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# Drone Zoning

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## DRONE ZONING\*

TROY A. RULE\*\*

*The growing popularity of small civilian drones has generated a wide array of complex and unprecedented regulatory challenges. Many of these challenges, such as keeping drones away from manned aircraft, are matters that the Federal Aviation Administration (“FAA”) is clearly authorized and well equipped to address. However, several other drone policy challenges relate solely to drones’ potential to disrupt landowners’ privacy and to otherwise interfere with activities on the ground. The nature and severity of these conflicts often varies greatly depending on a drone’s specific location; drone uses that are welcomed in some city neighborhoods may be prohibitively disruptive in others. The FAA, a centralized federal agency, lacks the information and resources necessary to effectively regulate these inherently local drone use issues. Recognizing this fact, cities and states are increasingly crafting their own drone laws. Soon, some municipalities might even find it beneficial to adopt drone zoning ordinances that specifically restrict where, when, and under what conditions civilian drones may fly within their jurisdictions. Unfortunately, the FAA has taken the position that it holds extremely broad regulatory authority over nearly every aspect of civilian drone activity—a position that threatens to preclude the development of valuable state and local drone policies. What aspects of drone activity could be better regulated at the state or local level than at the federal level? And what principles should guide municipal governments as they craft drone policies for their own communities? This Article tackles these questions, highlighting the potential merits of greater state and local involvement in drone law and identifying foundational principles*

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*and concepts for the pioneering design of drone zoning ordinances.*

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## INTRODUCTION

Which level of government should have authority to restrict where and when drones may fly above a particular city neighborhood to deliver pizzas or take aerial photos? Should federal regulators have sole power to make these determinations for every community in the country, or should local citizens and officials have a say? And what principles should guide policymaking aimed at addressing conflicts between drones and landowners? Technology often stretches the bounds of existing laws, compelling courts and legislators to confront complicated new policy challenges. Today, this pattern is repeating itself once again as governments face a complex set of issues arising from advancements in civilian unmanned aircraft or “drone” technologies.<sup>1</sup>

Many of the new regulatory challenges associated with civilian drones relate to the risks that these devices can pose to manned aviation and homeland security—risks that the Federal Aviation Administration (“FAA”) and other federal agencies are clearly authorized and well-positioned to handle. Federal regulation is needed both to restrict drone flying near airports, helicopters, military facilities, borders, and other nationally significant places and to keep drones out of the higher-altitude airspace where conventional airplanes fly. Nationwide drone registration programs, which would aid law enforcement officials and others in identifying unlawful drone operators, likewise require federal government involvement.<sup>2</sup> Uniform federal drone manufacturing and performance standards would benefit both the drone industry and consumers by enabling manufacturers to design drones suitable for sale anywhere within the United States.<sup>3</sup>

However, several other new policy questions involving drone technologies relate primarily to drones’ potential to cause localized disturbances to private landowners. For example, in what specific

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1. In this Article, I use the term “civilian” drones to refer to all non-military drones, including both commercial and recreational drones.

2. See *infra* text accompanying notes 156–63.

3. See *infra* text accompanying notes 143–55.

neighborhoods and during what times of day should Amazon be allowed to send drones to deliver packages? Where and when should real estate agents be permitted to use drones to take aerial photographs of homes they are listing for sale? And under what conditions should wedding photographers be authorized to capture drone-assisted footage of an outdoor wedding ceremony? The FAA currently claims that it has preemptive regulatory authority over most of these issues.<sup>4</sup> However, in many contexts, these matters bear little or no relation to protecting manned aviation, establishing national uniform design standards, addressing interstate conflicts, or protecting national interests, so arguments for preemptive federal jurisdiction over these matters seem tenuous at best.<sup>5</sup> And with more and more states and municipalities crafting their own drone use laws, it is increasingly apparent that many questions regarding the scope of the FAA's control over civilian drone activity remain up in the air.<sup>6</sup>

State and municipal governments seem better suited than the federal government to address many of the inherently local issues associated with civilian drones. Drones' impacts on landowners often vary significantly depending on where the drone is flying. For instance, drone activity tends to be far more disruptive over secluded residential backyards and pools than over warehouse buildings in industrial areas.<sup>7</sup> Unfortunately, a large federal agency like the FAA is neither designed nor equipped to engage in the degree of location-sensitive policymaking required to effectively account for these sorts of locational differences in every city in the country.<sup>8</sup> Indeed, broad-brush federal policymaking and enforcement can only take drone regulation so far. At some point, inventive new state and local drone policies will be needed to address those aspects of drone regulation that only landowners and officials with firsthand, neighborhood-level information can efficiently address.

Eventually, some cities might even wish to adopt "drone zoning" laws—ordinances that supplement FAA drone regulations by imposing an additional layer of restrictions on where and when small drones may fly within their municipal boundaries. Cities and counties throughout the country have long employed horizontal zoning

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4. See *infra* note 50 and accompanying text.

5. See *infra* Section II.A.

6. See *infra* notes 173–79 and accompanying text (providing examples of recently enacted state drone statutes); *infra* notes 240–46 and accompanying text (outlining examples of recently enacted local drone ordinances).

7. See *infra* note 271 and accompanying text.

8. See *infra* Section III.C.

techniques to segregate incompatible land uses and cluster synergistic ones in an effort to increase the productivity and value of scarce land resources.<sup>9</sup> Zoning law rests upon the notion that, like a “pig in the parlor instead of the barnyard[,]” certain land uses may be perfectly acceptable in some locations within a city and yet be prohibitively disruptive in others.<sup>10</sup> This truism applies equally to civilian drone flights. Accordingly, municipal drone zoning ordinances offer a potentially powerful way for cities to accommodate valuable drone uses within their boundaries without unduly compromising the safety and privacy interests of local citizens.

This Article sets forth legal and normative arguments favoring greater state and local involvement in civilian drone regulation and offers some foundational principles for this emerging area of law. Part I highlights the recent growth of the civilian drone industry and describes why it would be difficult for an almost exclusively federal regulatory structure to effectively govern the nation’s increasing volume of conflicts between drone operators and landowners. Part II analyzes the complicated federal preemption questions associated with drone regulation, ultimately arguing that many types of state and local drone laws are legally defensible and are vital to generating efficient policy outcomes. Part III delineates those aspects of drone regulation that seem best suited for governance at the federal, state, and local government levels, respectively. Part IV then applies basic microeconomics to identify some guiding principles for the structuring of drone use ordinances capable of promoting more optimal use of the low-altitude airspace above cities and towns as drone technologies mature and spread throughout the world.

### I. THE RISE OF SMALL DRONES

The civilian drone industry has taken off in dramatic fashion in recent years. Over the past decade, the industry has blossomed from a niche hobby market into one of the most rapidly expanding markets in the world. Global sales of small drones increased by 167% from 2013 to 2015, and sales are only expected to continue to climb over

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9. Mona Qureshi & Robin King, *3 Ways Land-Use Planning and Zoning Can Increase Urban Density*, THECITYFIX (Aug. 18, 2015), <http://thecityfix.com/blog/three-ways-land-use-planning-zoning-can-increase-urban-density-mona-qureshi-robin-king/> [https://perma.cc/C9KF-NXDY].

10. Justice George Sutherland is credited with first drawing this analogy between land uses and farm animals in the famous *Village of Euclid* opinion, in which the United States Supreme Court generally upheld the facial constitutionality of modern zoning laws. *Vill. of Euclid v. Ambler Realty Co.*, 272 U.S. 365, 388 (1926).

the next several years.<sup>11</sup> These futuristic flying devices, which are also termed “unmanned aircraft systems”<sup>12</sup> or “unmanned aerial vehicles,”<sup>13</sup> come in a wide variety of sizes and models.<sup>14</sup> Unlike the large military drones that have grown increasingly instrumental in overseas warfare,<sup>15</sup> most civilian drones weigh a few dozen pounds or less and are designed for commercial and recreational uses.<sup>16</sup>

#### A. *Soaring Popularity and a Growing List of Commercial Uses*

Markets for both recreational and commercial drones are expanding at breakneck pace. Major retailers now stock their shelves with recreational drones and actively market them alongside more familiar electronic devices.<sup>17</sup> For a few hundred dollars or less, one

11. FED. AVIATION ADMIN., FAA AEROSPACE FORECAST: FISCAL YEARS 2016–2036, at 31–32 (2016), [https://www.faa.gov/data\\_research/aviation/aerospace\\_forecasts/media/FY2016-36\\_FAA\\_Aerospace\\_Forecast.pdf](https://www.faa.gov/data_research/aviation/aerospace_forecasts/media/FY2016-36_FAA_Aerospace_Forecast.pdf) [<https://perma.cc/3UMS-986S>]; Paul Bedard, *Drone Sales Surge 167% to 4.3 Million, U.S. Leads but China Catching Up*, WASH. EXAMINER (May 29, 2015, 12:31 PM), <http://www.washingtonexaminer.com/drone-sales-surge-167-to-4.3-million-u.s.-leads-but-china-catching-up/article/2565240> [<http://perma.cc/Q5LE-ZJMP>].

12. See, e.g., *Unmanned Aircraft Systems*, FED. AVIATION ADMIN., <https://www.faa.gov/uas/> [<https://perma.cc/T346-YF62>] (last modified Aug. 29, 2016, 2:20:13 PM) (demonstrating that “unmanned aircraft system” is the term the FAA commonly uses to describe a small civilian drone).

13. See, e.g., John Horgan, *The Drones Come Home*, NAT’L GEOGRAPHIC, Mar. 2013, at 125 (stating that “drone advocates... generally prefer the term UAV, for unmanned aerial vehicle”). Drones have even more labels than those already identified.

14. See ASS’N FOR UNMANNED VEHICLE SYS. INT’L, <http://www.auvsi.org/home> [<http://perma.cc/D7UL-ZU6Z>] (providing an example of a large, global nonprofit association focused on advancing the civilian drone community, including by offering an unmanned systems and robotics directory and describing drone devices using various popular terms, including “unmanned systems” and “unmanned airborne surveillance”).

15. The primary legal issues related to military drones are markedly different from civilian drone questions and fall outside the scope of this Article. See generally Oren Gross, *The New Way of War: Is There a Duty to Use Drones?*, 67 FLA. L. REV. 1 (2015) (providing an introductory description of military drones).

16. See Jack Nicas & Colum Murphy, *Who Builds the World’s Most Popular Drones?*, WALL ST. J. (Nov. 10, 2014, 1:54 PM), <http://www.wsj.com/articles/who-builds-the-worlds-most-popular-drones-1415645659> (describing China-based DJI as “the world’s biggest consumer drone maker by revenue, selling thousands of its 2.8-pound, square-foot devices for about \$1,000 each” and portraying the ubiquity of DJI’s Phantom series of drones as comparable to that of Ford’s Model T in the early development of the automobile industry).

17. See, e.g., Sarah Nassauer, *Sam’s Club Bets Drones Will Fly off the Shelves at Christmas*, WALL ST. J. (June 8, 2015, 4:25 PM), <http://www.wsj.com/articles/sams-club-bets-drones-will-fly-off-the-shelves-at-christmas-1433795119> (reporting that, for the 2015 holiday shopping season, retailer Sam’s Club “plans to stock about a dozen [drones]—from \$100 models to \$4,000 versions with high resolution cameras or the ability to pick up small objects”); see also Rick Aristotle Munarriz, *A Drone Comes to Rescue Best Buy*, AOL. (Apr. 23, 2015, 6:00 AM), <http://www.aol.com/article/2015/04/23/drone-could-rescue-best-buy/21174684/> [<http://perma.cc/Q2FT-LVSV>] (describing retailer Best Buy’s preparations

can easily purchase a ready-to-fly drone equipped with a high-definition camera and zoom lens capable of capturing aerial photos and video previously attainable only aboard airplanes or helicopters.<sup>18</sup> In part because of this burgeoning retail market, some commentators predict that there will be more than one million drone flights per day in the United States by the year 2035.<sup>19</sup>

Commercial enterprises are also showing increasing interest in the wide range of potentially valuable applications of drone technologies. The agricultural industry is abuzz over the prospective cost savings and safety advantages of using drones for crop dusting<sup>20</sup> and surveying.<sup>21</sup> Amazon and other companies are actively pursuing plans to use drones for product deliveries.<sup>22</sup> Popular interest in drone-

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to begin selling drones in its brick and mortar stores as part of the company's turnaround plan); *Photography Drones*, AMAZON, <http://www.amazon.com/b?node=9699105011> [<http://perma.cc/EQ9F-BBNM>] (showing Amazon's online retail presence for civilian drones).

18. See Jim Fisher, *The Best Drones of 2016*, PCMAG.COM (Aug. 2, 2016), <http://www.pcmag.com/roundup/337251/the-best-drones> [<http://perma.cc/C3JJ-U6QX>] (reviewing several high-performing recreational drones that are available on the mainstream retail market).

19. Andrew Wood, *Are There Enough Drone Laws for the Coming Drone Wars?*, CNBC (May 29, 2015, 11:00 AM), <http://www.cnbc.com/2015/05/29/drones-and-drone-laws-are-starting-to-take-off.html> [<http://perma.cc/GQY9-N6RD>] (citing a study by the Consumer Electronics Association); *CEA Research: UAS Could Reach 1 Million U.S. Flights a Day in 20 Years*, CONSUMER TECH. ASS'N (May 5, 2015), <https://www.ce.org/News/News-Releases/Press-Releases/2015-Press-Releases/CEA-Research-UAS-Could-Reach-1-Million-U-S-Flights.aspx> [<http://perma.cc/E77S-89PD>].

20. Quinten Plummer, *FAA Approves Yamaha RMAX Drone to Spray Crops in U.S.*, TECH TIMES (May 6, 2015, 9:27 AM), <http://www.techtimes.com/articles/51049/20150506/faa-approves-yamaha-rmax-drone-to-spray-crops-in-u-s.htm> [<http://perma.cc/F2AX-V7VE>] (describing the FAA's grant of an exemption for the use of a type of Yamaha-produced drone to "disperse tanks of fertilizer and pesticides across large swathes of land"); see also Luke Runyon, *Monsanto, World's Largest Seed Company, Sets off a Corporate 'Feeding Frenzy'*, NEB. EDUC. TELECOMMS. (Aug. 17, 2015, 6:45 AM), <http://netnebraska.org/article/news/986002/monsanto-worlds-largest-seed-company-sets-corporate-feeding-frenzy> [<http://perma.cc/48YU-PRQK>] (noting that Monsanto has "started looking at how drones can be deployed on farms").

21. See Clay Dillow, *Why 2015 Is the Year Agriculture Drones Take off*, FORTUNE (May 18, 2015, 5:02 PM), <http://fortune.com/2015/05/18/drone-agriculture/> [<http://perma.cc/7UCQ-LX9W>] (describing some agricultural companies' plans to use drones to assist in crop monitoring and data gathering as a means of boosting crop yields).

22. See, e.g., Jordan Golson, *Patent Application Reveals New Details About Amazon's Drone*, WIRED (May 15, 2015, 7:32 PM), <http://www.wired.com/2015/05/patent-application-reveals-new-details-amazons-drone/> [<http://perma.cc/N6ZU-8AZV>] (describing Amazon's patent application for an elaborate aerial delivery system using drone technologies); see also *Delivery by Drone in 30 Minutes? Amazon Says It's Coming*, L.A. TIMES (June 17, 2015, 2:29 PM), <http://www.latimes.com/business/la-fi-amazon-drones-20150617-story.html> [<https://perma.cc/2JVN-NC3A>] (describing Amazon's plans to use drones to quickly deliver consumer products); Jack Nicas & Greg Bensinger, *Delivery Drones Hit Bumps on Path to Doorstep*, WALL ST. J. (Mar. 20, 2015, 12:04 PM), <http://www.wsj.com/articles/technical-hurdles-delay-drone-deliveries-1426867441> (describing drone delivery research

assisted real estate photography<sup>23</sup> and wedding photography<sup>24</sup> continues to grow. Additionally, companies are using drones to help monitor railway systems,<sup>25</sup> pipelines,<sup>26</sup> power lines,<sup>27</sup> and other infrastructure.

### B. *An Overwhelmed FAA*

The recent proliferation of civilian drones throughout the country has brought with it a wide range of new policy issues. Some of these issues relate to the threat of hazardous collisions between drones and conventional aircraft.<sup>28</sup> However, many other issues stem from the growing incidence of conflicts between civilian drones and activities on the ground. Individuals flying camera-fitted drones above residential neighborhoods have disturbed sunbathers in their private yards.<sup>29</sup> Sports fans have flown drones into stadiums and interfered

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conducted by Amazon.com, Inc., Alibaba Group Holding Ltd., Deutsche Post DHL, Google, and other companies).

23. See Amrita Jayakumar, *Using Drones to Sell Homes—Except in Washington*, WASH. POST (Feb. 9, 2015), [http://www.washingtonpost.com/business/on-it/using-drones-to-sell-homes-except-in-washington/2015/02/06/06f69320-a573-11e4-a06b-9df2002b86a0\\_story.html](http://www.washingtonpost.com/business/on-it/using-drones-to-sell-homes-except-in-washington/2015/02/06/06f69320-a573-11e4-a06b-9df2002b86a0_story.html) [<https://perma.cc/ZH2D-G466>] (“Real estate agents across the country have become enthusiastic adopters of drone technology, using the lightweight, camera-equipped quadcopters to get creative with their marketing material.”).

24. See Matt McFarland, *Drones: The Next Big Thing in Wedding Photography, or a Tacky Intrusion?*, WASH. POST (Feb. 24, 2015), <https://www.washingtonpost.com/news/innovations/wp/2015/02/24/drones-the-next-big-thing-in-wedding-photography-or-a-tacky-intrusion/> [<http://perma.cc/U9J7-7Y7N>] (“Drones outfitted with a camera are increasingly being used to document weddings as couples are drawn to the unique aerial perspective.”).

25. See David Z. Morris, *Why BNSF Railway Is Using Drones to Inspect Thousands of Miles of Rail Lines*, FORTUNE (May 29, 2015, 2:18 PM), <http://fortune.com/2015/05/29/bnsf-drone-program/> [<http://perma.cc/QH6Q-PQZ4>] (describing BNSF Railway’s receipt of FAA approval to use drones to more cheaply inspect its rail system to prevent derailments and other potential safety problems).

26. See Jack Nicas, *FAA Gives Approval to BP to Use Commercial Drones*, WALL ST. J. (June 10, 2014, 9:00 AM) <http://www.wsj.com/articles/bp-launches-landmark-drone-program-in-alaska-1402404549> (describing the FAA’s grant of regulatory approval for BP to use drones to inspect its oil fields and pipelines near Prudhoe Bay, Alaska).

27. See Rebecca Smith, *Utilities Turn to Drones to Inspect Power Lines and Pipelines*, WALL ST. J. (May 5, 2015, 11:04 PM), <http://www.wsj.com/articles/utilities-turn-to-drones-to-inspect-power-lines-and-pipelines-1430881491> (noting that “unmanned aerial systems can have tremendous value for utilities and other companies that must regularly inspect hard-to-reach equipment”).

28. See Ashley Halsey III, *\$1.9 Million Fine Proposed for Firm’s Drone Activities*, WASH. POST, Oct. 7, 2015, at A17 (“As of Sept. 27, the FAA had logged 920 reports of drone sightings [in 2015]—most coming from commercial or general-aviation pilots.”); Craig Whitlock, *Rogue Drones Clogging U.S. Airspace*, WASH. POST, Aug. 21, 2015, at A1 (describing more than seventy near encounters between drones and airplanes in the United States during the first twenty days of August 2015).

29. See Tara Evans, *Neighbors Complain of Drones Flying over Winter Park Back Yards*, CLICKORLANDO.COM (May 7, 2015, 8:33 AM), <http://www.clickorlando.com>

with athletic events.<sup>30</sup> Drones have crashed into houses<sup>31</sup> and into spectators at public parades<sup>32</sup> and festivals.<sup>33</sup> Individuals have also intentionally sought to ground unwelcome drones hovering near building fires,<sup>34</sup> next to large arenas,<sup>35</sup> or just outside their homes.<sup>36</sup> Because the widespread use of civilian drone technologies is so new, there are relatively few legal rules in place to address these conflicts.<sup>37</sup>

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/news/florida/orange-county/neighbors-complain-of-drones-flying-over-winter-park-back-yards [http://perma.cc/UR8W-DQYN] (quoting a Florida resident alleging that a drone flying in her neighborhood was “recording the teenager across the street, who lays out in her front yard in her bikini”); Harriet Thurley, *Flying Drone Films Woman Sunbathing in Her Garden*, COSMOPOLITAN (May 26, 2015), <http://www.cosmopolitan.co.uk/reports/news/a35960/drone-films-woman-sunbathing/> [https://perma.cc/6E6J-N2YU] (adding that “Selena Gomez, Rihanna, Anne Hathaway and Jennifer Garner have also been bothered” by drones).

30. See, e.g., Craig Whitlock, *Rogue Drones at Sports Events Propel Concerns About Safety*, WASH. POST, Nov. 10, 2014, at A1 (noting that between August 2014 and November 2014, “at least a half-dozen” drone sightings were reported at college or NFL football games); Melanie Burney, *Drone Spotted at Stadium During Phillies Game*, PHILLY.COM (June 2, 2015), [http://articles.philly.com/2015-06-02/news/62926148\\_1\\_phillies-game-drone-third-base-gate](http://articles.philly.com/2015-06-02/news/62926148_1_phillies-game-drone-third-base-gate) [https://perma.cc/F56T-YY5Q] (describing a flying drone inside the stadium at a Philadelphia Phillies Major League Baseball game); Margaret Harding, *FAA Investigating Drone Spotted Flying Above Pirates Game at PNC Park*, TRIBLIVE (June 27, 2014, 4:41 PM), <http://triblive.com/news/adminpage/6357452-74/game-drone-park> [https://perma.cc/F56T-YY5Q] (reporting on a drone flying over a Pittsburgh Pirates game).

31. See Jenna Portnoy, *Drone Airspace: A Legal Frontier*, WASH. POST, July 15, 2015, at B1 (describing a drone’s collision into the front of a residential home in Fairfax County, Virginia).

