

## ATTACHMENT B

### UMFUS Compatibility Showing (Lindon, UT; Call Sign E170165)

#### 1. Section 25.136(a)(4) assessment – 27.5-28.35 GHz

##### 1.1. Section 25.136(a)(4)(i) – Number of earth stations

As of November 2020, the only other earth station licensed or proposed in the 27.5-28.35 GHz band in the relevant license area is an earth station licensed to Hughes (call sign E150086) that is grandfathered in 27.85-28.35 GHz.

##### 1.2. Section 25.136(a)(4)(ii) and (iii) – Power Flux Density (“PFD”) contour population and highway/event/railway/port coverage

###### 1.2.1. Assumptions

The Section 25.136 PFD was determined using the publicly available software program Visualyse and based upon the Table 1 technical parameters for the Jupiter 3 earth station.

Parameter	Value
Latitude/longitude	40° 19' 46.2"N/ 111° 43' 36.8"W
Frequency (GHz)	28
Channel bandwidth (MHz)	470
Transmit power (dBW)	5.09
Antenna midline height above ground (m)	7
Antenna size (m)	10
On-axis antenna Gain (dBi)	67.91
Clear sky EIRP (dBW)	73
Antenna radiation pattern	Manufacturer calculated off-axis gain pattern (see Figure 1)
Clutter	Recommendation ITU-R P.452-16, Suburban
Terrain	NASA SRTM data 30 m resolution <sup>1</sup>

Table 1. Jupiter 3 gateway earth station technical parameters at 28 GHz

<sup>1</sup> <http://dwtkns.com/srtm30m/>

Figure 1 shows the sum of the manufacturer’s calculated co-polarized and cross-polarized off-axis gain patterns. Measured antenna patterns are not available for the off-axis angles of importance because of the size of the antenna<sup>2</sup>; hence, calculated antenna patterns provided by the manufacturer are used.

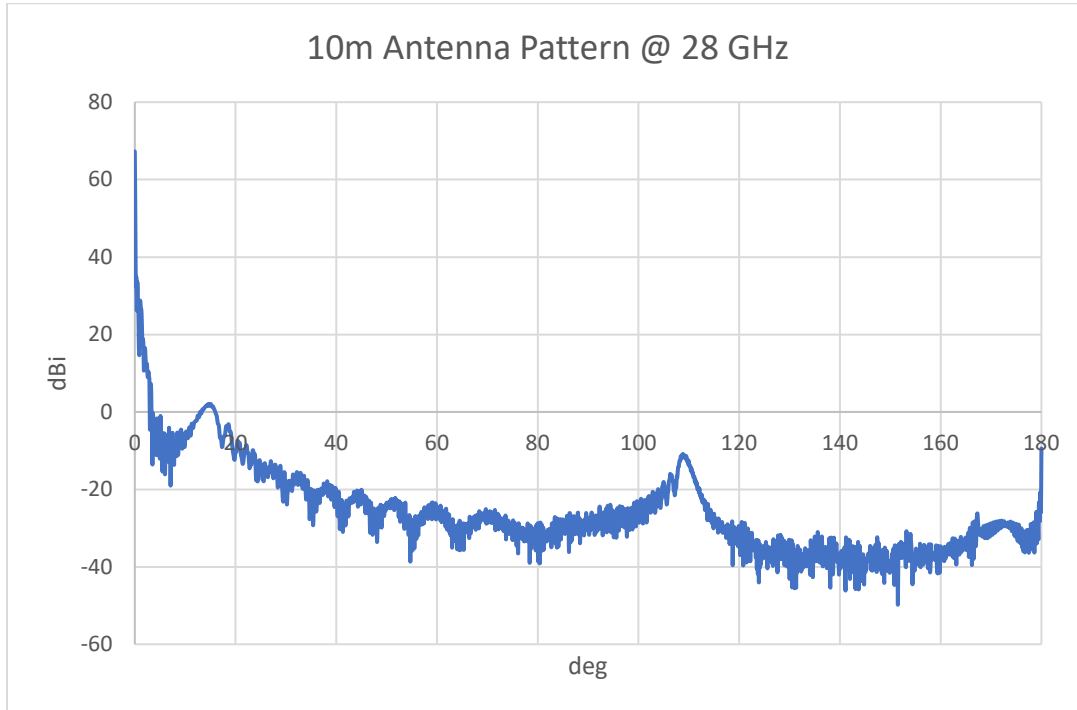


Figure 1. SED calculated off-axis gain pattern at 28 GHz

The earth station uses adaptive modulation and coding as well as uplink power control to maintain the desired availability. The percentage of time that the earth station will exceed the clear sky levels is small. Using Recommendation ITU-R P.618, Hughes has determined that the power levels are within 1 dB of the clear sky input power for 98.54% of the time and within 2 dB of the clear sky input power for 99.48% of the time.

