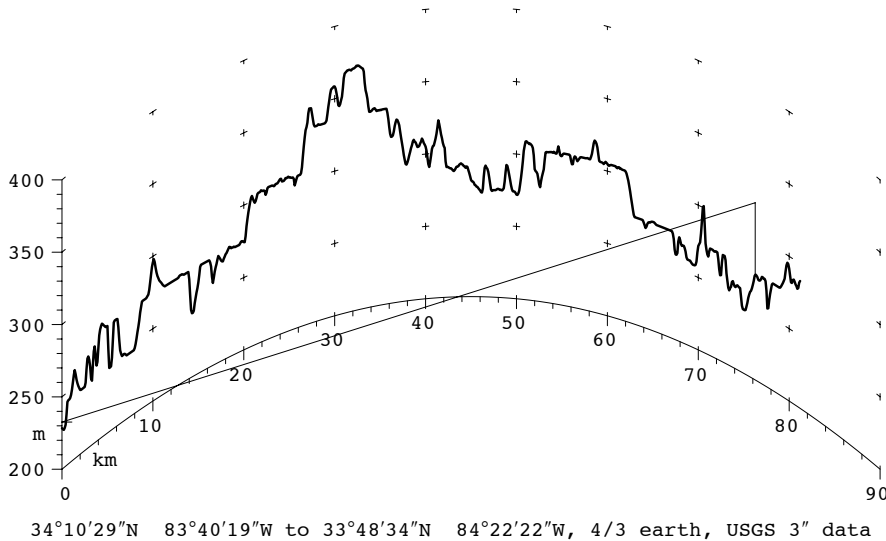
C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of MRC 902864-1 ENG receive dish on Fairplay tower = 172.2 m AGL/56.2 m AMSL.

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**Terrain Profile from Proposed Pendergrass EESS Uplink to
WXIA-TV TV Pickup Station KA74886 Sweat Mountain and WXIA Studios
Electronic News Gathering Receive-Only (ENG-RO) Sites**



C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of MRC UltraScan II ENG receive dish at Sweat Mountain = 54.5 m AGL/569.5 m AMSL.



C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of Andrew KP6F-19 ENG receive dish at WXIA studios = 50.0 m AGL/323.1 m AMSL.



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Calculation Results for WXIA-TV KA74886 ENG-RO Sites

ENG-RO site	Uplink Elevation Pattern*	Uplink Azimuth Pattern	Free Space Path Loss	Terrain Obstruction	ENG-RO Dish Gain	Predicted RSL†
Fox Tower‡	-36 dB	-21§ dB	-124 dB	-30 dB	20 dBi	-115 dBm
Westin Hotel	-35	0	-137	-71	16	-151
WXIA-TV	-35	0	-136	-68	26	-137
Fairplay	-35	0	-141	-72	20	-152
Sweat Mountain	-35	0	-142	-66	20	-147
WXIA-TV studios	-35	0	-136	-68	30	-133

* Based on minimum uplink dish elevation angle of 10°.

† Based on 83.2 dBm EIRP for main beam of EESS uplink, with a -7 dB allowance for bandwidth; that is, $10\log(1.31 \text{ MHz}/6 \text{ MHz})$. A 6 MHz ENG bandwidth was used rather than a 12 MHz ENG bandwidth because the Atlanta market reportedly sometimes uses split channel ENG.

