

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of

Kuiper Systems LLC

Application for TT&C Earth Station
Authorization

Call Sign _____

File No. SES-LIC _____

APPLICATION FOR TT&C EARTH STATION AUTHORIZATION

Kuiper Systems LLC (“Kuiper”), a wholly owned subsidiary of Amazon.com Services LLC (collectively “Amazon”), seeks authority to operate a fixed telemetry, tracking, and command (“TT&C”) earth station in Alpine, TX. This narrative demonstrates why authorizing this earth station would serve the public interest and explains how Amazon will operate consistent with the Commission’s rules.

I. INTRODUCTION AND BACKGROUND

On July 30, 2020, the Commission authorized Amazon to deploy a 3,236 satellite non-geostationary satellite orbit (“NGSO”) system to provide service using certain Fixed-Satellite Service (“FSS”) and Mobile-Satellite Service (“MSS”) Ka-band frequencies (the “Kuiper System”).¹ As the basis for that authorization, the Commission determined that Amazon’s system would expand the availability of high-speed broadband, thus serving the public interest.² Since then, Amazon has committed to invest at least \$10 billion to support Kuiper, and Amazon

¹ *In re Kuiper Systems LLC, Application for Authority to Deploy and Operate a Ka-band Non-Geostationary Satellite Orbit System*, Order and Authorization, 35 FCC Rcd 8324 (2020) (“*Kuiper System Authorization*”).

² *See Kuiper System Authorization*, 35 FCC Rcd at 8326 ¶ 9.

continues to advance toward its goal of providing affordable, reliable, high-quality connectivity to customers and communities around the world.

With this application, Amazon seeks authority to operate the proposed earth station in Alpine, TX. Authorizing this TT&C earth station will allow Kuiper to control and monitor in orbit satellites and will bring Amazon one step closer to delivering high-speed broadband service. The earth station will consist of two 2.8-meter antennas that will communicate with Amazon’s Kuiper satellites (call sign S3051) in the frequency bands 27.5-28.05 GHz (Earth-to-space) and 19.25-19.4 GHz (space-to-Earth). No more than one antenna will transmit on the same channel at any one time.

II. PUBLIC INTEREST BENEFITS

When the Commission originally authorized the Kuiper System, it “conclude[d] that grant of Kuiper’s application would advance the public interest” because the Kuiper System was “designed to increase the availability of high-speed broadband service to consumers, government, and businesses.”³ The same public interest considerations that supported grant of the original space station application support granting this earth station application now.

Grant of this application will allow Amazon’s Kuiper System to execute its plans to deliver satellite broadband communications services to tens of millions of unserved and underserved consumers and businesses in the United States and around the globe.⁴ Granting this earth station application will accelerate Kuiper’s ability to bring connectivity to consumers and enterprise

³ *Kuiper System Authorization*, 35 FCC Rcd at 8324 ¶ 3.

⁴ See, e.g., *In re Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion*, Fourteenth Broadband Deployment Report, 36 FCC Rcd 836, 837 ¶ 2 (2021) (noting that 14.5 million Americans lack access to fixed terrestrial broadband with benchmark download and upload speeds of 25 Mbps and 3 Mbps, respectively).

customers—enabling growth in local economies, improving access to government services, and supporting public safety and disaster relief communications.

III. SPECTRUM USE AND SHARING

Amazon will adhere to all International Telecommunication Union (“ITU”) and Commission requirements and pertinent future FCC rulemakings governing NGSO Ka-band earth stations. When sharing spectrum, Amazon will operate consistent with the *Kuiper System Authorization* and the Commission’s rules, as discussed below.⁵

A. Kuiper System TT&C Earth Station Transmit Frequencies

The earth station will transmit to Kuiper System satellites in the frequencies listed in Table 1 and follow relevant sharing requirements in the Commission’s rules.

Table 1: Kuiper System TT&C Earth Station Transmit Frequencies

Transmit Frequencies (GHz)	Status ⁶
27.5-28.05 ⁷	FSS secondary to UMFUS ⁸

⁵ See *Kuiper System Authorization*, 35 FCC Rcd at 8344-45 ¶ 59.

⁶ See generally 47 C.F.R. § 2.106; *In re Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, Report and Order and Further Notice of Proposed Rulemaking, 32 FCC Rcd 7809 (2017) (“*NGSO FSS Order*”); *id.* at 7850-51 Appendix B (“*Ka-band Plan*”).

⁷ Amazon will use the 27.5-27.55 GHz, 27.95-28.0 GHz, and 28.0-28.05 GHz bands. See *Kuiper System Authorization*, 35 FCC Rcd at 8325 ¶ 5 n.7.

⁸ Equivalent power flux-density (“EPFD”) compliance permits NGSO and GSO FSS sharing. See *NGSO FSS Order*, 32 FCC Rcd at 7817, 7821-22 ¶¶ 23, 37, 39; 47 C.F.R. § 25.289.

1. 27.5-28.05 GHz (NGSO FSS secondary to UMFUS)

NGSO FSS may transmit on a secondary basis without providing interference protection to the Upper Microwave Flexible Use Service (“UMFUS”) in the 27.5-28.05 GHz band.⁹ Exhibit A, the UMFUS analysis, demonstrates how the earth station satisfies the section 25.136(a) protection criteria and, therefore, does not need to protect future UMFUS deployments.¹⁰ Exhibit C, the Comsearch report, establishes that Amazon has coordinated with UMFUS licensees consistent with section 101.103(d).¹¹

B. Kuiper System TT&C Earth Station Receive Frequencies

The earth station will receive transmissions from the Kuiper System in the frequencies listed in Table 2 and follow relevant sharing requirements in the Commission’s rules.¹²

Table 2: Kuiper System TT&C Earth Station Receive Frequencies

Frequencies (GHz)	Status¹³
19.25-19.3	NGSO FSS primary
19.3-19.4	NGSO FSS secondary to FS, NGSO MSS FL, and GSO FSS

⁹ See 47 C.F.R. §§ 2.106, 25.136; *International Bureau Issues Guidance on Siting Methodologies for Earth Stations Seeking to Operate in the 24.75-25.25 GHz, 27.5-28.35 GHz, 37.5-40 GHz, 47.2-48.2 GHz, and 50.4-51.4 GHz Frequency Bands to Demonstrate Compliance with Section 25.136*, Public Notice, 35 FCC Rcd 6347 (IB 2020).

¹⁰ See 47 C.F.R. § 25.136(a); Exhibit A.

¹¹ See 47 C.F.R. § 101.103(d); Exhibit C. Note that the Comsearch report submitted as Exhibit C to this application covers the 27.5-27.6 GHz bands. Amazon will supplement Exhibit C to include the coordination report for 27.6-28.05 GHz within 45 days of the filing of this application and requests that the Commission continue to process its application (including by placing the application on Public Notice) in the interim.

¹² Before operating in these bands, Amazon will complete coordination with U.S. Federal systems. See 47 C.F.R. § 2.106 n.US334; *Kuiper System Authorization*, 35 FCC Rcd at 8345 ¶ 59(m).

¹³ See generally 47 C.F.R. § 2.106; *NGSO FSS Order*; Ka-band Plan.

1. 19.25-19.3 GHz (NGSO FSS primary)

NGSO FSS may receive on a primary basis in the 19.25-19.3 GHz band.¹⁴ Amazon's operations are licensed as NGSO FSS and, therefore, possess primary status in the band.¹⁵

2. 19.3-19.4 GHz (NGSO FSS secondary to FS)

NGSO FSS may receive on a secondary basis to FS in the 19.3-19.4 GHz band.¹⁶ To share with FS, the Kuiper System satellites will meet the power flux-density limits in ITU Radio Regulations Article 21.¹⁷ The Comsearch report confirms no additional limitations are necessary.¹⁸

3. 19.3-19.4 GHz (NGSO FSS secondary to NGSO MSS feeder link)

NGSO FSS may receive on a secondary basis to NGSO MSS feeder link systems in the 19.3-19.4 GHz band.¹⁹ To share with NGSO MSS feeder links, Amazon will (i) coordinate use of the band with previously authorized NGSO MSS system operators not in the March 2020 processing round before commencing service²⁰ and (ii) employ the section 25.261 spectrum-sharing framework with NGSO system operators in the March 2020 processing round while operating service.²¹

¹⁴ See 47 C.F.R. § 2.106; Ka-band Plan.

¹⁵ See *Kuiper System Authorization*, 35 FCC Rcd at 8327 ¶ 11.

¹⁶ See 47 C.F.R. § 2.106; Ka-band Plan.

¹⁷ See *Kuiper System Authorization*, 35 FCC Rcd at 8327, 8344 ¶¶ 13, 59(d)-(e).

¹⁸ See Exhibit C; see also *supra* n.11.

¹⁹ See 47 C.F.R. § 2.106; Ka-band Plan.

²⁰ Before using this band, Amazon's space station authorization requires it to coordinate with previously authorized NGSO MSS feeder link systems using the same frequencies and polarizations as Amazon. See *Kuiper System Authorization*, 35 FCC Rcd at 8345 ¶ 59(i).

²¹ See *id.*

4. 19.3-19.4 (NGSO FSS secondary to GSO FSS)

NGSO FSS may receive on a secondary basis with respect to GSO FSS in the 19.3-19.4 GHz band.²² Amazon will neither cause harmful interference to GSO FSS nor claim protection from harmful interference from GSO FSS.²³

IV. ANTENNA PATTERN

The Commission has not promulgated standards for NGSO Ka-band earth station antenna pattern performance. The Commission's existing standards consider only GSO Ku-/Ka-band or NGSO Ku-band operations because the Commission has "not yet determined what off-axis gain envelopes might be appropriate for [Ka-band] earth stations operating with NGSO FSS space stations, either to facilitate NGSO-to-NGSO or NGSO-to-GSO interference protection."²⁴ Amazon nonetheless will comply with the section 25.209(a)(1) mask for GSO Ka-band earth station antennas, as illustrated in Exhibit D's simulated antenna pattern.²⁵

V. RADIATION HAZARD ANALYSIS

Exhibit B, the Radiation Hazard Analysis, confirms that Amazon complies with relevant Commission standards and demonstrates there is no risk of radiation exposure beyond the acceptable limits.²⁶ To further protect the general public, Amazon will site the earth station either behind a fence or on private commercial property with limited access. Trained technicians

²² See 47 C.F.R. § 2.106; Ka-band Plan; *NGSO FSS Order*, 32 FCC Rcd at 7815-16 ¶ 19.

²³ See 47 C.F.R. § 2.105(c)(2).

²⁴ *In re Comprehensive Review of Licensing and Operating Rules for Satellite Services*, Second Report and Order, 30 FCC Rcd 14713, 14784 ¶ 213 (2015). See also *NGSO FSS Order*, 32 FCC Rcd at 7827 ¶¶ 54-55 & n.121 (declining to adopt NGSO earth station antenna performance standards). See generally 47 C.F.R. §§ 25.209, 25.132.