Further, the earth station is licensed for clear sky EIRP levels pursuant to Section 25.204(e) of the Commission’s rules.

The earth station is located near to but not on the same site as a grandfathered earth station (call sign E150086) operating in 27.85-28.35 GHz. The PFD contours for the two earth stations partially overlap. Results are provided in Section 2.2.2 for the 27.5-27.85 GHz band, where the Jupiter 3 single entry PFD is assessed, and in Section 2.2.3 for the 27.85-28.35 GHz band, where the aggregate PFD contour for the grandfathered earth station and Jupiter 3 operating together is compared to the grandfathered PFD contour.

---

<sup>2</sup> See 47 C.F.R. § 25.132(d)

### 1.2.2. Results for 27.5-27.85 GHz

Visualyse Version 7 software was run using the Recommendation ITU-R P.452-16 propagation model option to generate the Section 25.136 contour for the 28 GHz band where the earth station generates a PFD, at 10 meters above ground level, of greater than or equal to  $-77.6 \text{ dBm/m}^2/\text{MHz}$ . The resulting PFD contour is shown in Figure 2 (and further specified in a KMZ file submitted with this application).

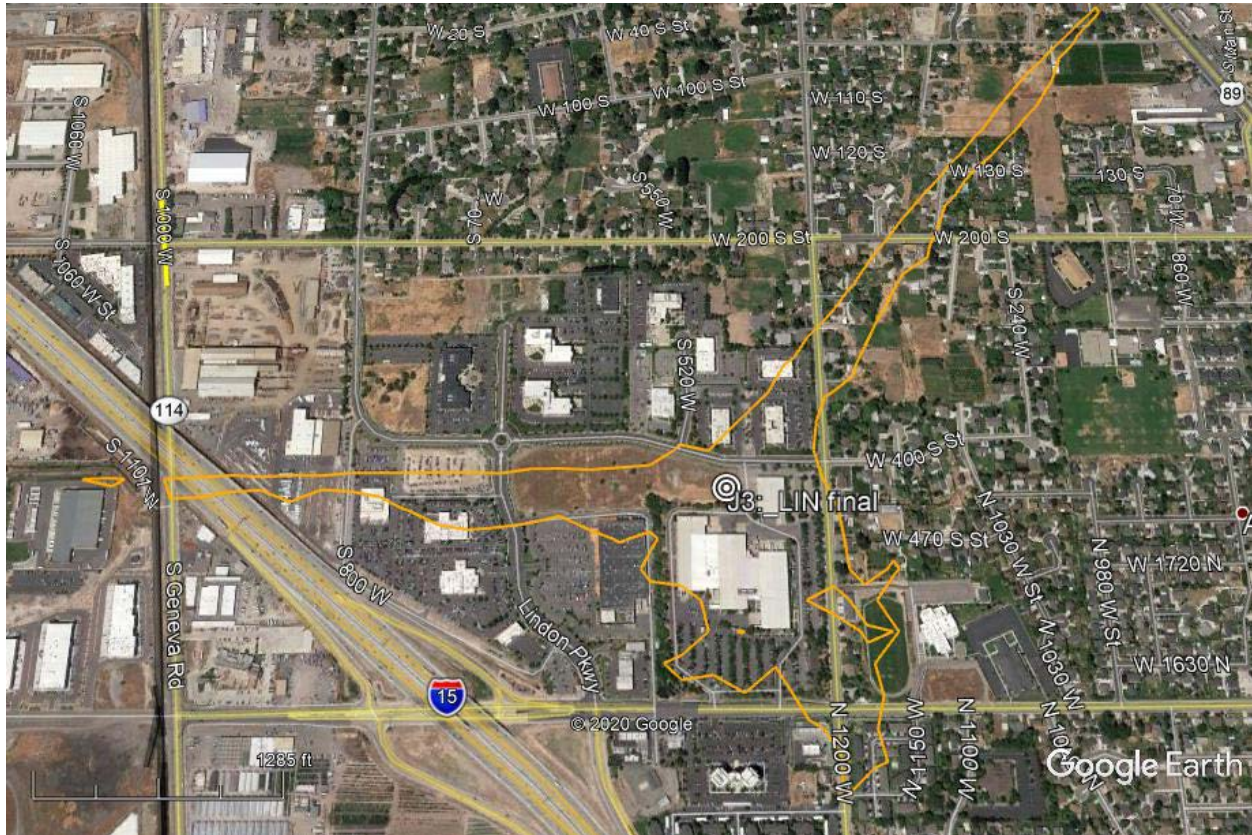


Figure 2. Section 25.136 pfd contour around the Lindon earth station in the 27.5-27.85 GHz band

With respect to coverage of major roads (*i.e.*, Interstate, Other Freeways and Expressways, or Other Principal Arterial, according to the Federal Highway Administration HEPGIS map or Other Freeways and Expressways, or Other Principal Arterials identified by the Utah State Department of Transportation), the 27.5-27.85 GHz PFD contour covers approximately 44 meters of Interstate 15 and 28 meters of Highway 114. The PFD contour also does not contain any major event venue, urban mass transit route, passenger railroad, or cruise ship port according to a visual inspection in Google Earth.

