SPACEX

August 13, 2021

BY ELECTRONIC FILING

Kerry E. Murray
Federal Communications Commission
45 L Street, N.E.
Washington, DC 20554

Re: *E202179*

Dear Ms. Murray:

This letter is in response to requests from the Federal Communication Commission to provide supplemental information with regard to the earth station application referenced above. Specifically, the Commission requested the following information:

1. Addition of county boundaries and distance/mileage scale to PFD contour plots
2. .kml file with PFD contour and census block boundaries
3. Clarification of power density ("clear sky power" value)
4. Confirmation that PFD contour will not cross any roads classified as "Other Freeways and Expressways or Other Principal Arterials," with details on related analysis and assumptions
5. Clarification of discrepancy in height above ground level
6. Explanation of changes in antenna sidelobe levels
7. Explanation of clutter assumptions
8. Technical details related to site shielding
9. Addition of coordination report

Responses are as follows:

1155 F Street, NW Suite 475 Washington, DC 20004
phone 202.649.2700 fax 202.649.2701
spacex.com

1) Addition of county boundaries and distance/mileage scale to PFD contour plots

In accordance with 47 CFR § 25.136(a)(4)(ii) and 47 CFR § 25.136(a)(4)(iii), county boundaries and map legends with distance/mileage scale for measuring the relative size of the proposed PFD contour are included as Figures 1-3 in the appendix of this document. The size and shape of the PFD contour in these figures differs from that of the initial license application for the following reasons:

- Change in antenna sidelobe levels; see section 6 of this pleading for detail
- Addition of clutter assumptions; see section 7 of this pleading for detail

Due to the aforementioned changes, this earth station will no longer require shielding to comply with 47 CFR § 25.136.

2) .kml files for PFD contours

The Federal Communications Commission has requested that a .kml file representing the PFD contour and relevant census block boundaries be submitted. This .kml file has been submitted as an attachment along with this supplement pleading.

3) Clarification of power density

To ensure compliance with 47 CFR § 25.136(a)(4)(ii) and 47 CFR § 25.136(a)(4)(iii) for the earth station related to this supplemental pleading, SpaceX used worst-case input power density. SpaceX did not change maximum power during rain fade conditions, so clear-sky maximum power is the same as during rain fade for this earth station application. This SpaceX license application is conservative and currently accounts for worst-case antenna input power density of -19.7 dBW/MHz.

4) Confirmation that PFD contour will not cross any roads classified as "Other Freeways and Expressways or Other Principal Arterials," with details on related analysis and assumptions

In accordance with 47 CFR § 25.136(a)(4)(iii), SpaceX certifies that the PFD contour of the earth station related to this supplemental pleading will not cross any roads classified as "Other Freeways and Expressways or Other Principal Arterials:"

To make this certification, SpaceX uses QGIS software to conduct an analysis of a comprehensive dataset of roadways obtained from the 2017 release of the HPMS[1] ARNOLD[2] dataset, belonging to the Federal Highway Administration of the Department of Transportation. To ensure compliance with 47 CFR § 25.136(a)(4)(iii), SpaceX analysis considers the following categories within the dataset: "Interstate," "Principal Arterial – Other Freeways and Expressways," and "Principal Arterial – Other". SpaceX uses QGIS and the comprehensive dataset of roadways to ensure that the PFD contour does not cross any roads classified as "Other Freeways and Expressways or Other Principal Arterials." According to

[1] Highway Performance Monitoring System
[2] All Road Network of Linear Referenced Data

the website from which the dataset is obtained[3]: "[the dataset] derives and is collected from State DOT road data. ARNOLD consists of locations of all roads in the U.S." Therefore, relevant state roadways are considered in our analysis.

5) Clarification of discrepancy in height above ground level

The "height above ground level" in all earth station applications (1.7m), is the true centerline height of the antennas, and the value SpaceX uses to calculate the PFD contours. The "Antenna Centerline (AGL)" value previously used in Comsearch (0.91m) has been found to be a clerical error, and will be changed to 1.7m in all future Comsearch reports. Comsearch has informed us that it is not necessary to re-do coordination or update Comsearch reports based on this change, because the change is not expected to impact any relevant analyses. Related email correspondence with Comsearch has been submitted as an attachment along with this supplement pleading.

6) Explanation of changes in antenna sidelobe levels

There have been changes over time in the antenna sidelobe level toward the horizon used in SpaceX's earth station applications. The changes are due to improvements in SpaceX earth station antenna design over time – newer antennas have a lower antenna sidelobe level toward the horizon.