²⁵ See 47 C.F.R. § 25.209(a)(1); Exhibit D.

²⁶ See FCC OET Bulletin No. 65, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields* (Aug. 1997); Exhibit B.

responsible for operating the earth station will turn off and secure the transmitters before performing any maintenance work.

VI. FAA NOTIFICATION

The Commission requires no Federal Aviation Administration (“FAA”) notification for an antenna structure of 6.1 meters or less in height above ground level.²⁷ Amazon’s antenna structure for the proposed earth station measures 4.30 meters above ground level and, therefore, requires no FAA notification.

VII. CONCLUSION

Amazon has satisfied the Commission’s licensing standards for NGSO Ka-band TT&C earth stations. Prompt grant of this application will accelerate the deployment of the Kuiper System and its ability to expand broadband access for consumers, schools, hospitals, businesses, and other organizations across the United States.

Respectfully submitted,

/s/ Liliana Farfan Roach
Liliana Farfan Roach
Corporate Counsel
Kuiper Systems LLC

March 25, 2022

²⁷ See 47 C.F.R. § 17.2 (defining antenna structure as a structure that is constructed or used to transmit and/or receive radio energy or that supports antennas that transmit and/or receive radio energy and other appurtenances mounted thereon); *id.* §§ 17.7(e), 25.115(j).

EXHIBIT A (SECTION 25.136 UMFUS PROTECTION ANALYSIS)

This Exhibit A demonstrates that the proposed Telemetry Tracking and Control (“TT&C”) earth station satisfactorily protects 27.5-28.35 GHz Upper Microwave Flexible Use Service (“UMFUS”) deployments in Brewster County, TX (“County”).

Section 25.136(a)(4) of the Commission’s rules describes how Fixed-Satellite Service (“FSS”) operators may deploy earth stations in the 27.5-28.35 GHz band without providing additional interference protection to co-frequency UMFUS licensees.¹ *First*, one U.S. county may not possess more than three co-frequency FSS earth stations operating in the 27.5-28.35 GHz band.² *Second*, the area in which the earth station generates a power flux-density (“PFD”) greater than or equal to -77.6 dBm/m²/MHz at 10 meters above ground level (“-77.6 dBm/m²/MHz”), together with the similar area of any other earth station authorized under section 25.136(a)(1)-(4), may not cover more than certain population amounts.³ *Third*, the -77.6 dBm/m²/MHz PFD contour may not contain any major event venue, urban mass transit route, passenger railroad, cruise ship port, or certain roads (Interstate, Other Freeways and Expressways, or Other Principal Arterial).⁴ *Fourth*, the FSS operator must have coordinated with existing UMFUS licensees located within a PFD contour greater than or equal to -77.6 dBm/m²/MHz at 10 meters above ground level pursuant to section 101.103(d) of the Commission’s rules.⁵

Amazon’s analysis is consistent with section 25.136(a)(4) and the Guidance. No more than three FSS earth stations will operate under the provisions of section 25.136(a)(4) in the county hosting the proposed earth station. Amazon’s -77.6 dBm/m²/MHz PFD contour covers 149 people of Brewster County’s total 9,546 people and 3 people of Presidio County’s 6,131 people. The PFD contour does not contain any major event venue, urban mass transit route, passenger railroad, cruise ship port, Interstate, Other Freeways and Expressways, or Other Principal Arterial. Amazon has also coordinated with existing UMFUS licensees, as required.⁶ Accordingly, the Commission,

¹ See 47 C.F.R. § 25.136(a)(4). The Commission has offered additional guidance on how to present section 25.136 showings. See generally *International Bureau Issues Guidance on Siting Methodologies for Earth Stations Seeking to Operate in the 24.75-25.25 GHz, 27.5-28.35 GHz, 37.5-40 GHz, 47.2-48.2 GHz, and 50.4-51.4 GHz Frequency Bands to Demonstrate Compliance with Section 25.136*, Public Notice, 35 FCC Rcd 6347 (IB 2020) (“Guidance”).

² See 47 C.F.R. § 25.136(a)(4)(i).

³ See 47 C.F.R. § 25.136(a)(4)(ii); *id.* at Table 1 to Paragraph (a)(4)(ii) (permitting the PFD contour to cover 0.1 percent of the population in a county with more than 450,000 people; 450 people in a county with 6,000-450,000 people; and 7.5 percent of the population in a county with fewer than 6,000 people).

⁴ See 47 C.F.R. § 25.136(a)(4)(iii). See also *In re Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, Second Report and Order, Second Further Notice of Proposed Rulemaking, Order on Reconsideration, and Memorandum Opinion and Order, 32 FCC Rcd 10988, 11031-32, 11085-86 ¶ 131, Appendix B (2017).

⁵ See 47 C.F.R. § 25.136(a)(4)(iv).

⁶ See Exhibit C, Comsearch Coordination Report. The Comsearch report submitted as Exhibit C to this application covers the 27.5-27.6 GHz bands. Amazon will supplement Exhibit C to include the coordination report for 27.6-28.05 GHz within 45 days of the filing of this application and requests that the Commission continue to process its application (including by placing the application on Public Notice) in the interim.

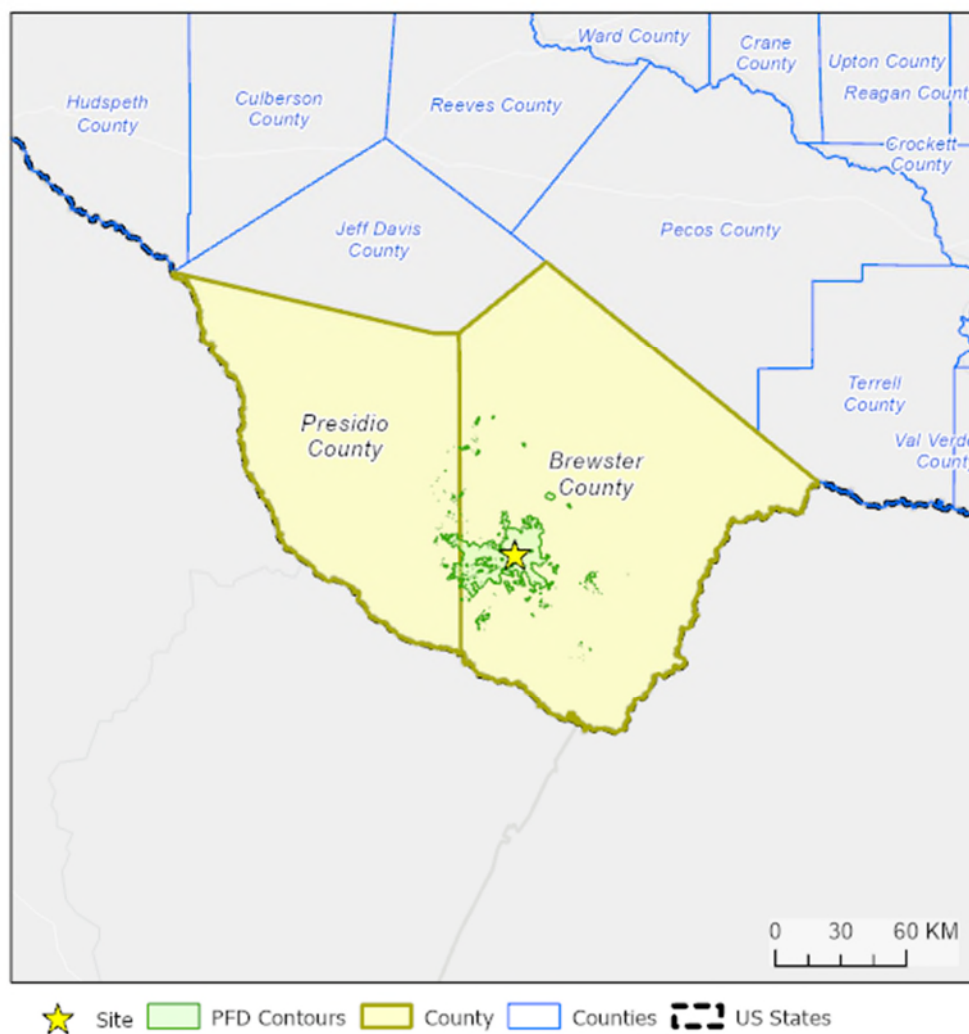
should grant this application and not require Amazon to provide additional interference protection to UMFUS licensees in the County.

Section 25.136(a)(4)(i) (no more than three co-frequency FSS earth stations in one county)

Section 25.136(a)(4)(i) of the Commission’s rules requires the applicant to demonstrate that “[t]here are no more than two other authorized earth stations operating in the 27.5-28.35 GHz band within the county where the proposed earth station is located that meet the criteria contained in either paragraph (a)(1), (2), (3), or (4) of this section.”⁷ For purposes of this rule, “multiple earth stations that are collocated with or at a location contiguous to each other shall be considered as one earth station.”⁸

Figure 1 depicts the proposed earth station’s location in the County. The earth station location, Brewster County PFD contour and Presidio County PFD contour are shown in yellow and green.

Figure 1. Location of Amazon Earth Station



⁷ 47 C.F.R. § 25.136(a)(4)(i).

⁸ *Id.*

As of the date of this submission, the Commission’s International Bureau Filing System shows one FSS earth station licensee authorized to use the 27.5-28.35 GHz band in Brewster County.⁹ As there are no more than two other authorized earth stations operating in the 27.5-28.35 GHz band within Brewster County, this earth station application complies with section 25.136(a)(4)(i). The number of earth stations operating in the 27.5-28.35 GHz band in Presidio County does not affect the TT&C’s compliance with section 25.136(a)(4)(i).

PFD Contour Generation – Sections 25.136(a)(4)(ii)–(iv)

To verify compliance with sections 25.136(a)(4)(ii)–(iv) for all applicable regions, Amazon generated the earth station’s -77.6 dBm/m²/MHz PFD contour as shown in Figure 2. The earth station’s maximum aggregate equivalent isotropic radiated power (“EIRP”) from its active antenna will be 16.0 dBW/MHz at the horizon in any azimuth direction based on a simulated antenna pattern.

Table 2. Amazon Earth Station Parameters

Field	Value	Units
County	Brewster, TX	
Latitude	29° 37' 1.7" N	
Longitude	103° 34' 3.8" W	
Simulation Frequency	27.5	GHz
Number of Active Antennas	1	
Antenna Centerline Height (Above Ground Level)	2.5	meters
Worst-case Antenna Gain toward the Horizon	5.8	dBi
RF Transmit Power	12.1	dBW/MHz
Aggregate EIRP toward the Horizon	17.9	dBW/MHz

Amazon generated the proposed earth station’s -77.6 dBm/m²/MHz PFD contour using internal satellite communications and geospatial analysis software and verified the results using Visualyse Pro. The PFD contours were generated by creating a raster grid of measurement points located 10 meters above ground level and surrounding the earth station, and calculating the path attenuation, received power, and power flux-density to each point. When using Visualyse Pro, the receive antennas were assigned a receive gain of 50.24 dBi in the direction of the transmitting earth station to account for the difference between a received power calculation and power flux-density.¹⁰ To assess radio propagation, Amazon used ITU-R Recommendation P.452 and National Aeronautics and Space Administration Shuttle Radar Topography Mission digital topology data, which employs a 1-arc second resolution.¹¹ The antenna gain toward the horizon is derived from antenna

⁹ See SpaceX Services Inc., File No. SES-LIC-20200505-00498, License (granted Feb. 14, 2021) (“SpaceX License”).