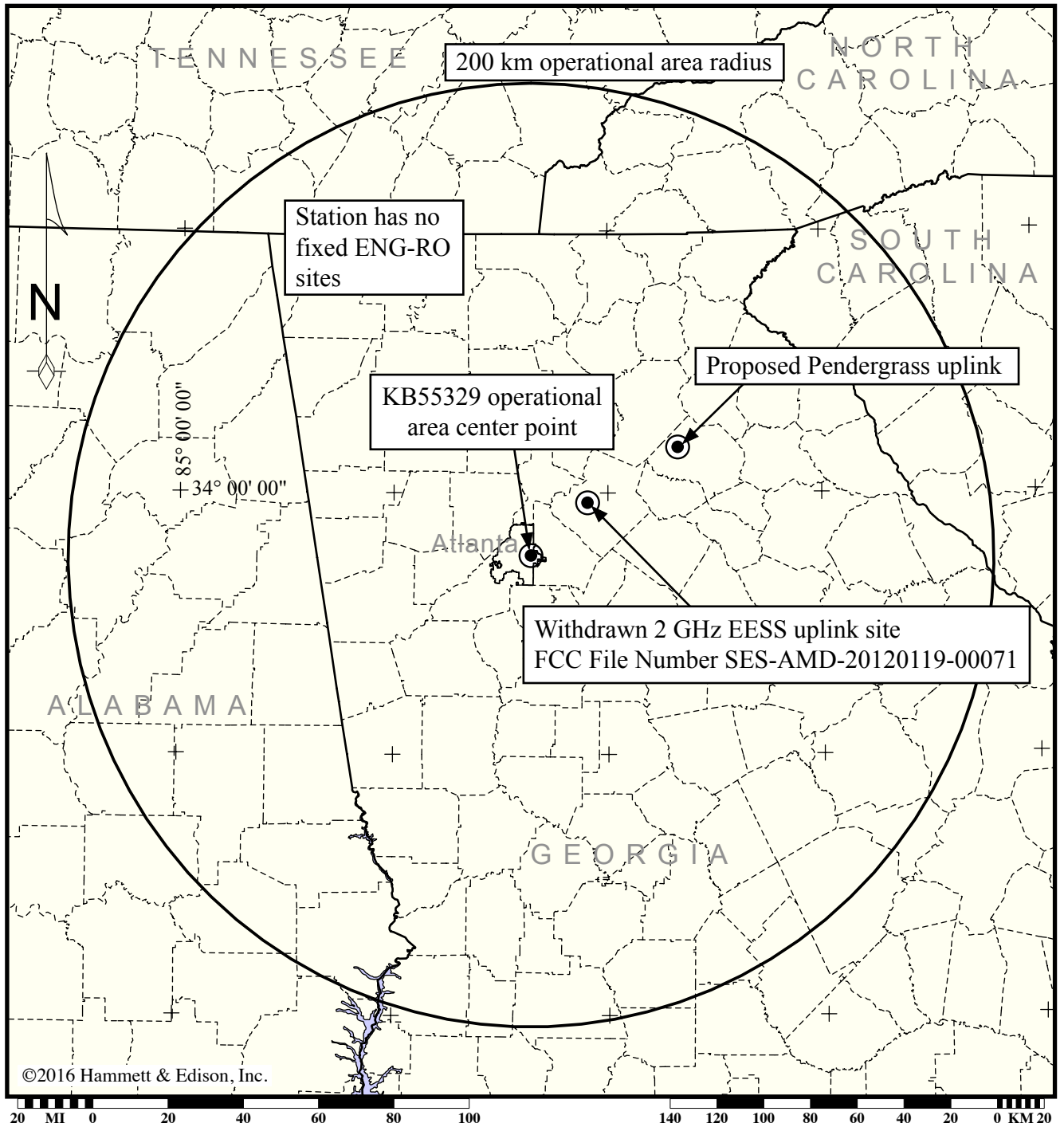
‡ Also known as “Gainesville” and “Flowery Branch.”

§ Based on azimuth notch out of $252.4^\circ \pm 3^\circ$.



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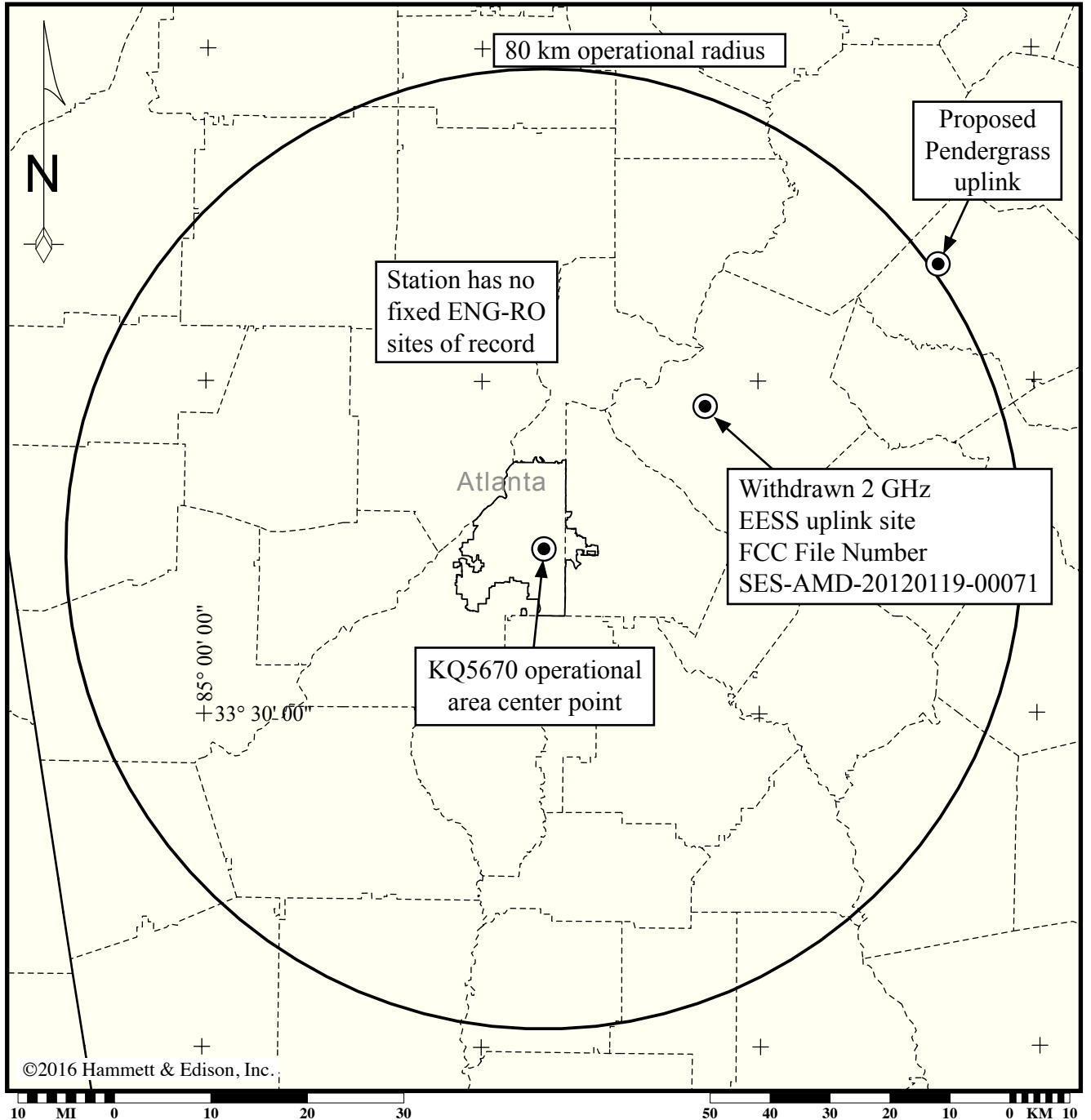
**WUPA(TV) TV Pickup Station KB55329
vs.
Proposed Pendergrass EESS Uplink**