32. See Steve Annear, *Drone Crashes on Parade Spectator in Marblehead*, BOS. GLOBE (May 26, 2015), <https://www.bostonglobe.com/metro/2015/05/26/drone-crashes-down-spectator-during-memorial-day-parade/Uft2MohBZ9ZQZU49EcLsXN/story.html> [https://perma.cc/DM5X-C5UG].

33. See Haley Rush, *Drone Hits Person at Albuquerque Festival*, KRQE NEWS 13 (June 14, 2015, 10:49 PM), <http://krqe.com/2015/06/14/drone-hits-person-at-albuquerque-festival/> [https://perma.cc/U78B-9SK4].

34. See Michael Franco, *Watch Firefighters Blast Drone out of Sky with Hose*, CNET (June 10, 2015, 10:22 AM), <http://www.cnet.com/news/watch-firefighters-blast-drone-out-of-sky-with-hose/> [https://perma.cc/P9CK-U9LF] (describing firefighters’ seemingly intentional use of a fire hose to spray a drone and prevent it from recording a house fire).

35. See Joseph Serna & Brian Bennett, *Mystery Surrounds Drone That Flew Above L.A. Kings Victory Party*, L.A. TIMES (June 16, 2014, 3:19 PM), <http://www.latimes.com/local/lanow/la-me-ln-kings-game-drone-no-owner-20140616-story.html> [https://perma.cc/7CUR-B4MR0].

36. See Douglas Ernst, *Ky. Man Arrested After Shooting Down \$1,800 Drone Hovering over Sunbathing Daughter*, WASH. TIMES (July 30, 2015), <http://www.washingtontimes.com/news/2015/jul/30/william-merideth-arrested-after-shooting-down-1800/> [https://perma.cc/27XL-69DU]; Jordan Graham, *Huntington Beach Man Swats, Destroys \$1,350 Drone with His T-Shirt*, ORANGE CTY. REG. (June 6, 2015, 7:55 PM), <http://www.ocregister.com/articles/drone-664910-flying-beach.html> [https://perma.cc/5Y2K-9ZWH].

37. See Frank Vallese, *New Rules Fuel the Growth of the Commercial Drone Industry*, TECHCRUNCH (Aug. 5, 2016), <https://techcrunch.com/2016/08/05/new-rules-fuel-the-growth>

Aware of the escalating need for laws to govern the domestic drone industry, Congress enacted provisions in the FAA Modernization and Reform Act of 2012 (“FMRA”) that instruct the Secretary of Transportation to develop a regulatory structure for the domestic drone industry.<sup>38</sup> Since then, the FAA, which operates within the United States Department of Transportation, has been diligently working to formulate policies capable of facilitating safe and orderly civilian drone activity.<sup>39</sup> Unfortunately, despite its steady efforts, sophistication, and long history of regulating manned flight,<sup>40</sup> the FAA has failed to meet statutory deadlines for regulating drone technologies.<sup>41</sup> Meanwhile, thousands of potential commercial drone technology users in the United States have had to wait on the sidelines.<sup>42</sup> By one estimate, the agency’s delays were costing the nation \$27 million in economic impact per day.<sup>43</sup>

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-of-the-commercial-drone-industry/ [https://perma.cc/9CDD-MN2C] (“The view from the industry is that the FAA’s final rules will successfully fuel the proliferation of drone technology for non-recreational applications.”); *infra* notes 183–85 and accompanying text.

38. FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, § 332(a)(1), 126 Stat. 11, 73 (2012) (providing that the FAA shall “develop a comprehensive plan to safely accelerate the integration of civil unmanned aircraft systems into the national airspace system”).

39. *Id.* § 332(a)(3), 126 Stat. at 73 (requiring the FAA to develop such policies “as soon as practicable”).

40. See Jeffrey A. Berger, Comment, *Phoenix Grounded: The Impact of the Supreme Court’s Changing Preemption Doctrine on State and Local Impediments to Airport Expansion*, 97 NW. U. L. REV. 941, 963–67 (2003) (providing a detailed summary of the history of regulating manned flight).

41. See FAA Modernization and Reform Act of 2012 § 332(a)(3)(1), 126 Stat. at 73–74 (identifying the deadline for the FAA to create a plan for the “integration of civil unmanned aircraft systems into the national airspace system”); Henry H. Perritt, Jr. & Eliot O. Sprague, *Law Abiding Drones*, 16 COLUM. SCI. & TECH. L. REV. 385, 400 (2015) (same); Keith Wagstaff, *FAA Misses Deadline for Creating Drone Regulations*, NBC NEWS (Oct. 1, 2015, 3:29 PM), <http://www.nbcnews.com/tech/innovation/faa-misses-deadline-creating-drone-regulations-n437016> [https://perma.cc/8BV4-2XFH] (reporting that the FAA had “failed to meet” its September 2015 deadline for creating a national drone regulatory structure).

42. See, e.g., John Goglia, *FAA Speeds up Small Drone Exemptions. But Why Not Just Issue Blanket Exemption?*, FORBES (Apr. 12, 2015, 8:45 AM), <http://www.forbes.com/sites/johngoglia/2015/04/12/faa-speeds-up-small-drone-exemptions-but-why-not-just-issue-blanket-exemption/#1437f8b24132> [https://perma.cc/5WJZ-6VUX] (describing the FAA’s initiation of a summary grant process to accelerate its issuance of section 333 exemptions for commercial drone uses and noting that, as a result, the agency meagerly increased to a pace of just thirty such exemptions per week, “highlight[ing] the FAA’s problem in regulating small drones on an individual basis . . . that are growing in popularity by the thousands or even tens of thousands”).

43. See Matt Grosack, *Stakes Are High for Domestic Drone Industry*, DAILY BUS. REV. (May 28, 2015), <http://www.dailybusinessreview.com/id=1202727703584/Stakes-Are-High-for-Domestic-Drone-Industry?slreturn=20160902140903> (citing figures from an economic report by the Association for Unmanned Vehicle Systems International).

C. *The FAA's Attempts to Fly Solo*

Rather than actively inviting state and local governments to join in forming a coordinated drone regulatory system to address these new and perplexing policy challenges, the FAA has thus far largely opted to regulate drones on its own. Unfortunately, as civilian drone use has expanded throughout the country, the nation's burgeoning volume of drone activity has made it increasingly impractical and inefficient for the agency alone to carry this ever-growing regulatory burden.<sup>44</sup>

In some instances, the FAA has responded to the growing volume of drone regulatory work by proposing wide-sweeping rules that strictly prohibit certain drone activities regardless of location.<sup>45</sup> In other instances, the FAA has taken a converse approach, weakening certain drone regulations in ways that reduce the agency's need to consider the locations where drones are proposed to fly.<sup>46</sup> Regrettably, despite these and other efforts, the FAA continues to have difficulty keeping up with the rapidly expanding drone industry. Its struggles were on display once again in late 2015 as the agency

44. See Ben Popper, *FAA Misses Deadline to Broadly Legalize Commercial Drones*, THE VERGE (Oct. 1, 2015, 12:02 PM), <http://www.theverge.com/2015/10/1/9432353/faa-misses-congressional-deadline-to-integrate-drones> [https://perma.cc/9S9S-MTBW] (noting that the FAA had granted more than 1,000 section 333 exemptions but that the “backlog of applicants is building”).

45. The FAA's long-awaited notice of proposed rulemaking (“NPRM”) on small commercial drones (released in February 2015) proposed multiple drone restrictions that give little or no consideration to the location where a drone is flying. See *Operation and Certification of Small Unmanned Aircraft Systems*, 80 Fed. Reg. 9544, 9544–46 (proposed Feb. 23, 2015) (to be codified at 14 C.F.R. pt. 107). For example, the NPRM proposed prohibitions on flying drones directly above individuals who are uninvolved with the drone flight and prohibitions on flying drones beyond the operator's or other designated observer's visual line of sight, even in areas where there are no people or potential hazards below. See *id.*; see also Steven Miller & Nicole Witt, *The Wild West of Commercial Drones—Why 2015 Could Be a Pivotal Year in California*, 38 CAL. PUB. L.J., no. 2, Spring 2015, at 1, 3–4 (summarizing major restrictions proposed in the February 2015 NPRM).

46. See, e.g., WILLIAM V. O'CONNOR ET AL., MORRISON & FOERSTER LLP, CLIENT ALERT: DRONES: FAA ANNOUNCES PATHFINDER PROGRAM TO EXPLORE BVLOS AND URBAN DRONE OPERATIONS 1 (May 22, 2015), <https://media2.mofo.com/documents/150522dronefaapathfinder.pdf> [https://perma.cc/RJZ6-2TV9] (stating that in March of 2015, the FAA began issuing broad “blanket” certificates of authorization (“COAs”) to dozens of drone operators who had previously received certain FAA exemptions). Recipients of these new COAs may operate their drones “anywhere in the country except restricted airspace and other areas, such as major cities, where the FAA prohibits [drone] operations.” See *FAA Streamlines UAS COAs for Section 333*, FED. AVIATION ADMIN., [http://www.faa.gov/news/updates/?newsId=82245&omniRss=news\\_updatesAoc&cid=101\\_N\\_U](http://www.faa.gov/news/updates/?newsId=82245&omniRss=news_updatesAoc&cid=101_N_U) [https://perma.cc/2Q6J-WXVT] (last modified Mar. 24, 2015, 12:46:43 PM). These blanket COAs essentially convert authorizations to fly drones in specific geographic areas into authorizations to fly them almost anywhere in the United States. *Id.*

scrambled to put a drone registration regime into place before the holiday season, when retailers in the United States anticipated selling hundreds of thousands of small drones.<sup>47</sup> As the agency hastily rolled out its registration system, critics expressed concerns about the FAA's use of an expedited rulemaking process and panned the FAA for not initiating action much sooner.<sup>48</sup>

## II. DRONES AND FEDERAL PREEMPTION

While waiting for the FAA to formulate a federal drone regulatory scheme, many states and municipalities have grown increasingly impatient and have begun to enact their own drone use restrictions.<sup>49</sup> Aware of this uptick in state and local drone laws, the FAA's Office of the Chief Counsel issued a fact sheet in December 2015 reiterating the agency's bold position that it holds broad authority to preempt nearly all forms of state and local drone restrictions.<sup>50</sup> Although statutory language in section 336 of the FMRA that took effect in August 2016 has led the FAA to be somewhat more light-handed in regulating recreational drones, the FAA continues to assert broad preemptive authority over both recreational and commercial drone uses.<sup>51</sup>

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47. See Craig Whitlock, *In Shift, FAA Will Require Drones to Be Registered*, WASH. POST, Oct. 20, 2015, at A1 (reporting on the FAA's plan to form a task force to generate recommendations on a drone registration system and noting that American consumers were expected to purchase more than 700,000 drones in 2015).

48. See, e.g., Eli Dourado, *The Government Is Rushing out an Ill-Conceived Plan to Regulate Consumer Drones*, VOX (Nov. 12, 2015, 8:30 AM), <http://www.vox.com/2015/11/12/9716350/drones-obama-faa-christmas> [<https://perma.cc/6NC2-43ZF>] (arguing that the FAA's perceived time pressure in getting registration rules into place is "entirely self-imposed" and noting that, "[i]n the past, courts have rejected the argument that the urgent need to take action constitutes good cause for dispensing with notice and comment when agencies themselves contributed to that urgency through prolonged inaction").

49. See *infra* notes 173–79, 240–46 and accompanying text.

50. See generally FED. AVIATION ADMIN., OFFICE OF THE CHIEF COUNSEL, STATE AND LOCAL REGULATION OF UNMANNED AIRCRAFT SYSTEMS (UAS) FACT SHEET 1 (Dec. 17, 2015), [https://www.faa.gov/news/updates/?newsId=84369&omniRss=news\\_updatesAoc&cid=101\\_N\\_U](https://www.faa.gov/news/updates/?newsId=84369&omniRss=news_updatesAoc&cid=101_N_U) [<https://perma.cc/3M7S-HXQ5>] (explaining the FAA's regulatory framework). The December 2015 fact sheet only lists four specific examples of drone-related regulations falling within the "police power" of state and local governments: (1) requirements that police obtain warrants before using drones for surveillance; (2) prohibitions against drone-assisted "voyeurism"; (3) prohibitions against drone-assisted hunting or fishing or the use of drones to harass individuals who are hunting or fishing; and (4) prohibitions on attaching weapons or firearms to drones. *Id.* at 3.

51. The FAA's statements have also generated confusion regarding the extent to which the agency's authority over commercial drone use exceeds its authority over recreational drone use. Congress has seemingly directed that the FAA treat these two uses differently, and yet the agency's own position on those differences is somewhat unclear. Compare Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg.

Given the unsettled nature of this debate, any serious discussion about potential state and municipal roles in drone regulation must therefore begin with an analysis of the federal preemption questions that plague this evolving area of the law.

A simple example helps to highlight the great importance of federal preemption issues to the future of drone regulation. Suppose that the city council of Sunnyville, a hypothetical city in the United States, adopted an ordinance restricting civilian drone flying over certain neighborhoods where drones had been disrupting residents' enjoyment of backyard patios and swimming pools.<sup>52</sup> Suppose further that, shortly after Sunnyville's new drone ordinance became effective, a large corporation received FAA authorization to make drone deliveries throughout much of the United States—including Sunnyville—so long as the company followed FAA rules. Then suppose this powerful company, relying on this FAA authorization,

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42,064, 42,081 (June 28, 2016) (to be codified at 14 C.F.R. pt. 107) (expressly excluding recreational drones from having to follow the requirements that small commercial drones must follow), *with* FED. AVIATION ADMIN., *supra* note 50, at 1–3 (describing a regulatory framework for the FAA's authority over drone usage that fails to distinguish between commercial and recreational drone use). The FAA's Small UAS Rule Part 107, for example, sets forth extensive rules for the operation of small commercial drones, including rules related to registration, pilot certification, visual line-of-sight requirements, and operational limitations. *See* Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,064–194. Operators who fly drones for recreational use, however, can choose whether they want to meet the requirements set forth under Part 107, or instead follow the less burdensome section 336 of the FMRA. *See* FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, § 336, 126 Stat. 11, 77–78 (2012); Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,064–194. Additionally, section 336 of the FMRA expressly prohibits the FAA from “promulgat[ing] any rule or regulation” regarding certain recreational drones, while also providing several exceptions to this rule, including allowing the FAA to pursue enforcement actions against those who “endanger the safety of the national airspace system.” FAA Modernization and Reform Act of 2012 § 336. The FMRA's Special Rules for Model Aircraft—which govern recreational use, specifically—also require drone operators to follow a community-based set of safety guidelines, implying to some degree that Congress does not intend for the FAA to preempt local authority over recreational drone use, at least. FAA Modernization and Reform Act of 2012 § 336. However, the FAA does purport to regulate recreational drones under the August 2016 “Registration and Marking Requirements for Small Unmanned Aircraft,” seemingly under its authority over air safety. Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. at 42,064–194. Although both Congress and the FAA appear to limit federal regulation of drone use, especially recreational drone use, the existence of exceptions allowing for more FAA regulation, the promulgation of new FAA rules, and the FAA's repeated assertions that it holds broad authority continue to cause confusion about the extent of state and local government authority in this area.

52. Such an ordinance is not purely theoretical. Multiple cities across the country have contemplated adopting local restrictions on drone use over the past few years, and some have already done so. *See infra* notes 173–79, 240–46 and accompanying text.

began flying its drones over parts of Sunnyville where commercial drone use was expressly restricted under the city ordinance. Under this set of facts, would the FAA's grant of authorization preempt Sunnyville's local ordinance, enabling the company to fly commercial drones freely within areas restricted under the ordinance? And, as a matter of policy, *should* FAA rules trump state or local laws in this context?

Unfortunately, Congress has not provided definitive guidance regarding the degree to which FAA rules should preempt state and local drone laws. The general case law governing federal implied preemption is inconclusive at best.<sup>53</sup> Multiple commentators have briefly weighed in on federal preemption questions relating to drone regulation,<sup>54</sup> and the FAA has expressed its own views on the topic,<sup>55</sup> but courts have yet to squarely address these issues. If the FAA indeed has broad power to preempt even the hypothetical Sunnyville ordinance described above, discussions like those in this Article about the potential roles of states and municipalities in drone regulation could have limited practical value. Accordingly, this Part includes rigorous legal and normative analyses of drone law preemption issues. The analyses ultimately suggests that a well-structured federal, state, and local drone regulatory system is legally defensible and could be far more efficient and effective than a purely federal regime.

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53. Other legal scholars have commented on the complexity and uncertainty surrounding federal preemption law. *See, e.g.*, Jamelle C. Sharpe, *Toward (A) Faithful Agency in the Supreme Court's Preemption Jurisprudence*, 18 GEO. MASON L. REV. 367, 367 (2011) ("Preemption has become one of the most frequently recurring and perplexing public law issues facing the federal courts today.").

54. *See, e.g.*, Margot E. Kaminski, *Drone Federalism: Civilian Drones and the Things They Carry*, 4 CALIF. L. REV. CIR. 57, 73 (2013) (observing that "FAA regulation of small, low-flying drones does not preclude all state regulation" and that "Congress has not created express statutory preemption of laws governing aerial surveillance, and has even expressly nodded to exceptions to federal preemption in the field of aviation"); Miller & Witt, *supra* note 45, at 6 (stating that it remains "unclear the extent to which a local agency will be able to regulate the manner in which drones are used within their jurisdictions" as a result of federal preemption uncertainty); Perritt & Sprague, *supra* note 41, at 437-39 (noting that "[d]rones present special challenges to simple extrapolation of traditional federal preemption doctrine in the aviation field" and advocating that state and local governments "have the power to regulate" drone operations occurring below an airspace floor designated by the FAA).

55. FED. AVIATION ADMIN., *supra* note 50, at 1 (providing information to states and localities regarding federal drone regulations and suggesting "careful[] consider[ation] prior to any [state] legislative action to ensure that [state laws] are consistent with applicable federal safety regulations").

A. *Drone Law Preemption: A Legal Perspective*

The FAA clearly possesses a substantial amount of regulatory authority over civilian drone activity, at least within “navigable airspace” and as the activity relates to “air safety” or “air commerce.”<sup>56</sup> But, as a legal matter, which aspects of drone regulation fall exclusively within the FAA’s control? Tackling this question requires analysis under three main preemption theories: express preemption, field preemption, and conflict preemption.<sup>57</sup>

1. No Express Federal Preemption

The federal government’s authority to preempt state and local law generally derives from the supremacy clause—a provision in the United States Constitution declaring that all federal laws “shall be the supreme Law of the Land” and that “the Judges in every State shall be bound thereby, any Thing in the Constitution or Laws of any State to the Contrary notwithstanding.”<sup>58</sup> The most straightforward applications of this clause arise when Congress has enacted a federal statute with language expressly preempting state or local laws.<sup>59</sup> In those contexts, the state and local laws at issue are expressly preempted: Congress’s preemption language renders them “null, void, invalid and inoperative.”<sup>60</sup>

Unfortunately, preemption questions can be much more difficult and contentious in areas such as civilian drone law, where no express federal statutory preemption language exists.<sup>61</sup> Congress has not

56. See 49 U.S.C. §§ 40103(b)(1), 40104 (2012) (directing the FAA to “develop plans and policy for the use of the navigable airspace and assign by regulation or order the use of the airspace necessary to ensure the safety of aircraft and the efficient use of airspace” and describing the FAA’s authority over air commerce).

57. Stephen A. Gardbaum, *The Nature of Preemption*, 79 CORNELL L. REV. 767, 767 n.3 (1994). “Frustration preemption” is a fourth but less frequently acknowledged preemption theory, allowing for preemption when “it would unduly frustrate the purposes of [a federal] statute to permit concurrent state regulation.” *Id.* at 808 n.206. Because there is no congressional language implying intent to give the FAA sole jurisdiction over every aspect of drone regulation, there would seem to be minimal support for applying this fourth theory in the context of civilian drones.

58. U.S. CONST. art. VI, § 2.

59. See, e.g., 29 U.S.C. § 1144(a) (2012) (“[T]he provisions of this subchapter and subchapter III shall supersede any and all State laws insofar as they may now or hereafter relate to any employee benefit plan . . .”).

60. *Cal. Fed. Sav. & Loan Ass’n v. Guerra*, 479 U.S. 272, 279 (1987) (quoting *Cal. Fed. Sav. & Loan Ass’n v. Guerra*, No. 83-4927R, 1984 WL 943, at \*1 (C.D. Cal. Mar. 24, 1984), *rev’d*, 758 F.2d 390 (9th Cir. 1985), *rev’d*, 479 U.S. 272 (1987)).

61. See generally 49 U.S.C. § 40103 (lacking express federal preemption language). It should be noted that at least one state has already rejected this idea and has enacted legislation that expressly prohibits municipal governments from adopting their own local

enacted legislation clearly directing that the FAA be the sole regulator of every facet of civilian drone activity.<sup>62</sup> Language in the FRMA does order the agency to develop federal regulations for drones; specifically, section 332(a)(1) of the FRMA instructs the secretary of transportation—the cabinet officer to whom the FAA directly reports—to “develop a comprehensive plan to safely accelerate the integration of civil unmanned aircraft systems into the national airspace system.”<sup>63</sup> However, neither that language nor any other language in the FMRA expressly calls for federal preemption of all state and local drone policies.<sup>64</sup>

## 2. Field Preemption Only Within a Correctly Defined Field

Given the absence of any express federal statutory language preempting state and local drone laws, a more plausible basis for at least some federal preemption might be the implied preemption theory known as “field preemption.”<sup>65</sup> Under the field preemption theory, federal laws preempt state and local laws whenever a body of federal statutes is so comprehensive that it unambiguously appears that Congress intended for federal laws to exclusively “occupy” or govern the entire regulatory field at issue.<sup>66</sup> The FAA seems to rely

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drone ordinances. *See* MD. CODE ANN., ECON. DEV. § 14-301(b)–(c) (West, Westlaw through 2016 Reg. Sess.) (precluding municipalities from regulating drones and reserving all regulatory jurisdiction over drone activity for the state and federal governments).

62. *See* FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, § 332(a)(1), 126 Stat. 11, 73 (2012) (directing the secretary of transportation to develop a plan for drone operation in national airspace “in consultation with” various federal agencies and actors in the drone industry).