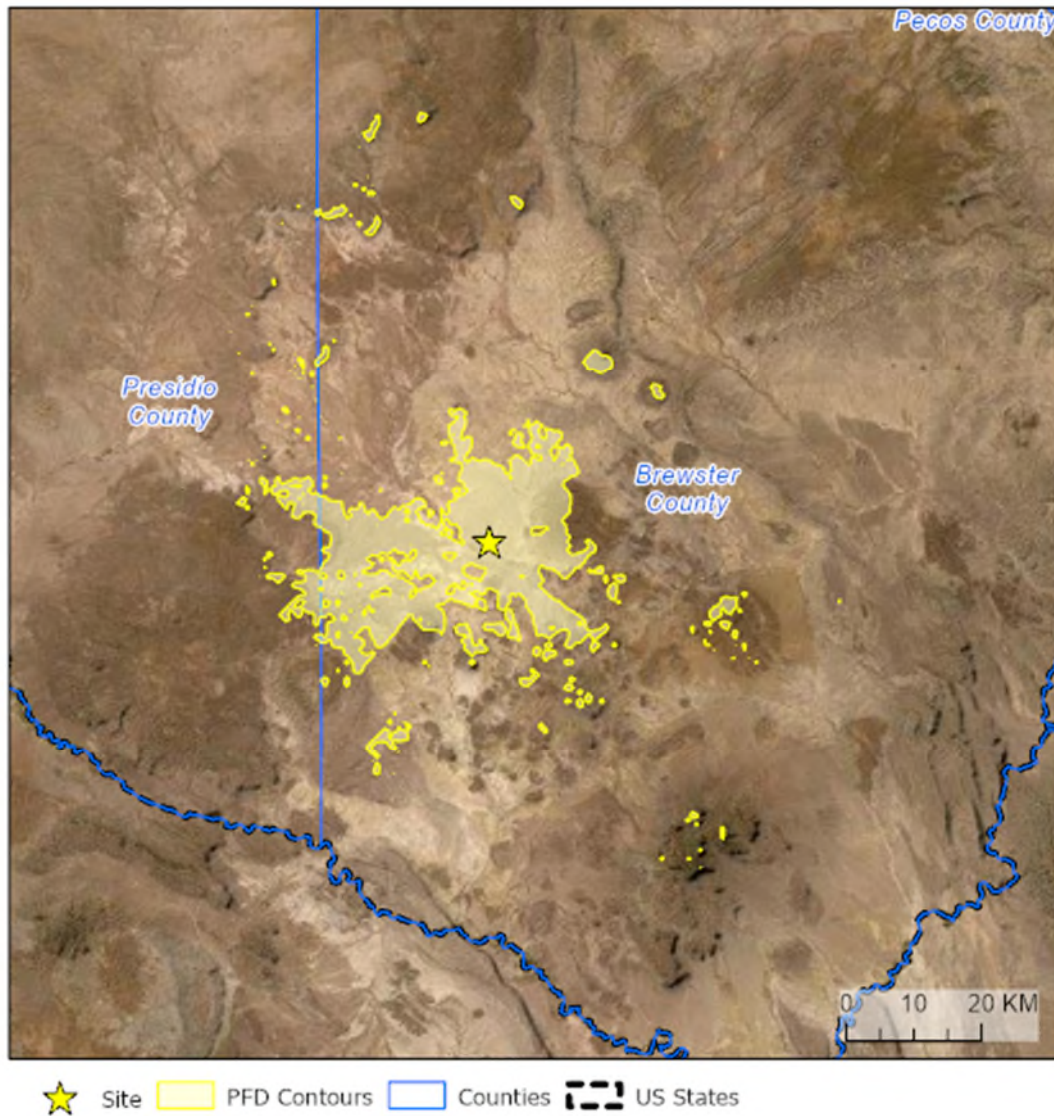
¹⁰ This gain value is calculated as $10 \cdot \log(4\pi/\lambda^2)$ where λ is the wavelength at 27.5 GHz. The adjustment is due to a limitation of the Visualyse Pro software and the conversion from PFD to received power.

¹¹ See Guidance, 35 FCC Rcd at 6349 (computing PFD contours and protection zones at bullets 2 and 4). For the application of ITU-R Recommendation P.452, no clutter category was assumed. Accordingly, the PFD contours generated for this application are conservative.

manufacturer calculations.¹² The PFD contour is generated using the worst-case input power density rather than the input power density during clear sky conditions.¹³

Figure 2 shows Amazon's PFD contour in Google Earth (shapefile attached in KML format) and confirms the contour complies with the Guidance.

Figure 2. Earth Station PFD Contour ($-77.6 \text{ dBm/m}^2/\text{MHz}$)



¹² See Guidance, 35 FCC Rcd at 6349 (computing PFD contours and protection zones at bullet 3).

¹³ See *id.* (computing PFD contours and protection zones at bullet 5).

Section 25.136(a)(4)(ii) (-77.6 dBm/m²/MHz PFD contour covering only certain population totals)

Section 25.136(a)(4)(ii) requires the applicant to demonstrate that “[t]he area in which the earth station generates a PFD, at 10 meters above ground level, of greater than or equal to -77.6 dBm/m²/MHz, together with the similar area of any other earth station authorized pursuant to paragraph (a) of this section, does not cover, in the aggregate, more than the amount of population of the UMFUS license area within which the earth station is located as noted in table 1 to this paragraph (a)(4)(ii).”¹⁴ The table is reproduced below:

TABLE 1 TO PARAGRAPH (a)(4)(ii)

Population within UMFUS license area	Maximum permitted aggregate population within -77.6 dBm/m²/MHz PFD contour of earth stations
Greater than 450,000	0.1 percent of population in UMFUS license area.
Between 6,000 and 450,000	450 people.
Fewer than 6,000	7.5 percent of population in UMFUS license area.

The PFD contour overlaps several census blocks, all within Brewster and Presidio Counties. These counties’ populations are 9,546 and 6,131 respectively, according to 2020 U.S. Census Bureau data.¹⁵ As a result, the maximum population permitted within the FSS earth station’s -77.6 dBm/m²/MHz PFD contour is 450 people within each county. Amazon’s analysis demonstrates that the proposed earth station’s PFD contour covers 149 people in Brewster and 3 people in Presidio—fewer than the 450 limit in each county—using 2020 U.S. Census Bureau data and the actual area method.¹⁶

Section 25.136(a)(4)(ii) considers the aggregate population covered by the proposed earth station and the FSS earth stations operating in the 27.5-28.35 GHz band within the County. At the time of filing, the one other earth station in Brewster County covers 2 people.¹⁷ At the time of filing, there are no people covered in Presidio County by other FSS earth stations operating in the 27.5-28.35 GHz band. The Amazon earth station’s PFD contour, therefore, does not exceed the section 25.136(a)(4)(ii) *aggregate* population coverage allowance of 450 people for either county.

¹⁴ 47 C.F.R. § 25.136(a)(4)(ii).

¹⁵ See *Brewster County TX, Presidio County TX*, U.S. Census Bureau, <https://www.census.gov/quickfacts/fact/table/presidiocountytexas,brewstercountytexas/PST120221> (last visited Mar. 18, 2022).

¹⁶ See Guidance, 35 FCC Rcd at 6350 (determining estimated aggregate population coverage at bullets 2 and 5).

¹⁷ See SpaceX License at 3 (stating that “the estimated aggregate population affected was determined to be 2 people, out of a maximum of 450 people allowed to be affected in this County, based on the decennial 2010 U.S. Census Population information”); see also SpaceX Services Inc., File No. SES-LIC-20200505-00498, Narrative, Technical Appendix (filed May 5, 2020) (estimating either 2 or 4 people within the PFD contour).

Figure 3 shows the census blocks that are fully or partially covered by the PFD contour. Table 3 shows the total population, fractional area coverage, and fractional population coverage for each fully and partially covered census block. Table 4 shows the total population covered in each county that the PFD contour overlaps.