Lambert conformal conic map projection. Map data taken from Sectional Aeronautical Charts, published by the National Ocean Survey. Geographic coordinate marks shown at 60-minute increments. State, county, and city limits shown taken from U.S. Census Bureau TIGER/Line 2010 data.

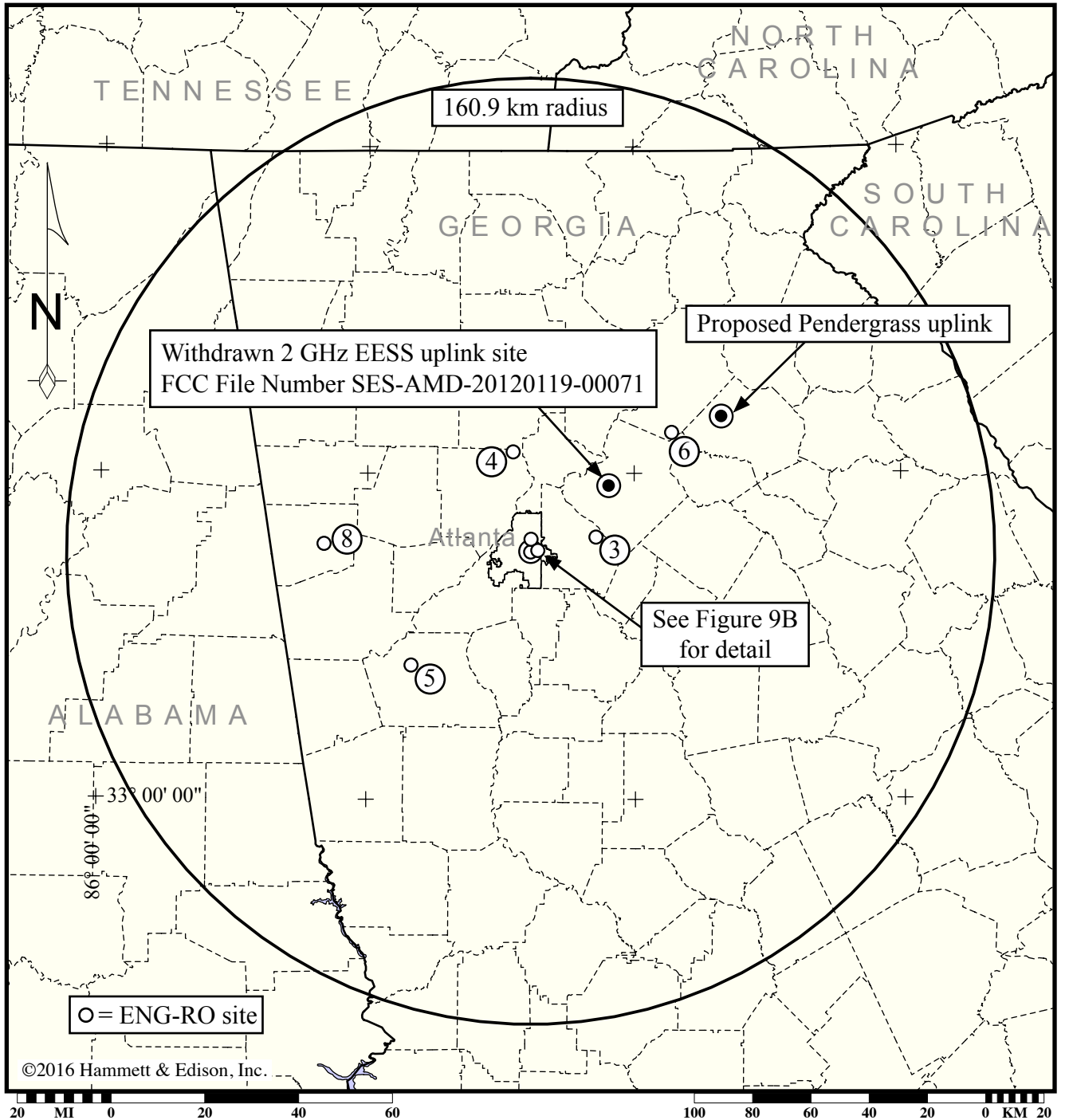
ViaSat, Inc.