63. *Id.*

64. At least one other commentator has taken note of the absence of express federal preemption provisions precluding state or local drone regulatory activity. *See* Kaminski, *supra* note 54, at 73. It is worth noting that the FAA included no preemption provision in its February 2015 NPRM for civilian drones, in spite of alleged vigorous lobbying for such a provision. William V. O’Connor et al., *The Small Drones Rule: FAA Takes a Step in the Right Direction*, DAILY REP. FOR EXECUTIVES (BNA), No. 32, Feb. 18, 2015, at 3 (observing that the FAA’s February 2015 NPRM for drones did “not propose an express preemption provision, despite significant lobbying, including a formal petition filed with the FAA, by certain groups for such a provision” and that “[t]his leaves open the possibility that state and local governments may attempt to regulate UAS operations differently from the manner proposed by FAA in the NPRM”).

65. For a useful explanation of the basic difference between express preemption and field preemption, see Caleb Nelson, *Preemption*, 86 VA. L. REV. 225, 227 (2000) (noting that, “[e]ven in the absence of an express preemption clause, the [United States Supreme] Court sometimes is willing to conclude that a federal statute wholly occupies a particular field and withdraws state lawmaking power over that field”).

66. *English v. Gen. Elec. Co.*, 496 U.S. 72, 79 (1990); *see also* *Freightliner Corp. v. Myrick*, 514 U.S. 280, 287 (1995) (stating that “a federal statute implicitly overrides state

primarily on field preemption arguments to support its positions regarding certain state and local drone regulation within “navigable airspace” and cited multiple cases describing that theory in its December 2015 fact sheet.<sup>67</sup>

Analyzing whether federal laws preempt state or local laws based on field preemption generally involves what some commentators have characterized as a simple two-prong test.<sup>68</sup> The first prong asks whether the field in question has traditionally been governed under federal law rather than state or local law.<sup>69</sup> If it has traditionally been governed under federal law, then a court is more likely to find federal field preemption.<sup>70</sup> The second prong of a typical field preemption analysis asks whether Congress intended to leave room for state or local governments to supplement federal law in the field.<sup>71</sup> If it is evident that Congress intended not to leave such room, then field preemption is more likely to be found.<sup>72</sup>

Regrettably, attempts to apply both prongs of this test in the context of civilian drone regulation are quickly complicated by the fact that the field at issue is not clearly defined. The FAA clearly believes it has extremely broad jurisdiction over those aspects of drone regulation that relate directly to protecting the safety and efficiency of traditional manned aviation—a field over which the agency undisputedly holds broad authority.<sup>73</sup> However, several other aspects of civilian drone regulation relate more to governing discrete, small-scale, localized conflicts between drone operators and individual landowners than to protecting conventional aviation.<sup>74</sup> State and local laws aimed solely at addressing these sorts of conflicts occurring very close to the ground and far from airports and manned

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law . . . when the scope of a statute indicates that Congress intended federal law to occupy a field exclusively” (citing *English*, 496 U.S. at 78–79)).

67. See FED. AVIATION ADMIN., *supra* note 50, at 2–3.

68. See, e.g., Paul S. Weiland, *Federal and State Preemption of Environmental Law: A Critical Analysis*, 24 HARV. ENVTL. L. REV. 237, 255 (2000) (describing the two-step test for field preemption).

69. *Id.*

70. See, e.g., *Hines v. Davidowitz*, 312 U.S. 52, 70, 73–74 (1941) (holding that federal naturalization law preempted Pennsylvania’s naturalization law in part because the federal government has always maintained supreme power over matters of foreign affairs).

71. See Weiland, *supra* note 68, at 255.

72. *Arizona v. United States*, 132 S. Ct. 2492, 2502 (2012) (“Field preemption reflects a congressional decision to foreclose any state regulation in the area, even if it is parallel to federal standards.” (citing *Silkwood v. Kerr-McGee Corp.*, 464 U.S. 238, 249 (1984))).

73. 49 U.S.C. § 40103(b)(1) (2012) (giving the FAA the authority to implement and enforce regulations necessary “to ensure the safety of aircraft and the efficient use of [navigable] airspace”).

74. See *supra* notes 29–36 and accompanying text.

aircraft arguably fall outside any field that Congress intended to reserve solely for the FAA.<sup>75</sup>

The FAA has effectively taken the position that its field of expansive regulatory authority encompasses nearly every activity involving objects moving above the ground.<sup>76</sup> And at first glance, federal legislation providing that the federal government “has exclusive sovereignty of airspace of the United States” and instructing the FAA to “develop plans and policy for the use of the navigable airspace” might seem to support this stance.<sup>77</sup> However, in reality, Congress has not expressly defined “airspace of the United States.”<sup>78</sup> Therefore, the FAA has conveniently opted to interpret the term to encompass every inch of airspace above land, all the way to the ground, at least when it comes to air safety regulation.<sup>79</sup> These air safety interpretations are so broad that, as one administrative law judge observed, some are arguing that even the flight of a paper airplane or a “toy balsa wood glider” could fall under the agency’s jurisdiction.<sup>80</sup> For similar reasons, under the FAA’s interpretation of its own authority, even Marty McFly’s magnetic hoverboard in the movie *Back to the Future Part II* could qualify as an aircraft flying through national airspace, subject to FAA’s ever-reaching regulation.<sup>81</sup>

75. Although the FAA has authority over more than just traditional manned aviation, including authority over navigable airspace, air safety, and the safety of those on the ground, these other bases of authority do not justify federal preemption over the kinds of localized conflicts this Article suggests are better suited for regulation by state and municipal governments. See § 40103(b).

76. See FED. AVIATION ADMIN., *supra* note 50, at 1 (stating that “Congress has vested the FAA with authority to regulate the area[] of airspace use, management and efficiency, air traffic control, safety, navigational facilities, and aircraft noise at its source”).

77. § 40103(a)(1), (b)(1).

78. See *generally id.* § 40102 (lacking definition of “airspace of the United States”). Congress has defined “navigable airspace,” but the definition does not clearly identify which areas are included therein. *Id.* § 40102(32) (defining “navigable airspace” as “airspace above the minimum altitudes of flight prescribed by regulations . . . including airspace needed to ensure safety in the takeoff and landing of aircraft”).

79. *Busting Myths About the FAA and Manned Aircraft—Update*, FED. AVIATION ADMIN., <http://www.faa.gov/news/updates/?newsId=76381> [<https://perma.cc/D969-Q774>] (last modified Mar. 7, 2014, 7:39:39 PM) (debunking myths about the FAA and declaring as “fact” that the FAA “has broad authority” and responsibility for the safety of airspace in the United States “from the ground up” and stating that some FAA regulations apply “irrespective of the altitude at which the aircraft is operating”).

80. Pirker, Docket No. CP-217, at 3 (NTSB Mar. 6, 2014) (decisional order), <http://www.nts.gov/legal/alj/Documents/Pirker-CP-217.pdf> [<https://perma.cc/2N4N-9ZX5>].

81. *BACK TO THE FUTURE PART II* (Universal Pictures 1989). For general information about the famed hoverboard appearing in the movie and continued attempts to create a fully functional version of the device, see Jonah Bromwich & Daniel Victor, *Why*

By conflating conventional, manned aviation activities with essentially all other activities involving objects moving above the ground, the FAA is seeking to rationalize its wholesale extension of numerous well-established aviation law concepts to drones. Consider, for example, the following statement set forth in the agency's December 2015 fact sheet:

If one or two municipalities enacted ordinances regulating [drones] in the navigable airspace and a significant number of municipalities followed suit, fractionalized control of the navigable airspace could result. In turn, this 'patchwork quilt' of differing restrictions could severely limit the flexibility of [the] FAA in controlling the airspace and flight patterns, and ensuring safety and an efficient air traffic flow. A navigable airspace free from inconsistent state and local restrictions is essential to the maintenance of a safe and sound air transportation system.<sup>82</sup>

The FAA cites multiple cases involving conventional manned aviation to support these statements—statements that are certainly applicable to the extent they describe federal restrictions on drone flights near airports or at higher altitudes where traditional aircraft fly.<sup>83</sup> However, the FAA's rationale becomes far more questionable when applied to regulations of small civilian drones traveling very short distances, staying low to the ground, and far from ordinary air traffic. Local drone restrictions like the Sunnyville ordinance described above would not materially impact the FAA's ability to continue controlling conventional air traffic flight patterns or maintaining safety near airports or aboard traditional aircraft and thus arguably fall outside of the agency's expansive regulatory field.<sup>84</sup>

States' and municipalities' long histories of regulating activities in the low-altitude airspace where small civilian drones fly cast further doubt on the notion that the FAA's field of broad regulatory jurisdiction engulfs that space.<sup>85</sup> Consider, for example, the laws implicated when a landowner seeks to construct a new building on a parcel of land. Municipal zoning ordinances will likely restrict the

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a 'Back to the Future' Hoverboard Never Took Off, N.Y. TIMES (Oct. 21, 2015), <http://www.nytimes.com/2015/10/22/business/why-a-back-to-the-future-hoverboard-never-took-off.html>.

82. FED. AVIATION ADMIN., *supra* note 50, at 2.

83. *Id.* (first citing *Montalvo v. Spirit Airlines*, 508 F.3d 464 (9th Cir. 2007); then citing *French v. Pan Am Express, Inc.*, 869 F.2d 1 (1st Cir. 1989); then citing *Arizona v. United States*, 132 S. Ct. 2492, 2502 (2012); and then citing *Morales v. Trans World Airlines, Inc.*, 504 U.S. 374, 386–87 (1992)).

84. *See supra* text accompanying note 52.

85. *See infra* Section III.C.2.

bulk and height of such a building, limiting the amount of low-altitude airspace it may occupy.<sup>86</sup> In some cities, local laws regulate building contractors' use of tall cranes within the parcel's airspace during the construction process.<sup>87</sup> If portions of the new building ultimately protrude into the airspace above neighboring parcels, neighbors may have claims under state property law to compel removal of these overhang encroachments.<sup>88</sup> Furthermore, state or local laws may even govern a small aerial fireworks display at the building's grand opening or the flying of small kites above the site.<sup>89</sup> Although the FAA has some limited regulatory jurisdiction over these sorts of activities, including authority over air commerce, that jurisdiction has historically extended only so far as is necessary to protect the safety and efficiency of the sort of aviation that was regularly occurring several decades ago when Congress passed the Federal Aviation Act.<sup>90</sup>

If there were some compelling policy reason to broadly interpret "airspace of the United States" as encompassing low-altitude space, then the FAA might have a stronger argument for its expansive interpretation of the term. For example, courts have long interpreted the terms "navigable waterway" and "waters of the United States" quite liberally under the Clean Water Act on the rationale that such interpretations advance the nation's strong public policy interest in

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86. See, e.g., County of San Diego, Cal., Ordinance §§ 4600–4631 (May 2016), <http://www.sandiegocounty.gov/content/dam/sdc/pds/zoning/z4000.pdf> [<https://perma.cc/9Q8E-W8Y4>]. In some instances, courts have upheld local governments' regulatory authority to impose height restrictions in the face of FAA preemption challenges, even near airports. See, e.g., *La Salle Nat'l Bank v. Cty. of Cook*, 340 N.E.2d 79, 87–88 (Ill. App. Ct. 1975) (holding that FAA regulations did not preempt a county zoning height restriction and specifically stating that "the goals of the federal and local governments are different" because "[t]he FAA is concerned with safe air traffic" while "the County is concerned with the health, welfare and safety of people who live or work near an airfield").

87. See, e.g., *Steel Inst. of N.Y. v. City of New York*, 832 F. Supp. 2d 310, 325, 327, 331 (S.D.N.Y. 2011) (holding that New York City's crane use restrictions aimed at protecting the public were not preempted by federal Occupational Safety and Health Administration regulations related to the use of cranes on jobsites to the extent that such laws were more strict than federal ones and were aimed at protecting the public), *aff'd*, 716 F.3d 31 (2d Cir. 2013).

88. See generally L.C. Warden, Annotation, *Mandatory Injunction to Compel Removal of Encroachments by Adjoining Landowner*, 28 A.L.R.2d 679, § 18 (1953) (summarizing state court decisions ordering removal of overhanging wall encroachments).

89. 14 C.F.R. § 101.1(a)(2)–(3) (2015) (excluding aerial fireworks displays and kites weighing less than five pounds from general FAA regulations).

90. See 49 U.S.C. §§ 40103, 40104 (2012) (describing the FAA's authority over air commerce). The widespread existence of local building setbacks and height restrictions is one example of evidence of this limitation on the FAA's exclusive jurisdiction over low-altitude airspace. See *infra* Section III.C.2.

aggressively addressing water pollution at its source.<sup>91</sup> In contrast, there is no compelling policy justification for expanding the scope of “airspace of the United States” to include even the airspace below our noses.

It seems far more plausible that Congress intended for “airspace of the United States” to only encompass space regularly involved in manned air flight—airspace near airports or situated at least 500 feet above ground in most places.<sup>92</sup> That sort of interpretation seems far more consistent with the Supreme Court’s declaration in the famous case *United States v. Causby*<sup>93</sup> that a landowner owns “at least as much of the space above the ground as he can occupy or use in connection with the land.”<sup>94</sup> In sum, the long history of state and local laws regulating within low-altitude airspace and the lack of evidence that Congress intended for the FAA to exclusively control all activities in that space call into question the notion that a field preemption theory justifies broad preemption of laws like the Sunnyville drone ordinance described above.<sup>95</sup> The Supreme Court’s general hesitancy to find field preemption only further weakens these arguments.<sup>96</sup>

Fortunately, the FAA appears to be beginning to recognize that there are aspects of drone regulation that do not or should not fall within its expansive jurisdiction. When the FAA issued its long-anticipated Final Rule on Operation and Certification of Small

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91. See, e.g., *United States v. Riverside Bayview Homes, Inc.*, 474 U.S. 121, 132–33 (1985) (finding that “[p]rotection of aquatic ecosystems, Congress recognized, demanded broad federal authority to control pollution” at the source of discharge and thus holding that Congress purposely defined “navigable waters” broadly under the Clean Water Act with an intent to “regulate at least some waters that would not be deemed ‘navigable’ under the classical understanding of [the] term”); see also 33 U.S.C. §§ 1251–1387 (West, Westlaw through P.L. 114-244). It should be noted that the debate over precisely how broadly to interpret “navigable waters” under various federal statutes rages on. See generally Jeffrey G. Miller, *Plain Meaning, Precedent, and Metaphysics: Interpreting the “Navigable Waters” Element of the Clean Water Act Offense*, 45 ENVTL. L. REP. 10,548 (2015) (providing a recent summary of courts’ activity in this area).

92. See 49 U.S.C. § 40102(32) (defining “navigable airspace” as “airspace above the minimum altitudes of flight prescribed by regulations under this subpart and subpart III of this part, including airspace needed to ensure safety in the takeoff and landing of aircraft”); 14 C.F.R. § 91.119(b)–(c) (2016) (defining the minimum safe altitude for aircraft operations as 1,000 feet above the highest obstacle near “congested areas” and 500 feet above the surface of “other than congested areas”).

93. 328 U.S. 256 (1946).

94. *Id.* at 264.

95. See *supra* text accompanying note 52.

96. See Nelson, *supra* note 65, at 227 (noting that the United States Supreme Court “has grown increasingly hesitant to read implicit field-preemption clauses into federal statutes”).

Unmanned Aircraft Systems in June of 2016, it intentionally excluded a broad federal preemption provision from its pages.<sup>97</sup> In the FAA's published "Discussion of the Final Rule," the agency acknowledged its decision not to include preemption language:

The FAA is not persuaded that including a preemption provision in the final rule is warranted at this time. Preemption issues involving small UAS necessitate a case-specific analysis that is not appropriate in a rule of general applicability. Additionally, certain legal aspects concerning small UAS use may be best addressed at the State or local level.<sup>98</sup>

The FAA's conscious constraint in its final rule is a promising sign that even the agency itself is beginning to acknowledge that not all drone activities do or should fall within its regulatory power.

### 3. Very Limited Conflict Preemption

In addition to field preemption, another set of rules, categorized in this Article as "conflict preemption"<sup>99</sup> theories, provide another conceivable ground for implied federal preemption of some state and local drone laws.<sup>100</sup> Establishing conflict preemption generally requires a showing that it would be "impossible for a private party to comply with both state and federal requirements" or that the state or local law in question "stands as an obstacle to the accomplishment and execution of the full purposes and objectives of Congress."<sup>101</sup>

Conflict preemption theories could certainly provide a basis for federal preemption of some limited categories of state or local drone

97. See Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. 42,064, 42,064–194 (June 28, 2016) (to be codified at 14 C.F.R. pt. 107).

98. *Id.* at 42,194.

99. See Nelson, *supra* note 65, at 227–28 (citing *English v. Gen. Elec. Co.*, 496 U.S. 72, 79 (1990)) (defining "conflict preemption" and explaining that "even if a federal statute contains no express preemption clause, and even if it does not impliedly occupy a particular field, it preempts state law with which it 'actually conflicts'").

100. *Id.* Some commentators make a distinction between "conflict preemption" and "obstacle preemption," which is also sometimes termed "frustration of purpose" preemption. See Thomas W. Merrill, *Preemption and Institutional Choice*, 102 Nw. U. L. REV. 727, 739 (2008). Others categorize these two similar types of preemption together. See *id.* (explaining that "[s]ome writers collapse [conflict preemption and frustration of purpose preemption] into one, which they tend to call conflict preemption—the point being that the difference between conflict and frustration of purpose relates only to how sharp the tension is between federal and state law" (citation omitted)). For simplicity, and because the distinction does not seem material enough to warrant separation in this instance, this Article embraces the latter approach and treats these two varieties of preemption theory as one in the same.

101. *Sprietsma v. Mercury Marine*, 537 U.S. 51, 65 (2002) (quoting *Freightliner Corp. v. Myrick*, 514 U.S. 280, 287 (1995)).

regulations.<sup>102</sup> For example, if the FAA were to establish uniform nationwide manufacturing requirements for new drones, a state or local regulation calling for different drone features might well be unenforceable based on a conflict preemption rationale.<sup>103</sup> Similar federal manufacturing standards serve valuable functions in other industries, enabling manufacturers to design products that are salable in every state.<sup>104</sup>

However, it is doubtful that conflict preemption would be grounds for broad FAA preemption of local drone use restrictions comparable to the Sunnyville ordinance described above.<sup>105</sup> Such local drone ordinances would not necessarily stand as obstacles to the FAA's objective of protecting the safety and efficiency of manned flight; drone operators who comply with federal drone restrictions and keep their devices at low altitudes and far from airports and helicopters could simultaneously comply with Sunnyville's additional restrictions on where or when drones may fly. And the "patchwork quilt" of local restrictions that might result from allowing such local drone laws would arguably be no different than the degree of local variation that has long existed in automobile traffic laws.<sup>106</sup> Contrary to Amazon's recent assertions,<sup>107</sup> most commercial drone flying involves short flights that are less likely to routinely cross interstate boundaries and do not necessarily qualify as inherently interstate

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102. See O'Connor et al., *supra* note 64, at 3 (stating that "[a]bsent an express preemption provision in the [FAA's] final rules [regarding drones], . . . state and local regulation would not be foreclosed at the threshold, but would instead have to be analyzed under existing conflict preemption principles on a case-by-case basis" (citation omitted)).

103. See FED. AVIATION ADMIN., *supra* note 50, at 3 (drawing similar conclusions and stating that state or local laws "[m]andating equipment or training for UAS related to aviation safety such as geo-fencing would likely be preempted").

104. See, e.g., William W. Buzbee, *Asymmetrical Regulation: Risk, Preemption, and the Floor/Ceiling Distinction*, 82 N.Y.U. L. REV. 1547, 1561–63 (2007) (describing "federal requirements concerning product design or engineering" as "[m]ore common and more defensible" than most other forms of federal preemption).

105. See *supra* text accompanying note 52.

106. See FED. AVIATION ADMIN., *supra* note 50, at 2 (asserting that a "patchwork quilt" of differing restrictions [on drones in navigable airspace] could severely limit the flexibility of FAA in controlling the airspace and flight patterns, and ensuring safety and an efficient air traffic flow").

107. *Hearing on Drones: The Next Generation of Commerce? Before the Comm. on Oversight & Gov't Reform*, 114th Cong. 6 (2015), <https://oversight.house.gov/wp-content/uploads/2015/06/Amazon-Misener-HOGR-Testimony-Pkg-6-17-15-rev.pdf> [<https://perma.cc/X3Y4-HYLB>] (testimony of Paul Misener, Vice President for Global Public Policy, Amazon.com) (arguing that states and localities should be precluded from restricting the flights of FAA-authorized drones "given the interstate nature of commercial [drone] operations").

activities.<sup>108</sup> Neither conflict preemption nor any other preemption argument has precluded state or municipal regulations of automobile driving, which routinely involves trips of a couple of hundred miles or more on a single tank of gas.<sup>109</sup> Accordingly, claims that express preemption, field preemption, or conflict preemption theories justify broad preemption in the drone law context seem tenuous at best.

### B. Drone Law Preemption: A Normative Analysis

Given the unsettled state of legal questions surrounding federal preemption of state and local drone law, it is worthwhile to conduct a “functional,” or normative, analysis of these issues as well.<sup>110</sup> Over the years, legal academics have identified several types of situations in which federal preemption of state or local law tends to promote favorable policy outcomes.<sup>111</sup> They have likewise described multiple situations in which it tends to be more advantageous to preserve state or local lawmaking authority against preemption challenges.<sup>112</sup> As described below, this academic literature suggests that an optimal regulatory system for drones would allocate regulatory authority among federal, state, and local governments.

#### 1. Regulatory Floors Versus Regulatory Ceilings

The distinction between “floor” preemption and “ceiling” preemption is particularly useful in examining the policy implications of drone law preemption. Federal regulatory floors are federal laws that create a baseline level of regulation, preempting any state or local laws that are less stringent than the federal standards.<sup>113</sup> For example, federal regulations generally require that children aged

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108. See Matt Burns, *Parrot's Newest Drone Packs a Serious Camera, Extreme Range*, TECHCRUNCH (May 11, 2014), <https://techcrunch.com/2014/05/11/parrots-newest-drone-packs-a-serious-camera-extreme-range/> [<https://perma.cc/53SY-K88C>] (describing a new drone model's two-kilometer range as “extreme”).