Figure 3. Census Block and Population Coverage of Earth Station PFD Contour

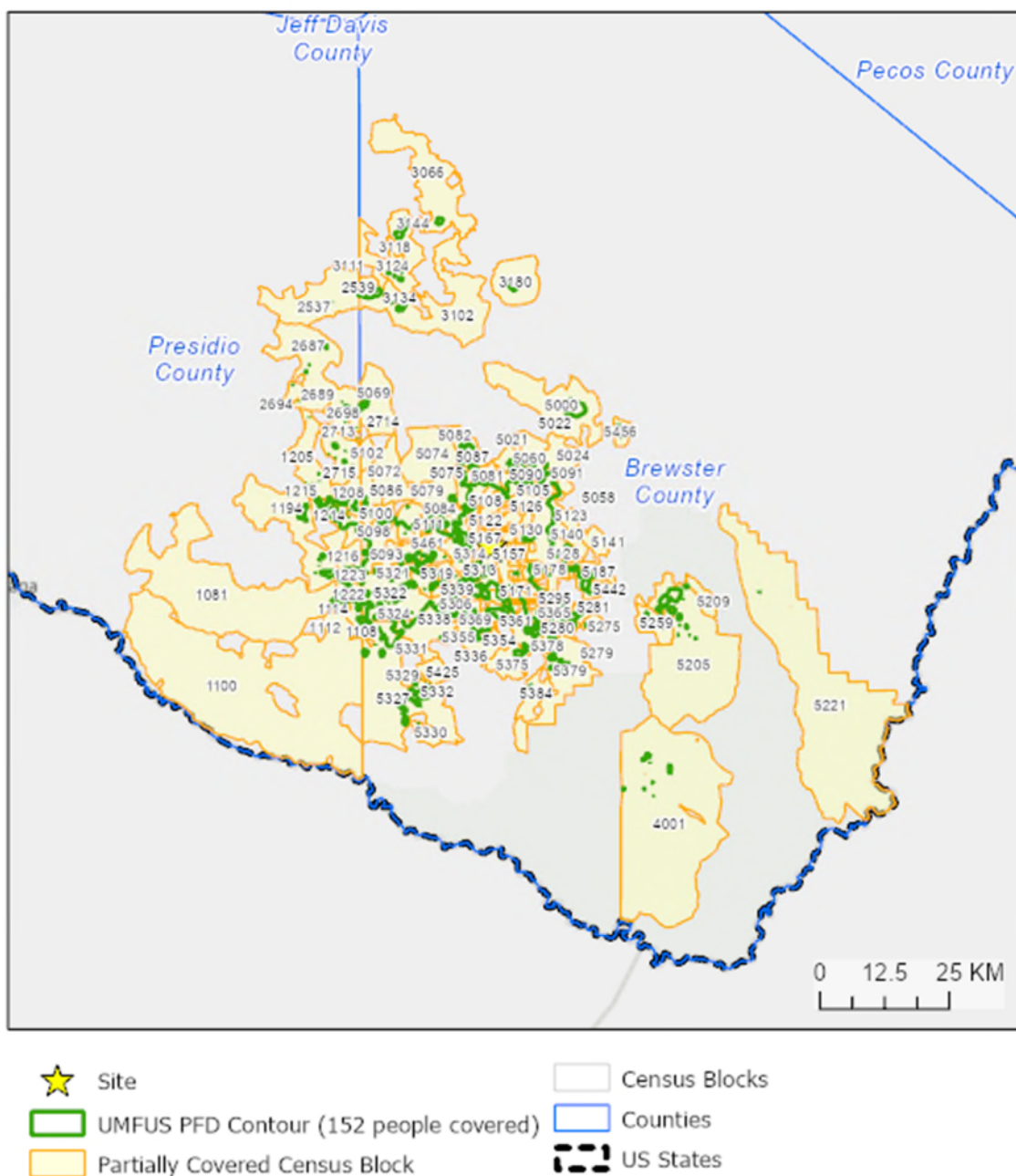


Table 3. PFD Contour Population Coverage, by Census Block

State	County	Block ID	Block Population	Coverage Fraction	Covered Population
Texas	Brewster	480439505003066	2	0.7%	0
Texas	Brewster	480439505003102	1	2.5%	0
Texas	Brewster	480439505003144	0	7.1%	0
Texas	Brewster	480439505003180	5	2.4%	0
Texas	Brewster	480439505004001	63	0.3%	0
Texas	Brewster	480439505005000	0	5.9%	0
Texas	Brewster	480439505005022	0	2.0%	0
Texas	Brewster	480439505005024	0	2.5%	0
Texas	Brewster	480439505005058	0	8.6%	0
Texas	Brewster	480439505005059	0	72.4%	0
Texas	Brewster	480439505005060	0	85.2%	0
Texas	Brewster	480439505005061	0	21.8%	0
Texas	Brewster	480439505005069	7	3.0%	0
Texas	Brewster	480439505005074	0	0.0%	0
Texas	Brewster	480439505005075	0	0.4%	0
Texas	Brewster	480439505005079	0	2.1%	0
Texas	Brewster	480439505005080	0	36.6%	0
Texas	Brewster	480439505005081	0	46.0%	0
Texas	Brewster	480439505005082	0	17.3%	0
Texas	Brewster	480439505005083	0	67.9%	0
Texas	Brewster	480439505005084	0	41.6%	0
Texas	Brewster	480439505005085	0	45.9%	0
Texas	Brewster	480439505005086	0	37.1%	0
Texas	Brewster	480439505005087	0	50.2%	0
Texas	Brewster	480439505005088	0	40.0%	0
Texas	Brewster	480439505005089	0	57.4%	0
Texas	Brewster	480439505005090	0	75.9%	0
Texas	Brewster	480439505005091	0	99.0%	0
Texas	Brewster	480439505005092	0	100.0%	0
Texas	Brewster	480439505005093	0	83.7%	0
Texas	Brewster	480439505005094	0	100.0%	0
Texas	Brewster	480439505005095	0	100.0%	0
Texas	Brewster	480439505005096	0	96.9%	0
Texas	Brewster	480439505005098	0	100.0%	0
Texas	Brewster	480439505005099	0	20.4%	0
Texas	Brewster	480439505005100	0	80.6%	0
Texas	Brewster	480439505005101	0	4.8%	0
Texas	Brewster	480439505005104	0	62.5%	0

State	County	Block ID	Block Population	Coverage Fraction	Covered Population
Texas	Brewster	480439505005105	0	100.0%	0
Texas	Brewster	480439505005106	0	100.0%	0
Texas	Brewster	480439505005107	0	89.3%	0
Texas	Brewster	480439505005108	7	100.0%	7
Texas	Brewster	480439505005109	1	100.0%	1
Texas	Brewster	480439505005110	0	100.0%	0
Texas	Brewster	480439505005111	0	100.0%	0
Texas	Brewster	480439505005112	3	83.3%	3
Texas	Brewster	480439505005113	0	57.4%	0
Texas	Brewster	480439505005114	0	100.0%	0
Texas	Brewster	480439505005115	0	100.0%	0
Texas	Brewster	480439505005116	2	100.0%	2
Texas	Brewster	480439505005117	2	68.5%	1
Texas	Brewster	480439505005118	2	100.0%	2
Texas	Brewster	480439505005119	0	100.0%	0
Texas	Brewster	480439505005120	2	100.0%	2
Texas	Brewster	480439505005121	9	100.0%	9
Texas	Brewster	480439505005122	4	100.0%	4
Texas	Brewster	480439505005123	3	64.0%	2
Texas	Brewster	480439505005124	4	100.0%	4
Texas	Brewster	480439505005125	0	100.0%	0
Texas	Brewster	480439505005126	0	100.0%	0
Texas	Brewster	480439505005127	1	100.0%	1
Texas	Brewster	480439505005128	0	51.8%	0
Texas	Brewster	480439505005129	4	100.0%	4
Texas	Brewster	480439505005130	0	100.0%	0
Texas	Brewster	480439505005131	0	100.0%	0
Texas	Brewster	480439505005132	0	100.0%	0
Texas	Brewster	480439505005133	0	100.0%	0
Texas	Brewster	480439505005134	1	100.0%	1
Texas	Brewster	480439505005135	0	100.0%	0
Texas	Brewster	480439505005136	0	100.0%	0
Texas	Brewster	480439505005140	4	0.6%	0
Texas	Brewster	480439505005141	4	17.4%	0
Texas	Brewster	480439505005146	2	55.1%	1
Texas	Brewster	480439505005147	0	100.0%	0
Texas	Brewster	480439505005148	4	100.0%	4
Texas	Brewster	480439505005149	0	100.0%	0
Texas	Brewster	480439505005150	0	100.0%	0

State	County	Block ID	Block Population	Coverage Fraction	Covered Population
Texas	Brewster	480439505005151	6	100.0%	6
Texas	Brewster	480439505005152	0	100.0%	0
Texas	Brewster	480439505005153	0	100.0%	0
Texas	Brewster	480439505005154	2	100.0%	2
Texas	Brewster	480439505005155	0	100.0%	0
Texas	Brewster	480439505005156	3	100.0%	3
Texas	Brewster	480439505005157	1	100.0%	1
Texas	Brewster	480439505005158	0	100.0%	0
Texas	Brewster	480439505005159	0	100.0%	0
Texas	Brewster	480439505005160	13	90.9%	12
Texas	Brewster	480439505005161	5	100.0%	5
Texas	Brewster	480439505005162	0	97.1%	0
Texas	Brewster	480439505005163	0	100.0%	0
Texas	Brewster	480439505005164	0	100.0%	0
Texas	Brewster	480439505005165	0	100.0%	0
Texas	Brewster	480439505005166	4	100.0%	4
Texas	Brewster	480439505005167	0	100.0%	0
Texas	Brewster	480439505005168	0	58.7%	0
Texas	Brewster	480439505005169	0	22.6%	0
Texas	Brewster	480439505005170	2	1.5%	0
Texas	Brewster	480439505005171	0	55.9%	0
Texas	Brewster	480439505005172	0	100.0%	0
Texas	Brewster	480439505005173	0	85.8%	0
Texas	Brewster	480439505005174	0	82.3%	0
Texas	Brewster	480439505005175	1	23.6%	0
Texas	Brewster	480439505005177	1	13.7%	0
Texas	Brewster	480439505005178	0	100.0%	0
Texas	Brewster	480439505005179	0	1.1%	0
Texas	Brewster	480439505005180	0	16.0%	0
Texas	Brewster	480439505005186	3	14.9%	0
Texas	Brewster	480439505005187	0	12.2%	0
Texas	Brewster	480439505005205	1	2.8%	0
Texas	Brewster	480439505005259	0	1.6%	0
Texas	Brewster	480439505005272	6	20.7%	1
Texas	Brewster	480439505005275	3	1.9%	0
Texas	Brewster	480439505005279	2	14.1%	0
Texas	Brewster	480439505005280	0	27.7%	0
Texas	Brewster	480439505005281	2	78.9%	2
Texas	Brewster	480439505005282	7	63.1%	4

State	County	Block ID	Block Population	Coverage Fraction	Covered Population
Texas	Brewster	480439505005287	3	2.0%	0
Texas	Brewster	480439505005288	3	58.9%	2
Texas	Brewster	480439505005289	3	98.2%	3
Texas	Brewster	480439505005290	5	0.2%	0
Texas	Brewster	480439505005291	0	9.0%	0
Texas	Brewster	480439505005292	0	94.7%	0
Texas	Brewster	480439505005293	1	100.0%	1
Texas	Brewster	480439505005294	0	96.9%	0
Texas	Brewster	480439505005295	10	33.7%	3
Texas	Brewster	480439505005296	6	100.0%	6
Texas	Brewster	480439505005297	0	100.0%	0
Texas	Brewster	480439505005298	2	100.0%	2
Texas	Brewster	480439505005299	4	100.0%	4
Texas	Brewster	480439505005300	8	64.5%	5
Texas	Brewster	480439505005302	3	72.6%	2
Texas	Brewster	480439505005303	2	0.3%	0
Texas	Brewster	480439505005304	0	32.2%	0
Texas	Brewster	480439505005305	0	13.5%	0
Texas	Brewster	480439505005306	0	36.6%	0
Texas	Brewster	480439505005307	4	73.0%	3
Texas	Brewster	480439505005308	1	100.0%	1
Texas	Brewster	480439505005309	0	100.0%	0
Texas	Brewster	480439505005310	0	100.0%	0
Texas	Brewster	480439505005311	0	100.0%	0
Texas	Brewster	480439505005312	3	68.4%	2
Texas	Brewster	480439505005313	1	100.0%	1
Texas	Brewster	480439505005314	6	100.0%	6
Texas	Brewster	480439505005315	0	100.0%	0
Texas	Brewster	480439505005316	0	100.0%	0
Texas	Brewster	480439505005317	0	100.0%	0
Texas	Brewster	480439505005318	0	100.0%	0
Texas	Brewster	480439505005319	0	100.0%	0
Texas	Brewster	480439505005320	0	100.0%	0
Texas	Brewster	480439505005321	0	100.0%	0
Texas	Brewster	480439505005322	6	93.8%	6
Texas	Brewster	480439505005323	0	68.3%	0
Texas	Brewster	480439505005324	0	56.9%	0
Texas	Brewster	480439505005325	0	100.0%	0
Texas	Brewster	480439505005326	1	100.0%	1