While the analysis and PFD contours provided with the initial license application for this earth station (filed 10/16/2020) feature an antenna sidelobe level towards the horizon of -1 dBi, the analysis and PFD contours submitted with this pleading feature an antenna sidelobe level towards the horizon of -8 dBi.

For the reasons explained above, an antenna sidelobe level towards the horizon of -8 dBi is a more accurate representations of reality for this earth station than the value of -1 dBi that was previously used. See appendix Figure 4 for detail on antenna sidelobe measurements and related methodology.

7) Explanation of clutter assumptions

No clutter was assumed in the PFD contour analysis that was submitted for this earth station in initial filing on 10/16/20. Since initial filing, the FCC has advised SpaceX to use ITU P.452 clutter categories.

The "deciduous trees" and "mixed tree forest" clutter categories of the ITU P.452 model were used for the updated PFD contour submitted with this pleading. According to the ITU P.452 model, this translates to clutter assumptions of 15 meters nominal height and 0.05 kilometers nominal distance.

[3] Source: https://www.bts.gov/geography/geospatial-portal/NTAD-direct-download

The "deciduous trees" and "mixed tree forest" clutter categories were determined to be most appropriate based on measurements and analysis via Google Earth software and in-person site survey. Figures 5-7 provide visuals of the site environment, obtained via Google Earth software and in-person site surveys.

8) Technical details related to site shielding

All ground-based SpaceX earth stations in the US are surrounded with a solid metal panel fence, which is 8 feet in height and is set 11 feet and 6 inches from the centerline of the outermost antennas. Each earth station is analyzed independently to determine the shielding value required to comply with 47 CFR § 25.136(a)(4)(ii) and 47 CFR § 25.136(a)(4)(iii), based on PFD contours. The independent nature of the analysis explains the variation in shielding values between applications. SpaceX installs shielding at all sites with effectiveness equal to or greater than the value required to remain in compliance with 47 CFR § 25.136(a)(4)(iii) and 47 CFR § 25.136(a)(4)(iii).

9) Addition of coordination report

The coordination report for this earth station was unintentionally omitted as an attachment from initial filing. It has been submitted with this supplemental pleading.

