Before the
UNITED STATES DEPARTMENT OF AGRICULTURE
Washington, DC 20250

In the Matter of	)	
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Current and Anticipated Future Spectrum Requirements for Commercial Agriculture, Forestry, Mining, and Rural Manufacturing	)))	Document ID: FSA_FRDOC_0001-0326

COMMENTS OF THE GPS INNOVATION ALLIANCE

The GPS Innovation Alliance ("GPSIA")[1/] submits these comments in response to the Notice of Inquiry and Request for Comments issued by the Farm Service Agency of the United States Department of Agriculture ("USDA") in the above-referenced proceeding.[2/] GPSIA applauds the USDA for initiating an inquiry into the spectrum needs of emerging technologies in commercial agriculture, forestry, mining, and rural manufacturing. The Global Positioning System ("GPS") and other international Global Navigation Satellite Systems ("GNSS") have become a vital resource to those industries, affecting nearly every facet of modern-day life in rural areas. It is therefore critical that, as the USDA evaluates the spectrum requirements of non-federal users in rural settings, it recognize the importance of GPS technologies, their need for associated broadband and wireless coverage in rural areas, and the importance of policies that will ensure their continued growth and protection.

1/ GPSIA was formed in February 2013 to protect, promote, and enhance the use of Global Positioning System and Global Navigation Satellite System technologies. Members and affiliates of GPSIA come from a wide variety of fields and businesses reliant on GPS, including manufacturing, aviation, agriculture, construction, transportation, first responders, surveying, and mapping. GPSIA also includes organizations representing consumers who depend on GPS for boating and other outdoor activities and in their automobiles, smartphones, and tablets.

2/ *See Current and Anticipated Future Spectrum Requirements for Commercial Agriculture, Forestry, Mining, and Rural Manufacturing*, Notice of Inquiry and Request for Comments, 84 Fed. Reg. 9,078 (Mar. 13, 2019) ("*NOI*").

I. GPS TECHNOLOGIES PROVIDE SIGNIFICANT BENEFITS IN RURAL AREAS AND FOSTER ECONOMIC GROWTH

The USDA asks commenters to provide information about current and emerging uses of technologies in commercial agriculture, mining, forestry, and rural manufacturing as well as their economic benefits.[3/] Over the last 30 years, GPS-enabled technologies have become a critical and irreplaceable part of our national infrastructure, and they continue to become more deeply ingrained and essential every year. GPS is utilized by federal agencies, state and local governments, first responders, airlines, farmers, pilots, boaters, surveyors, construction workers, and everyday consumers to do their jobs and conduct their lives. In addition, millions of individuals utilize GPS technologies for recreational and personal use.

GPS is particularly important to the commercial agriculture, mining, forestry, and rural manufacturing industries.[4/] For instance, GPS is critical to today's high precision farming techniques that enable farmers to increase crop yields, cost efficiencies, and environmental sustainability through the precise application of seed, water, fertilizers, and pesticides and the efficient use of fuel.[5/] High precision GPS also allows for close coordination of agricultural equipment in the field, greatly reducing costly downtime and delays.[6/] Together these efficiencies decrease consumer costs, benefit rural economies, and support crop production to meet the growing world demand for food.

3/ *See id.* at 9,079.

4/ *See generally* Irv Leveson, *GPS Civilian Economic Value to the U.S.*, Interim Report (v.3), ASRC Federal Research and Technology Solutions, Inc., Aug. 31, 2015 ("GPS Report").

5/ *See, e.g.*, *Trimble Ag Field Solutions*, Trimble, https://agriculture.trimble.com/precision-ag/ (last visited Mar. 22, 2019) (noting that precision agriculture solutions help farmers "operate efficiently, save on input costs, and improve crop performance and productivity"); *Precision Ag Technology*, John Deere, https://www.deere.com/en/technology-products/precision-ag-technology/#/ (last visited Mar. 22, 2019) (explaining that "[s]atellite guidance reduces overlap, saving you time, fuel and inputs").

6/ *See* GPS Report at 12.

Similarly, in open pit mining, GPS is used to guide loaders, dozers, drills, and draglines to within centimeters, ensuring precise cuts of rocks and boulders and minimizing waste.[7/] GPS is also employed in forestry to monitor forest health, facilitate ecological restoration, and reduce fire and other hazards.[8/] Equipment manufacturers likewise rely on GPS technologies to improve worker safety, reduce production delays, and protect manufacturing equipment.