State	County	Block ID	Block Population	Coverage Fraction	Covered Population
Texas	Brewster	480439505005327	16	10.3%	0
Texas	Brewster	480439505005329	1	2.0%	0
Texas	Brewster	480439505005331	0	0.1%	0
Texas	Brewster	480439505005332	0	7.3%	0
Texas	Brewster	480439505005336	9	6.4%	0
Texas	Brewster	480439505005338	0	51.8%	0
Texas	Brewster	480439505005339	0	100.0%	0
Texas	Brewster	480439505005340	0	100.0%	0
Texas	Brewster	480439505005354	0	0.9%	0
Texas	Brewster	480439505005355	0	26.3%	0
Texas	Brewster	480439505005356	4	18.9%	1
Texas	Brewster	480439505005358	1	29.0%	0
Texas	Brewster	480439505005360	0	33.9%	0
Texas	Brewster	480439505005361	3	30.4%	1
Texas	Brewster	480439505005362	1	41.7%	0
Texas	Brewster	480439505005363	0	46.3%	0
Texas	Brewster	480439505005364	10	73.0%	7
Texas	Brewster	480439505005365	0	99.5%	0
Texas	Brewster	480439505005366	8	0.2%	0
Texas	Brewster	480439505005367	0	5.3%	0
Texas	Brewster	480439505005368	0	46.8%	0
Texas	Brewster	480439505005369	0	49.5%	0
Texas	Brewster	480439505005375	18	3.7%	1
Texas	Brewster	480439505005377	0	14.0%	0
Texas	Brewster	480439505005378	0	7.0%	0
Texas	Brewster	480439505005379	14	3.2%	0
Texas	Brewster	480439505005384	35	2.1%	1
Texas	Brewster	480439505005433	0	100.0%	0
Texas	Brewster	480439505005434	0	100.0%	0
Texas	Brewster	480439505005442	4	5.5%	0
Texas	Brewster	480439505005448	0	100.0%	0
Texas	Brewster	480439505005456	0	15.6%	0
Texas	Brewster	480439505005461	0	100.0%	0
Texas	Presidio	483779501001103	0	21.7%	0
Texas	Presidio	483779501001215	0	73.4%	0
Texas	Presidio	483779501001208	0	29.5%	0
Texas	Presidio	483779501001114	0	77.6%	0
Texas	Presidio	483779501001222	5	63.4%	3
Texas	Presidio	483779501001194	3	0.0%	0

State	County	Block ID	Block Population	Coverage Fraction	Covered Population
Texas	Presidio	483779501001081	0	0.0%	0
Texas	Presidio	483779501001108	0	0.2%	0
Texas	Presidio	483779501001112	0	18.6%	0
Texas	Presidio	483779501001213	0	99.9%	0
Texas	Presidio	483779501001223	0	63.4%	0
Texas	Presidio	483779501001216	0	1.8%	0
Texas	Presidio	483779501001205	0	0.3%	0
Texas	Presidio	483779501001194	3	2.4%	0
Texas	Presidio	483779501001214	0	3.4%	0
Texas	Presidio	483779501001205	0	0.4%	0
Texas	Presidio	483779501002715	0	1.5%	0
Texas	Presidio	483779501002687	0	0.9%	0
Texas	Presidio	483779501002539	0	6.6%	0
Texas	Presidio	483779501002537	0	0.1%	0

Table 4. PFD Contour Population Coverage, by County

State	County	County Population	Allowable Population Coverage	Covered Population
Texas	Brewster	9,546	450	149
Texas	Presidio	6,131	450	3

Section 25.136(a)(4)(iii) (major event venue, urban mass transit route, passenger railroad, cruise ship port, Interstate, Other Freeways and Expressways, or Other Principal Arterial in the -77.6 dBm/m²/MHz PFD contour)

Section 25.136(a)(4)(iii) requires an applicant to demonstrate as follows:

The area in which the earth station generates a PFD, at 10 meters above ground level, of greater than or equal to -77.6 dBm/m²/MHz does not contain any major event venue, urban mass transit route, passenger railroad, or cruise ship port. In addition, the area mentioned in paragraph (a)(4)(ii) of this section shall not cross any of the following types of roads, as defined in functional classification guidelines issued by the Federal Highway Administration pursuant to 23 CFR 470.105(b): Interstate, Other Freeways and Expressways, or Other Principal Arterial. The Federal Highway Administration Office of Planning, Environment, and Realty Executive Geographic Information System (HEPGIS) map contains information on the classification of roads. For purposes of this rule, an urban area shall be an Adjusted Urban Area as defined in section 101(a)(37) of Title 21 of the United States Code.¹⁸

Using Google Earth, visual analysis, and shapefile data available on data.gov and the U.S. Census Bureau website, Amazon determined that the proposed earth station's -77.6 dBm/m²/MHz PFD

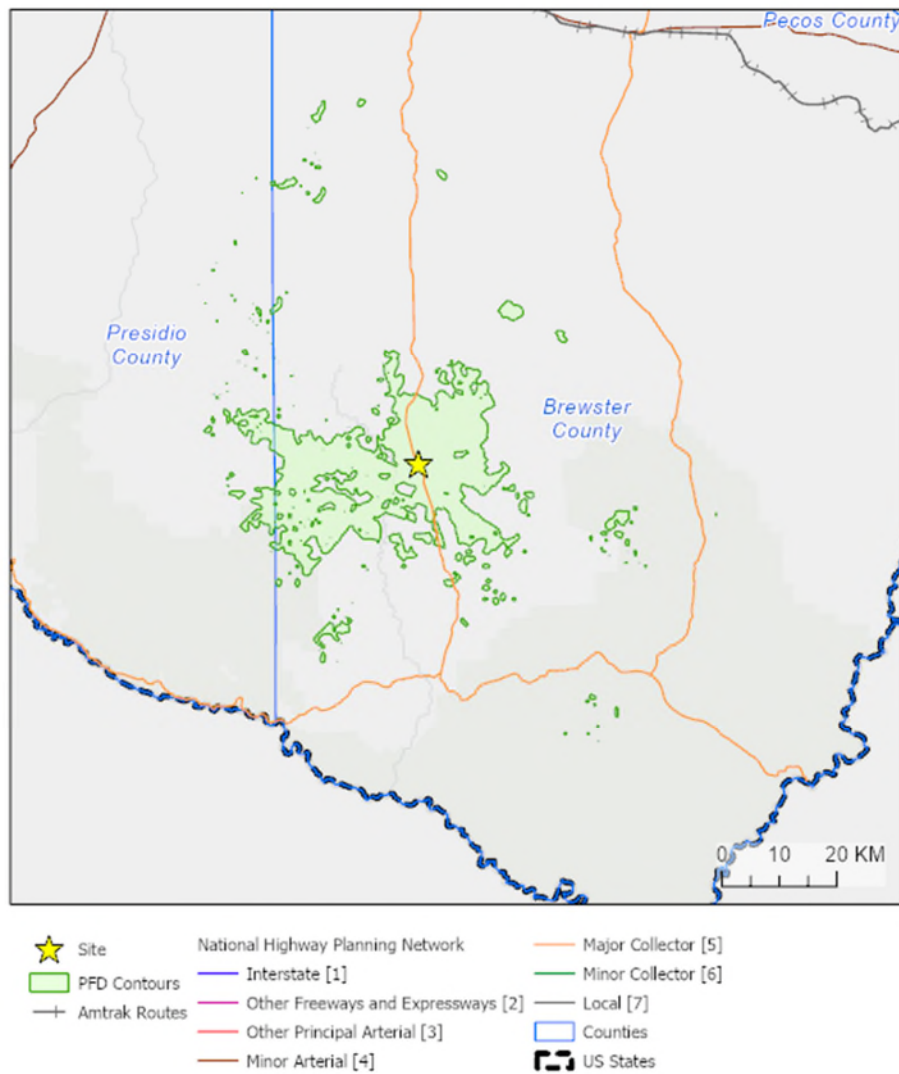
¹⁸ 47 C.F.R. § 25.136(a)(4)(iii).

contour does not contain any major event venues, urban mass transit route, passenger railroad, or cruise ship port. As shown in Figure 2 and Figure 4, the PFD contour does not overlap any such infrastructure. Further, the PFD contour does not cross any Interstate, Other Freeways and Expressways, or Other Principal Arterial, as defined by the Federal Highway Administration Office of Planning, Environment, and Realty Executive Geographic Information System.¹⁹ Amazon also consulted the state Department of Transportation functional classifications to confirm that the contour does not intersect any Other Freeways and Expressways or Other Principal Arterials.²⁰ The proposed earth station, therefore, is consistent with the requirements of section 25.136(a)(4)(iii).

¹⁹ See *Planning, Environment, Realty (HEP) HEPGIS*, U.S. Department of Transportation Federal Highway Administration, <https://hepgis.fhwa.dot.gov/fhwagis/> (last visited Mar. 18, 2022). Texas State Highway 118, which intersects the proposed earth station’s contour, is major collector.

²⁰ See Guidance, 35 FCC Rcd at 6351 (defining roadways at bullet 2); *Statewide Planning Map*, Texas Department of Transportation, <https://bit.ly/3AWJec5> (last visited Mar. 18, 2022) (indicating no “Highway Designations,” “Memorial Highway,” “National Highway System,” or “Strategic Highway Network (STRAHNET)” intersections in the proposed earth station’s contour, and describing Texas State Highway 118 as “Major Collector” as per the functional classification system).

Figure 4. -77.6 dBm/m²/MHz PFD contour overlaid with major roadways and passenger railroads



Section 25.136(a)(4)(iv) (coordination with existing UMFUS licensees located within a PFD contour greater than or equal to -77.6 dBm/m²/MHz)

Section 25.136(a)(4)(iv) requires the applicant to demonstrate that it “has successfully completed frequency coordination with the UMFUS licensees within the area in which the earth station generates a PFD, at 10 meters above ground level, of greater than or equal to -77.6 dBm/m²/MHz with respect to existing facilities constructed and in operation by the UMFUS licensee.”²¹ The applicant is required to use the applicable processes in section 101.103(d) in coordinating with UMFUS licensees.²²

Exhibit C, the Comsearch report, establishes that Amazon has coordinated with existing UMFUS licensees.²³

²¹ 47 C.F.R. § 25.136(a)(4)(iv).

²² *See id.*

²³ *See* 47 C.F.R. § 101.103(d). In the *Kuiper System Authorization*, the Commission authorized Amazon to use the frequency bands 27.5-28.05 GHz (Earth-to-space). *In re Kuiper Systems LLC, Application for Authority to Deploy and Operate a Ka-band Non-Geostationary Satellite Orbit System*, Order and Authorization, 35 FCC Rcd 8324 (2020). *See also supra* n.6.