109. See *infra* note 202 and accompanying text.

110. See David Freeman Engstrom, *Drawing Lines Between Chevron and Pennhurst: A Functional Analysis of the Spending Power, Federalism, and the Administrative State*, 82 TEX. L. REV. 1197, 1223 (2004) (“Functional analysis supplements consideration of text, history, and precedent and seeks solutions to difficult doctrinal questions by asking what makes sense from a policy perspective.”).

111. See *infra* Section III.A.

112. See generally Annie Decker, *Preemption Conflation: Dividing the Local from the State in Congressional Decision Making*, 30 YALE L. & POL'Y REV. 321, 351 (2012) (providing a more thorough summary of goals favoring and disfavoring preemption).

113. See Buzbee, *supra* note 104, at 1554 (defining federal regulatory floors as laws that “preclude less stringent state and local regulation, but allow for additional and more stringent regulation”).

thirteen and younger wear life jackets when aboard recreational boats—a regulatory floor that creates a minimum standard, applicable in all fifty states.<sup>114</sup> However, this federal requirement does not preclude state governments from imposing more stringent laws that regulate beyond the federal floor and require life jackets for older passengers, as some states have done.<sup>115</sup> Floor preemption approaches can be appealing from a public policy perspective because they give states and municipalities flexibility to impose additional rules based on local needs and preferences, and the ability to experiment with innovative new regulatory strategies.<sup>116</sup> In Professor William Buzbee’s words, the flexible dynamic achievable through federal floors can offer distinct advantages, preserving the “benefits of multiple regulatory voices, protections, and diverse regulatory modalities.”<sup>117</sup>

Floor preemption is often contrasted with regulatory “ceiling” preemption<sup>118</sup> or “federal unitary choice preemption.”<sup>119</sup> This less common and more controversial category of preemption largely precludes states or localities from imposing supplemental regulations on an activity or industry.<sup>120</sup> There are certainly situations in which nationally uniform rules offer such sizable benefits that ceiling

114. See 33 C.F.R. § 175.15(c) (2015).

115. See, e.g., IDAHO ADMIN. CODE r. 26.01.30.050.01(f) (2015) (“Children fourteen (14) years of age and younger, onboard vessels nineteen (19) feet or less, must wear an approved flotation device when the vessel is underway.”).

116. See *New State Ice Co. v. Liebmann*, 285 U.S. 262, 311 (1932) (Brandeis, J., dissenting) (popularizing the “laboratories of democracy” theory, in which a “single courageous state may, if its citizens choose, serve as a laboratory[] and try novel social and economic experiments without risk to the rest of the country”).

117. See Buzbee, *supra* note 104, at 1555.

118. See, e.g., Robert L. Glicksman & Richard E. Levy, *A Collective Action Perspective on Ceiling Preemption by Federal Environmental Regulation: The Case of Global Climate Change*, 102 NW. U. L. REV. 579, 583 (2008) (contrasting regulatory floors and ceilings); Jim Rossi & Thomas Hutton, *Federal Preemption and Clean Energy Floors*, 91 N.C. L. REV. 1283, 1303 (2013) (suggesting that “absent clear evidence of a congressional purpose to adopt unitary standards or an obvious conflict or obstacle to a clearly defined regulatory program, courts and agencies should generally favor floor preemption over ceiling preemption in the context of energy statutes”); Katherine A. Trisolini, *All Hands on Deck: Local Governments and the Potential for Bidirectional Climate Change Regulation*, 62 STAN. L. REV. 669, 736 (2010) (describing the advantages of regulatory floors over ceiling preemption). This floor-ceiling dichotomy has grown particularly commonplace among scholars in the environmental law arena, often citing Professor William Buzbee’s writings on the topic. See, e.g., Glicksman & Levy, *supra*, at 258; Alice Kaswan, *Climate Adaptation and Land Use Governance: The Vertical Axis*, 39 COLUM. J. ENVTL. L. 390, 451 (2014); Rossi & Hutton, *supra*, at 1288, 1301.

119. See Buzbee, *supra* note 104, at 1558 (observing that the term “ceiling” can be a misnomer when describing preemption rules that effectively preclude state and local regulation).

120. *Id.* at 1559.

preemption is a useful and appropriate regulatory tool.<sup>121</sup> However, in many instances, ceiling preemption approaches can unjustifiably displace state and local government regulations that were far better tailored to local needs and preferences.<sup>122</sup> For example, a 2010 case held that certain federal manufacturing standards for air conditioners preempted Albuquerque's more environmentally responsible standards, highlighting the potential hazards of this sort of preemption.<sup>123</sup> Federal ceiling preemption arguments can provide an avenue for powerful industry stakeholders to lobby for and secure self-serving, excessively lenient federal laws that shield them from more stringent state or local regulations.<sup>124</sup>

Federal ceiling regulations are particularly problematic when applied to inherently local activities. For instance, the fireworks industry and fireworks fanatics might heartily favor a federal law allowing consumers in all fifty states to legally use small aerial fireworks and preempting state and local restrictions on such use. Such a law would give companies operating within that industry broad license to operate throughout the country and would spare them from having to worry about more restrictive state or local laws. However, such an approach would likely be disadvantageous from a public policy perspective. Among other things, it would prohibit states and municipalities from tailoring fireworks laws to suit their own unique circumstances. Such flexibility is important in the case of consumer firework regulation because the scope and severity of fireworks' impacts likely varies tremendously based on local factors such as population density or localized drought conditions.<sup>125</sup>

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121. See *infra* notes 131–33 and accompanying text (alluding to some of the possible policy justifications for regulatory ceilings, including establishing nationwide uniform standards and protecting national security interests and assets).

122. See Buzbee, *supra* note 104, at 1569. In his article on the topic, Professor Buzbee adds that unitary federal choice preemption strategies are “likely to be a disaster” from a social welfare perspective and are “particularly vulnerable to regulatory failure.” *Id.* at 1597, 1599.

123. See *Air Conditioning, Heating & Refrigeration Inst. v. City of Albuquerque*, 835 F. Supp. 2d 1133, 1137 (D.N.M. 2010).

124. See, e.g., J.R. DeShazo & Jody Freeman, *Timing and Form of Federal Regulation: The Case of Climate Change*, 155 U. PA. L. REV. 1499, 1505–06 (2007) (“[W]hat will industry demand from Congress? It will demand a federal standard that preempts inconsistent state regulation and eliminates regulatory uncertainty. Uniformity is not enough, however. Industry will also try to undercut the most aggressive state standards by seeking a lower federal ceiling.”).

125. See, e.g., Tom Moore, *Amid Drought and Wildfires, Fourth of July Fireworks Are Banned in Parts of West*, WEATHER.COM (June 30, 2016, 5:46 PM), <https://weather.com/news/news/fireworks-ban-hot-dry-fires-west> [<https://perma.cc/X3G7-PVKT>] (describing how

Accordingly, no federal fireworks law creating this sort of undesirable ceiling preemption exists. Instead, the federal government has adopted regulatory floors for consumer fireworks and allows states and municipalities to independently determine whether and how to impose more stringent restrictions.<sup>126</sup>

## 2. Justifiable Regulatory Floors

How might this floor versus ceiling distinction inform the present preemption debate over civilian drone regulation? First, it is worth noting that several types of federal regulatory floors relating to drones seem easily justifiable from a policy perspective. Consider, for instance, FAA regulations requiring that civilian drones stay below a certain altitude and away from airports and helicopters.<sup>127</sup> So long as these sorts of regulations leave room for states and localities to impose additional drone use restrictions, they exemplify the regulatory floor approach. Such rules further the FAA's congressionally mandated objectives of promoting the safety and efficiency of manned aviation.<sup>128</sup> However, they also preserve the ability of states and localities to craft more stringent drone use rules based on local needs.

Federal regulatory floors could also be justifiable as a way for the FAA and other federal agencies to protect national interests and assets against drone-related threats. For example, such agencies are likely justified in imposing federal restrictions on drone activities near or above national parks;<sup>129</sup> Washington, D.C.,<sup>130</sup> and critical national

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drought conditions in the western United States in the summer of 2016 prompted many state and local governments to impose special fireworks restrictions).

126. See 35 C.J.S. *Explosives* § 11 (2009) (stating that a “county ordinance regulating storage and use of explosives is not preempted by federal statutes regulating explosives, even if the ordinance imposes more stringent requirements” (citing *S. Blasting Servs., Inc. v. Wilkes Cty.*, 162 F. Supp. 2d 455, 462 (W.D.N.C. 2001), *aff’d*, 288 F.3d 584, 590 (4th Cir. 2002))).

127. See *Operation and Certification of Small Unmanned Aircraft Systems*, 81 Fed. Reg. 42,064, 42,211 (June 28, 2016) (to be codified at 14 C.F.R. pt. 107); see also *Fly for Fun*, FED. AVIATION ADMIN., [https://www.faa.gov/uas/model\\_aircraft/](https://www.faa.gov/uas/model_aircraft/) [<https://perma.cc/VDS2-TWUR>] (last modified July 21, 2016, 12:05:25 PM) (providing further details on the FAA's restrictions on flying drones and model aircrafts).

128. See 49 U.S.C. § 40103(b)(1) (2012); *infra* notes 154–55 and accompanying text (describing the FAA's congressional mandates).

129. See Mark Berman, *National Park Service Bans Drone Use in All National Parks*, WASH. POST (June 20, 2014), <https://www.washingtonpost.com/news/post-nation/wp/2014/06/20/national-park-service-bans-drone-use-in-all-national-parks/> [<https://perma.cc/92SW-K4D5>] (stating that the National Park Service banned drones in all of its parks due to “concerns about the negative impact that flying unmanned aircraft is having in parks”).

security sites. If a city ordinance contained more lenient provisions that expressly authorized drone activity in one of these nationally important areas, it would be appropriate for federal restrictions to preempt those ordinance provisions.

### 3. Justifiable Regulatory Ceilings

Federal regulatory ceilings that preclude certain types of state or local drone laws may also be justifiable in some contexts. As mentioned, a ceiling preemption approach may be necessary to preserve nationwide uniformity in drone manufacturing or performance standards—an area of drone law where such standardization offers substantial efficiency advantages.<sup>131</sup> Federal laws already mandate certain specified features of passenger aircraft sold within the United States, sparing manufacturers from having to meet fifty different sets of standards.<sup>132</sup> For similar reasons, comparable nationwide standardization in the drone context would help to reduce manufacturing costs and could thereby benefit consumers. Federal uniform drone tracking and registration requirements would likewise offer distinct policy advantages and justify preemption of conflicting state or local laws.<sup>133</sup>

### 4. The Advantages of Greater State and Local Involvement

However, outside of those limited areas where federal regulation is justified lie several other aspects of civilian drone activity that have distinctly local impacts and thus warrant at least some localized

130. See 14 C.F.R. § 93.341(a) (2016) (prohibiting flying aircrafts over the Washington, D.C., without FAA authorization); see also *FAA: Washington DC is a No Drone Zone*, FED. AVIATION ADMIN. (June 30, 2016), <https://www.faa.gov/news/updates/?newsId=83267> [<https://perma.cc/98C5-T9AA>] (stating that restrictions on the airspace around Washington, D.C., establish a “national defense airspace” for homeland security reasons).

131. It should be noted that even unitary federal choice preemption based on this “nationwide standardization” rationale can generate undesirable policy outcomes. The Energy Policy Conservation Act (“EPCA”) and its capacity to preempt more stringent energy efficiency requirements under state and local building codes illustrates this risk. See, e.g., Alexandra B. Klass, *State Standards for Nationwide Products Revisited: Federalism, Green Building Codes, and Appliance Efficiency Standards*, 34 HARV. ENVTL. L. REV. 335, 356 (2010) (describing how the EPCA “presents potential roadblocks to municipal green building codes that include increased appliance efficiency standards”).

132. See, e.g., 14 C.F.R. § 23.1 (2016) (establishing federal airworthiness standards for different types of airplanes). See generally Thomas N. Tarnay, *Aircraft Designs Subjected to FAA Special Certification Review—Mitsubishi MU-2 and Beechcraft Bonanza: The Role of the SCR in Aircraft Design Certification and Implications on Federal Preemption*, 62 J. AIR L. & COM. 591, 597–98, 601–07 (1996) (providing a useful overview of the federal standards for the design, production, and maintenance of manned aircraft).

133. See *infra* Section III.A.2.

regulation. A ceiling preemption approach, like the one suggested in the FAA's December 2015 fact sheet, is difficult to justify from a policy perspective; it would preclude states and municipalities from imposing supplemental drone use restrictions that address these inherently local issues.

Simple analogies to other areas of the law help to emphasize this point. There is no federal land use administration equivalent to the FAA through which citizens in every city in the country must seek approval for real estate development.<sup>134</sup> Nor is there a federal automobile driving administration that manages traffic flows and sets speed limits for every road in all fifty states.<sup>135</sup> The nation's federal system wisely allows for state and local officials, which tend to have greater geographic proximity to and information about the predominantly local impacts of these sorts of activities than federal officials, to be the primary regulators of these activities.<sup>136</sup> Like land development and automobile driving, civilian drone activity's impacts can vary greatly by location and thus benefit from the precision available through localized governance. Entrusting regulatory authority to subnational governments in these areas also creates "laboratories of democracy"—a vast array of uniquely situated policymakers brainstorming and experimenting with various approaches to drone regulation on a relatively small scale.<sup>137</sup> This experimentation can be a valuable tool for accelerating policy innovation in areas—including the civilian drone industry—that involve new and rapidly changing technologies.

### III. ENVISIONING A COORDINATED FEDERAL, STATE, AND LOCAL DRONE REGULATORY SYSTEM

For the aforementioned reasons, involving states and municipalities in the regulation of civilian drones seems both legally

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134. See generally 1 ARDEN H. RATHKOPF ET AL., RATHKOPF'S THE LAW OF ZONING AND PLANNING § 1:9, Westlaw (database updated Nov. 2016) (stating that the authority to enact zoning ordinances and the manner in which they may be enacted are delegated to local governments).

135. See generally *Highway Safety Laws by State*, GOVERNORS HIGHWAY SAFETY ASS'N, <http://www.ghsa.org/html/stateinfo/bystate/> [<https://perma.cc/GJ5X-7Z8V>] (providing a listing of automobile administration agencies and highway safety laws by state).

136. See, e.g., *Road Rules*, N.C. DEP'T OF TRANSP., <https://www.ncdot.gov/programs/ghsp/> [<https://perma.cc/2KM6-8DXM>] (listing highway safety laws that drivers in North Carolina must follow, including seat belt and litter laws).

137. See *New St. Ice Co. v. Liebmann*, 285 U.S. 262, 311 (1932) (Brandeis, J., dissenting) (stating that "one of the happy incidents of the federal system [is] that a single courageous State may, if its citizens choose, serve as a laboratory[] and try novel social and economic experiments without risk to the rest of the country").

defensible and normatively advantageous. But which specific areas of drone regulation seem best suited for implementation by the federal government, and which would be better implemented at lower levels of government? As highlighted in this Part of the Article, some specific areas of the civilian drone industry are best suited for regulation at the federal level, the state level, and the local level, respectively.

The existing federal, state, and local regulatory regime for land development offers a useful starting point for developing a coordinated structure to regulate civilian drones. At the federal level, a handful of federal standards regulate such matters as the protection of endangered species and their habitats to prevent states from engaging in a “race to the bottom.”<sup>138</sup> Above this federal regulatory floor, state laws govern numerous other land development issues such as the allocation of property rights in land and the protection of wetlands.<sup>139</sup> Municipal governments then operate atop both the federal and state floors, exercising wide discretion in determining precisely where and under what conditions various types of land development may occur within their jurisdictions.<sup>140</sup> Most states’ zoning enabling acts delegate land use regulatory and zoning authority to local governments, integrating municipalities into a broader regulatory system in which each level of government plays a role.<sup>141</sup> This multi-layered regulatory approach seems to have governed land development relatively well for several decades.

What might a corollary regulatory structure look like for drones? The following Sections identify the major elements of a comprehensive drone regulatory scheme that seem most appropriate for implementation at the federal, state, and local levels.

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138. See Endangered Species Act, 16 U.S.C. §§ 1531–1544 (2015); see also *Rancho Viejo, LLC v. Norton*, 323 F.3d 1062, 1069 n.7 (D.C. Cir. 2003) (finding that the “[a]pplication of the [Endangered Species Act] to habitat degradation has a further impact on interstate commerce by removing the incentives for states ‘to adopt lower standards of endangered species protection in order to attract development,’ thereby preventing a destructive ‘race to the bottom’” (quoting *Nat’l Ass’n of Home Builders v. Babbitt*, 130 F.3d 1041, 1049, 1055 (D.C. Cir. 1997))).

139. See, e.g., MASS. GEN. LAWS ANN. ch. 131, § 40 (West, Westlaw through ch. 175 of the 2016 Legis. Sess.); see also ENVTL. L. INST., STATE WETLAND PROTECTION: STATUS, TRENDS & MODEL APPROACHES 9–36 (Mar. 2008), [https://www.eli.org/sites/default/files/eli-pubs/d18\\_06.pdf](https://www.eli.org/sites/default/files/eli-pubs/d18_06.pdf) [<https://perma.cc/645B-CM8W>].

140. See Robert C. Ellickson, *Suburban Growth Controls: An Economic and Legal Analysis*, 86 YALE L.J. 385, 388 (1977) (stating that there are few legal doctrines for “limiting the range of municipal discretion”).

141. See generally RATHKOPF ET AL., *supra* note 134, § 1:9 (stating that the authority to enact zoning ordinances and the manner in which they may be enacted are delegated to local governments).

*A. Drone Laws Most Suitable for the Federal Government*

Federal regulators unquestionably have a vital role to play in regulating civilian drone activity in the United States. Having served as the nation's chief aviation regulator for nearly a century, the FAA has unparalleled resources and expertise in several areas related to drone use.<sup>142</sup> Additionally, the agency's position within the federal government could enable it to facilitate valuable nationwide uniformity within certain aspects of drone regulation.

*1. Uniform Design and Performance Standards*

As already suggested, federal regulations would be the most efficient and effective way to establish uniform drone manufacturing standards and specifications that are enforceable in all fifty states. Much like the existing federal performance and safety standards for automobiles, a set of uniform drone performance and safety standards would give civilian drone manufacturers certainty and clarity regarding the specifications their products must meet to be eligible for sale anywhere in the country.<sup>143</sup> Courts have long recognized that a compelling need for uniform, nationwide rules can be reason enough to vest regulatory authority over certain activities solely with the federal government.<sup>144</sup> Nationwide drone manufacturing standards, which would prevent the formation of a

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142. See Operation and Certification of Small Unmanned Aircraft Systems, 80 Fed. Reg. 9,544, 9,545 (proposed Feb. 23, 2015) (purporting the FAA's "experience with the certification, exemption, and [Certificate of Waiver or Authorization] process" to be part of the basis for its authority to regulate non-recreational drone use); see also Berger, *supra* note 40, at 965–71 (describing the FAA's formation and the considerable scope of its power).

143. See Troy A. Rule, *Airspace in an Age of Drones*, 95 B.U. L. REV. 155, 200–01 (2015) (suggesting that the FAA could promulgate federal manufacturing standards for civilian drones comparable to federal motor vehicle manufacturing and safety standards). See generally 49 C.F.R. § 571 (2015) (setting forth federal manufacturing standards for automobiles).

144. See, e.g., *Leisy v. Hardin*, 135 U.S. 100, 108–09 (1890) ("Where the subject matter [to be regulated] requires a uniform system as between the States, the power controlling it is vested exclusively in Congress, and cannot be encroached upon by the States . . ."). Commentators have also noted the potential advantages of federal regulatory activity in contexts in which national uniformity is particularly important. See Alan N. Greenspan, *The Constitutional Exercise of the Federal Police Power: A Functional Approach to Federalism*, 41 VAND. L. REV. 1019, 1049 (1988) (arguing for federal rulemaking in instances "[w]hen national uniformity facilitates interstate transactions in a way that individual state regulation cannot").

varied patchwork of state-level standards, would seemingly fall well within this principle.<sup>145</sup>

For example, federal drone manufacturing standards might someday require that all new drones have collision avoidance or “sense and avoid” systems, enabling the devices to detect other physical objects and automatically adjust course to avoid them.<sup>146</sup> Such standards might also require return-to-home or other lost-link emergency response features that preprogram drones to respond in safe ways if they lose a wireless connection with their operator,<sup>147</sup> or anti-hacking software to help prevent third parties from using counterfeit electromagnetic signals to hijack the devices mid-flight.<sup>148</sup>

Federal drone manufacturing standards might also eventually require that all drones made available for sale in the United States include software and hardware features to ensure their compatibility with a nationally-standardized geofence system. A growing number of drone manufacturers—including DJI, the world’s largest civilian drone producer—already embed geofence software into many of their drones.<sup>149</sup> This software uses GPS technologies to create invisible “fences” that prevent the company’s drones from flying into the

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145. See *supra* text accompanying note 131 (acknowledging that there is a need for uniform nationwide rules to regulate drones).

146. At least one major drone manufacturer has already developed a “sense and avoid” system for one of its newer drones. Ben Popper, *DJI Just Released Its First Drone That Can See and Avoid Obstacles*, THE VERGE (June 8, 2015, 9:45 AM), <http://www.theverge.com/2015/6/8/8745415/dji-guidance-system-matrice-100-sense-avoid> [<https://perma.cc/XWX9-JLXX>] (describing drone manufacturer DJI’s new drone guidance system as a “combination of ultrasonic sensors and stereo cameras that allow the drone to detect objects up to 65 feet (20 meters) away and keep your aircraft at a preconfigured distance”).

147. See generally Jack Nicas, *What Happens When Your Drone Escapes*, WALL ST. J., Dec. 9, 2014, at B1 (providing information on technological issues with drones such as the drones losing connections with their operators, and discussing the industry efforts to address these problems through new functions like return to home features).