**CNN TV Pickup Station KQ5670
vs.
Proposed Pendergrass EESS Uplink**



Lambert conformal conic map projection. Map data taken from Sectional Aeronautical Charts, published by the National Ocean Survey. Geographic coordinate marks shown at 30-minute increments. City limits shown taken from U.S. Census Bureau TIGER/Line 2010 data.

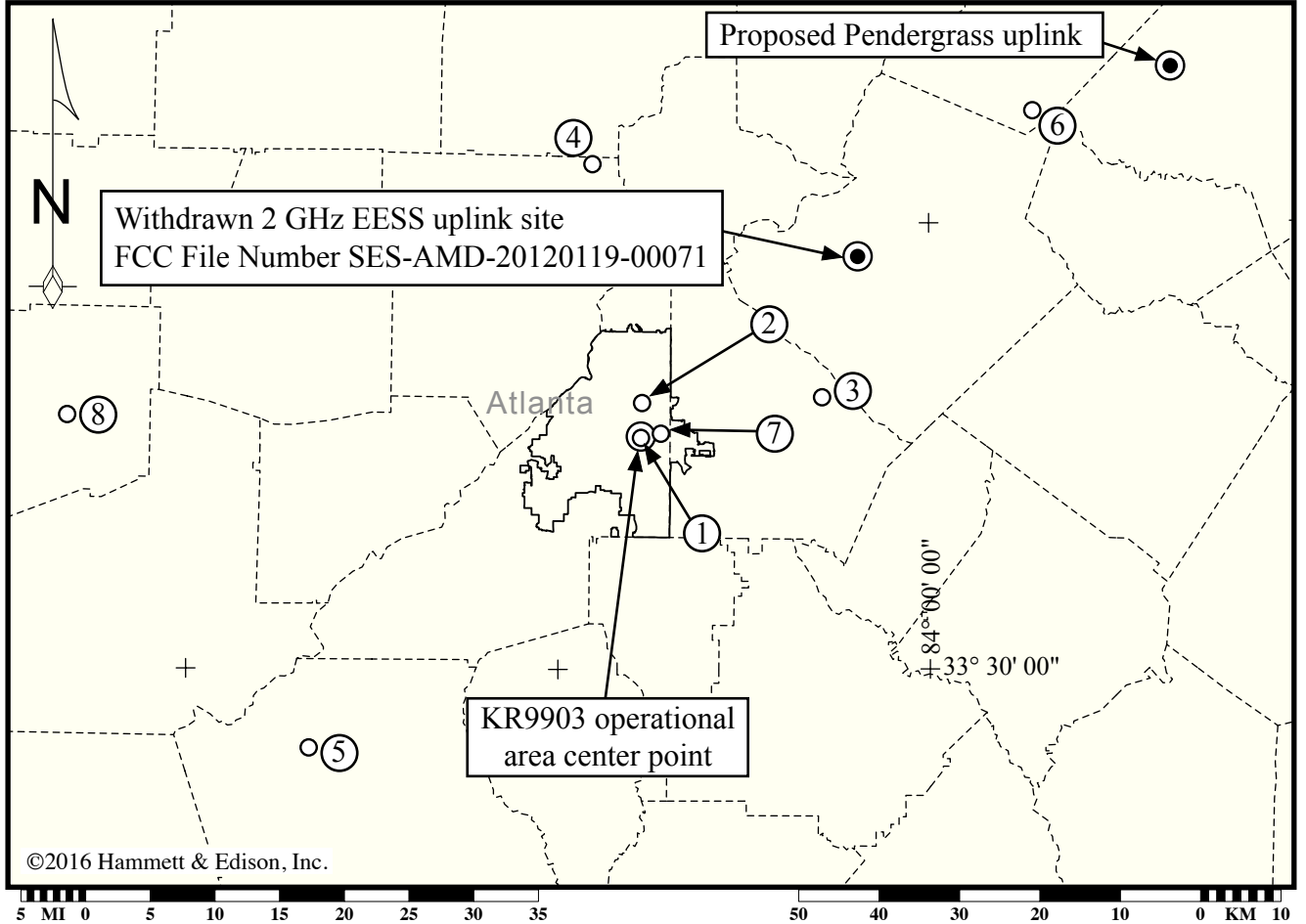
**WSB-TV KR9903 ENG-RO Sites
vs.
Proposed Pendergrass Uplink**



Lambert conformal conic map projection. Map data taken from Sectional Aeronautical Charts, published by the National Ocean Survey. Geographic coordinate marks shown at 60-minute increments. State, county, and city limits shown taken from U.S. Census Bureau TIGER/Line 2010 data.