The tremendous penetration of GPS and GPS-based technologies has resulted in widespread economic benefits. One estimate found that GPS provided between $37 and $75 billion dollars in value to the U.S. economy in 2013.[9/] And it found that, of this amount, the benefits of GPS to precision agriculture alone were between $10 and $17 billion.[10/] These economic gains, including job growth, are only expected to increase in the future. In fact, another report has estimated that GPS technology will create $122.4 billion in benefits per year and directly impact more than 5.8 million jobs.[11/]

7/ *See* GPS Report at 14; *see also, e.g.*, Trimble News Release, *Increase Quality, Safety and Productivity with Trimble Groundworks Machine Control System for Drilling and Piling* (Feb. 26, 2019), https://www.trimble.com/news/release.aspx?id=022819a (reporting that its GPS technologies give "contractors the ability to easily and precisely drill to the specified location, depth, orientation and inclination angle").

8/ *See* GPS Report at 13; *see also, e.g.*, *Forestry*, John Deere, https://www.deere.com/en/forestry/ (last visited Mar. 22, 2019).

9/ *See* GPS Report at VII; *see also* GREG MILNER, PINPOINT 100-101 (W.W. Norton & Co. 2016) (explaining that the global market for the "Internet of Things" could reach $1.5 trillion by 2020 and that these cloud-based networks often require GPS technologies).

10/ *See* GPS Report at VIII.

11/ *See* Nam D. Pham, Ph.D., *The Economic Benefits of Commercial GPS Use in the U.S. and the Costs of Potential Disruption*, NDP Consulting (June 2011), http://www.ndpanalytics.com/economic-benefits-gps-us-economy; *see also* Nam D. Pham, Ph.D., *The Economic Benefits of Global Navigation Satellite System and Its Commercial and Non-Commercial Applications*, NDP Analytics (Dec. 2013), http://static1.squarespace.com/static/52850a5ce4b068394a270176/t/52d57f29e4b0dad117c5e3bb/1389723433433/Economic+Impacts+of+GPS+December+2013.pdf (expanding the benefit estimate beyond just commercial applications).

II. EXPANDING MOBILE BROADBAND IN RURAL AREAS IS NECESSARY TO SUPPORT THE VITAL SERVICES THAT GPS PROVIDES

The USDA also requests input on the level and type of growth in spectrum demand that is expected in rural areas, the research and development efforts that are being made to advance access to fixed and mobile wireless technologies in rural areas, and any other relevant factors concerning current and anticipated future spectrum requirements for commercial agriculture, forestry, mining, and rural manufacturing.[12/] To ensure that GPS performance in commercial agriculture and other industries remains robust, the USDA should encourage expanded broadband coverage through the deployment of fixed and wireless broadband facilities in rural areas. As GPSIA and its members have explained to the Federal Communications Commission ("FCC"), adequate rural broadband and wireless coverage will help high precision agriculture and smart farming techniques to meet the demand for greater efficiency and enhanced performance.[13/] Specifically, expediting the deployment of high-speed broadband services, especially wireless and backhaul facilities, to rural areas will support faster and more reliable real-time processing of critical agricultural data, such as information on soil conditions, equipment status, and operational needs. In high precision agriculture, this could significantly increase crop yield and reduce costs and environmental burdens.[14/]

12/ *See NOI* at 9,079.

13/ *See, e.g.*, Comments of Deere & Company, IB Docket No. 11-109; IBFS File Nos. SAT-MOD-20151231-00090; SAT-MOD-20151231-00091; SES-MOD-20151231-00981; SAT-AMD-20180531-00044; SAT-AMD-20180531-00045, at 2 (filed July 9, 2018) ("Deere Comments"); *see also* Comments of the GPS Innovation Alliance, GN Docket No. 13-185, at 2 (filed Sep. 13, 2018) ("The GPSIA supports the Commission's goal to promote expanded wireless broadband services and commends the Commission's efforts to identify the spectrum resources necessary to deliver those services in rural areas as well as in densely populated metropolitan centers.").

14/ *See* Letter from Mark N. Lewellen, Manager, Spectrum Policy, Deere & Company, to Ms. Marlene H. Dortch, WC Docket No. 11-10, at 1 (filed Oct. 24, 2017).