148. See Christian de Looper, *Drones Now Big Hacking Target; First Drone Malware Identified*, TECH TIMES (Feb. 4, 2015, 11:00 AM), <http://www.techtimes.com/articles/30634/20150204/drone-hacking-next-big-security-concern.htm> [<https://perma.cc/MU8K-7R9V>] (reporting that hacking is a growing issue with drones as there is a “thriving community of drone hackers[.]” and that there are “several open source projects available such as Skyjack which use[] your drone to take over the drones around it”).

149. See Tim Moynihan, *Things Will Get Messy If We Don’t Start Wrangling Drones Now*, WIRED (Jan. 30, 2016, 7:00 AM), <https://www.wired.com/2016/01/things-will-get-messy-if-we-dont-start-wrangling-drones-now/> [<https://perma.cc/ZZK7-V69U>] (stating that multiple drone manufacturers have put geofencing systems into place); see also Nick Lavars, *DJI Launches New Software to Block Drones Wandering into Dangerous Areas*, NEW ATLAS (Jan. 3, 2016), <http://www.gizmag.com/dji-drone-software-geofencing/41123/> [<https://perma.cc/5SEB-SDCA>] (describing DJI’s geofencing software).

airspace near thousands of airports across the world.<sup>150</sup> When a drone approaches a “geofenced” area, software within the drone automatically reduces the drone’s power and prevents it from entering the restricted space.<sup>151</sup> Wireless signals can even remotely update drones’ geofence software from time to time to revise or add new geofenced areas.<sup>152</sup> Uniform laws established by the federal government could most easily ensure that all new drones sold in the country were compatible with such a nationwide system.<sup>153</sup>

As a legal matter, rules establishing drone performance and geofence compatibility standards would likewise seem well within the FAA’s regulatory jurisdiction because of the agency’s congressional mandate to protect the safety of aircraft.<sup>154</sup> Among other things, preserving such safety involves reducing the risk that a civilian drone will fly into other objects in the air. It also involves preventing drones from flying near airports or within “navigable airspace”—the space more than 500 feet above the ground in most places that serves as a sort of federal public highway for manned air travel.<sup>155</sup> FAA rules

150. See Brian Fung, *You Won’t Be Able to Fly This Hugely Popular Drone in D.C. Much Longer, Thanks to That White House Crash*, WASH. POST (Jan. 28, 2015), <https://www.washingtonpost.com/news/the-switch/wp/2015/01/28/a-simple-software-update-could-have-prevented-a-drone-from-buzzing-the-white-house/> [https://perma.cc/A9RS-RD2F] (reporting that drone manufacturer DJI’s geofence database already blocks its newer drones from 3,500 airports and that the company is working to expand the database to cover more than 10,000 airports around the world).

151. See *id.* (stating that when a drone is within 1.5 miles of a geofenced area, it will automatically be grounded and unable to fly).

152. See, e.g., *DJI Introduces New Geofencing System for Its Drones*, DJI (Nov. 18, 2015), <https://www.dji.com/newsroom/news/dji-fly-safe-system> [https://perma.cc/XG8V-NK4C] (stating that for DJI manufactured drones, updated information on drone flight restrictions will be sent to DJI drone operators using the DJI GO application).

153. At least one congressman has publicly advocated for mandatory federal geofence features. See Jake Swearingen, *1 Million Drones Will Be Sold This Christmas, and the FAA Is Terrified*, POPULAR MECHANICS (Sept. 29, 2015), <http://www.popularmechanics.com/flight/drones/news/a17535/the-faa-is-terrified-that-1-million-drones-will-be-sold-this-christmas/> [https://perma.cc/985G-DZPQ] (quoting Oregon Congressman Peter DeFazio who has argued that small civilian drones “should be set up so they can’t be sold unless they’re geo-fenced for altitude and perimeters”).

154. See 49 U.S.C. § 40103(b)(1) (2012) (stating that the FAA shall develop policies “to ensure the safety of aircraft and the efficient use of airspace”).

155. *Id.* § 40103(32) (defining “navigable airspace” as “airspace above the minimum altitudes of flight prescribed by regulations under this subpart and subpart III of this part, including airspace needed to ensure safety in the takeoff and landing of aircraft”); see also Major Walter S. King, *The Fifth Amendment Takings Implications of Air Force Aircraft Overflights and the Air Installation Compatible Use Zone Program*, 43 A.F. L. REV. 197, 199 (1997) (observing that Congress established navigable airspace in order to “provide the public with rights to the airspace above the United States[,]” and stating that the Civil Aeronautics Authority determined the “minimum safe altitudes of flight,” and therefore the navigable airspace, “to be 500 feet above ground level”).

requiring that all new drones have the basic features described above and be compatible with a nationwide geofence system could do much to help further those congressionally mandated goals by making it easier to keep drones out of restricted areas.

## 2. Federal Drone Registration and Tracking Systems

The federal government is likewise well-positioned to establish drone registration and tracking software requirements capable of enabling law enforcement officers and others on the ground to identify the owners of airborne drones. Many civilian drones can fly a considerable distance away from their operators, making it difficult to identify operators of the devices while they are in flight.<sup>156</sup> Databases already enable patrol officers on roads to retrieve information on licensed motor vehicles, including out-of-state vehicles, using license plate information.<sup>157</sup> However, since many civilian drones are much smaller than cars and can fly hundreds of feet above the ground, any aluminum license plate mounted on such a drone would be difficult for observers on the ground to read.<sup>158</sup> Fortunately, federal drone registration requirements and a national, GPS-supported tracking system could eventually allow patrol officers and others throughout the nation to quickly access identifying information for any drone.

Legislators in the United Kingdom recently proposed similar electronic identification requirements for drones.<sup>159</sup> In December of 2015, the FAA introduced its own web-based national registration

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156. See Michael Zhang, *FAA Testing Tech That Locates Drone Owners Flying Illegally Near Airports*, PETAPIXEL (Oct. 8, 2015), <http://petapixel.com/2015/10/08/faa-testing-tech-that-locates-drone-owners-flying-illegally-near-airports/> [https://perma.cc/5N63-276E] (stating that one of the FAA's biggest challenges is locating drone operators, and describing technology that could "pinpoint exactly where the operator is located while the drone is in the air").

157. See, e.g., *License Plate Search*, WIS. DEP'T OF TRANSP., <https://trust.dot.state.wi.us/pinq/pinqservlet?whoami=pinqp1> [https://perma.cc/228B-7VYY] (providing a publicly searchable database for motor vehicle license plates).

158. See Tom Simonite, *License Plates for Drones Could Make Rogue Operators Accountable*, MIT TECH. REV. (Aug. 18, 2015), <https://www.technologyreview.com/s/540391/license-plates-for-drones-could-make-rogue-operators-accountable/> [https://perma.cc/74SV-WK5E] (describing potential problems with attaching license plates to drones such as the license plates only being visible to the naked eye if they are less than 100 meters away).

159. See Robert Wall, *U.K. Politicians Call for Tracking of Drone Flights*, WALL ST. J. (Mar. 4, 2015, 7:01 PM), <http://www.wsj.com/articles/u-k-calls-for-tracking-of-drone-flights-1425513662> (reporting that Parliament members sought new drone tracking system requirements partly as a way to "avoid having safety concerns stifle an industry considered to have huge potential for job creation").

system for all operators of drones weighing more than 250 grams.<sup>160</sup> Under the new system, registrants for both commercial and recreational drones must obtain a unique registration or serial number and affix the number directly onto their drones.<sup>161</sup> Registration requires providing name, address, and contact information, making it easier to identify drone owners and operators, as well.<sup>162</sup> Although this approach does not make it possible to identify owners or operators of drones while they are flying high in the air, it could be a valuable first step toward such a system.

### 3. Restrictions That Protect Federal Assets and Interests

For the reasons described above,<sup>163</sup> there are also compelling legal and policy justifications for federal restrictions on drone activity above or near nationally important sites and security infrastructure. The National Park Service (“NPS”) has already imposed restrictions to address growing concerns about drone uses within national parks. In 2014, NPS announced a temporary ban on drones flying above eighty-four million acres of NPS-controlled waters and lands.<sup>164</sup> These restrictions fall squarely within the agency’s regulatory authority, given its legislatively created role as the nation’s protector of these scenic and historic sites.<sup>165</sup> For homeland security purposes, the FAA has likewise declared Washington, D.C. and all space within a thirty-mile radius of the Ronald Reagan Washington National Airport to be a “No Drone Zone” in which drone flying is greatly limited.<sup>166</sup>

For analogous reasons, the FAA or other federal agencies could be well justified in restricting drone flying near national borders, on national public lands, near nuclear energy or military facilities, or in the vicinity of other important national security areas. Given the inherently national nature of the interests protected under such

160. Registration and Marking Requirements for Small Unmanned Aircraft, 80 Fed. Reg. 78,593, 78,646 (Dec. 16, 2015) (to be codified at 14 C.F.R. pt. 48).

161. *See id.* at 78,647–48.

162. *See id.*

163. *See supra* Section II.B.

164. *See* Mike M. Ahlers, *National Park Service Bans Drones over Safety, Noise Worries*, CNN (June 21, 2014, 11:11 PM), <http://www.cnn.com/2014/06/20/travel/national-park-service-drone-ban/> [<https://perma.cc/DGH6-J663>].

165. *See* 54 U.S.C. § 100101(a) (2014) (stating that the purpose of the NPS is to “conserve the scenery, natural and historic objects, and wild life” at national park sites “and to provide for the enjoyment” of those sites).

166. *See No Drone Zone*, FED. AVIATION ADMIN., [https://www.faa.gov/uas/no\\_drone\\_zone/dc](https://www.faa.gov/uas/no_drone_zone/dc) [<https://perma.cc/S22U-DF6B>] (last modified June 14, 2016, 2:02:57 PM) (providing more information on the FAA’s No Drone Zone designation affecting the D.C. area).

restrictions, it would seem sensible to enforce them under federal law, as is already sometimes done.<sup>167</sup> Geofences could eventually be useful tools for helping to enforce these sorts of restrictions as well.

### B. *Drone Laws Most Suitable for State Governments*

In contrast, several other drone regulatory tasks are arguably better suited for lower levels of government. The following Section discusses those tasks that could seemingly be addressed most effectively through state regulation.

#### 1. Privacy and Safety Rules to Protect Landowners

State governments are arguably in a better position than the FAA to craft laws aimed at protecting citizens on the ground from many of the safety and privacy risks associated with civilian drones. The Tenth Amendment to the United States Constitution reserves a substantial amount of regulatory authority to state governments.<sup>168</sup> States routinely exercise this authority—commonly known as the “police power”—to enact laws in a wide range of areas aimed at promoting the general health, safety, and welfare of their citizenry.<sup>169</sup> Such state laws often sit atop federal regulatory floors, helping to govern activities ranging from automobile driving<sup>170</sup> to hunting<sup>171</sup> and lighting fireworks.<sup>172</sup>

Much of the recent flurry of state drone legislation throughout the country is classifiable as police power regulation. For instance,

167. For example, the FAA already limits drone flying near “military operation areas.” See *Airspace Restrictions*, FED. AVIATION ADMIN., [https://www.faa.gov/uas/where\\_to\\_fly/airspace\\_restrictions/](https://www.faa.gov/uas/where_to_fly/airspace_restrictions/) [<https://perma.cc/5C3G-EP84>] (last modified July 14, 2016, 11:49:58 AM).

168. See U.S. CONST. amend. X (“The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people.”).

169. See *Police Power*, BLACK’S LAW DICTIONARY (10th ed. 2014) (defining “police power” as “[a] state’s Tenth Amendment right . . . to establish and enforce laws protecting the public’s health, safety, and general welfare, or to delegate this right to local governments”).

170. See generally *Highway Safety Laws by State*, GOVERNORS HIGHWAY SAFETY ASS’N, <http://www.ghsa.org/html/stateinfo/bystate/> [<https://perma.cc/6DB4-NUBX>] (providing a user-friendly summary of automobile traffic laws by state).

171. See generally *Where to Hunt: Hunting Info for Every State*, NAT’L SHOOTING SPORTS FOUND., [www.wheretohunt.org](http://www.wheretohunt.org) [<https://perma.cc/ND9J-DU7Q>] (providing convenient access to state hunting laws and regulations).

172. See generally *Directory of State Laws*, AM. PYROTECHNICS ASS’N, <http://www.americanpyro.com/state-law-directory> [<https://perma.cc/N3DN-RTGP>] (providing a detailed listing of fireworks restrictions by state).

statutes recently enacted in Florida,<sup>173</sup> Idaho,<sup>174</sup> and North Carolina<sup>175</sup> create civil causes of action against citizens and state agencies who use drones to conduct intentional surveillance of individuals or property, and Texas classifies recording surveillance of a person or real property without permission, including recordings from drones, as a misdemeanor.<sup>176</sup> Drone statutes enacted in other states restrict the use of drones for certain purposes, such as hunting or interfering with legal hunting.<sup>177</sup> These new state statutes represent the beginnings of what could ultimately become a full body of state-level drone safety and privacy laws. They are evidence that state legislatures are already engaged in valuable policy experimentation for this new and growing industry. Fortunately, the FAA appears to have recently acknowledged that many such laws fall within a state's police power authority;<sup>178</sup> it now seems undisputed that states enjoy at least some discretion to tailor these sorts of drone laws to fit the needs and preferences of their own jurisdictions.<sup>179</sup>

173. See FLA. STAT. § 934.50(3) (2015) (prohibiting law enforcement agencies from using a drone “to gather evidence or other information”).

174. See IDAHO CODE § 21-213(2) (LEXIS through 2016 Reg. Sess.) (prohibiting a “person, entity or state agency” from using “an unmanned aircraft system to intentionally conduct surveillance of, gather evidence or collect information” about an individual, an individual's curtilage, or an agricultural industry, without written consent).

175. See N.C. GEN. STAT. § 15A-300.1 (2015) (prohibiting a “person, entity, or State agency” from conducting surveillance of a person or private real property without the person's consent, with exceptions for newsgathering and certain instances for law enforcement).

176. See TEX. GOV'T CODE ANN. § 423.003 (West, Westlaw through 2015 Reg. Sess. of 84th Legis.). See generally *id.* § 423.002 (providing exceptions to restrictions on drone-assisted photography and filming for such activities as “professional or scholarly research,” military exercises, and natural gas or electric utility operations).

177. See IDAHO CODE § 36-1101(b) (LEXIS through 2016 Reg. Sess.) (prohibiting hunting with an “unmanned aircraft system” or using an unmanned aircraft to “molest, stir up, rally or drive in any manner any of the game animals or game birds of this state”); MICH. COMP. LAWS ANN. § 324.40112(2)(c) (West, Westlaw through 2016 Reg. Sess. of 98th Legis.) (prohibiting the use of unmanned vehicles “to affect animal or fish behavior in order to hinder or prevent the lawful taking of an animal or a fish”); *id.* § 324.40111(5) (prohibiting the use of unmanned vehicles to “take game or fish”); N.C. GEN. STAT. § 14-401.24 (2015) (prohibiting hunting or fishing with a drone). See generally *Current Unmanned Aircraft State Law Landscape*, NAT'L CONF. OF STATE LEGISLATURES. (Aug. 16, 2016), <http://www.ncsl.org/research/transportation/current-unmanned-aircraft-state-law-landscape.aspx> [https://perma.cc/JPC5-GS5V] (describing hunting-related state drone laws).

178. See FED. AVIATION ADMIN., *supra* note 50, at 3 (listing examples of police power laws that are not subject to federal preemption, including warrant requirements for drone-assisted police surveillance, prohibitions on drone voyeurism, prohibitions on drone-assisted fishing or hunting, and prohibitions on the attachment of firearms or weapons to drones).

179. This is not to ignore that Congress has granted the FAA the power to ensure the “safety of aircraft” in “navigable airspace.” 49 U.S.C. § 40103(b) (2012).

## 2. Clarifications of Landowners' Airspace Rights

State governments are also best positioned to clarify certain questions of state property law that have grown increasingly relevant with the recent proliferation of drone technologies. Chief among these are questions regarding the extent to which landowners are entitled to exclude drones from flying at low altitudes directly over their parcels. Should landowners be legally entitled to exclude unwanted objects from hovering a mere two feet above their backyards? What if an object hovers at twenty feet? What if it hovers at 200 feet? Away from airports and below altitudes where airplanes routinely fly, these questions about the scope of landowners' rights in low-altitude airspace have very little to do with regulating interstate commerce, establishing nationwide uniformity, or protecting manned aviation; they are primarily issues of state property law.<sup>180</sup>

Property law has long recognized that owners of real property hold more than mere rights in the surface of a parcel; they have interests in at least some of the airspace immediately above the surface as well.<sup>181</sup> State condominium laws further reinforce this doctrine, governing landowners' rights to convey interests in specific portions of their airspace to others by deed.<sup>182</sup> However, laws in most states offer relatively little guidance regarding the extent of landowners' rights to exclude unwanted objects such as drones from the low-altitude airspace directly above their land.<sup>183</sup> The common law rules applicable to this issue in most states rely upon vague, nuisance-like balancing tests to address conflicts between flying objects and landowners.<sup>184</sup> These fuzzy rules may have adequately governed such conflicts prior to the civilian drone era, but they are becoming increasingly inadequate as the incidence of conflicts between landowner and drone operators grows.<sup>185</sup>

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180. See, e.g., *Butner v. United States*, 440 U.S. 48, 55 (1979) (stating that “[p]roperty interests are created and defined by state law”).

181. See *supra* notes 93–94 and accompanying text.

182. See, e.g., COLO. REV. STAT. § 38-33-102 (LEXIS through 2016 Legis. Sess.) (recognizing the ownership of condominiums “to consist of a separate estate in an individual air space unit of a multi-unit property together with an undivided interest in common elements”). See generally Donna S. Bennett, *Condominium Homeownership in the United States: A Selected Annotated Bibliography of Legal Sources*, 103 L. LIBR. J. 249 (2011) (providing a useful primer on condominium law).

183. See Rule, *supra* note 143, at 182–86 (discussing variations in property law for low-altitude airspace).

184. See *id.*

185. See *id.* at 169–74 (describing how drone technologies are raising questions in such areas as aerial trespass, takings, and Fourth Amendment limitations on law enforcement searches).

Large corporations such as Amazon<sup>186</sup> and Alphabet<sup>187</sup> that are interested in offering drone-assisted delivery services in the United States would benefit greatly if the FAA were to eliminate rather than clarify landowners' rights to exclude in low-altitude space. They could likewise benefit if federal laws broadly preempted municipal authority to regulate drone activities in that space, allowing companies with federal drone use authorizations to ignore most state and local drone use restrictions. Expanding drone delivery throughout the country could be less complicated and expensive for these companies if the FAA were to establish sole control over low-altitude airspace and leave minimal room for aerial trespass claims or state or local drone use restrictions.<sup>188</sup> However, such a sweeping, unsubstantiated, federal "unitary choice preemption" approach to landowner airspace rights laws would also arguably orchestrate one of the largest uncompensated transfers of property interests in United States history.<sup>189</sup> Millions of Americans would lose valuable rights to prevent unwanted devices from physically invading the airspace just above their backyards and rooftops, receiving almost nothing in return.

Ironically, prevailing property theory principles suggest that the growing conflicts between drone operators and landowners over the use of low-altitude airspace call for an opposite policy response: that of strengthening and clarifying landowners' property interests in that space.<sup>190</sup> State statutes that better defined landowners' respective

186. See Jacob Pramuk, *Drone Battle's Next Front: Your Local Government*, CNBC (Dec. 24, 2015, 9:00 AM), <http://www.cnbc.com/2015/12/23/drone-battles-next-front-your-local-government.html> [<https://perma.cc/CL7T-XY5W>] (reporting that Amazon declared that "states and localities must not be allowed to regulate small drones that the FAA has authorized").

187. See Hope King, *Google X Hopes to Launch Drone Deliveries by 2017*, CNN (Nov. 2, 2015, 4:04 PM), <http://money.cnn.com/2015/11/02/technology/google-drone-delivery/> [<https://perma.cc/U5KR-RQUR>] (describing "Project Wing," a project of Alphabet's tech lab Google X, that is developing technologies for drone-assisted product deliveries).

188. See Cecilia Kang, *Localities Object as F.A.A. Asserts Drone Authority*, N.Y. TIMES, Dec. 28, 2015, at B1 (stating that tech companies would benefit from "[a]ny rollback . . . of local drone regulations" and reporting that "[c]ompanies such as Amazon and Google have hired dozens of lobbyists over the last year to visit aviation committees on Capitol Hill" and that these "companies want a light touch by regulators to help give their drone efforts the widest possible latitude").

189. See *supra* notes 118–24 and accompanying text (explaining difficulties surrounding "federal unitary choice preemption"); see also *infra* note 193 and accompanying text.

190. A handful of states have enacted statutes that seemingly affirm landowners' substantial airspace rights. See, e.g., CAL. CIV. CODE § 659 (West, Westlaw through 2016 Reg. Sess.) ("Land . . . includes free or occupied space for an indefinite distance upwards . . . subject to limitations upon the use or airspace imposed, and rights in the use of airspace granted, by law."); GA. CODE ANN. § 51-9-9 (2015) ("The owner of realty has

entitlements in low-altitude airspace and established that those entitlements ran with the land would make it easier for parties to negotiate drone-related covenants and easements involving that space.<sup>191</sup> Communities could more easily incorporate private drone use rules into their covenants, conditions, and restrictions.<sup>192</sup> Municipal governments would operate under greater legal certainty when purchasing or condemning airspace easements for “drone corridors” above private land. And such statutes could potentially even help to simplify certain criminal law and takings law questions arising from the use of drone technologies.<sup>193</sup>

Several state legislatures have already enacted laws providing that landowners have at least some rights to exclude drones from the airspace directly above their parcels. An Oregon statute enables landowners to recover treble damages for injuries caused when private citizens fly unwelcome drones less than 400 feet above their land.<sup>194</sup> Additionally, a Nevada statute creates civil liability for drone operators who fly less than 250 feet above private property after the underlying landowner objects.<sup>195</sup> Clear signals from the FAA that it intends to embrace a regulatory floor approach and not seek to preempt such state laws would go far in encouraging other states to enact similar legislation.