The population covered by the 27.5-27.85 GHz PFD contour was determined using the actual area method, where the population within the contour was calculated based on the proportion of the census geographic area covered by the PFD contour. Figure 3 shows the PFD contour overlaid on a census block map of the service area, with census block ID numbers depicted.

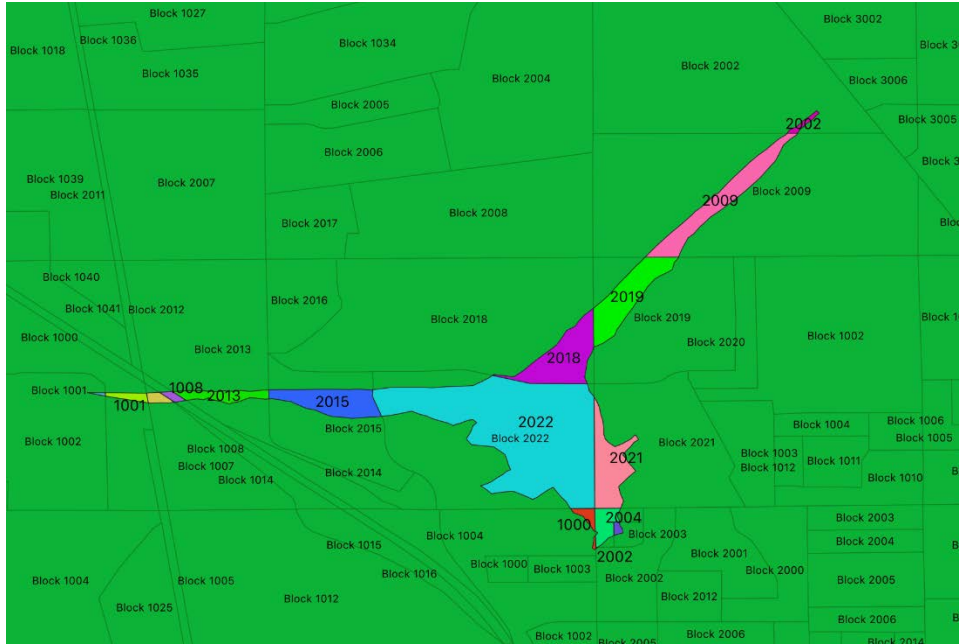


Figure 3. 27.5-27.85 GHz pfd contour overlaid on labeled census blocks

Table 2 provides the percentage of area of each census block covered by the contour, the associated population covered, and sums the population covered. The population covered is 117, thus the population coverage limit of 540 persons is met.

Census Tract	Census Block	Block Population	Total Block Area	Area Covered	Weighted Population
000601	2002	222	311818	1273.8	0.9
000601	2009	323	316901	22853.8	23.3
000601	2013	0	178608	6604.9	0.0
000601	2015	0	89795	18362.4	0.0
000601	2018	69	257810	23673.0	6.3
000601	2019	150	136871	21709.6	23.8
000601	2021	137	128546	19447.6	20.7
000601	2022	0	211546	126468.9	0.0
000706	1000	412	153579	2262.3	6.1
000706	2002	187	47578	9.7	0.0
000706	2003	52	5725	754.6	6.9
000706	2004	48	9114	5503.4	29.0
02201	1001	0	338272	2204.9	0.0
02201	1002	0	552201	239.4	0.0
02201	1007	0	73508	1652.4	0.0
02201	1008	0	14652	1088.0	0.0
02201	1014	0	15301	5.5	0.0
<b>Total</b>					<b>117</b>

Table 2. Population coverage of 27.5-27.85 GHz pfd contour

### 1.2.3. Results for 27.85-28.35 GHz

Visualyse Version 7 software was run using the Recommendation ITU-R P.452-16 propagation model option to generate the Section 25.136 PFD contours for the 27.85-28.35 GHz band where 1) the collocated grandfathered earth station generates a pfd, at 10 meters above ground level, of greater than or equal to  $-77.6 \text{ dBm/m}^2/\text{MHz}$  ("the grandfathered PFD contour") and 2) where the collocated grandfathered earth station operating simultaneously with the Jupiter 3 earth station generates the same PFD ("the aggregate PFD contour").