Sincerely,

David Liptsyn

David Liptsyn
Gateway Site Acquisition Analyst
SpaceX

Appendix

Figure 1: PFD Contour with county boundaries and distance/mileage scale

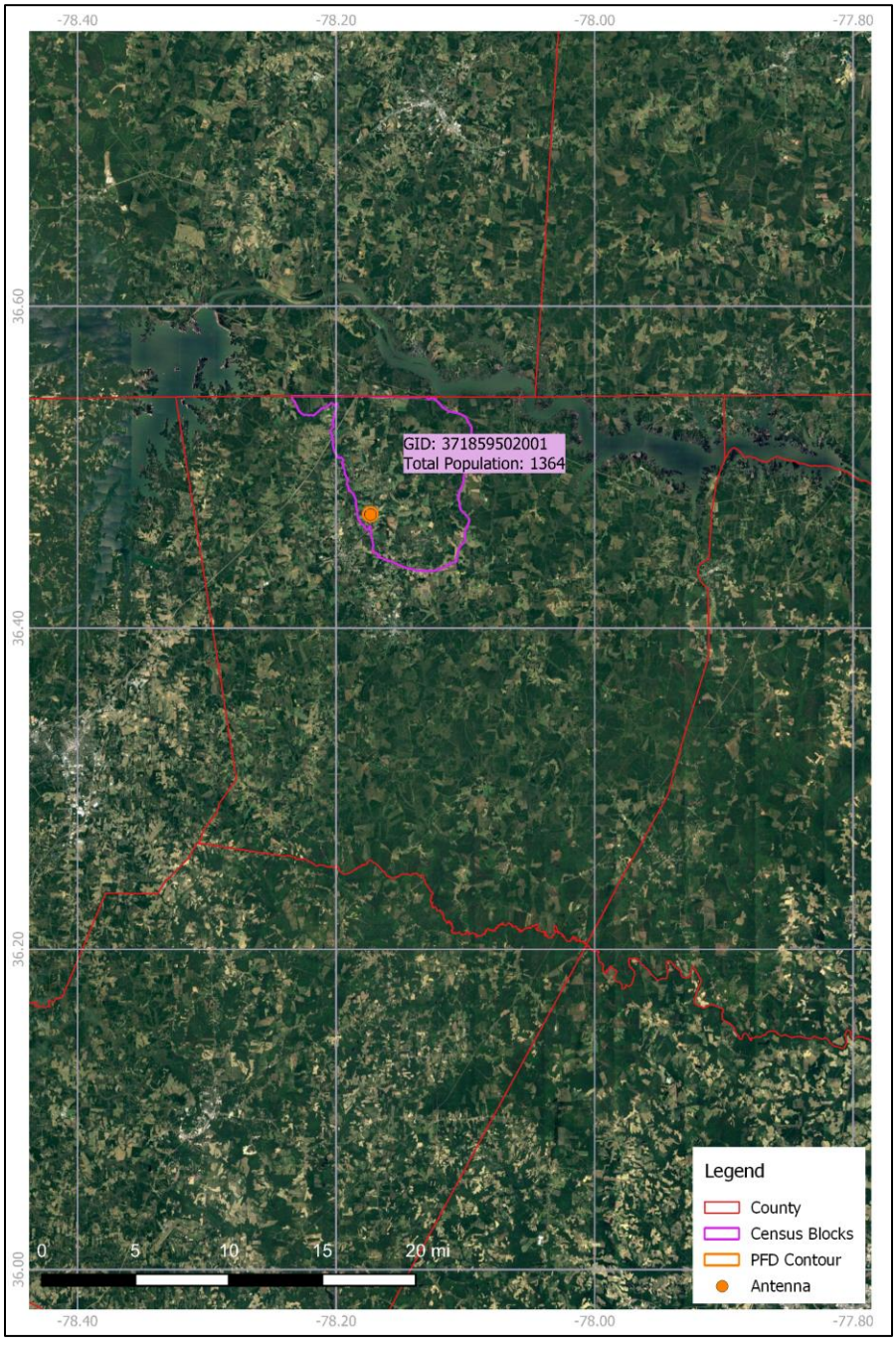
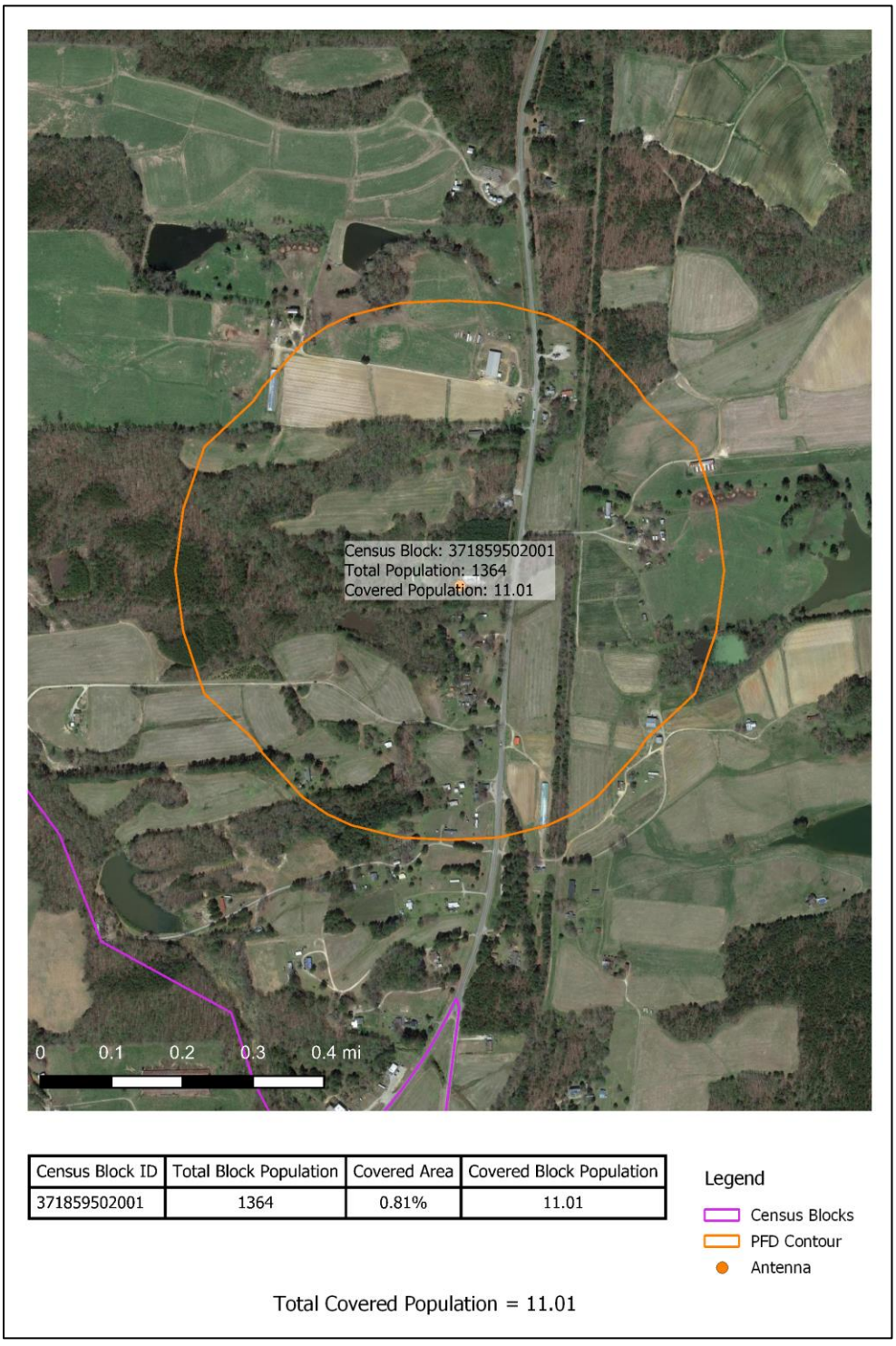