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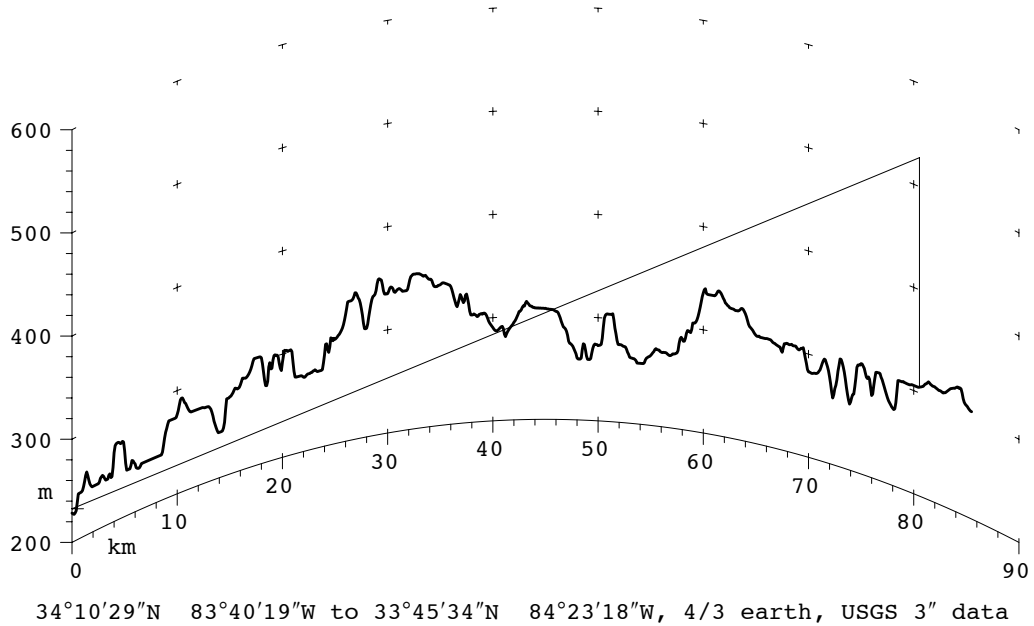
**WSB-TV KR9903 ENG-RO Sites
vs.
Proposed Pendergrass Uplink**



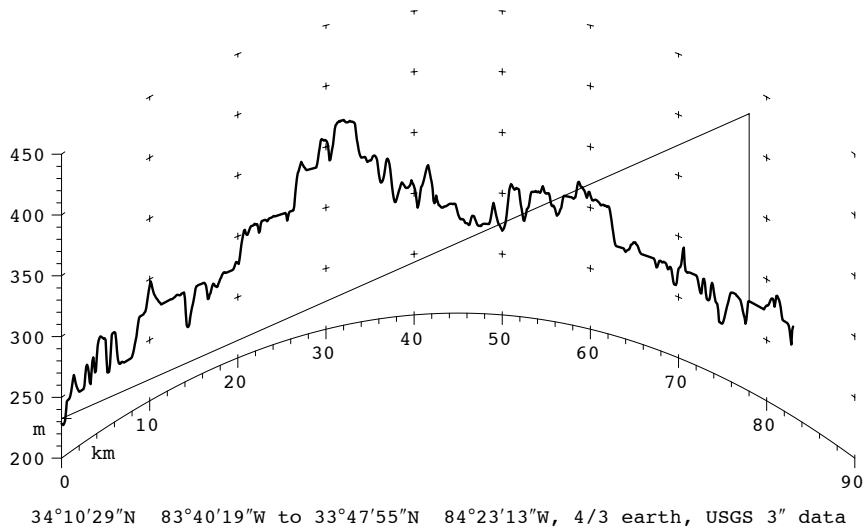
Lambert conformal conic map projection. Map data taken from Sectional Aeronautical Charts, published by the National Ocean Survey. Geographic coordinate marks shown at 30-minute increments. City limits shown taken from U.S. Census Bureau TIGER/Line 2010 data.