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title downwards and upwards indefinitely; and an unlawful interference with his rights, either below or above the surface, gives him a right of action.”); MINN. STAT. § 360.012.2 (LEXIS through 2016 Reg. Sess.) (“The ownership of the space above the lands . . . of this state is declared to be vested in the several owners of the surface beneath, subject to the right of flight . . .”). See Rule, *supra* note 143, at 179–86 (providing a recent analysis on this topic).

191. For a full description of the Coasean concept that clearly exhibited how land-related entitlements can facilitate more efficient bargaining, see WILLIAM A. FISCHER, *THE ECONOMICS OF ZONING LAWS* 112 (1985) (“Not only must initial entitlements be assigned, but rules by which the entitlements are legally protected must also be established.”).

192. Private covenants that regulate the exterior colors of buildings, the placement of TV antennas, roof-mounted air conditioning units, and other conspicuous items serve similar functions. See generally David L. Callies, *Common Interest Communities: An Introduction*, 37 URB. LAW. 325 (2005) (describing the use of private covenants in residential settings).

193. See Rule, *supra* note 143, at 171–74 (describing takings law and Fourth Amendment questions arising from drones, and discussing how uncertainty regarding landowners’ rights to exclude drones from airspace above their parcels is complicating those questions).

194. OR. REV. STAT. ANN. § 837.380 (West, Westlaw through 2016 Reg. Sess.).

195. NEV. REV. STAT. ANN. § 493.103 (West, Westlaw through 78th Reg. Sess. & 29th Spec. Sess. of 2015).

### 3. State Registration and Operator Licensing Programs

One other regulatory task that arguably suits state governments well is that of assisting the FAA in administering registration and licensing programs for civilian drones and drone operators. In December of 2015, the FAA introduced its first-ever federal registration requirements for noncommercial drones weighing less than fifty-five pounds.<sup>196</sup> Unfortunately, these new requirements involve little more than paying five dollars, providing some basic contact information, clicking through some disclosures, and affixing a unique serial number to each registered drone device.<sup>197</sup> No knowledge test or live interaction with a government official is required.<sup>198</sup> Already, these new registration rules have been criticized as being potentially unenforceable<sup>199</sup> and as doing too little to address the safety and privacy risks associated with civilian drones.<sup>200</sup>

Fortunately, state governments throughout the nation have motor vehicles divisions and offices that already handle a large volume of registrants each year.<sup>201</sup> These offices help to ensure that automobiles registered within a given state meet state and federal

196. See Registration and Marking Requirements for Small Unmanned Aircraft, 80 Fed. Reg. 78,593, 78,593–648 (Dec. 16, 2015) (to be codified in scattered parts of 14 C.F.R.).

197. See *id.* at 78,645–48. See generally *Welcome to the Small Unmanned Aircraft System (sUAS) Registration Service*, FED. AVIATION ADMIN., <https://registermyuas.faa.gov/> [<https://perma.cc/YXN5-3EXP>] (providing more information about the registration process).

198. See Registration and Marking Requirements for Small Unmanned Aircraft, 80 Fed. Reg. at 78,645–48.

199. See, e.g., Seung Lee, *Is the FAA's Drone Registration Program Legal?*, NEWSWEEK (Dec. 23, 2015, 4:10 PM), [http://www.newsweek.com/faas-drone-registration-program-legal-408701?piano\\_t=1](http://www.newsweek.com/faas-drone-registration-program-legal-408701?piano_t=1) [<https://perma.cc/VSX3-WKRQ>] (describing a Florida attorney's legal challenge to the validity of the new FAA registration requirements for small civilian drones).

200. See, e.g., Editorial Board, *Opinion, The Government's Plan to Register Drones Doesn't Go Far Enough*, WASH. POST (Oct. 26, 2015), [https://www.washingtonpost.com/opinions/the-governments-plan-to-register-recreational-drones-doesnt-go-far-enough/2015/10/26/bd21aac8-79c5-11e5-a958-d889faf561dc\\_story.html](https://www.washingtonpost.com/opinions/the-governments-plan-to-register-recreational-drones-doesnt-go-far-enough/2015/10/26/bd21aac8-79c5-11e5-a958-d889faf561dc_story.html) [<https://perma.cc/DE9Y-YTVV>] (arguing that the FAA's drone registration rules are “not nearly enough” to address issues associated with the nation's rapidly rising volume of civilian drone activities).

201. See Bureau of Transp. Statistics, *Table 1-16: Retail(a) New Passenger Car Sales (Thousands of Units)*, U.S. DEP'T OF TRANSP., [http://www.rita.dot.gov/bts/sites/rita.dot.gov/bts/files/publications/national\\_transportation\\_statistics/html/table\\_01\\_16.html](http://www.rita.dot.gov/bts/sites/rita.dot.gov/bts/files/publications/national_transportation_statistics/html/table_01_16.html) [<https://perma.cc/4LXR-XG26>] (last updated Oct. 2015) (reporting that approximately 7,585,000 new passenger cars were purchased in the United States in 2013, the vast majority of which would presumably need to be registered in state agency offices).

safety and performance requirements and are registered and plated.<sup>202</sup> Such offices could also serve as convenient places for citizens and businesses to register drones or to renew drone registrations based on periodic drone safety and performance inspections. The sheer volume of new drone sales in the United States is already far more comparable to that of new automobile sales than to that of new manned airplane or helicopter sales.<sup>203</sup> Accordingly, a cooperative, federalism-based approach to drone registration that utilizes the FAA's expertise and leverages existing state resources might be policymakers' best chance at affordably implementing a truly robust, meaningful drone registration program.<sup>204</sup>

For the hundreds of thousands of drones manufactured and sold before safety and performance requirements for registration go into effect, states and the FAA could create a Class B registration option that allows some limited use of these noncompliant devices. Such a tiered regulatory system, which has analogs in land use zoning<sup>205</sup> and automobile registration realms,<sup>206</sup> might help to appease owners of preexisting nonconforming drones without unduly sacrificing the safety of manned aircraft and of individuals on the ground.

State governments might also be well-positioned to assist with the licensing of drone operators. The FAA's proposed federal drone

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202. See generally *Residency Requirement for First Time California Driver License and Identification Card Applicants*, STATE OF CAL. DEP'T OF MOTOR VEHICLES, <https://www.dmv.ca.gov/portal/dmv> [<https://perma.cc/4MS9-NCZ6>] (providing information about the types of valuable functions that motor vehicles division offices typically perform).

203. See Office of the Assistant Secretary for Research and Technology, U.S. Department of Transportation, *Table 1-12: U.S. Sales or Deliveries of New Aircraft, Vehicles, Vessels, and Other Conveyances*, U.S. DEP'T OF TRANSP., [http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national\\_transportation\\_statistics/html/table\\_01\\_12.html](http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_01_12.html) [<https://perma.cc/E7WS-TVZK>] (last updated Apr. 2016) (reporting that less than 3,000 new aviation aircrafts are delivered for sale in the United States in a typical year). But see Michal Addady, *The Number of Drones Expected to Sell During the Holidays Is Scaring the Government*, FORTUNE (Sept. 29, 2015, 3:15 PM), <http://fortune.com/2015/09/29/drones-holiday-sales/> [<https://perma.cc/YN23-GBQ9>] (reporting that United States retailers were expected to sell more than one million small drones in the 2015 holiday season alone).

204. See generally Robert A. Schapiro, *Toward a Theory of Interactive Federalism*, 91 IOWA L. REV. 243, 283–85 (2005) (providing a basic overview of “cooperative federalism”).

205. See generally Deepa Varadarajan, *Billboards and Big Utilities: Borrowing Land-Use Concepts to Regulate “Nonconforming” Sources Under the Clean Air Act*, 112 YALE L.J. 2553, 2566–68 (2003) (discussing the treatment of preexisting nonconforming land uses under zoning law and legal and policy rationales for such treatment).

206. See, e.g., N.Y. VEH. & TRAF. LAW § 25 (McKinney, Westlaw through July 2016) (describing distinct, more restrictive rules for “limited use vehicles” in New York that do not meet conventional automobile registration requirements).

operator licensing system for commercial drone fliers could easily become overwhelmed if the industry continues to rapidly expand. Consider, for instance, the “knowledge test” requirement for commercial drone operators, loosely described in the FAA’s notice of proposed rulemaking (“NPRM”) that was released in February of 2015.<sup>207</sup> How does the FAA plan to administer these tests and facilitate the licensing of the potentially tens of thousands of drone operators per year who may soon be seeking them?<sup>208</sup> The agency’s proposed procedures, which are significantly less onerous than conventional pilot licensing procedures, are arguably more akin to automobile driver licenses than to conventional FAA pilot licenses.<sup>209</sup> Given these strong similarities, why not explore the possibility of using state government resources to help administer these licensing programs?

Most state governments already have well-established licensing procedures for automobile drivers.<sup>210</sup> These often include driving tests and written or computer-assisted applicant exams designed to ensure that licensed individuals are adequately educated about traffic laws and trained to drive competently and safely.<sup>211</sup> One can easily imagine comparable licensing procedures administered through state motor vehicle division offices that use many of the same government resources presently used for driver license certification and testing.

207. See Notice of Proposed Rulemaking, Docket No. FAA-2015-0150, Notice No. 15-01, Operation and Certification of Small Unmanned Aircraft Systems 107–10 (Feb. 15, 2015), [https://www.faa.gov/regulations\\_policies/rulemaking/recently\\_published/media/2120-AJ60\\_NPRM\\_2-15-2015\\_joint\\_signature.pdf](https://www.faa.gov/regulations_policies/rulemaking/recently_published/media/2120-AJ60_NPRM_2-15-2015_joint_signature.pdf) [<https://perma.cc/5PTT-JQ2L>].

208. See generally Henry H. Perritt, Jr. & Eliot O. Sprague, *Developing DROP Discipline: Training and Testing Operators of Small Unmanned Aircraft Systems*, 7 HASTINGS SCI. & TECH. L.J. 143 (2015) (discussing the issue of drone operator licensing in detail).

209. See, e.g., Kelsey D. Atherton, *The Future of Urban Planning: Zoning for Drones*, POPULAR SCI. (Aug. 22, 2014), <http://www.popsci.com/article/technology/future-urban-planning-zoning-drones> [<https://perma.cc/EQ3B-A3QJ>] (drawing similar parallels between drone flying and automobile driving by quoting urban designer Mitchell Sipus as stating that drone flying is “not really that different than regular automobile traffic”).

210. See, e.g., *Requirements for a California Driver License (FFDL5)*, STATE OF CAL. DEP’T OF MOTOR VEHICLES (June 2016), [https://www.dmv.ca.gov/portal/dmv/?1dmy&uril=wcm:path:/dmv\\_content\\_en/dmv/pubs/brochures/fast\\_facts/ffd105](https://www.dmv.ca.gov/portal/dmv/?1dmy&uril=wcm:path:/dmv_content_en/dmv/pubs/brochures/fast_facts/ffd105) [<https://perma.cc/M886-74T9>] (providing California’s requirements for obtaining a driver license).

211. See, e.g., *DMV’s Driving Test (FFDL 22)*, STATE OF CAL. DEP’T OF MOTOR VEHICLES (May 2012), [https://www.dmv.ca.gov/portal/dmv/detail/pubs/brochures/fast\\_facts/ffd122](https://www.dmv.ca.gov/portal/dmv/detail/pubs/brochures/fast_facts/ffd122) [<https://perma.cc/QU55-HAWY>] (describing California’s physical driving test requirement); see also *Samples of Driver License Knowledge Tests*, STATE OF CAL. DEP’T OF MOTOR VEHICLES, <https://www.dmv.ca.gov/portal/dmv/detail/pubs/interactive/tdrive/exam> [<https://perma.cc/92LS-342Y>] (providing information regarding California’s written driver license test requirement covering state traffic laws).

North Carolina has already enacted a statute establishing a state-level commercial drone operator licensing program.<sup>212</sup> Among other things, North Carolina's statute requires that commercial drone operators be at least sixteen years of age, have a valid driver's license, and pass a drone flying knowledge test to obtain an operator license.<sup>213</sup> Operating a drone for commercial purposes in North Carolina without this license is a Class 1 misdemeanor.<sup>214</sup> As North Carolina's statute shows, there is no compelling reason for such requirements to be implemented and enforced solely at the federal level.<sup>215</sup>

### C. *The Need for Municipal Government Involvement*

Although federal and state governments are well equipped to handle much of the nation's drone regulation, some drone regulatory tasks are so inherently local in nature that local governments are better suited to manage them. Municipalities, holding land use regulatory authority under state zoning enabling acts,<sup>216</sup> are arguably authorized under those same statutes to regulate activities in the airspace just above the ground as well. The subsections below describe why involving local governments in drone regulation could allow for a degree of precision and efficiency that are otherwise unattainable.

#### 1. Access to Firsthand, Local Information

Municipalities' access to firsthand information about the unique preferences and attributes of their communities makes them essential contributors to any comprehensive drone regulatory system. Consider, for example, a simple policy decision of whether and under what conditions to permit civilian drone activity in the low-altitude airspace above a particular city neighborhood. If the neighborhood is

212. See N.C. GEN. STAT. § 63-96 (2015) (requiring permits for the commercial operation of an unmanned aircraft system).

213. See Act of July 1, 2016, ch. 90, sec. 14.5(b), § 63-96(b), 2016 N.C. Sess. Laws \_\_, \_\_ (to be codified at N.C. GEN. STAT. § 63-96(b)).

214. See N.C. GEN. STAT. § 63-96(e).

215. See Christopher Simmons, *The Drone Act of 2016: Calif. Assemblyman Mike Gatto Announces Consumer Aviation Measure*, CAL. NEWSWIRE (Jan. 13, 2016), <http://californianewswire.com/the-drone-act-of-2016-calif-assemblyman-mike-gatto-announces-consumer-aviation-measure/> [<https://perma.cc/D35J-5JH8>] (announcing the California State Legislature's consideration of its own bill that would require drone owners to have insurance policies and tiny electronic license plates for their devices).

216. See FISCHER, *supra* note 192, at 22 ("Zoning is one of the community's 'police powers[,]'" and "[t]his broad regulatory authority is derived by the municipality from the state government. In most cases a special enabling act, patterned after a standard act promulgated in the 1920s, gives the locality the power to zone.").

situated near an airport or important security site, then federal agencies should obviously have authority to restrict or prohibit nearby drone use. Beyond that, however, municipalities are better equipped than federal agencies to gather and process the information relevant to determining where and when drones should be permitted to fly. Is the neighborhood filled with single-family homes, secluded private patios, and backyard pools? Or is it merely a collection of old warehouses in an industrially zoned area of town? Unlike the FAA, the nation's thousands of local governments have this sort of information at their fingertips and use it on a regular basis to make land use regulatory decisions and to otherwise tailor policies to fit the needs of their own communities.

## 2. Longtime Regulation of Other Airspace Uses

The long history of municipalities regulating other activities in low-altitude airspace is yet another compelling reason to involve them in the nation's regulatory structure for drones.<sup>217</sup> Many new small civilian drones are programmed to hover primarily in the layer of airspace that rests just above a community's buildings, trees, and other grounded structures,<sup>218</sup> building setbacks, height restrictions, and other common municipal ordinance provisions already regulate uses of that same space.<sup>219</sup>

Building height restrictions and setbacks benefit landowners, in part, by giving them greater long-term certainty regarding the scope and degree of their seclusion from neighbors. For example, suppose that a landowner who is installing a backyard pool purposefully situates the pool area on the lot and designs it such that neighbors in nearby homes cannot peer through their windows and watch the homeowner's family swim. Local setbacks and height restrictions can

217. See, e.g., County of San Diego, Cal., Ordinance § 4600 (May 2016), <http://www.sandiegocounty.gov/content/dam/sdc/pds/zoning/z4000.pdf> [<https://perma.cc/9Q8E-W8Y4>].

218. A growing number of drone manufacturers are embedding software into new drones with preprogrammed maximum altitude limits of 400 feet. See, e.g., Lance Ulanoff, *Yuneec Typhoon H Drone Is Full of Awesome Power and Frustrating Complexity*, MASHABLE (July 7, 2016), <http://mashable.com/2016/07/07/yuneec-typhoon-h-drone-review/#oGGkrz8Ab5q9> [<https://perma.cc/GY5W-LYL4>] (noting that one new drone's "angle mode" is the least restrictive and allows it to "go to its max 400-foot altitude"); *Phantom 3 Professional- Flight Limits and No-Fly Zones*, DJI, [http://wiki.dji.com/en/index.php/Phantom\\_3\\_Professional\\_Flight\\_Limits\\_and\\_No-Fly\\_Zones](http://wiki.dji.com/en/index.php/Phantom_3_Professional_Flight_Limits_and_No-Fly_Zones) [<https://perma.cc/ZZ6V-2WG7>] (last modified Dec. 3, 2015 9:28 PM) (noting that the DJI's Phantom 3 drone is pre-programmed to have a maximum height limit of 400 feet).

219. See Troy A. Rule, *Airspace in a Green Economy*, 59 UCLA L. REV. 270, 284–85 (2011) (describing how building setbacks and height restriction ordinances limit the use of low-altitude airspace).

make it much more difficult for neighbors to renovate nearby homes in ways that threaten the privacy-protecting elements of this homeowner's pool design. From an academic perspective, these sorts of land use restrictions effectively designate the low-altitude airspace near the homes involved as a "conservation commons,"<sup>220</sup> enabling the space to serve as a valuable seclusion buffer that reciprocally benefits residents below.<sup>221</sup>

By keeping eyes, ears, and noises out of low airspace, height restrictions, setbacks, and similar regulations help to protect citizens' investments in pool walls, privacy hedges, privacy fences, and other types of seclusion-driven land development designs. However, as drone activity—a "rival" use of the same low-altitude space—becomes more commonplace, it increasingly interferes with landowners' longtime use of the space as a seclusion buffer.<sup>222</sup> With the increasing affordability of drones, the cost-related barriers that have enabled low-altitude airspace to serve this valuable seclusion function for decades are quickly evaporating. Low-cost, camera-mounted drones—readily available at big box stores throughout the country—are now enabling ordinary citizens to gain access to visual vantage points into backyards and other private land areas that were previously attainable only aboard helicopters or manned airplanes with FAA-licensed pilots. In much of the country, this emerging threat to privacy surely exceeds any threats the devices might pose to manned air flight.<sup>223</sup> And local government officials seem better positioned than the FAA to determine which of these two competing airspace uses—drone activity or preservation of seclusion—to prioritize in each specific neighborhood.

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220. See *id.* at 296–97 (characterizing height-restricted airspace as a "conservation commons"); see also Abraham Bell & Gideon Parchomovsky, *Of Property and Antiproperty*, 102 MICH. L. REV. 1, 39 (2003) (describing conservation commons as "commons whose most efficient use is nonuse").

221. See Rule, *supra* note 221, at 285 (describing bulk and height restrictions as "reciprocal in that they require nearly all neighboring landowners to give up those same rights and nearly all landowners get the same general benefit from the restrictions" and suggesting that because of this reciprocal nature, such restrictions "generally respect existing airspace rights").

222. See *id.* at 294–95 (distinguishing between "rival" and "nonrival" airspace uses and detailing the economic analysis of low-altitude airspace).

223. See, e.g., Mike Nolan, *As Popularity of Drones Takes off, More Limits on Where They Can Fly*, CHI. TRIB. (Jan. 25, 2016, 3:28 PM), <http://www.chicagotribune.com/suburbs/daily-southtown/news/ct-sta-drone-restrictions-st-0122-20160125-story.html> [<https://perma.cc/8QMP-TPCY>] (quoting Tim McCarthy, the police chief of Orland Park, Illinois, as stating that the city's "No. 1 concern was privacy" in enacting a drone use restriction ordinance, and that "[p]eople don't want to have a camera looking at them on their property").

### 3. Unique Capacity to Craft Location-Specific Rules

One other argument supporting greater municipal involvement in drone regulation is that recent advancements in drone technologies necessitate a location-sensitive regulatory approach that only localities are equipped to effectively establish and enforce. Courts and policymakers relied upon similar sorts of arguments to justify the emergence of municipal land use controls—and, ultimately, zoning laws—nearly a century ago.

In the late nineteenth century, most municipal governments in the United States did relatively little to regulate land use within their communities. During that era, common law nuisance claims and private covenants were the primary means of balancing competing land uses among neighbors.<sup>224</sup> Most of the nation's predominantly rural and low-density communities had no pressing need for more regulation than that.<sup>225</sup> However, advancements in building techniques and other technological and social changes occurring shortly thereafter sparked a period of rapid urbanization.<sup>226</sup> Many cities quickly grew larger and more crowded, generating an unprecedented volume and degree of conflicts among neighbors.<sup>227</sup>

Rather than relying on the federal government to address these new challenges, municipalities began implementing their own policies aimed at promoting safer and more efficient land use.<sup>228</sup> For example, in an effort to mitigate urban fire risks, the city of Boston adopted an ordinance in 1906 that imposed varying building height restrictions depending on whether land was in a predominantly commercial or residential area.<sup>229</sup> Other cities in the late nineteenth century began adopting ordinances to prohibit potentially disruptive land uses from certain predominantly residential areas; many of these local ordinances seemed largely reactionary in nature.<sup>230</sup> For example, complaints about the smells of slaughterhouses prompted ordinances

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224. RATHKOPF ET AL., *supra* note 134, § 1:1 (detailing the history of land use disputes and nuisance litigation).

225. *See id.*

226. *See id.* § 1:2.

227. *See* Rule, *supra* note 219, at 284–85 (detailing how urbanization and advancements in high-rise building construction fueled landowner conflicts).

228. *See* ROBERT H. NELSON, ZONING AND PROPERTY RIGHTS 112 (1977) (stating that the “introduction of zoning in 1916 and its subsequent spread are typically explained as constituting the establishment of public control over use of private property that was made necessary by the increasing complexity, congestion, and density of modern urban life”); RATHKOPF ET AL., *supra* note 134, § 1:1.

229. *See* MICHAEL HOLLERAN, BOSTON'S “CHANGEFUL TIMES” 166–73 (1998) (providing a detailed history of Boston's building height restrictions).