The Table 3 technical parameters were used for the grandfathered earth station:

Parameter	Value
Latitude/longitude	40° 19' 58.5" N / 111° 43' 43.0" W
Frequency (GHz)	28
Channel bandwidth (MHz)	250
Transmit power (dBW)	7
Antenna midline height above ground (m)	3.2
Antenna size (m)	5.6
On-axis antenna Gain (dBi)	62
Clear sky EIRP (dBW)	69
Antenna radiation pattern	Section 25.209(a)(1)
Clutter	Recommendation ITU-R P.452-16, Suburban
Terrain	NASA SRTM data 30 m resolution <sup>3</sup>

Table 3. Grandfathered gateway earth station technical parameters at 28 GHz

The resulting PFD contours are shown in Figure 4 (and further specified in a KMZ file submitted with this application). The blue PFD contour is the grandfathered PFD contour, and the red PFD contour is the aggregate PFD contour.

---

<sup>3</sup> <http://dwtkns.com/srtm30m/>

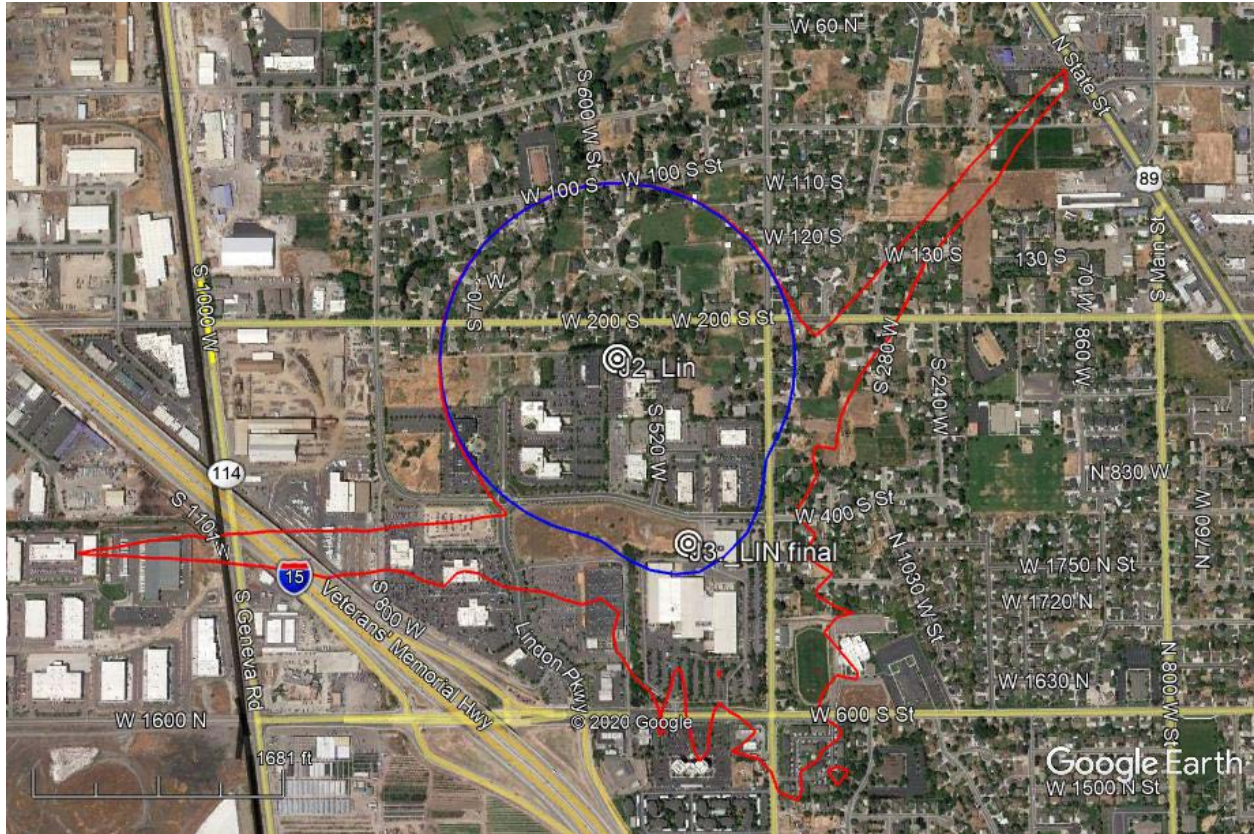


Figure 4. Section 25.136 grandfathered and aggregate PFD contours around the Lindon earth station in the 27.85-28.35 GHz band

With respect to coverage of any major roads (i.e., Interstate, Other Freeways and Expressways, or Other Principal Arterial, according to the Federal Highway Administration HEPGIS map or Other Freeways and Expressways, or Other Principal Arterials identified by the Utah Department of Transportation), the 27.85-28.35 GHz aggregate PFD contour covers approximately 146 meters of Interstate 15 and 65 meters of US Route 114. The PFD contour does not contain any major event venue, urban mass transit route, passenger railroad, or cruise ship port according to a visual inspection in Google Earth.