EXHIBIT B (RADIATION HAZARD ANALYSIS)

Introduction

In accordance with OET Bulletin 65,¹ this Radiation Hazard Analysis demonstrates that the Amazon 2.8m TT&C antenna complies with Commission limits for human exposure to radiofrequency (“RF”).

OET Bulletin 65 and section 1.1310 of the Commission’s rules specify two separate tiers of maximum permissible exposure (“MPE”).² The occupational/controlled MPE limit is 5 milliwatts per centimeter squared averaged over any six-minute period.³ The general population/uncontrolled MPE limit is 1 milliwatt per centimeter squared averaged over any thirty-minute period.⁴ Amazon calculated the (i) power over the sub-reflector and antenna surface and (ii) near-field and far-field power density for the main and off-axis beams and confirms compliance with both MPE tiers’ limits for all regions.

- **Occupational/controlled exposure.** The relevant population will not experience harmful radiation levels, as determined by the Commission. The results for the worst-case scenario (nearfield, main-beam power density) support this conclusion.
- **General population/uncontrolled exposure.** The relevant population will not experience harmful radiation levels, as determined by the Commission. The results for the worst-case scenario (near-field, off-axis power density) support this conclusion. Furthermore, earth stations will be deployed in occupational/controlled exposure environments within access-controlled, locked facilities and will be inaccessible to the general population.

Input Parameters

Input Parameter	Unit	Value
Aperture Diameter	Meters	2.80
Aperture Radius	Meters	1.40
Sub-reflector Diameter	Meters	0.44
Sub-reflector Radius	Meters	0.22
Aperture Efficiency	Percentage	69%
Frequency	MHz	27500
Total Transmitter Power	Watts	81
Minimum Elevation Angle	Degrees	5.00

¹ See FCC OET Bulletin 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields (Aug. 1997) (“OET Bulletin 65”). Amazon is aware of and will comply with the recently modified rules for radiofrequency exposure that are relevant to fixed earth stations. See generally *In re Proposed Changes in the Commission’s Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields et al.*, Second Report and Order *et al.*, 34 FCC Rcd 11687 (2019).

² See 47 C.F.R. § 1.1310.

³ See OET Bulletin 65 at Appendix A, Table 1(A).

⁴ See *id.* at Appendix A, Table 1(B).

Calculations

Calculated Variables	Unit	Value	Variable	OET Ref
Wavelength	Meters	0.01	$\lambda = \frac{c}{f}$	
Area of Reflector	Meters^2	6.16	$A = \pi r^2$	
Area of Sub-reflector	Meters^2	0.1521	$A_{sub} = \pi r^2$	
Antenna Gain		446646.47	$G = \frac{\eta 4\pi A}{\lambda^2}$	(15)
Antenna Gain	dBi	56.5	$G_{dBi} = 10 * \log_{10}(G)$	
Near-Field Distance	Meters	179.79	$R_{nf} = \frac{D^2}{4\lambda}$	(12)
Far-Field Distance	Meters	431.50	$R_{ff} = \frac{0.6D^2}{\lambda}$	(16)
Far-Field Off-Axis Gain	dBi	11.53	$G_{ff(dBi)} = 29 - 25 \log_{10}(\theta)$ $\theta = \text{min elevation} = 5^\circ$	
Far-Field Off-Axis Gain		14.21	$G_{ff} = 10^{\frac{G_{ff(dBi)}}{10}}$	
Power over Sub-reflector	mW/cm^2	213.08	$S_{surface} = \frac{4P}{A_{sub}}$	(11)
Power over Antenna Surface	mW/cm^2	5.26	$S_{surface} = \frac{4P}{A}$	(11)
Near-Field Power Density (Main Beam)	mW/cm^2	3.61	$S_{nf} = \frac{16\eta P}{\pi D^2}$	(13)
Near-Field Power Density (Off-Axis)	mW/cm^2	0.036	$S_{nf} = \frac{16\eta P}{100\pi D^2}$	(13) ⁵
Far-Field Power Density (Main Beam)	mW/cm^2	1.55	$S_{ff} = \frac{PG}{4\pi R^2}$	(18)
Far-Field Power Density (Off-Axis)	mW/cm^2	0.000	$S_{ff_{off-axis}} = \frac{PG_{ff}}{4\pi R^2}$	(18) ⁶

⁵ See *id.* at 30 (“For off-axis calculations in the near-field and in the transition region it can be assumed that, if the point of interest is at least one antenna diameter removed from the center of the main beam, the power density at that point would be at least a factor of 100 (20 dB) less than the value calculated for the equivalent distance in the main beam (see Reference [15])” (alteration in original)).

⁶ See *id.* (“For practical estimation of RF fields in the off-axis vicinity of aperture antennas, use of the antenna radiation pattern envelope can be useful. For example, for the case of an earth station in the fixed-satellite service, the Commission’s Rules specify maximum allowable gain for antenna sidelobes not within the plane of the geostationary satellite orbit, such as at ground level. . . . Use of the gain obtained from these relationships in simple far-field calculations, such as Equation 18,

Additional Safety

Access to Amazon's antennas will be carefully controlled. The antennas will be enclosed by a fence with locked gates. There will be clear and visible signage that will warn individuals of potential RF exposure risk. Each antenna will have an emergency stop switch that is to be engaged whenever personnel are working on or close to the antenna. The emergency stop switch will disable all RF transmissions from the antenna. All pedestrian gates shall be fully access controlled. Emergency or delivery gates shall be secured with a lock and monitored. Additionally, the transmitter will be turned off during maintenance activities.

Results

In a controlled area accessible to the occupational population, the peak near-field power density (3.61 mW/cm^2) and peak far-field power density (1.55 mW/cm^2) levels do not exceed the MPE limit of 5 mW/cm^2 averaged over a period of six minutes.

In an uncontrolled area accessible to the general population, the off-axis near-field power density (0.036 mW/cm^2) and off-axis far-field power density (0.000 mW/cm^2) levels are below the MPE limit of 1 mW/cm^2 averaged over a period of thirty minutes.⁷

This Radiation Hazard Analysis demonstrates that harmful levels of radiation will not occur in the regions accessible by both the occupational and general populations.

will generally be sufficient for estimating RF field levels in the surrounding environment, since the apparent aperture of the antenna is typically very small compared to its frontal area.”).

⁷ The minimum elevation angle of 5 degrees mostly prohibits the potential for the general population to be affected by the peak power density levels. Additionally, the constant repositioning of the antennas as they track Kuiper System low-earth orbit satellites also ensures that the average power density levels will be significantly reduced when averaged over any six-minute period.

EXHIBIT C (COMSEARCH REPORT)

FREQUENCY COORDINATION AND INTERFERENCE ANALYSIS REPORT

Prepared for
Kuiper Systems LLC.
ALPINE, TX
Satellite Earth Station

Prepared By:
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147
December 15, 2021

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1. CONCLUSIONS

An interference study considering all existing, proposed and prior coordinated microwave facilities within the coordination contours of the proposed earth station demonstrates that this site will operate satisfactorily with the common carrier microwave environment. Further, there will be no restrictions of its operation due to interference considerations.

2. SUMMARY OF RESULTS

A number of great circle interference cases were identified during the interference study of the proposed earth station. Each of the cases, which exceeded the interference objective on a line-of-sight basis, was profiled and the propagation losses estimated using NBS TN101 (Revised) techniques. The losses were found to be sufficient to reduce the signal levels to acceptable magnitudes in every case.

3. SUPPLEMENTAL SHOWING

Pursuant to Part 25.203(c) of the FCC Rules and Regulations, the satellite earth station proposed in this application was coordinated by Comsearch using computer techniques and in accordance with Part 25 of the FCC Rules and Regulations.

Coordination data for this earth station was sent to the below listed carriers with a letter dated 10/26/2021.

Company

AMA Communications, LLC
Business Only Broadband, LLC
Enterprise Products Operating, LLC
New Cingular Wireless PCS LLC - N Texas
Olympic Wireless, LLC
Shell Communications Inc
T-Mobile License LLC
Texas New Mexico Power Company

4. EARTH STATION COORDINATION DATA

This section presents the data pertinent to frequency coordination of the proposed earth station that was circulated to all carriers within its coordination contours.

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 <http://www.comsearch.com>

Date: 12/15/2021
Job Number: 211026COMSGE06

Administrative Information

Status: ENGINEER PROPOSAL
Call Sign:
Licensee Code: KUIPER
Licensee Name: Kuiper Systems LLC.

Site Information

ALPINE, TX

Venue Name:
Latitude (NAD 83): 29° 37' 1.7" N
Longitude (NAD 83): 103° 34' 3.8" W
Climate Zone: A
Rain Zone: 5
Ground Elevation (AMSL): 1025.41 m / 3364.2 ft

Link Information

Satellite Type: Low Earth Orbit
Mode: TR - Transmit-Receive
Modulation: Digital
Minimum Elevation Angle: 5.0°
Azimuth Range: 0.0° to 360°
Antenna Centerline (AGL): 2.5 m / 8.2 ft

Antenna Information

Receive - FCC32

Transmit - FCC32

Manufacturer	Amazon	Amazon
Model	2.8 meter	2.8 meter
Gain / Diameter	53.5 dBi / 2.8 m	56.5 dBi / 2.8 m
3-dB / 15-dB Beamwidth	0.77° / 1.70°	0.49° / 1.17°
Max Available RF Power	(dBW/4 kHz) (dBW/MHz)	-11.9 12.1
Maximum EIRP	(dBW/4 kHz) (dBW/MHz)	44.6 68.6
Interference Objectives:	Long Term Short Term	-156.0 dBW/MHz 20% -146.0 dBW/MHz 0.01%
		-151.0 dBW/4 kHz 20% -128.0 dBW/4 kHz 0.0025%

Frequency Information

Receive 18.0 GHz

Transmit 28.0 GHz

Emission / Frequency Range (MHz)	1M00G7D - 5M00G7D / 19300.0 - 19400.0	1M00G7D - 5M00G7D / 27500.0 - 27600.0
Max Great Circle Coordination Distance	256.0 km / 159.1 mi	200.0 km / 124.3 mi
Precipitation Scatter Contour Radius	100.0 km / 62.1 mi	100.0 km / 62.1 mi

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 <http://www.comsearch.com>

Coordination Values

ALPINE, TX

Licensee Name Kuiper Systems LLC.
Latitude (NAD 83) 29° 37' 1.7" N
Longitude (NAD 83) 103° 34' 3.8" W
Ground Elevation (AMSL) 1025.41 m / 3364.2 ft
Antenna Centerline (AGL) 2.5 m / 8.2 ft
Antenna Model Amazon 2.8 meter
Antenna Mode Receive 18.0 GHz Transmit 28.0 GHz
Interference Objectives: Long Term -156.0 dBW/MHz 20% -151.0 dBW/4 kHz 20%
Short Term -146.0 dBW/MHz 0.01% -128.0 dBW/4 kHz 0.0025%
Max Available RF Power -11.9 (dBW/4 kHz)