Figure 2: PFD Contour with distance/mileage scale



Census Block ID	Total Block Population	Covered Area	Covered Block Population
371859502001	1364	0.81%	11.01

Figure 3: PFD Contour with population density and distance/mileage scale

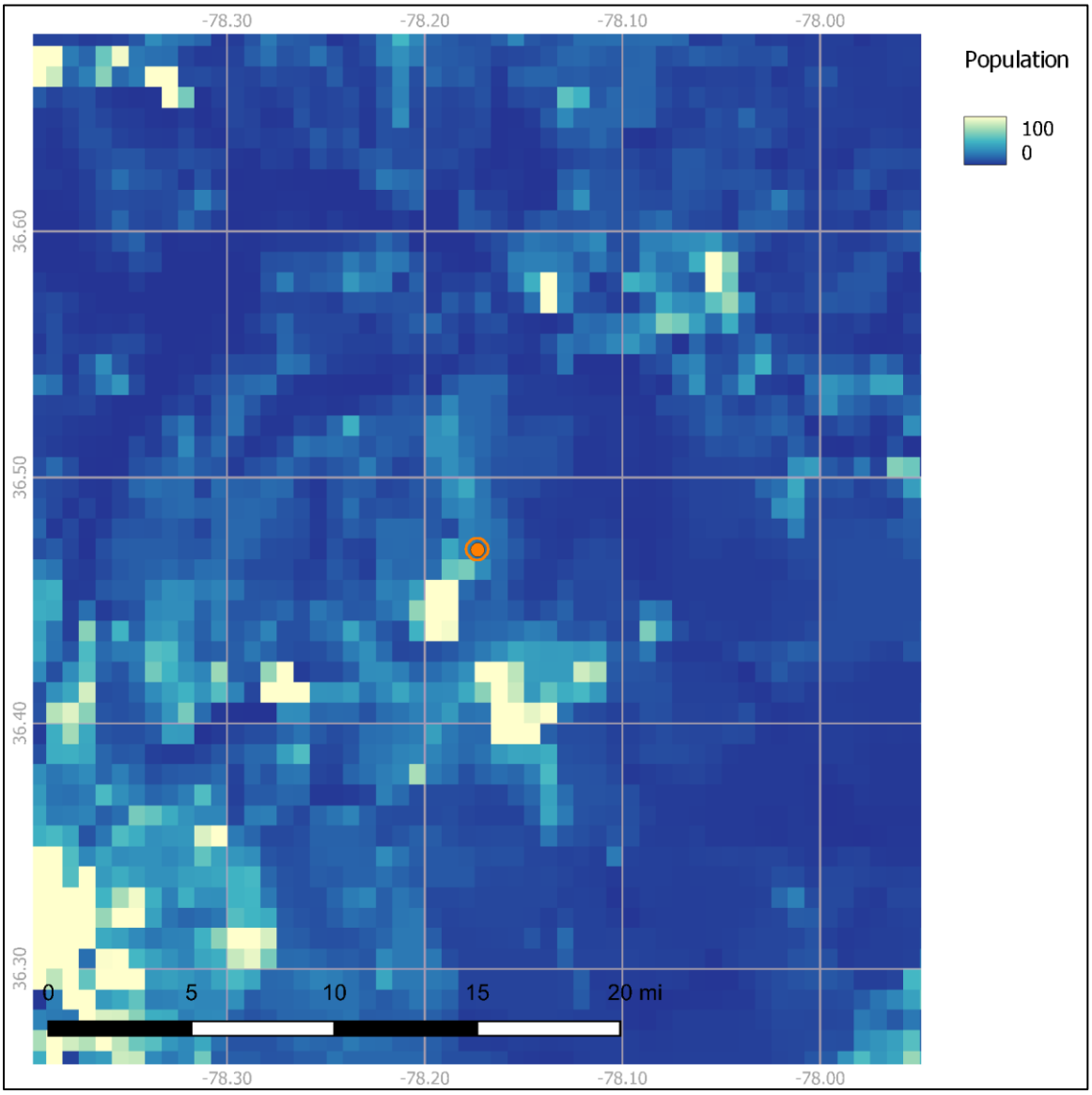


Figure 4: A measured antenna pattern is shown below for relevant off-axis angles that intersect the horizon. The maximum observed sidelobe level is -8.37 dBi. This measurement was completed by an independent third party (NSI-MI Technologies) at the NSI-MI Compact Antenna Test Range at the NSI-MI Technologies facilities in Atlanta, GA. All measurement equipment was also manufactured by NSI-MI to ensure accuracy and precision.

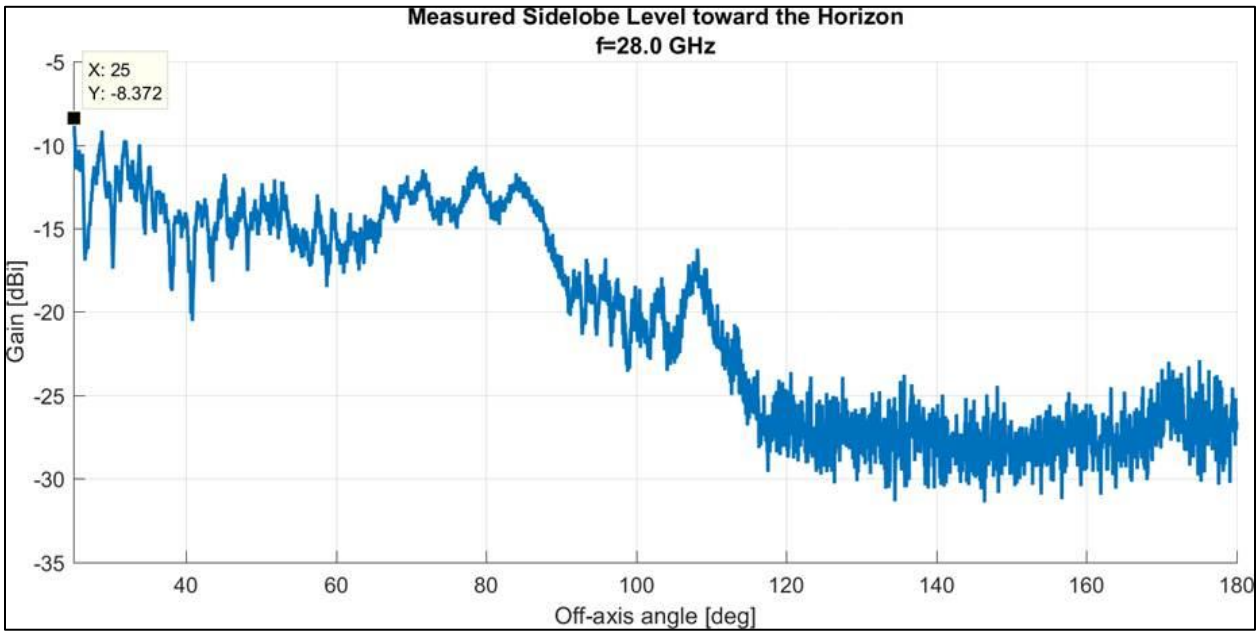


Figure 5: Satellite view of earth station and surroundings obtained via Google Earth. The earth station location is represented by an earth station layout with an orange border. The red box indicates the location from which street view images in Figure 6 were obtained. The trees immediately surrounding the earth station were cleared, but trees remain surrounding the earth station. The distance between the remaining trees and the earth station itself are generally aligned with, or more conservative than, the clutter assumption of 50 meters of distance that is being used for PFD contour analysis.

Figure 6: Street view of earth station surroundings obtained via Google Earth. These images are taken from the red box shown in Figure 5. These images demonstrate a mix of deciduous and coniferous trees. This is aligned with the clutter categories of “deciduous trees” and “mixed tree forest” that are being used for PFD contour analysis, and the related clutter assumptions.

Facing northwest:

Facing southwest:

Figure 7: Photos of earth station surroundings obtained during in-person site survey, which preceded earth station construction. Both images taken from the dirt road between the roadway and earth station location, facing westward. These photos demonstrate a mix of deciduous and coniferous trees. This is aligned with the clutter categories of “deciduous trees” and “mixed tree forest” that are being used for PFD contour analysis, and the related clutter assumptions.