The population covered by the 27.85-28.35 GHz aggregate PFD contour, but not within the grandfathered contour, was determined using the actual area method, where the population within the contour was calculated based on the proportion of the census geographic area covered by the PFD contour. Figure 5 shows the PFD contours overlaid on a census block map of the service area, with census block ID numbers depicted. The area colored blue – inside the aggregate PFD contour but outside the grandfathered PFD contour – was assessed against the population limits.

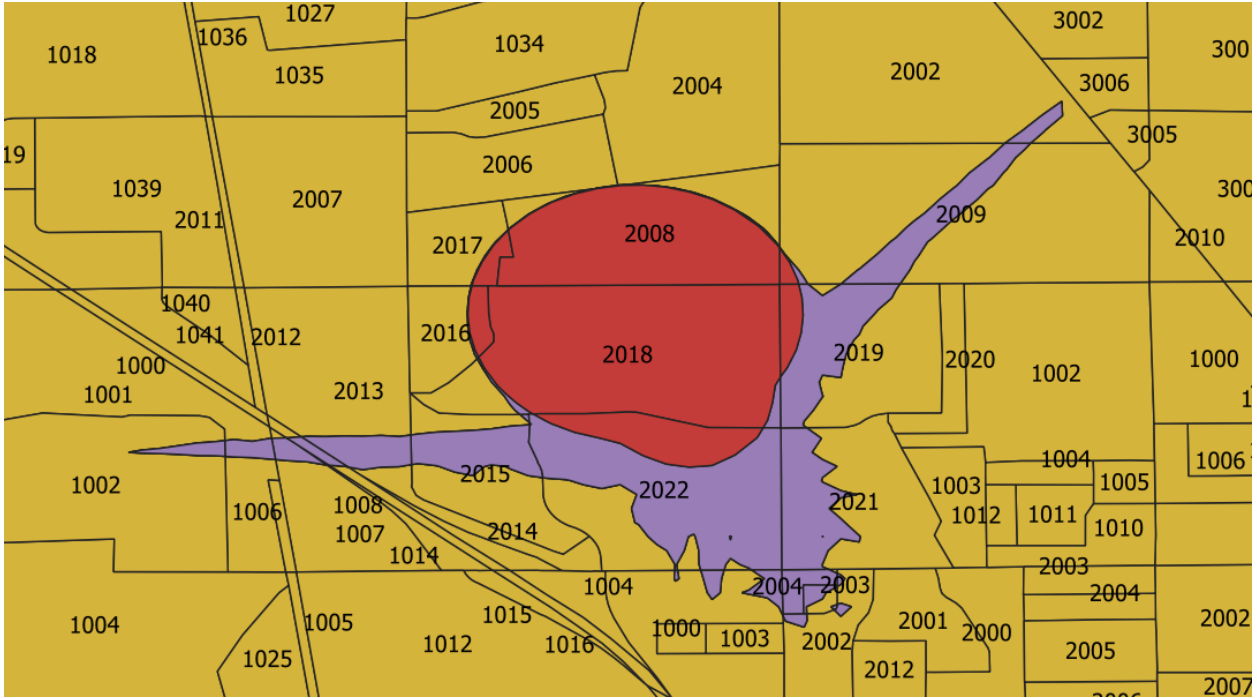


Figure 5. 27.85-28.35 GHz pfd contour overlaid on labeled census blocks

Table 4 provides the percentage of area of each census block covered by the purple area, the associated population covered, and sums the population covered. The population covered is 248, thus the population coverage limit of 540 persons is met.

Census Tract	Census Block	Block Population	Block Area	Block Area covered by Agg but not J2	Weighted Population
601	2002	222	312453.2	4825.4	3.4
601	2004	187	219550	17.9	0.0
601	2006	108	90524.89	57.2	0.1
601	2008	172	175000.1	1041.7	1.0
601	2009	323	316907.7	34244.9	34.9
601	2013	0	182203.1	16869.7	0.0
601	2015	0	92982.71	30374.3	0.0
601	2016	21	46210.51	517.8	0.2
601	2017	116	48473.36	286.0	0.7
601	2018	69	257815.8	4428.6	1.2
601	2019	150	136869	48473.7	53.1
601	2021	137	128546.2	44094.4	47.0
601	2022	0	211547.2	125820.2	0.0
601	2022	0	211547.2	26.8	0.0
706	1000	412	155739.5	8134.6	21.5
706	2002	187	47577.52	2538.7	10.0

706	2003	52	5725.234	2935.0	26.7
706	2004	48	9114.46	8999.9	47.4
2201	1001	0	338270.9	5346.1	0.0
2201	1002	0	552200.5	5022.0	0.0
2201	1007	0	76921.44	4548.0	0.0
2201	1008	0	14653.41	2868.0	0.0
2201	1014	0	11870.08	113.2	0.0
Total					248

Table 4. Population coverage of 27.85-28.35 GHz PFD contour (aggregate – grandfathered)

### 1.3. Section 25.136(a)(4)(iv) – Coordination

As demonstrated in the attached Coordination Report (Attachment A), coordination of the modified earth station operations was completed through Comsearch pursuant to Sections 25.136(a)(4)(iv) and 101.103(d) of the Commission’s rules.