In addition, enhancing mobile broadband connectivity in rural areas is essential for the "smart farming" technologies that will make up today *and* tomorrow's agricultural operations. The National Telecommunications and Information Administration ("NTIA") recently noted that the agricultural industry increasingly relies on precision technologies made possible with GPS and stated that "[t]apping into broadband wireless networks and embedding information technology (IT) devices in farm machinery such as tractors and harvesters, [will] allow farmers to use 'telematics' to optimize machine use for field preparation, precision planting, water optimization, harvesting and overall production efficiency."[15/] And wearables for tracking the whereabouts and health of livestock that will rely on broadband connectivity is also under development.[16/] As several senators have recognized, "[t]he extension of high-speed mobile and backhaul facilities to agricultural croplands and ranch lands must keep pace with the ongoing deployment of technology in the field."[17/]

As part of the Farm Bill signed into law last year, Congress included the Precision Agriculture Connectivity Act.[18/] That bill directs the FCC, in consultation with the USDA, to create a task force to evaluate the broadband connectivity and technology needs of precision agriculture in the U.S. Among other things, the task force is directed to identify and measure current gaps in broadband access on agricultural land and develop policy recommendations to address those gaps.[19/] GPSIA supports those efforts and urges the USDA to recognize the

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15/ Broadband USA Newsletter, *Broadband and Precision Agriculture*, at 1 (June 2018) ("NTIA Newsletter"), https://broadbandusa.ntia.doc.gov/sites/default/files/resource-files/bbusa_newsletter_2018_06june.pdf; *see also* Deere Comments at 2.

16/ *See* NTIA Newsletter at 1.

17/ Letter from Roger F. Wicker and Joe Manchin, III, *et al.*, U.S. Senators, to the Hon. Tom Wheeler, Chairman, FCC, at 1-2 (dated July 17, 2016).

18/ *See* Agriculture Improvement Act of 2018, Pub. L. No. 115-334, § 12511 (2018).

19/ *See id*.

importance of GPS technologies when assessing broadband connectivity and spectrum needs in rural areas. As GPSIA has explained, "[w]hen broadband connectivity and GPS technology are combined together, our nation's farmers win by being able to save time, money and unnecessary waste of critical resources."[20/]

III. ANY CONSIDERATION OF SPECTRUM USES IN RURAL AREAS MUST ENSURE THAT GPS TECHNOLOGIES ARE PROTECTED

Finally, the USDA seeks comment on whether there are certain frequencies that should be protected from interference as it evaluates spectrum use in rural areas.[21/] GPSIA cautions that, in considering spectrum requirements for non-federal spectrum users in rural settings, the USDA must consider the many factors that are implicated by the provision of diverse services in adjacent spectrum bands. In particular, as GPSIA and its members have explained to NTIA and the FCC,[22/] spectrum policies must consider that systems that support *navigation* functions like GPS are sensitive to adjacent-band operations in different ways than systems that operate *communications* services. GPS satellites, which orbit more than 12,000 miles above the earth, rely on solar panels to generate the power needed to send GPS signals back to the ground. As a result, GPS satellites transmit with no more power than a 50-watt light bulb, and signals that are

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20/ GPSIA News Release, *GPSIA Applauds Enactment of Precision Agriculture Provision in Farm Bill* (Dec. 20, 2018), https://www.gpsalliance.org/precision-ag-enacted.

21/ *See NOI* at 9,079.

22/ *See, e.g.*, Comments of the GPS Innovation Alliance, Docket No. 181130999-8999-01, RIN 0660-XC044 (filed Jan. 22, 2019) ("GPSIA NTIA Comments"); Comments of the GPS Innovation Alliance, ET Docket No. 17-340, at 5 (filed Jan. 31, 2018) ("GPSIA 2018 TAC Comments"); Comments of Trimble Inc., IB Docket No. 12-340; IB Docket No. 11-109; IBFS File Nos. SAT-MOD-20151231-00090; SAT-MOD-20151231-00091; SES-MOD-20151231-00981; SAT-AMD-20180531-00044; SAT-AMD-20180531-00045, at 7 (filed July 9, 2018) ("Trimble 2018 Comments"); Letter from F. Michael Swiek, Executive Director, GPSIA, to Marlene H. Dortch, Secretary, FCC, IB Docket No. 12-340; IB Docket No. 11-109; IBFS File Nos. SAT-MOD-20120928-00160; SAT-MOD-20120928-00161; SAT-MOD 20101118-00239; SES-MOD-20121001-00872, at 5 (filed July 13, 2017) ("GPSIA July 2017 *Ex Parte*"); Comments of the GPS Innovation Alliance, ET Docket No. 16-191, at 2 (filed Aug. 11, 2016).

received by GPS devices are at a power level that is less than a millionth of a billionth of a watt – substantially below the thermal noise floor.[23/] GPS receivers must therefore perform an extraordinary engineering feat by extracting these faint signals and delivering a signal to the end user that is accurate, has integrity, and is available and continuous in nature.[24/]

Terrestrial-based communications networks, on the other hand, operate above the thermal noise floor at a significantly higher power level. Indeed, as GPSIA and its members have explained, mobile broadband base stations can transmit (downlink) signals that can be billions of times stronger than GPS signals.[25/] Even mobile broadband handset (uplink) transmissions can be billions of times stronger than GPS satellite signals as received on earth when a mobile handset is transmitting in close proximity to a GPS receiver (for example, when the passenger in the front seat of a car with a GPS navigation system is using his or her cell phone).