- 1 = Remote 1, Westin Plaza Hotel
- 2 = Remote 2, WSB-TV studio
- 3 = Remote 3, Stone Mountain
- 4 = Remote 4, Sweat Mountain
- 5 = Remote 5, Newnan
- 6 = Remote 6, Flowery Branch
- 7 = Remote 7, Willoughby Way Atlanta
- 8 = Remote 8, Buchanan

**Terrain Profile from Proposed Pendergrass EESS Uplink to
WSB-TV TV Pickup Station KR9903
Remote 1 Westin Plaza Hotel and Remote 2 "Studio"
Electronic News Gathering Receive-Only (ENG-RO) Sites**

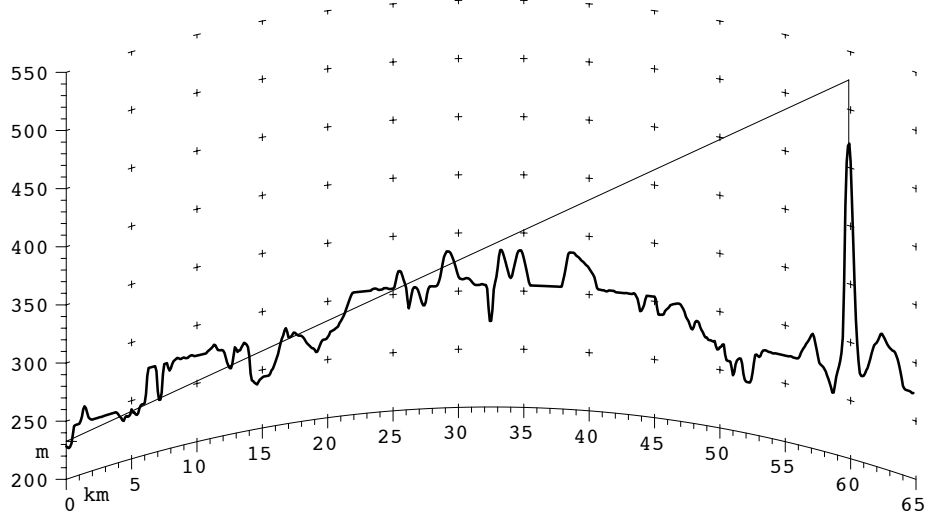


C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of NSI quad array ENG receive dish on Remote 1 Westin Plaza Hotel = 222.5 m AGL/547.1 m AMSL.



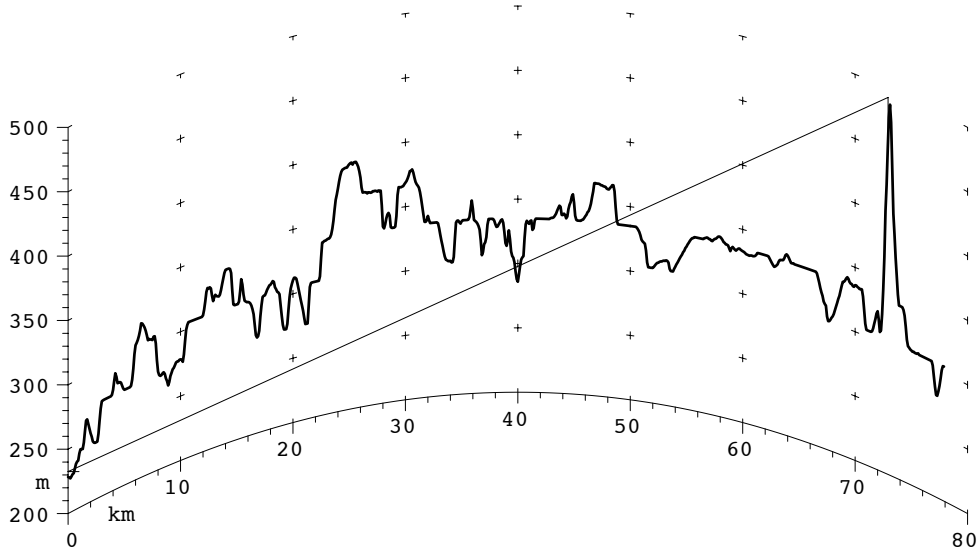
C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of NSI Superquad ENG receive dish on Remote 2 "Studio" tower = 154.2 m AGL/442.3 m AMSL.

**Terrain Profile from Proposed Pendergrass EESS Uplink to
WSB-TV TV Pickup Station KR9903
Remote 3 “Stone Mountain” and Remote 4 “Sweat Mountain”
Electronic News Gathering Receive-Only (ENG-RO) Sites**