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Receive 18.0 GHz		Transmit 28.0 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
0	0.93	83.65	11.50	256.00	11.50	200.00
5	0.92	78.98	11.50	256.00	11.50	200.00
10	0.96	74.34	11.50	256.00	11.50	200.00
15	0.91	69.69	11.50	256.00	11.50	200.00
20	0.85	65.07	11.50	256.00	11.50	200.00
25	0.78	60.47	11.50	256.00	11.50	200.00
30	0.72	55.91	11.50	256.00	11.50	200.00
35	0.67	51.40	11.50	256.00	11.50	200.00
40	0.60	46.95	11.50	256.00	11.50	200.00
45	0.57	42.61	11.50	256.00	11.50	200.00
50	0.50	38.37	11.50	256.00	11.50	200.00
55	0.45	34.30	11.50	256.00	11.50	200.00
60	0.57	30.59	11.50	256.00	11.50	200.00
65	0.69	27.25	11.50	256.00	11.50	200.00
70	0.99	24.59	11.50	256.00	11.50	200.00
75	1.94	23.30	11.50	256.00	11.50	200.00
80	1.19	21.36	11.50	256.00	11.50	200.00
85	1.19	21.20	11.50	256.00	11.50	200.00
90	0.59	21.59	11.50	256.00	11.50	200.00
95	0.97	23.88	11.50	256.00	11.50	200.00
100	1.46	26.96	11.50	256.00	11.50	200.00
105	1.61	30.28	11.50	256.00	11.50	200.00
110	1.60	33.88	11.50	256.00	11.50	200.00
115	1.61	37.77	11.50	256.00	11.50	200.00
120	1.60	41.86	11.50	256.00	11.50	200.00
125	1.64	46.11	11.50	256.00	11.50	200.00
130	1.69	50.48	11.50	256.00	11.50	200.00
135	1.69	54.91	11.50	256.00	11.50	200.00
140	1.79	59.43	11.50	256.00	11.50	200.00
145	1.79	63.96	11.50	256.00	11.50	200.00
150	1.88	68.55	11.50	256.00	11.50	200.00
155	1.84	73.14	11.50	256.00	11.50	200.00
160	1.74	77.75	11.50	256.00	11.50	200.00
165	1.67	82.38	11.50	256.00	11.50	200.00
170	1.21	87.01	11.50	256.00	11.50	200.00
175	0.72	91.68	11.50	256.00	11.50	200.00
180	0.87	96.35	11.50	256.00	11.50	200.00
185	0.42	101.05	11.50	256.00	11.50	200.00

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 <http://www.comsearch.com>

Coordination Values

ALPINE, TX

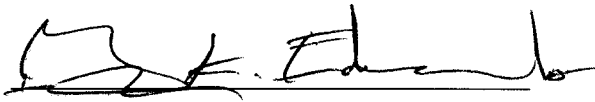
Licensee Name Kuiper Systems LLC.
Latitude (NAD 83) 29° 37' 1.7" N
Longitude (NAD 83) 103° 34' 3.8" W
Ground Elevation (AMSL) 1025.41 m / 3364.2 ft
Antenna Centerline (AGL) 2.5 m / 8.2 ft
Antenna Model Amazon 2.8 meter
Antenna Mode Receive 18.0 GHz Transmit 28.0 GHz
Interference Objectives: Long Term -156.0 dBW/MHz 20% -151.0 dBW/4 kHz 20%
Short Term -146.0 dBW/MHz 0.01% -128.0 dBW/4 kHz 0.0025%
Max Available RF Power -11.9 (dBW/4 kHz)

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Receive 18.0 GHz		Transmit 28.0 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
190	0.43	105.72	11.50	256.00	11.50	200.00
195	0.40	110.38	11.50	256.00	11.50	200.00
200	0.43	115.00	11.50	256.00	11.50	200.00
205	0.43	119.60	11.50	256.00	11.50	200.00
210	0.24	124.21	11.50	256.00	11.50	200.00
215	0.00	128.80	11.50	256.00	11.50	200.00
220	0.00	133.26	11.50	256.00	11.50	200.00
225	0.00	137.62	11.50	256.00	11.50	200.00
230	0.00	141.87	11.50	256.00	11.50	200.00
235	0.00	145.94	11.50	256.00	11.50	200.00
240	0.27	149.60	11.50	256.00	11.50	200.00
245	0.43	152.94	11.50	256.00	11.50	200.00
250	0.57	155.76	11.50	256.00	11.50	200.00
255	0.61	157.94	11.50	256.00	11.50	200.00
260	0.65	159.17	11.50	256.00	11.50	200.00
265	0.67	159.31	11.50	256.00	11.50	200.00
270	0.67	158.34	11.50	256.00	11.50	200.00
275	0.66	156.38	11.50	256.00	11.50	200.00
280	0.68	153.64	11.50	256.00	11.50	200.00
285	0.75	150.30	11.50	256.00	11.50	200.00
290	0.77	146.61	11.50	256.00	11.50	200.00
295	0.76	142.66	11.50	256.00	11.50	200.00
300	0.75	138.51	11.50	256.00	11.50	200.00
305	0.72	134.23	11.50	256.00	11.50	200.00
310	0.67	129.85	11.50	256.00	11.50	200.00
315	0.62	125.38	11.50	256.00	11.50	200.00
320	0.59	120.85	11.50	256.00	11.50	200.00
325	0.65	116.26	11.50	256.00	11.50	200.00
330	0.71	111.63	11.50	256.00	11.50	200.00
335	0.65	107.00	11.50	256.00	11.50	200.00
340	0.66	102.34	11.50	256.00	11.50	200.00
345	0.66	97.67	11.50	256.00	11.50	200.00
350	0.77	92.99	11.50	256.00	11.50	200.00
355	0.84	88.32	11.50	256.00	11.50	200.00

5. CERTIFICATION

I HEREBY CERTIFY THAT I AM THE TECHNICALLY QUALIFIED PERSON RESPONSIBLE FOR THE PREPARATION OF THE FREQUENCY COORDINATION DATA CONTAINED IN THIS APPLICATION, THAT I AM FAMILIAR WITH PARTS 101 AND 25 OF THE FCC RULES AND REGULATIONS, THAT I HAVE EITHER PREPARED OR REVIEWED THE FREQUENCY COORDINATION DATA SUBMITTED WITH THIS APPLICATION, AND THAT IT IS COMPLETE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

BY: _



Gary K. Edwards
Senior Manager
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147

DATED: December 15, 2021

Ka-Band Earth Station – Alpine, TX

Frequency Coordination Report

28 GHz



Prepared on Behalf of
KUIPER SYSTEMS, LLC

December 14, 2021



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5.	Contact Information	- 7 -

1. Summary of Results

On behalf of KUIPER SYSTEMS, LLC, Comsearch performed a coordination notice under Section 25.203(c) and Section 25.136(a)(4) of the FCC's rules for all existing and proposed terrestrial licenses within the coordination contours of their proposed Ka-Band earth station in Alpine, TX, which will transmit at 28 GHz¹. Prior-notification letters were sent to the licensees and a copy of the notification data is provided in section four of this report. The earth station coordination was finalized on December 14, 2021.

There are no unresolved objections from any of the incumbent 28 GHz licensees.

2. 28 GHz Common Carrier and LTTS Coordination

In accordance with FCC Rules and Regulations, the Ka-Band earth station in Alpine, TX was prior-coordinated by Comsearch. A notification letter and datasheets for this earth station were sent to the following 28 GHz common carrier fixed microwave licensees. These licensees are authorized to operate temporary fixed operations from 27.5 – 29.5 GHz on a nationwide basis or local basis.

Licensee	Authorized Geographic Area
None Found	-

A notification letter and datasheets for the Ka-Band earth station in Alpine, TX were also sent to the following 28 GHz local television transmission licensee. This licensee is authorized to operate temporary fixed operations from 27.5 – 29.5 GHz on a nationwide basis.

Licensee	Authorized Geographic Area
None Found	-

No objections were received from the common carrier or local television transmission service incumbents.

¹ The proposed earth station will operate in the 27.5 – 27.6 GHz portion of the Ka-Band.

3. 28 GHz UMFUS Coordination

There were four 28 GHz UMFUS licensees identified within the coordination distance of the proposed earth station. The proposed earth station will operate on frequencies that overlap Channel L1 & L2 of the UMFUS service. The total frequency allocation for Channels L1 & L2 of the UMFUS spectrum appears below.

Channel: **L1** 27.500 - 27.925 GHz
 L2 27.925 - 28.350 GHz

Licensee	Authorized Geographic Area
Central Texas Communications	Market Based
DISH	Market Based
T-Mobile	Market Based
Verizon	Market Based

No objections were received from the UMFUS incumbents within coordination distance.

4. Earth Station Coordination Data

This section presents the data pertinent to the proposed Ka-Band earth station in Alpine, TX. This data was circulated to all incumbent licensees in the shared 28 GHz frequency ranges.

Job Number: 211026COMSGE06

Administrative Information

Status: ENGINEER PROPOSAL
Call Sign:
Licensee Code: KUIPER
Licensee Name: Kuiper Systems LLC.