230. *See* RATHKOPF ET AL., *supra* note 134, § 1:1.

limiting their locations.<sup>231</sup> Residential landowners' complaints about nearby taverns and fears of one opening next door surely contributed to the growing number of restrictions on where taverns could be sited, as well.<sup>232</sup>

As urbanization continued into the early twentieth century, ordinances that targeted certain types of land uses and particular areas of town eventually became insufficient to adequately address growing tensions among neighboring urban land uses in some cities.<sup>233</sup> At that historic breaking point, zoning ordinances began to quickly spread across the nation.<sup>234</sup> Municipalities throughout the country increasingly adopted zoning laws to help preserve the precious tranquility of residential neighborhoods in modern times.<sup>235</sup> To quote Justice Sutherland's words in the famous 1926 zoning case, *Village of Euclid v. Ambler Realty Co.*:<sup>236</sup>

Building zone laws are of modern origin . . . . Until recent years, urban life was comparatively simple; but with the great increase and concentration of population, problems have developed, and constantly are developing, which require, and will continue to require, additional restrictions in respect of the use and occupation of private lands in urban communities. Regulations, the wisdom, necessity and validity of which . . . are so apparent that they are now uniformly sustained, a century ago, or even half a century ago, probably would have been rejected as arbitrary and oppressive. Such regulations are sustained, under the complex conditions of our day, for reasons analogous to those which justify traffic regulations, which, before the advent of automobiles and rapid transit street railways, would have been condemned as fatally arbitrary and unreasonable. And in this there is no inconsistency, for while the meaning of constitutional guaranties never varies, the scope of their application must expand or contract to meet the new and different conditions . . . .<sup>237</sup>

An analogous situation arguably exists today, as drone technologies increasingly engender conflicts that ordinary trespass or

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231. *See id.*

232. *See id.* (providing historical background on the tensions and problems that sparked local ordinances and restrictions in the early twentieth century).

233. *See id.* § 1:2.

234. *See id.* § 1:1.

235. *See id.* § 1:2 (detailing the “city beautiful” movement, which sought to preserve the tranquility and attractiveness of residential areas).

236. 272 U.S. 365 (1926).

237. *Id.* at 386–87.

nuisance claims and broad federal regulations are ill-equipped to govern. Even state aerial trespass laws or other airspace rights statutes can only offer limited privacy protection for landowners in many settings.<sup>238</sup> Particularly in urban areas where parcel sizes tend to be relatively small, a drone hovering 100 feet above an adjacent parcel can get nearly as much visual access into a secluded yard next door as a drone that flies directly above the secluded area. Nuisance claims do not require any sort of physical intrusion into the space of another and thus might theoretically provide a basis for liability in some situations.<sup>239</sup> However, just as nuisance law and other general state law provisions ultimately proved inadequate on their own to govern land use conflicts in the early twentieth century, such laws will ultimately prove insufficient to govern drone use conflicts among neighbors.

Early twentieth century policymakers turned to municipal zoning to more effectively manage the growing volume of land use conflicts arising in that period, and drone zoning could serve a similar function as drones increasingly compete for the use of low-altitude airspace in the coming years. Already, several cities have crafted ordinances aimed at protecting the serenity of residential neighborhoods from powerful drone technologies.<sup>240</sup> The city of Evanston, Illinois, imposed a two-year moratorium on drones in 2013.<sup>241</sup> In the same year, Iowa City, Iowa, adopted an ordinance by popular petition that prohibited the use of drones for the enforcement of qualified traffic law violations.<sup>242</sup> A few months later, the small town of St.

238. See *supra* notes 174–77 and accompanying text.

239. See RESTATEMENT (SECOND) OF TORTS § 821D (AM. LAW INST. 1979) (defining private nuisance as a “nontrespassory invasion of another’s interest in the private use and enjoyment of land”).

240. See, e.g., PARADISE VALLEY, ARIZ., MUN. CODE §§ 10-12-1 to -4 (2015), <http://www.ci.paradise-valley.az.us/DocumentCenter/Home/View/101> [<https://perma.cc/UD3X-7HV4>] (discussing prohibitions against flying drones above others’ land without express permission and against flying drones above public property without a special permit, and listing requirements for city-level registration of commercial drones).

241. See Ciara McCarthy, *Evanston City Council Passes Moratorium on Drones, Debates Zoning Ordinance*, DAILY NORTHWESTERN (May 28, 2013), <http://dailynorthwestern.com/2013/05/28/city/evanston-council-passes-moratorium-on-drones-debates-zoning-ordinance/> [<https://perma.cc/L7S8-SJRK>] (describing the ordinance as “an important symbol of Evanston’s commitment to protecting the privacy and safety of its residents”).

242. IOWA CITY, IOWA, CITY CODE § 9-11-1 to -2 (2016), [http://www.sterlingcodifiers.com/codebook/index.php?book\\_id=953](http://www.sterlingcodifiers.com/codebook/index.php?book_id=953) [<https://perma.cc/9KMW-Z63W>]; see also Adam B. Sullivan, *Iowa City’s Drone Ban May Be First of Its Kind in the U.S.*, PRESS-CITIZEN.COM (June 5, 2013), [http://www.iowadot.gov/aviation/news/pdfs/Iowa%20City's%20drone%20ban%20may%20be%20first%20of%20its%20kind%20in%20the%20U.S.%20\\_%20Iowa%20City%20Press.pdf](http://www.iowadot.gov/aviation/news/pdfs/Iowa%20City's%20drone%20ban%20may%20be%20first%20of%20its%20kind%20in%20the%20U.S.%20_%20Iowa%20City%20Press.pdf) [<https://perma.cc/L26N-UZUZ>].

Bonafacius, Minnesota, enacted an indefinite ban on civilian drones.<sup>243</sup> More recently, the Board of Commissioners of Long Beach Township, New Jersey, adopted an ordinance providing that unauthorized operators of drones within township limits could face up to ninety days of jail time or fines of up to \$2,000.<sup>244</sup> Multiple other local governments have also recently adopted or considered drone use restrictions, and additional ordinances are sure to come.<sup>245</sup> Much like the early twentieth century location restrictions on slaughterhouses and taverns that served as precursors to modern zoning, many of these proposed or adopted ordinances only restrict drone flying in certain localized areas such as residential neighborhoods.<sup>246</sup>

243. ST. BONIFACIUS, MINN., CITY CODE §§ 9-9.1 to -9.6 (2013), <http://www.ci-st-bonifacius.mn.us/drones.pdf> [<https://perma.cc/D65J-4KSH>]; see also Tom Meersman, *St. Bonifacius Says No to Drones*, STAR TRIB. (Apr. 6, 2013, 12:07 AM), <http://www.startribune.com/st-bonifacius-says-no-to-drones/201723501/> [<https://perma.cc/PU6H-JVWF>].

244. TOWNSHIP OF LONG BEACH, N.J., CODE §§ 1-17, 57-2 to -4 (2015), <http://ecode360.com/30512985> [<https://perma.cc/NTM4-FZ5E>]; see also Erik Larsen, *Long Beach Township Bans Drones*, ASBURY PARK PRESS (May 26, 2015, 11:12 AM), <http://www.app.com/story/news/local/ocean-county/2015/05/22/long-beach-township-bans-drones/27817439/> [<https://perma.cc/E8PD-DJJN>].

245. See, e.g., PARADISE VALLEY, ARIZ., MUN. CODE §§ 10-12-1 to -4 (2015), <http://www.ci.paradise-valley.az.us/DocumentCenter/Home/View/101> [<https://perma.cc/UD3X-7HV4>] (detailing prohibitions against drone flying above others' land without express permission and against drone flying above public property without a special permit, and listing requirements for city-level registration of commercial drones); see also John Best, *Forks Township Supervisors Discuss Possibility of Drone Laws*, LEHIGHVALLEYLIVE (June 8, 2015, 12:52 PM), [http://www.lehighvalleylive.com/easton/index.ssf/2015/06/forks\\_township\\_supervisors\\_dis.html](http://www.lehighvalleylive.com/easton/index.ssf/2015/06/forks_township_supervisors_dis.html) [<https://perma.cc/2RUW-3LNX>]; Molly Eadie, *Public Safety Committee Tables Ordinance Regulating Drone Use*, TROY REC. POL. (Feb. 19, 2015, 9:34 PM), <http://www.troyrecord.com/government-and-politics/20150219/public-safety-committee-tables-ordinance-regulating-drone-use> [<https://perma.cc/M4KH-2SND>] (describing possible changes to a proposed ordinance in Troy, New York, that would allow for either a \$250 fine or fifteen days of jail time for the unauthorized use of drones in the city); *Lake Havasu Officials Mull Regulating Use of Drones*, WASH. TIMES (May 30, 2015), <http://www.washingtontimes.com/news/2015/may/30/lake-havasu-officials-mull-regulating-use-of-drone/> [<https://perma.cc/84DC-TMBB>] (stating that city council officials in Lake Havasu City, Nevada, were considering an ordinance that would prohibit flying drones below 600 feet in local airspace); Steve Myric, *No Fly Zone for Drones on Land Bank Properties*, VINEYARD GAZETTE (Dec. 28, 2015, 4:59 PM), <http://vineyardgazette.com/news/2015/12/28/no-fly-zone-drones-land-bank-properties?k=vg5682b565e7863&r=1> [<https://perma.cc/R6XT-Q44P>] (describing a new ban on drone flying over 3,100 acres of conservation lands on Martha's Vineyard, Massachusetts); Jourdan Vian, *Bangor Finishes Ordinance Revamp; Hearing in August*, COULEE NEWS (May 28, 2015), [http://lacrossetribune.com/couleenews/news/local/bangor-finishes-ordinance-revamp-hearing-in-august/article\\_71b941ce-5449-5df0-aa59-0a1a9ccafcc0.html](http://lacrossetribune.com/couleenews/news/local/bangor-finishes-ordinance-revamp-hearing-in-august/article_71b941ce-5449-5df0-aa59-0a1a9ccafcc0.html) [<https://perma.cc/R4GX-VER6>] (reporting that officials in the Village of Bangor, Wisconsin, drafted ordinances that would ban flying drones within the village without a permit).

246. See, e.g., Blake Herzog, *California City to Vote on Banning Drones*, USA TODAY (Apr. 4, 2013, 9:45 AM), <http://www.usatoday.com/story/news/nation/2013/04/04/rancho->

In other countries, drone restrictions are similarly growing more location-specific. For example, the Japanese government enacted a law in 2016 prohibiting unauthorized civilian drone flights over government buildings and certain other areas.<sup>247</sup> The United Arab Emirates has enacted similar rules.<sup>248</sup> These location-based restrictions likewise resemble the early land use ordinances that served as precursors to modern zoning laws in the early twentieth century.<sup>249</sup>

Given these historical similarities, it is not surprising that at least a couple of commentators have already begun to imagine the possibilities of using horizontal zoning ordinances to help regulate civilian drone use.<sup>250</sup> The legal rules applicable to drone uses under these ordinances would vary depending on the specific “zone” of land over which the drone would fly. Such drone zoning laws could utilize existing land use zoning maps, basing drone use rules on whether a drone is flying above a residential, commercial, industrial, or other

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mirage-hobby-drones-ban/2052193/ [https://perma.cc/G3SH-N823] (reporting that the city of Rancho Mirage, California, contemplated adopting an ordinance that would have prohibited drone flying below 400 feet in all “areas zoned residential” within the city); Michael Riconda, *County Legislature Approves Restrictions on Drone Use*, ROCKLAND CTY. TIMES (June 17, 2015), <http://www.rocklandtimes.com/2015/06/17/county-legislature-approves-restrictions-on-drone-use/> [https://perma.cc/73CV-8HPN] (describing a newly adopted ordinance in Rockland County, New York, that prohibits drone flying above “governmental buildings such as the Rockland County Jail and Sheriff’s complex, houses of worship, courts or sewer facilities”).

247. See *Japan’s Safety Rules on Unmanned Aircraft (UA)*, CIV. AVIATION BUREAU, <http://www.mlit.go.jp/en/koku/uas.html> [https://perma.cc/RMR8-E7RK]; Miriam McNabb, *Japan Passes Strict Drone Laws Ahead of G7 Summit*, DRONELIFE.COM (Mar. 17, 2016), <http://dronelife.com/2016/03/17/japan-passes-strict-drone-laws-ahead-of-g7-summit/> [https://perma.cc/2R5N-MZ56].

248. See Gen. Civil Aviation Auth., *Civil Aviation Regulation* pt. 8, sub-pt. 10, §§ 3.7–3.9 (2015) (U.A.E.), <https://www.gcaa.gov.ae/en/publication/pages/cars.aspx> [https://perma.cc/LN6G-748J] (stating the limitations on drone use in controlled and segregated airspace); see also Mohammed El Sadafy, *Drones with Cameras in Residential Areas Punishable*, EMIRATES 24/7 (Feb. 15, 2015), <http://www.emirates247.com/news/emirates/drones-with-cameras-in-residential-areas-punishable-2015-02-15-1.580800> [https://perma.cc/L3VQ-X2ES] (quoting a police official in Dubai, United Arab Emirates, as stating that “[f]lying drones fitted with cameras in residential areas is a punishable offence as per the Federal Criminal Code”).

249. See *supra* Section III.C.3.

250. See, e.g., Robert A. Heverly, *The State of Drones: State Authority to Regulate Drones*, 8 ALB. GOV’T L. REV. 29, 61 (2015) (arguing that “devising appropriate zoning rules is one step that states and localities can take now to ensure appropriate integration of drones into the local community”); Jordan Ferguson, *Drone on Drones: Drone Zones*, BBKNOWLEDGE.COM (Jan. 8, 2015), <http://www.bbknowledge.com/public-safety/drone-on-drones-drone-zones/> [https://perma.cc/LK5T-WEVK] (suggesting that “[f]or now, zoning for drones is premature—yet we may soon see a time where localities are forced to think about how to accommodate more crowded skies”).

land use zone. Alternatively, municipalities could create overlay zoning maps that sit atop land use zoning maps and apply solely to drone flying activity.<sup>251</sup> Because drone activities could increasingly impact land use permitting decisions and comprehensive land use planning, municipalities could benefit from having the ability to craft drone zoning laws for their own jurisdictions.<sup>252</sup>

#### IV. DESIGNING AN EFFICIENT DRONE ZONING LAW

Where should cities begin in their attempts to craft drone zoning ordinances? Unfortunately, municipal officials tasked with creating these ordinances are likely to soon discover that they have few templates or examples from which to commence the drafting process. The sort of horizontal drone zoning ordinance contemplated in this Article is largely unprecedented, and few policymakers or scholars have written about such an approach.<sup>253</sup>

Because drone zoning is a strategy borne out of conventional land use zoning policies, the existing body of land use zoning laws is a valuable starting point for designing any drone zoning ordinance. Land use zoning seeks to keep loud factories away from doctors' offices and to prevent nightclubs from popping up in residential neighborhoods. Rather than waiting to address conflicts after they arise, conventional zoning ordinances regulate land uses *ex ante* and thereby prevent many conflicts from ever occurring.<sup>254</sup> Of course, land use zoning is not without its critics—it can contribute to socioeconomic and racial segregation, isolation, sprawl, and other problems.<sup>255</sup> However, the widespread adoption of zoning laws

251. For more in-depth information on the practice of overlay zoning, see Patricia E. Salkin, *Zoning and Land Use Planning: Effective Disaster Mitigation Depends upon Well-Coordinated Local Land Use Planning and Zoning*, 34 REAL EST. L.J. 108, 116–18 (2005) (providing more information about overlay zoning and describing it as “a flexible zoning technique that enables a municipality to essentially layer an additional set of regulations on top of existing requirements in a particular zoning district” and providing details on potential uses of overlay zoning ordinances).

252. For more details on the role of comprehensive plans in local zoning policy, see generally FISCHER, *supra* note 191, at 31.

253. Few have referenced drone zoning in this way. To review these limited references, as of early 2016, see generally Rule, *supra* note 143 and Atherton, *supra* note 209.

254. See Stephen J. Eagle, Kelo, *Directed Growth, and Municipal Industrial Policy*, 17 SUP. CT. ECON. REV. 63, 70–71 (2009) (“The common law dealt with . . . negative externality problem[s] through private and public nuisance law. To deal with the problem *ex ante* rather than *ex post*, localities imposed comprehensive zoning regulations almost a century ago.”).

255. See, e.g., Garrett Power, *The Unwisdom of Allowing City Growth to Work out Its Own Destiny*, 47 MD. L. REV. 626, 668–69 (1988) (summarizing briefly many of the common criticisms of land use zoning).

throughout the country and the continued use of such laws are evidence of their great value to modern society. Several elements of this established body of law could eventually prove useful in the drone zoning context as well.

To be clear, the vision of drone zoning described in this Article is substantially different from the supposed drone “zoning” model that Amazon Prime Air unveiled in July 2015.<sup>256</sup> Amazon’s vision of drone zoning necessarily assumed broad federal power, enabling the company to freely fly drones over the vast majority of the nation’s land, regardless of the wishes of landowners or of state or local authorities. Under Amazon’s proposal, the FAA would divide nearly all of the nation’s low-altitude airspace vertically rather than horizontally.<sup>257</sup> Specifically, the agency would designate space between 400 and 500 feet above the ground as a drone no-fly zone, reserve space between 200 and 400 feet for “high-speed transit” of drones, and leave space below 200 feet for “low-speed, localized transit.”<sup>258</sup> Amazon’s plan provided for no horizontal zoning of drone uses except to designate certain predefined low-risk areas where hobbyist drones with fewer safety features could freely fly.<sup>259</sup>

In contrast, the drone zoning policies envisioned in this Article would allow drone use rules to vary from neighborhood to neighborhood, much as land use restrictions in commercially zoned or industrially zoned areas differ from those in single family residential areas. For the reasons described above, such variation and tailoring of drone use restrictions by location could promote more optimal uses of the nation’s scarce low-altitude airspace as drone activity increases in the United States.<sup>260</sup> Drone zoning ordinances could eventually become a key means of accommodating valuable drone uses in a city without unduly sacrificing other important uses of the airspace involved. The following subsections describe how the same simple economics principles that help to shape land use zoning ordinances could eventually serve a similar function in the development of municipal drone zoning laws.

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256. See Elizabeth Weise, *Amazon Proposes Dividing Air into Drone Zones*, USA TODAY (July 29, 2015, 11:57 AM), <http://www.usatoday.com/story/tech/2015/07/28/amazon-drone-zone/30798777/> [<https://perma.cc/K6BC-2925>] (describing a policy proposal by Amazon Prime Air Vice President Gur Kimchi that would divide Class G airspace—space less than 500 feet above the ground—into three layers to segregate drone uses by type and to provide a buffer between drones and conventional air traffic).

257. See *id.*

258. *Id.*

259. See *id.*

260. See *supra* Section III.C.

A. *Weighing Costs and Benefits*

Basic microeconomic theory provides a useful general framework for designating drone zones and crafting drone restrictions applicable to each type of zone. In essence, drone use should be legally permissible only when and where its net social benefits are greater than zero. In other words, if the aggregate benefits to society of allowing a particular type of drone to fly in a particular location and at a particular time exceed the aggregate social costs of that drone flight, then the activity should be allowable under the law.<sup>261</sup> If not, then laws should generally prohibit the drone activity.

Concededly, recitations of this sort of simple cost-benefit analysis, in the abstract, almost always obscure the complexity and challenges of actually making the calculations. For example, if a pizzeria charges a five-dollar fee to deliver a pizza from its restaurant to a home three miles away, what is the net social benefit of that activity?<sup>262</sup> A naïve answer might be that the flight generated five dollars in value, since that is what the pizza customer paid for it. However, the actual net benefit could be significantly greater or less than five dollars. Among other things, the use of a drone rather than an automobile to deliver the pizza would likely reduce the total carbon dioxide emissions or other harmful environmental impacts involved.<sup>263</sup> Drone-assisted deliveries might also help reduce traffic congestion and pose comparatively fewer risks to pedestrians and on-

261. For a more thorough examination of this concept, see *supra* Section IV.B.

262. Some pizza companies in and out of the United States have already hinted to consumers that they intend to offer drone-assisted pizza delivery in the future. See, e.g., Rebecca Borison, *This Russian Pizzeria Will Deliver Your Pizza by Drone*, BUS. INSIDER (June 23, 2014, 4:52 PM), <http://www.businessinsider.com/russian-pizzeria-delivers-pizza-by-drone-2014-6> [<https://perma.cc/HK7Z-ELZG>] (reporting that DoDo Pizza, a restaurant in Syktyvkar, Russia, is using drones to deliver pizzas to customers); Sarah Dougherty, *India Delivers First Pizza by Drone, Kind Of...*, NBC NEWS (May 29, 2014, 12:01 PM), <http://www.nbcnews.com/news/world/india-delivers-first-pizza-drone-kind-n117611> [<https://perma.cc/MLF4-VW3E>] (describing how, in India, Francesco's Pizza reduced its pizza delivery time from thirty minutes to ten minutes by delivering the pizza with a drone); Frank Rosario, *Pizzeria Owner Uses Drone to Deliver Pie in Test Flight*, N.Y. POST (Nov. 7, 2014, 3:25 AM), <http://nypost.com/2014/11/07/pizzeria-owner-uses-drone-to-deliver-pie-in-test-flight/> [<https://perma.cc/8YT2-5EHU>] (describing a pizzeria owner in Brooklyn, New York, who predicts that his company will “have a fleet of at least 25 drones to deliver pizza” by the year 2018).

263. See generally *Climate Change: The Social Cost of Carbon*, U.S. ENVTL. PROT. AGENCY, <http://www3.epa.gov/climatechange/EPAactivities/economics/scc.html> [<https://perma.cc/4FTJ-9D6X>] (last updated Aug. 9, 2016) (providing the Environmental Protection Agency's estimation of the social costs of carbon dioxide emissions).

road vehicles.<sup>264</sup> On the other hand, the delivery drone's buzz and presence overhead might disturb land use activities below or create additional safety or privacy risks. In practice, it would be impossible to accurately measure all such costs and benefits for every conceivable drone flight and fully account for them in a set of local drone restrictions. And even if that were possible, the calculation would still be incomplete; officials would need to factor all of the costs of creating, implementing, and enforcing drone use restrictions into the calculation as well.