Coordination and management of potential interference between such dissimilar uses – *i.e.*, carrier-based mobile broadband operations and the reception of low-power satellite-to-earth transmissions like GPS signals – therefore present a challenging scenario.[26/] Even though GPS receivers are designed to withstand adjacent-band transmissions hundreds of millions of times

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23/ *See, e.g.*, Tim Bartlett, *Threats to GPS from Land-Based Signal Boosters*, POWER AND MOTORYACHT, May 7, 2012, https://www.powerandmotoryacht.com/electronics/understanding-impact-threats-gps-land-based-signal-boosters ("GPS signals come from solar-powered 50-Watt transmitters 12,000 miles out in space."); *see also* Sebastian Anthony, *Think GPS is Cool? IPS Will Blow Your Mind*, EXTREMETECH, Apr., 24, 2012, http://www.extremetech.com/extreme/126843-think-gps-is-cool-ips-will-blow-your-mind ("Detecting a GPS signal on Earth is comparable to detecting the light from a 25-watt bulb from 10,000 miles.").

24/ *See* GPSIA 2018 TAC Comments at 8-9 (explaining that the accuracy, integrity, availability, and continuity requirements of space-based navigation services and safety-of-life systems differ greatly from those of terrestrial high-power communications systems); GPSIA July 2017 *Ex Parte* at 4.

25/ *See, e.g.*, GPSIA NTIA Comments at 4, 6; GPSIA 2018 TAC Comments at 5; Trimble 2018 Comments at 7; GPSIA July 2017 *Ex Parte* at 5; *Improving Federal Spectrum Systems*, 114th Cong. 1, at 2, 4 (Oct. 16, 2015) (written testimony of GPSIA), https://docs.wixstatic.com/ugd/a5ea08_187ad436a8ce470991a8389a9fa189c3.pdf ("GPSIA 2015 Testimony").

26/ *See* GPSIA NTIA Comments at 6-7; GPSIA 2015 Testimony at 4.

stronger than GPS signals, they can easily be degraded by in-band or out-of-band transmissions, particularly if the signals are billions of times stronger.[27/] The co-existence of terrestrial mobile broadband networks and GPS receivers is further complicated by the fact that both mobile broadband networks and GPS operations are effectively ubiquitous from a user standpoint. Consumers take their mobile handsets wherever they go, and with over a half a billion GPS devices in everyday use in the U.S., including GPS receivers in almost every cell phone, GPS satellite signals are available nearly everywhere.

Accordingly, GPSIA has proposed to Congress and NTIA that a "zoning" approach should be utilized to manage different spectrum uses.[28/] A "zoning" approach would group similar services together to the greatest extent possible to minimize the number of band edges or "border areas" where dissimilar uses in close proximity create serious interference challenges. This approach can generally protect navigation services by ensuring that high-powered communications services are separated from services like GPS that require a "quiet neighborhood." GPSIA and its members also continue to believe that spectrum management policies and rules should employ the internationally established criteria of a 1 decibel ("dB") decrease in Carrier-to-Noise Ratio ("C/N_0") as an interference protection criterion.[29/] The 1 dB standard has not only had a long and well-established history in both international and domestic regulatory proceedings of protecting GPS operations from harmful interference, but it also provides the most readily identifiable and predictable metric that will ensure a harmful

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27/ *See* GPSIA NTIA Comments at 7; GPSIA 2015 Testimony at 4.

28/ *See* GPSIA NTIA Comments at 8-9; GPSIA 2015 Testimony at 6.

29/ *See* GPSIA NTIA Comments at 10-16 (explaining that the 1 dB standard measures whether a new service causes a 1 dB degradation in a receiver's C/N_0 or a 25 percent increase in the noise floor); Trimble 2018 Comments at 1-2; GPSIA July 2017 Ex Parte at 3; GPSIA 2015 Testimony at 5.

interference level is prevented in the first place. Consideration of these two approaches will allow GPS to thrive and continue to perform its critical role in serving rural communities and propelling economic growth.

IV. CONCLUSION

GPSIA appreciates that the USDA is evaluating the non-federal spectrum needs of emerging technologies in commercial agriculture, mining, forestry, and rural manufacturing. These industries rely heavily on GPS technologies in rural areas, and the GPS industry is committed to fulfilling their needs. To realize the full benefit of GPS and best serve those industries in the future, the USDA's evaluation must recognize that GPS technologies need greater broadband and wireless coverage in rural areas and the establishment of protection criteria such as spectrum zoning and a 1 dB protection criterion.

Respectfully submitted,

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