Site Information

Venue Name: ALPINE, TX
Latitude (NAD 83): 29° 37' 1.7" N
Longitude (NAD 83): 103° 34' 3.8" W
Climate Zone: A
Rain Zone: 5
Ground Elevation (AMSL): 1025.41 m / 3364.2 ft

Link Information

Satellite Type: Low Earth Orbit
Mode: TR - Transmit-Receive
Modulation: Digital
Minimum Elevation Angle: 5.0°
Azimuth Range: 0.0° to 360°
Antenna Centerline (AGL): 2.5 m / 8.2 ft

Antenna Information

Manufacturer: Amazon
Model: 2.8 meter
Gain / Diameter: 53.5 dBi / 2.8 m
3-dB / 15-dB Beamwidth: 0.77° / 1.70°

Transmit - FCC32

Amazon
2.8 meter
56.5 dBi / 2.8 m
0.49° / 1.17°

Max Available RF Power (dBW/4 kHz)
(dBW/MHz)

-11.9
12.1

Maximum EIRP (dBW/4 kHz)
(dBW/MHz)

44.6
68.6

Interference Objectives: Long Term
Short Term

-156.0 dBW/MHz 20%
-146.0 dBW/MHz 0.01%

-151.0 dBW/4 kHz 20%
-128.0 dBW/4 kHz 0.0025%

Frequency Information

Emission / Frequency Range (MHz)

Receive 18.0 GHz

1M00G7D - 5M00G7D / 19300.0 - 19400.0

Transmit 28.0 GHz

1M00G7D - 5M00G7D / 27500.0 - 27600.0

Max Great Circle Coordination Distance
Precipitation Scatter Contour Radius

256.0 km / 159.1 mi
100.0 km / 62.1 mi

200.0 km / 124.3 mi
100.0 km / 62.1 mi

Coordination Values	ALPINE, TX		
Licensee Name	Kuiper Systems LLC.		
Latitude (NAD 83)	29° 37' 1.7" N		
Longitude (NAD 83)	103° 34' 3.8" W		
Ground Elevation (AMSL)	1025.41 m / 3364.2 ft		
Antenna Centerline (AGL)	2.5 m / 8.2 ft		
Antenna Model	Amazon 2.8 meter		
Antenna Mode	Receive 18.0 GHz		Transmit 28.0 GHz
Interference Objectives: Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz 20%
Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz 0.0025%
Max Available RF Power		-11.9 (dBW/4 kHz)	

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Receive 18.0 GHz		Transmit 28.0 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
0	0.93	83.65	11.50	256.00	11.50	200.00
5	0.92	78.98	11.50	256.00	11.50	200.00
10	0.96	74.34	11.50	256.00	11.50	200.00
15	0.91	69.69	11.50	256.00	11.50	200.00
20	0.85	65.07	11.50	256.00	11.50	200.00
25	0.78	60.47	11.50	256.00	11.50	200.00
30	0.72	55.91	11.50	256.00	11.50	200.00
35	0.67	51.40	11.50	256.00	11.50	200.00
40	0.60	46.95	11.50	256.00	11.50	200.00
45	0.57	42.61	11.50	256.00	11.50	200.00
50	0.50	38.37	11.50	256.00	11.50	200.00
55	0.45	34.30	11.50	256.00	11.50	200.00
60	0.57	30.59	11.50	256.00	11.50	200.00
65	0.69	27.25	11.50	256.00	11.50	200.00
70	0.99	24.59	11.50	256.00	11.50	200.00
75	1.94	23.30	11.50	256.00	11.50	200.00
80	1.19	21.36	11.50	256.00	11.50	200.00
85	1.19	21.20	11.50	256.00	11.50	200.00
90	0.59	21.59	11.50	256.00	11.50	200.00
95	0.97	23.88	11.50	256.00	11.50	200.00
100	1.46	26.96	11.50	256.00	11.50	200.00
105	1.61	30.28	11.50	256.00	11.50	200.00
110	1.60	33.88	11.50	256.00	11.50	200.00
115	1.61	37.77	11.50	256.00	11.50	200.00
120	1.60	41.86	11.50	256.00	11.50	200.00
125	1.64	46.11	11.50	256.00	11.50	200.00
130	1.69	50.48	11.50	256.00	11.50	200.00
135	1.69	54.91	11.50	256.00	11.50	200.00
140	1.79	59.43	11.50	256.00	11.50	200.00
145	1.79	63.96	11.50	256.00	11.50	200.00
150	1.88	68.55	11.50	256.00	11.50	200.00
155	1.84	73.14	11.50	256.00	11.50	200.00
160	1.74	77.75	11.50	256.00	11.50	200.00
165	1.67	82.38	11.50	256.00	11.50	200.00
170	1.21	87.01	11.50	256.00	11.50	200.00
175	0.72	91.68	11.50	256.00	11.50	200.00
180	0.87	96.35	11.50	256.00	11.50	200.00
185	0.42	101.05	11.50	256.00	11.50	200.00

Coordination Values	ALPINE, TX		
Licensee Name	Kuiper Systems LLC.		
Latitude (NAD 83)	29° 37' 1.7" N		
Longitude (NAD 83)	103° 34' 3.8" W		
Ground Elevation (AMSL)	1025.41 m / 3364.2 ft		
Antenna Centerline (AGL)	2.5 m / 8.2 ft		
Antenna Model	Amazon 2.8 meter		
Antenna Mode	Receive 18.0 GHz		
Interference Objectives: Long Term	-156.0 dBW/MHz	20%	Transmit 28.0 GHz
Short Term	-146.0 dBW/MHz	0.01%	-151.0 dBW/4 kHz 20%
Max Available RF Power		-11.9 (dBW/4 kHz)	-128.0 dBW/4 kHz 0.0025%

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Receive 18.0 GHz		Transmit 28.0 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
190	0.43	105.72	11.50	256.00	11.50	200.00
195	0.40	110.38	11.50	256.00	11.50	200.00
200	0.43	115.00	11.50	256.00	11.50	200.00
205	0.43	119.60	11.50	256.00	11.50	200.00
210	0.24	124.21	11.50	256.00	11.50	200.00
215	0.00	128.80	11.50	256.00	11.50	200.00
220	0.00	133.26	11.50	256.00	11.50	200.00
225	0.00	137.62	11.50	256.00	11.50	200.00
230	0.00	141.87	11.50	256.00	11.50	200.00
235	0.00	145.94	11.50	256.00	11.50	200.00
240	0.27	149.60	11.50	256.00	11.50	200.00
245	0.43	152.94	11.50	256.00	11.50	200.00
250	0.57	155.76	11.50	256.00	11.50	200.00
255	0.61	157.94	11.50	256.00	11.50	200.00
260	0.65	159.17	11.50	256.00	11.50	200.00
265	0.67	159.31	11.50	256.00	11.50	200.00
270	0.67	158.34	11.50	256.00	11.50	200.00
275	0.66	156.38	11.50	256.00	11.50	200.00
280	0.68	153.64	11.50	256.00	11.50	200.00
285	0.75	150.30	11.50	256.00	11.50	200.00
290	0.77	146.61	11.50	256.00	11.50	200.00
295	0.76	142.66	11.50	256.00	11.50	200.00
300	0.75	138.51	11.50	256.00	11.50	200.00
305	0.72	134.23	11.50	256.00	11.50	200.00
310	0.67	129.85	11.50	256.00	11.50	200.00
315	0.62	125.38	11.50	256.00	11.50	200.00
320	0.59	120.85	11.50	256.00	11.50	200.00
325	0.65	116.26	11.50	256.00	11.50	200.00
330	0.71	111.63	11.50	256.00	11.50	200.00
335	0.65	107.00	11.50	256.00	11.50	200.00
340	0.66	102.34	11.50	256.00	11.50	200.00
345	0.66	97.67	11.50	256.00	11.50	200.00
350	0.77	92.99	11.50	256.00	11.50	200.00
355	0.84	88.32	11.50	256.00	11.50	200.00

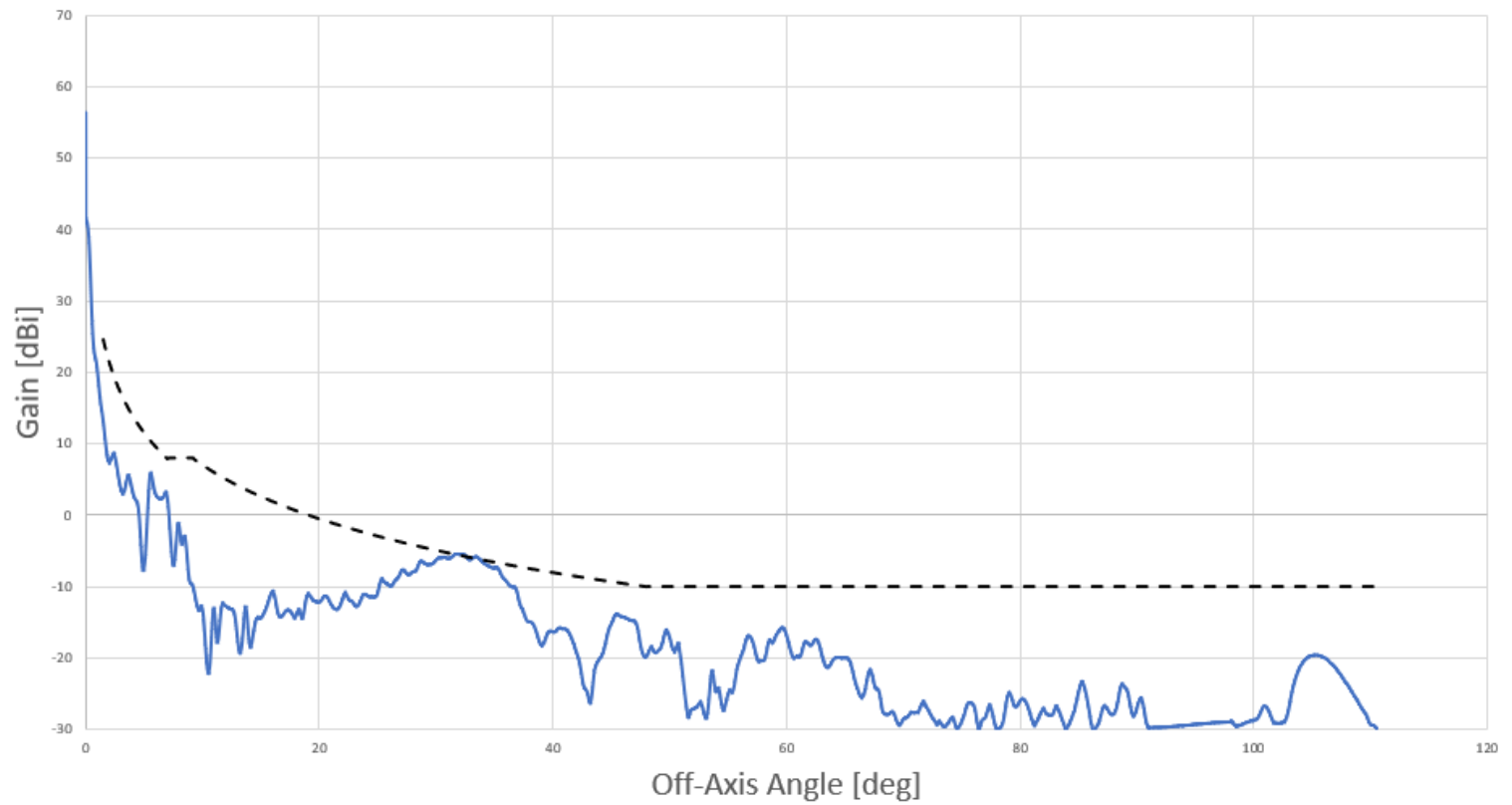
5. Contact Information

For questions or information regarding the 28 GHz Frequency Coordination Report, please contact:

Contact person:	Dennis Jimeno
Title:	Engineer III, Telecommunications
Company:	Comsearch
Address:	19700 Janelia Farm Blvd., Ashburn, VA 20147
Telephone:	703-726-5858
Fax:	703-726-5599
Email:	DJimeno@Comsearch.com
Web site:	www.comsearch.com

EXHIBIT D (ANTENNA PATTERN)

2.8m Antenna Pattern
Frequency: 27500 MHz (CoPol)
Gain: 56.5 dBi



— Antenna Gain -- FCC 25.209(a)(1)