34°10'29"N 83°40'19"W to 33°48'18"N 84°08'40"W, 4/3 earth, USGS 3" data

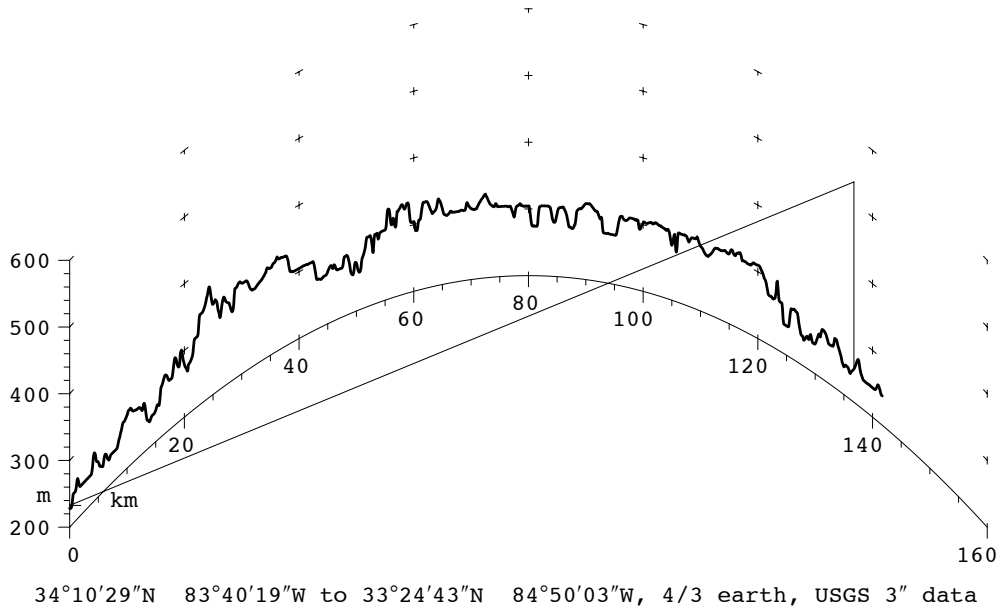
C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of NSI Superquad ENG receive dish on Remote 3 “Stone Mountain” = 55.5 m AGL/552.0 m AMSL.



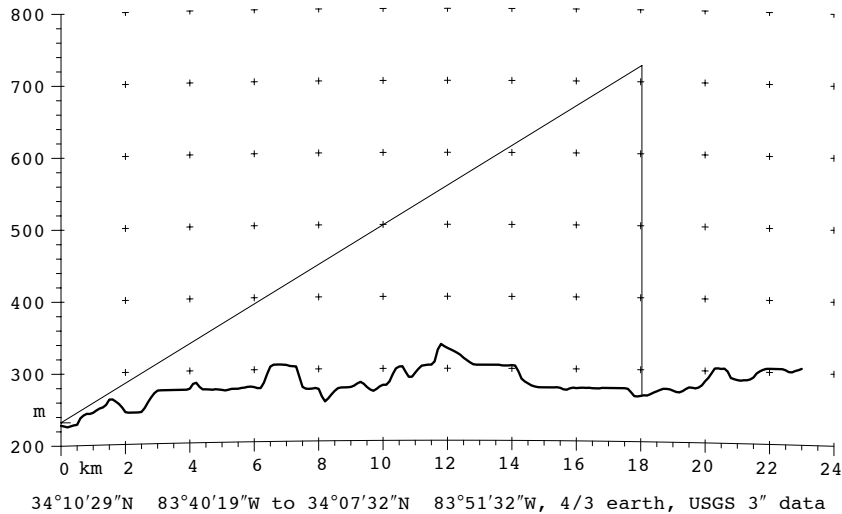
34°10'29"N 83°40'19"W to 34°03'59"N 84°27'14"W, 4/3 earth, USGS 3" data

C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of NSI Superquad ENG receive dish on Remote 4 “Sweat Mountain” = 32.9 m AGL/538.9 m AMSL.

**Terrain Profile from Proposed Pendergrass EESS Uplink to
WSB-TV TV Pickup Station KR9903
Remote 5 "Newnan" and Remote 6 "Flowery Branch"
Electronic News Gathering Receive-Only (ENG-RO) Sites**

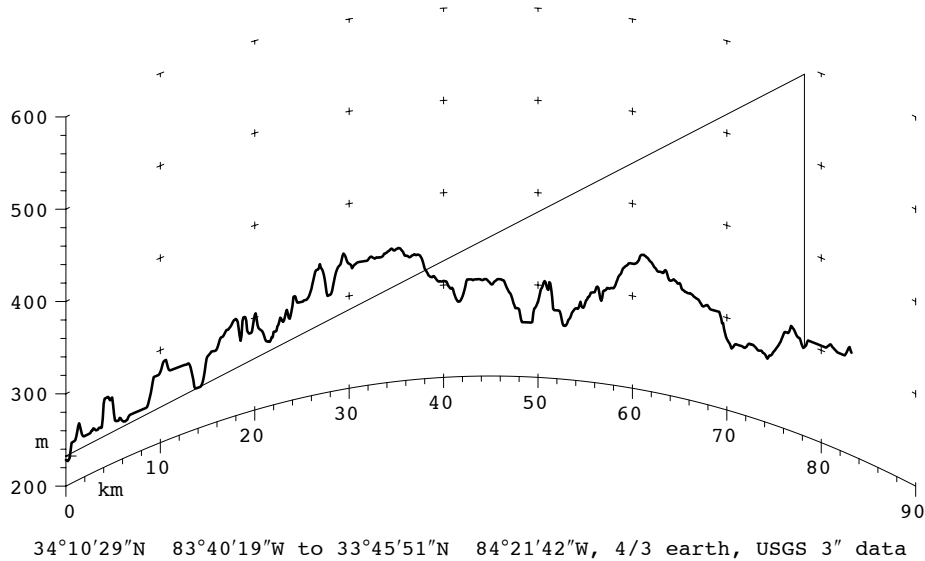


C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of NSI Superquad ENG receive dish on Remote 5 "Newnan" tower = 280.4 m AGL/552.3 m AMSL.