## 2. Section 25.136(d)(4) assessment – 47.2-48.2 GHz

### 2.1. Section 25.136(d)(4)(i) – Number of earth stations

As of November 2020, there are no other earth stations licensed or proposed in the 47.2-48.2 GHz band in the relevant license area.

### 2.2. Section 25.136(d)(4)(ii) and (iii) – PFD contour population and highway/event/railway/port coverage

#### 2.2.1. Assumptions

The Section 25.136 PFD was determined using the publicly available software program Visualyse and based upon the Table 5 technical parameters for the Jupiter 3 earth station.

Parameter	Value
Latitude/longitude	40° 19' 46.2"N/ 111° 43' 36.8"W
Frequency (GHz)	47
Channel bandwidth (MHz)	470
Transmit power (dBW)	0.39
Antenna midline height above ground (m)	7
On-axis antenna Gain (dBi)	71.61
Clear sky EIRP (dBW)	72
Antenna radiation pattern	Manufacturer calculated off-axis gain pattern



Clutter	Recommendation ITU-R P.452-16, Suburban
Terrain	NASA SRTM data 30 m resolution <sup>4</sup>

Table 5. Jupiter 3 gateway earth station technical parameters at 47 GHz

Figure 6 provides a plot of the manufacturer’s calculated combined co-polarized and cross-polarized off-axis gain patterns. Measured antenna patterns are not available for the off-axis angles of importance because of the size of the antenna; hence, calculated antenna patterns provided by the manufacturer are used.

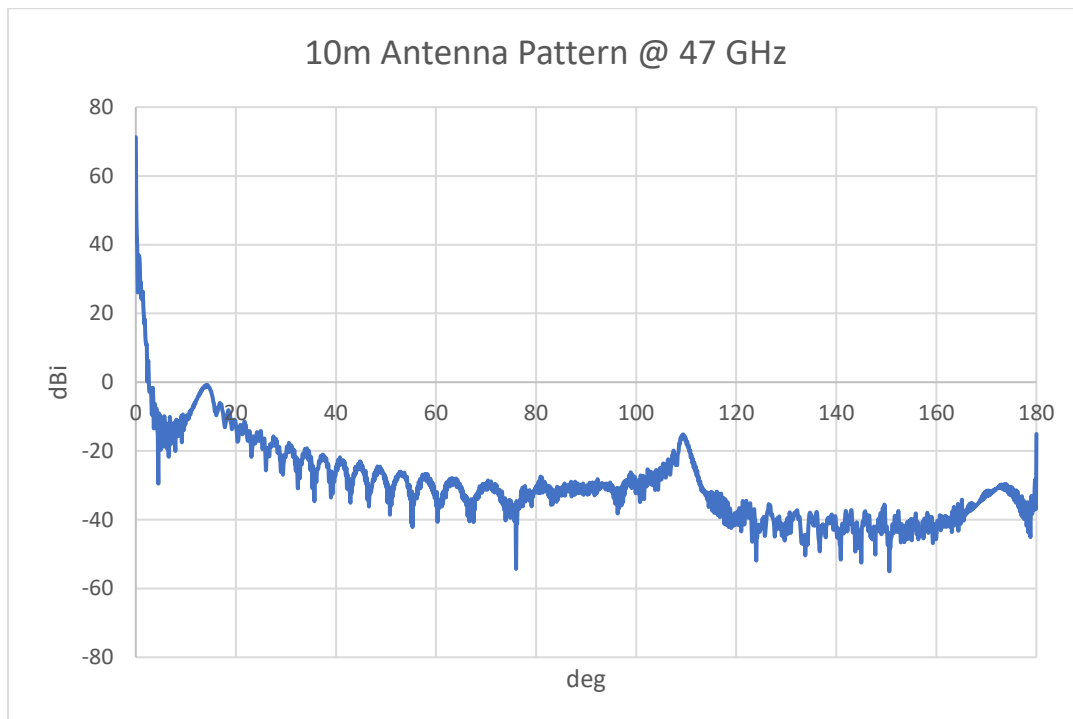


Figure 6. SED calculated off-axis gain pattern at 47 GHz

The earth station uses adaptive modulation and coding as well as uplink power control to maintain the desired availability. The percentage of time that the earth station will exceed the clear sky levels is small. Using Recommendation ITU-R P.618, Hughes has determined that the power levels are within 1 dB of the clear sky input power for 95.06% of the time and within 2 dB of the clear sky input power for 98.1% of the time.

Further, the earth station is licensed for clear sky EIRP levels pursuant to Section 25.204(e) of the Commission’s rules.

### 2.2.2. Results

<sup>4</sup> <http://dwtkns.com/srtm30m/>

Visualyse Version 7 software was run using the Recommendation ITU-R P.452-16 propagation model option to generate the Section 25.136 contour for the 47 GHz band where the earth station generates a pfd, at 10 meters above ground level, of greater than or equal to  $-77.6 \text{ dBm/m}^2/\text{MHz}$ . The resulting PFD contour is shown in Figure 7 (and further specified in a KMZ file submitted with this application).



Figure 7. Section 25.136 pfd contour around the Lindon earth station in the 47 GHz band

The 47 GHz PFD contour does not cover any major roads (*i.e.*, Interstate, Other Freeways and Expressways, or Other Principal Arterial according to the Federal Highway Administration HEPGIS map, or highways designated as Other Freeways and Expressways, or Other Principal Arterials by the Utah Department of Transportation). The PFD contour also does not contain any major event venue, urban mass transit route, passenger railroad, or cruise ship port according to a visual inspection in Google Earth.

The population covered by the 47 GHz PFD contour was determined using the actual area method, where the population within the contour was calculated based on the proportion of the census geographic area covered by the PFD contour. Figure 8 shows the 47 GHz PFD contour overlaid on a census block map of the service area, with census block ID numbers depicted.

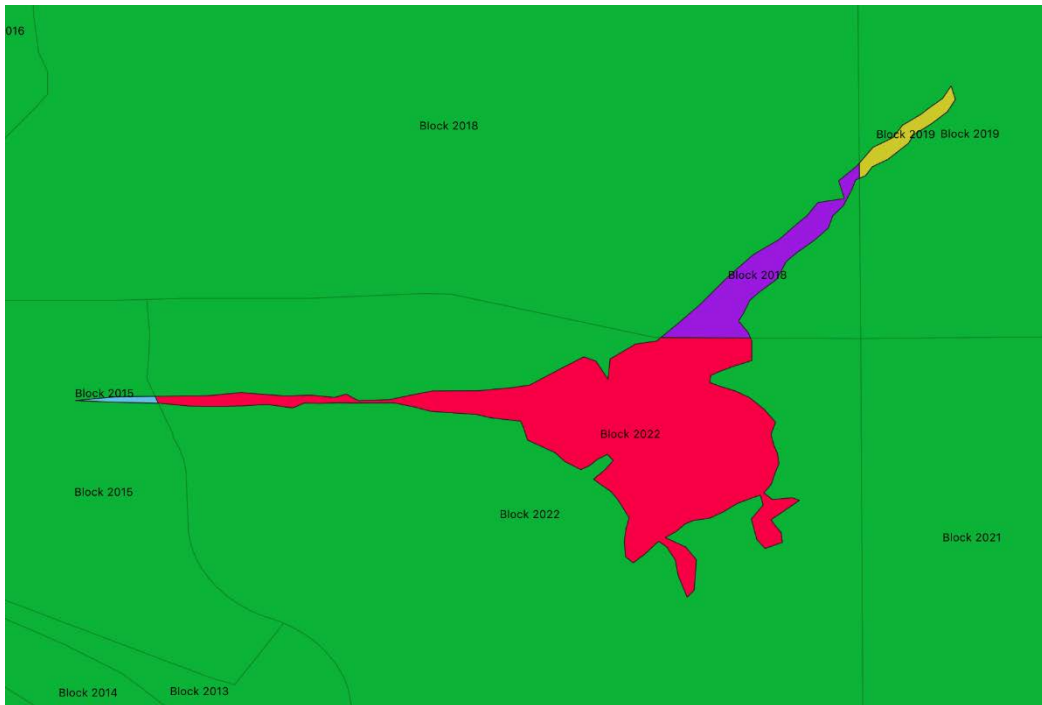


Figure 8. 47 GHz pfd contour overlaid on labeled census blocks

Table 6 provides the percentage of area of each census block covered by the contour, the associated population covered, and sums the population covered. The population coverage limit of 2250 persons is met.

Census Tract	Census Block	Block Population	Total Block Area	Area Covered	Weighted Population
000601	2015	0	89795	500	0.0
000601	2018	69	257810	9986	2.7
000601	2019	150	136871	2545	2.8
000601	2022	0	211546	64382	0.0
<b>Total</b>					<b>6</b>

Table 6. Population coverage of 47 GHz pfd contour

### 2.3. Section 25.136(d)(4)(iv) – Coordination

As demonstrated in the attached Coordination Report (Attachment B), coordination of the modified parameters for the earth station was completed through Comsearch pursuant to Sections 25.136(d)(4)(iv) and 101.103(d) of the Commission’s rules.