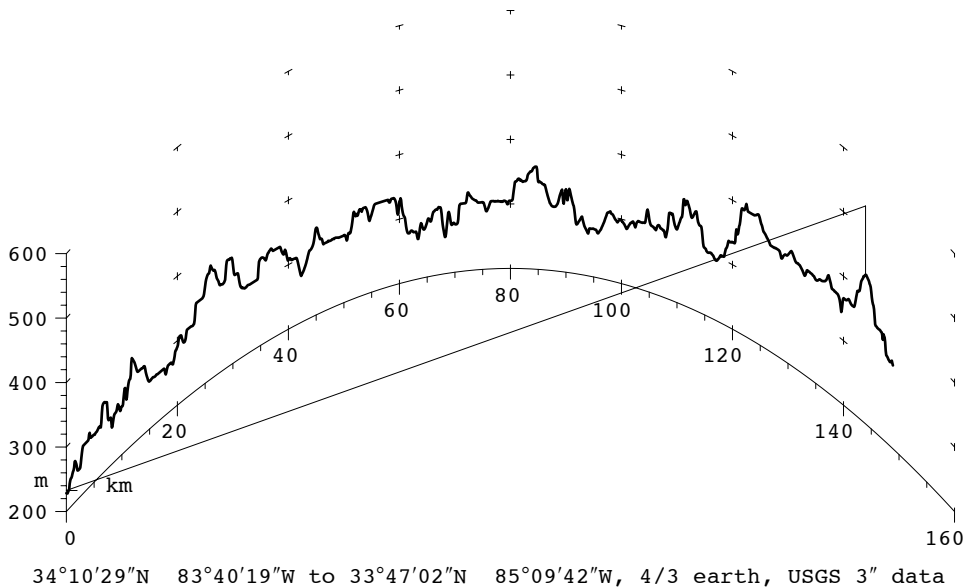


C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of NSI Superquad ENG receive dish on Remote 6 "Flowery Branch" tower = 458.7 m AGL/730.0 m AMSL.

**Terrain Profile from Proposed Pendergrass EESS Uplink to
WSB-TV TV Pickup Station KR9903
Remote 7 "Willoughby Way" and Remote 8 "Buchanan"
Electronic News Gathering Receive-Only (ENG-RO) Sites**



C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of NSI Superquad ENG receive dish on Remote 7 "Willoughby Way" site = 295.7 m AGL/592.2 m AMSL.



C.O.R. of EESS uplink = 4.6 m AGL/232.6 m AMSL. C.O.R. of NSI Superquad ENG receive dish on Remote 6 "Buchanan" tower = 106.7 m AGL/533.1 m AMSL.

ViaSat, Inc.

Calculation Results for WSB-TV KR9903 ENG-RO Sites

ENG-RO site	Uplink Elevation Pattern*	Uplink Azimuth Pattern	Free Space Path Loss	Terrain Obstruction	ENG-RO Dish Gain	Predicted RSL†
Westin Plaza Hotel Remote 1	-35 dB	0 dB	-137 dB	-71 dB	15 dBi	-152 dBm
Studio Remote 2	-34	0	-137	-71	25	-141
Stone Mountain Remote 3	-36	0	-134	-48	25	-117
Sweat Mountain Remote 4	-35	0	-136	-64	25	-134
Newnan Tower Remote 5	-34	0	-141	-74	25	-148
Flowery Branch‡ Remote 6	-33	-21§	-124	0	25	-77
Willoughby Way Remote 7	-35	0	-137	-70	25	-141
Buchanan Remote 8	-34	0	-142	-72	25	-147

Flowery Branch ENG-RO fails -114 dBm received signal level (RSL) protection criteria by 37 dB, even with an uplink main beam azimuth pattern notch out of $252.4^{\circ}T \pm 3^{\circ}$.

* Based on minimum uplink dish elevation angle of 10° .

† Based on 83.2 dBm EIRP for main beam of EESS uplink, with a -7 dB allowance for bandwidth; that is, $10\log(1.31 \text{ MHz}/6 \text{ MHz})$. A 6 MHz ENG bandwidth was used rather than a 12 MHz ENG bandwidth because the Atlanta market reportedly sometimes uses split channel ENG.

‡ Also known as “Fox Tower” and as “Gainesville.”

§ Based on transmit dish azimuth notch out of $252.4^{\circ}T \pm 3^{\circ}$,