### 3. Section 25.136(e)(3) assessment – 50.4-51.4 GHz

Operations in the 50.4-51.4 GHz band are grandfathered pursuant to 47 C.F.R. § 25.136(e)(3). The proposed modifications create no significant increase in interference risk to terrestrial operations with respect to PFD contour coverage of populations and major roads and venues, as shown below.

### 3.1. PFD contour population and highway/event/railway/port coverage

#### 3.1.1. Assumptions

The Section 25.136 PFD was determined using the publicly available software program Visualyse and based upon the 7 technical parameters for the Jupiter 3 earth station.

Parameter	Old site	New site
Latitude/longitude	40°19'58.10"N / 111°43'50.20"W	40° 19' 58.5" N / 111° 43' 43.0" W
Frequency (GHz)	50.9	50.9
Channel bandwidth (MHz)	470	470
Transmit power (dBW)	0	0
Antenna midline height above ground (m)	7	7
On-axis antenna Gain (dBi)	72	72
Clear sky EIRP (dBW)	72	72
Antenna radiation pattern	Manufacturer calculated off-axis gain pattern	Manufacturer calculated off-axis gain pattern
Clutter	Recommendation ITU-R P.452-16, Suburban	Recommendation ITU-R P.452-16, Suburban
Terrain	NASA SRTM data 30 m resolution <sup>5</sup>	NASA SRTM data 30 m resolution <sup>6</sup>

Table 7. Jupiter 3 gateway earth station technical parameters at 50.9 GHz

Figure 9 provides a plot of the manufacturer's calculated combined co-polarized and cross-polarized off-axis gain patterns. Measured antenna patterns are not available for the off-axis angles of importance because of the size of the antenna; hence, calculated antenna patterns provided by the manufacturer are used.

<sup>5</sup> <http://dwtkns.com/srtm30m/>

<sup>6</sup> <http://dwtkns.com/srtm30m/>

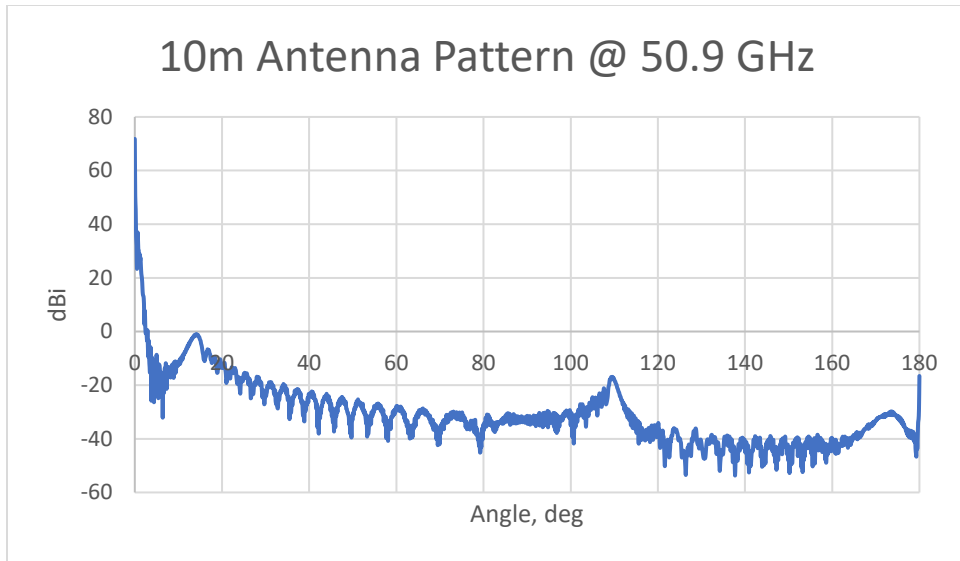


Figure 9. SED calculated off-axis gain pattern at 50.9 GHz

### 3.1.2. Results

Visualyse Version 7 software was run using the Recommendation ITU-R P.452-16 propagation model option to generate the Section 25.136 contour for the 50 GHz band where the earth station generates a pfd, at 10 meters above ground level, of greater than or equal to  $-77.6 \text{ dBm/m}^2/\text{MHz}$ . The resulting PFD contours for the old and new sites are shown in yellow and orange, respectively, in Figure 10.



Figure 10. Section 25.136 pfd contours around the Lindon earth station in the 50 GHz band at the old site location (yellow) and the new (orange)

Neither PFD contour covers: (i) any major roads (*i.e.*, Interstate, Other Freeways and Expressways, or Other Principal Arterial according to the Federal Highway Administration HEPGIS map, or highways designated as Other Freeways and Expressways, or Other Principal Arterials by the Washington State Department of Transportation); or (ii) any major event venue, urban mass transit route, passenger railroad, or cruise ship port, according to a visual inspection in Google Earth.