Fortunately, despite imperfect information and other limitations, a wide range of valuable land use regulatory activities still occur every day in municipalities throughout the country, and cost-benefit analysis is often implicit in those policy decisions.<sup>265</sup> Local drone use regulations would be no different in that regard, and at least attempting to identify and consider costs and benefits is a vital exercise when forming local drone zoning policies.

#### B. *Incorporating the Dimension of Time*

One promising way to improve the precision and efficiency of local drone use regulation is to craft drone use rules that vary based on the time of day, the day of the week, the month, or the year. There seem to be greater possibilities for varying restrictions based on this "fourth dimension" of time in the context of drone law than there has ever been in the realm of land use regulation.<sup>266</sup> Flying a drone is a far more temporary activity than most of the land development matters that municipalities restrict under ordinary zoning ordinances.<sup>267</sup>

264. See Mark Delucchi, *The Social Cost of Motor Vehicle Use*, ANNALS AM. ACAD. POL. & SOC. SCI., Sept. 1997, at 130, 131–33, 135, 138–39 (1997) (describing research that uses factors such as injuries from accidents and traffic congestion to measure the social costs of automobile travel); Benjamin J. Wickizer & Andrew Snow, *Rediscovering the Transportation Frontier: Improving Sustainability in the United States Through Passenger Rail*, SUSTAINABLE DEV. L. & POL'Y, Fall 2010, at 12, 12 ("Reliance on automobile use exacts a social cost in the form of compromised environmental, health, and quality of life factors.").

265. See, e.g., David Schleicher, *City Unplanning*, 122 YALE L.J. 1670, 1681–91 (2013) (describing the ongoing economics-oriented debate over zoning and highlighting how economics principles influence land use planning). See generally Robert C. Ellickson, *Alternatives to Zoning: Covenants, Nuisance Rules, and Fines as Land Use Controls*, 40 U. CHI. L. REV. 681, 687–99 (1973) (advocating for the use of cost-benefit analysis in the land use regulatory context).

266. For a detailed discussion of the integral nature of time in law, see generally Rebecca R. French, *Time in the Law*, 72 U. COLO. L. REV. 663 (2001).

267. Compare Cara McGoogan, *These Hydrogen-Powered Drones Can Fly for Hours*, WIRED UK (Dec. 15, 2015), <http://www.wired.co.uk/news/archive/2015-12/15/drones-hydrogen-fuel-cells-intelligent-energy> [https://perma.cc/F522-EX4B] (highlighting the

Constructing a building on land involves a sizable financial investment, tends to occur infrequently on any given parcel, and often has decades-long impacts.<sup>268</sup> In contrast, civilian drone flights and their effects on land uses tend to be short-lived and can recur multiple times in a day.<sup>269</sup>

The specific timing and context of drone activity can also greatly impact the nature and extent of its impacts on nearby land uses.<sup>270</sup> For example, in residential communities where preserving the privacy of backyard patios and swimming pools is paramount, drone flights on weekend afternoons during the summer months might be far more disruptive than identical flights over the same areas on weekday mornings during winter months.<sup>271</sup> Accordingly, policymakers are already beginning to tailor drone restrictions to specify not only *where* citizens may operate drones, but also *when* they may operate them.<sup>272</sup>

A simple graphical analysis comparable to the one Professor William Fischel has used in the air pollution context helps to illustrate the potential efficiency advantages of incorporating the dimension of time into drone use restrictions.<sup>273</sup> Figure A below depicts the costs and benefits of drone activity in a hypothetical residential

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temporary nature of the use of drones), with Mark Magnier, *Japan's Houses of Horror*, L.A. TIMES, Mar. 6, 2002, at A1 (emphasizing the durability of United States' buildings by stating that a United States home has an average life of forty-four years).

268. See Magnier, *supra* note 267, at A4 (comparing the average life of a Japanese house, which is twenty-six years, to that of a United States house, which is forty-four years).

269. See McGoogan, *supra* note 267 (reporting that the "typical" flight time limit for small drones is about twenty minutes, but that newer prototypes using solar and hydrogen technologies have remained airborne for several hours).

270. See Margot E. Kaminski, *Enough with the "Sunbathing Teenager" Gambit*, SLATE (May 17, 2016, 9:00 AM), [http://www.slate.com/articles/technology/future\\_tense/2016/05/drone\\_privacy\\_is\\_about\\_much\\_more\\_than\\_sunbathing\\_teenage\\_daughters.html](http://www.slate.com/articles/technology/future_tense/2016/05/drone_privacy_is_about_much_more_than_sunbathing_teenage_daughters.html) [<https://perma.cc/848N-BJAJ>] (articulating many circumstances in which drone use impacts people, from peeping into backyards to thermal imaging a person's facial expressions).

271. See *id.* (conceding that examples of drones peeping down onto private swimmers and sunbathers are concrete and relatable, implying a real and heightened privacy concern, but emphasizing that these are not the only privacy concerns related to drone use).

272. See, e.g., Press Release, Fed. Aviation Admin., *Cities Hosting the Papal Visit Are No Drone Zones* (Sept. 15, 2015), [https://www.faa.gov/news/press\\_releases/news\\_story.cfm?newsId=19474](https://www.faa.gov/news/press_releases/news_story.cfm?newsId=19474) [<https://perma.cc/V3AT-7CW8>] (demonstrating an example of a time-based restriction and explaining that Washington, D.C.; New York, New York; and Philadelphia, Pennsylvania, were FAA-designated no drone zones from September 22 to September 27, 2015).

273. See FISCHEL, *supra* note 191, at 82–93.

neighborhood.<sup>274</sup> The curve labeled *MC* in Figure A represents the marginal cost to society from each additional hour per year of low-altitude drone activity occurring in the area.<sup>275</sup> Most of the costs reflected in this sort of curve are likely to relate to drones' potential to interfere with residents' safety, privacy, and quiet enjoyment of their land. The curve's shape, initially sloping downward and then gradually sloping upward, is based on assumptions that the first few hours of permitted drone activity per year tend to be particularly disruptive of landowner privacy and that the severity of disruption beyond that initial quantity of flying varies depending on the time of day or year.<sup>276</sup>

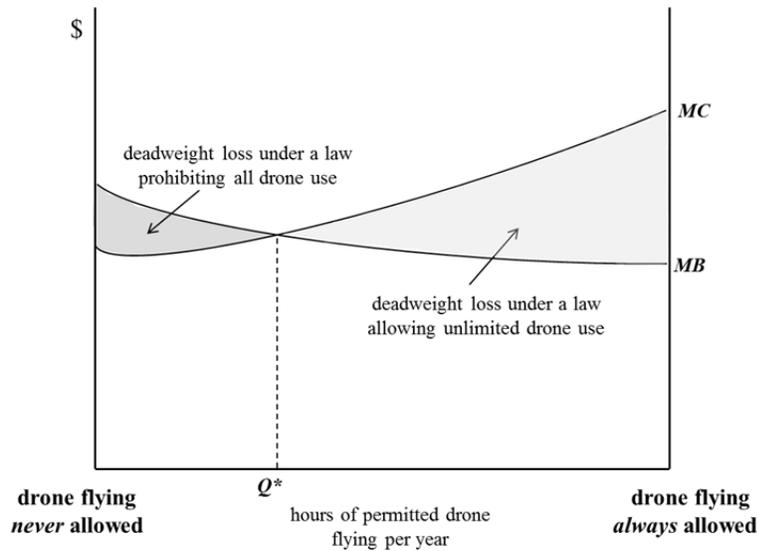
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274. See, e.g., *id.* (using an analytical approach—which is analogous to that of this Section—to conduct a similar analysis for determining the optimal amount of permissible air pollution from a mill based on the benefits to the mill and costs to the community).

275. This analysis assumes that the social marginal cost of a drone flight includes all costs to the individual operating the drone (private marginal cost) and all costs to all others in society that are attributable to that drone flight. It makes similar assumptions regarding the social marginal benefits of drone flying. For a more detailed explanation of the concept of social marginal cost and how it differs from private marginal cost, see generally KARL E. CASE & RAY C. FAIR, *PRINCIPLES OF ECONOMICS* 381–83 (1989). For simplicity, the analysis also holds all other variables constant, including the types of involved drones, the nature of their flight activity, and the population density and land uses below drone flights.

276. While such assumptions would not conform to reality in all locations, they are seemingly plausible as a hypothetical matter and are made to facilitate full illustration of this mode of analysis.

**Figure A: Social Marginal Costs and Benefits of Drone Use in a Hypothetical Residential Neighborhood**



In contrast, the curve labeled *MB* in Figure A represents the hypothetical marginal benefits to society from each additional hour per year of drone flying in this hypothetical neighborhood. Such benefits might include the enjoyment that hobbyists and spectators derive from operating or watching small drones within the community. They might also include the time and resource savings achievable through drone-assisted delivery services, or the value of being able to capture drone-assisted aerial photos or video footage without the greater expense and safety risks associated with using manned aircraft. The benefits associated with countless other potential drone uses, ranging from agricultural applications<sup>277</sup> to data gathering,<sup>278</sup> would be encompassed in this curve as well. The curve's slight downward slope reflects an assumption of diminishing marginal

277. See generally Todd J. Janzen & Thomas P. Redick, *Drone Use in Agriculture at Home and Abroad—U.S. Law Still “Up in the Air”*, 19 A.B.A AGRIC. MGMT. COMM. NEWSL., Sept. 2014, at 6, 6–7 (showing an introductory primer on the potential use of drone technologies in agriculture and some of the unresolved legal issues associated with drones).

278. See, e.g., Emma Marris, *Fly, and Bring Me Data*, NATURE, June 2013, at 156, 156–58 (2013) (showing the potential applications of drone technologies by describing how drones are assisting with data gathering for scientific research).

returns from each additional hour of drone activity in the community.<sup>279</sup>

The point labeled  $Q^*$ , situated at the intersection of the  $MC$  and  $MB$  curves in Figure A, represents the optimal quantity of drone activity in this hypothetical neighborhood. The location of  $Q^*$  near the middle of the graph's x-axis suggests that drone activity in this hypothetical neighborhood would generate positive net social benefits much of the time. An optimal set of rules for this neighborhood would produce exactly  $Q^*$  hours per year of drone use.<sup>280</sup>

Unfortunately, much of today's drone use regulation fails to consider the element of time and is thus highly prone to inefficiency.<sup>281</sup> The shaded areas in Figure A illustrate the potential social welfare losses associated with these sorts of imprecise drone restrictions. The shaded triangular area to the left of  $Q^*$  in Figure A represents the deadweight loss that would result under a law flatly prohibiting any and all drone activity in this hypothetical neighborhood.<sup>282</sup> Such a restriction would create this deadweight loss because it would preclude  $Q^*$  hours of cost-justified drone flying per year—drone activity that would have otherwise generated societal benefits in excess of its costs. Ordinances recently adopted in some cities that sweepingly prohibit all civilian drone activity within their boundaries generate these sorts of efficiency losses.<sup>283</sup>

Conversely, the lighter shaded triangular area situated to the right of  $Q^*$  represents the potential deadweight loss under an excessively permissive rule that allows drone activity within this hypothetical neighborhood all day every day. Such a rule would permit hours of drone activities in excess of  $Q^*$ , which would impose costs on society that would outweigh the commensurate benefits. If the FAA granted broad drone use authorizations to companies such as Amazon and Alphabet under a “ceiling preemption” rule that

279. See, e.g., CASE & FAIR, *supra* note 275, at 140, 170–71 (describing diminishing marginal returns, diminishing marginal utility, and diminishing marginal productivity).

280. See *id.* at 196–97 (explaining the general principle that the optimal quantity of an activity is the quantity at which the marginal benefit equals the marginal cost).

281. See, e.g., FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, § 333, 126 Stat. 75, 75–76 (2012) (lacking temporal restrictions on drone regulations).

282. See, e.g., PARADISE VALLEY, ARIZ., MUN. CODE § 10-12 (2015), <http://www.ci.paradise-valley.az.us/DocumentCenter/Home/View/101> [<https://perma.cc/UD3X-7HV4>] (demonstrating an example of a city that has adopted a flat prohibition of drone use in neighborhoods).

283. See *id.*

would preempt state and local restrictions, it would generate this troubling class of social welfare losses.<sup>284</sup>

Temporal drone use restrictions have the potential to reduce the sorts of efficiency losses represented in the two shaded areas in Figure A. An ordinance allowing drone uses only on certain days of the week or times of day within a neighborhood could do far better than either a flat prohibition or a broad authorization of drone use at promoting a quantity of drone activity that approximates  $Q^*$ . For instance, local officials might opt to allow drone activity within a neighborhood only on weekdays from 9:00 a.m. to 11:00 a.m. and 2:00 p.m. to 4:00 p.m., if it determined that drone flying during these limited hours seemed to generate the greatest net benefits based on officials' estimates of the value of drone delivery services and other drone uses in the area, landowners' privacy interests, and other relevant factors. As technology advances, municipalities might someday even be able to charge fees for drone uses that vary based on the drone's location and the time of day. Some governments already use similar temporal fee systems to help regulate traffic on congested roadways.<sup>285</sup>

### C. Designating Drone Zones

The greatest potential advantage of drone zoning ordinances over general drone regulations is the ability to tailor drone use rules to fit specific neighborhoods across a city. The graph in Figure A shows only the costs and benefits of drone activity associated with a single hypothetical neighborhood. Other neighborhoods within a city are likely to have quite different cost-benefit profiles. Drone zoning can help governments craft restrictions that account for such differences in the same way that land use zoning has served that function for nearly a century.<sup>286</sup> The following extended hypothetical helps to demonstrate the potential usefulness of drone zoning and highlights some additional principles for designating drone zones.

Suppose that, after receiving multiple citizen complaints about civilian drones flying within certain neighborhoods, officials in Hoverville, a second hypothetical city in the United States, began

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284. See *supra* notes 119–27 and accompanying text (providing a more detailed description of “ceiling preemption” and its potential impacts).

285. See Jonathan Remy Nash, *Economic Efficiency Versus Public Choice: The Case of Property Rights in Road Traffic Management*, 49 B.C. L. REV. 673, 723–25 (2008) (describing temporal congestion pricing schemes applicable on certain roadways in New Jersey and elsewhere).

286. See *supra* Section III.C.3.

considering ordinances aimed at addressing the problem. Intrigued by the potential economic development opportunities available through drone technologies, officials did not want to impose a blanket moratorium or prohibition on drone use within the city. Therefore, they opted to instead treat civilian drone activity as something akin to a land use and tackle the issue through a drone zoning ordinance.

**Figure B: Portions of Hoverville’s Hypothetical Zoning Map**

<p><b>D-1</b> Zoned Residential</p>		<p><b>D-2</b> Zoned Commercial</p>	<p><b>D-3</b> Zoned Industrial</p>	<p><b>D-2</b> Zoned Multi-Family/ Mixed-Use</p>
		<p><b>D-3</b> Zoned Industrial</p>		
<p><b>D-1</b> Public Park/ Golf Course</p>		<p><b>D-3</b> Zoned Industrial</p>	<p><b>D-1</b> Public Park</p>	<p><b>D-2</b> Zoned Commercial</p>
<p><b>D-1</b> Zoned Residential</p>	<p><b>D-2</b> Zoned Commercial</p>			

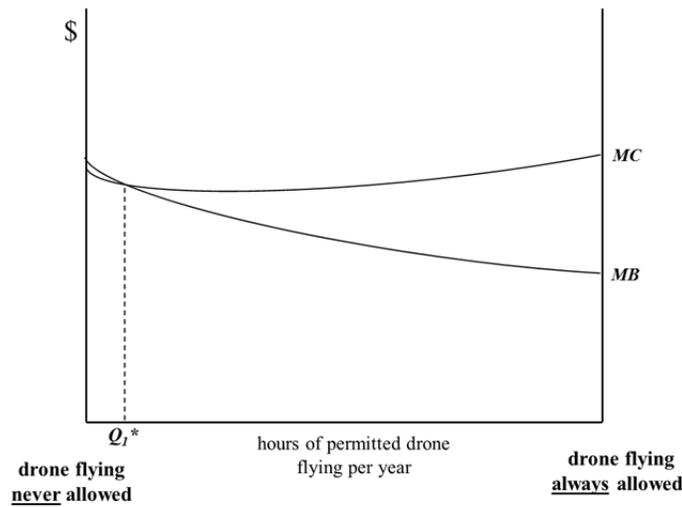
Using the best information available to them, Hoverville city officials prepared the simple drone overlay zoning map shown in Figure B above. The map shows the new “drone zoning” designations the officials made for each area, labeled as D-1, D-2, and D-3. These new designations supplemented rather than displaced the residential, commercial, industrial, and other land use zoning designations on the city’s existing zoning map.

#### 1. No Drone Zones

Drone zoning ordinances could enable cities to severely restrict drone uses in neighborhoods that are poorly suited for widespread drone activity. Suppose, for example, that most of the drone-related complaints that prompted Hoverville city officials to craft the city’s drone ordinance involved certain residential areas near a public park and golf course on the western side of town. In these neighborhoods, which were filled with single-family homes and backyard swimming

pools, most residents opposed any flying of drones except in emergency situations. The overriding concern in these residential communities was the threat of drones interfering with privacy and tranquility.

**Figure C: Social Marginal Costs and Benefits of Drone Use in a Hypothetical “No Drone Zone”**



The graph in Figure C above employs the basic graphical approach and background assumptions used in Figure A to depict the hypothetical costs and benefits of drone flying in these types of privacy-sensitive neighborhoods. The optimal quantity of drone activity shown in this new graph—labeled  $Q_I^*$ —is significantly lower than the  $Q^*$  equilibrium quantity shown in Figure A. Only drone activity up to a quantity of  $Q_I^*$  hours per year within these communities would generate social benefits sufficient to outweigh the accompanying social costs.

Recognizing that only a negligible amount of drone activity in these sorts of neighborhoods was cost-justifiable, Hoverville’s city council opted to designate them as “D-1” or “no drone zones,” generally prohibiting drone activity.<sup>287</sup> However, the city also knew that  $Q_I^*$  was greater than zero; therefore, officials recognized some

287. See PARADISE VALLEY, ARIZ., MUN. CODE § 10-12 (2015), <http://www.ci.paradise-valley.az.us/DocumentCenter/Home/View/101> [<https://perma.cc/UD3X-7HV4>] (showing an example of a city that has already enacted an ordinance effectively designating its entire jurisdiction as a no drone zone).

narrow circumstances under which the benefits of drone flying in these areas exceeded the costs. For instance, residents might occasionally wish to capture drone-assisted aerial video footage of a backyard wedding on their land or to take aerial photos of a home they were listing for sale.<sup>288</sup> To accommodate this narrow set of justifiable drone uses, the city could add provisions to its drone ordinance that would allow citizens to seek temporary use permits for drone activities at certain requested places and times within D-1 zones.<sup>289</sup> That permit process could require applicants to provide written notice to all landowners within a specified radius of the flight area, making neighbors aware of the proposed drone use and providing an opportunity for them to reasonably object. The ordinance provisions relating to these D-1 zones could likewise provide clear exceptions for occasional drone uses by law enforcement agencies and emergency responders under specified conditions.

## 2. Limited Drone Use Zones

Of course, drone zoning can enable cities to establish and enforce less restrictive drone use rules in neighborhoods where drone activity is somewhat more cost-justifiable. For simplicity, this diverse set of neighborhoods better suited for somewhat less restrictive rules is collectively classified in this Article as “D-2” or “limited drone use” zones. The commercially zoned areas and the multi-family/mixed use neighborhood shown in Figure B are potentially good candidates for the D-2 drone zoning designation. The social costs and benefits of drone activity in these sorts of areas are generally comparable to those graphically depicted in Figure A above, which shows  $Q^*$ —some moderate amount—as the optimal quantity of drone use.<sup>290</sup>

There are countless reasons why this D-2 class of neighborhoods might benefit from a greater amount of drone activity than is permitted in D-1 zones. On the cost side of the equation, if fewer residents within an area have private backyards or swimming pools, drone flights there might pose a comparatively smaller threat to landowner privacy. On the benefits side, severe traffic congestion, a

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288. See *supra* notes 23–24 and accompanying text (referencing these types of drone uses, which landowners tend to demand only occasionally on any given parcel).

289. Temporary use permits are a common and often valuable tool for incorporating flexibility into land use and zoning policies. See David S. Silverman, *The Temporary Use and Economic Development*, 66 PLAN. & ENVT. L., July 2014, at 8, 8 (providing an informative discussion of temporary use permits).

290. See *supra* notes 273–80 and accompanying text.

dearth of nearby brick-and-mortar shopping, or parking limits that make shopping more difficult in an area might make drone-assisted delivery services comparatively more appealing.

As stated above, neighborhoods in this middle ground may be best served through ordinances that only allow drone activities during certain specified hours and days.<sup>291</sup> Ordinance provisions for these zones that limit drone use might also distinguish between commercial or recreational drone uses. For example, an ordinance might allow registered commercial drones to operate on weekdays during certain business hours, yet limit recreational drone activity to a narrower set of places and times.

### 3. Open Drone Zones

Those areas of a city or county that are ideally suited for a high volume of drone activity may warrant an even less restrictive regulatory approach than is available under a drone zoning designation like D-2. The neighborhoods designated as “D-3,” or “open drone use” zone areas on the hypothetical map in Figure B, represent this third general category of zones. Many industrially zoned neighborhoods, which have few residents and instead house warehouses, factories, rail yards, and the like, might fit into this category. Even the downtown areas of some major cities may benefit from relatively relaxed drone restrictions. Such areas tend to be densely developed, with window-covered, high-rise buildings towering above both sides of the street. Since there are fewer backyards or outdoor living spaces in these areas, drone activity might pose less of a threat to landowner privacy than in single-family residential communities. And severe traffic congestion problems in some downtown cores could make drone delivery service there particularly valuable.<sup>292</sup>

The hypothetical marginal costs and benefits associated with drone flying within these open drone use zoning areas are graphically depicted in Figure D below. As the location of the  $Q_3^*$  equilibrium point on the right side of the graph suggests, the social benefits of drone activity within these areas exceeds its potential social costs

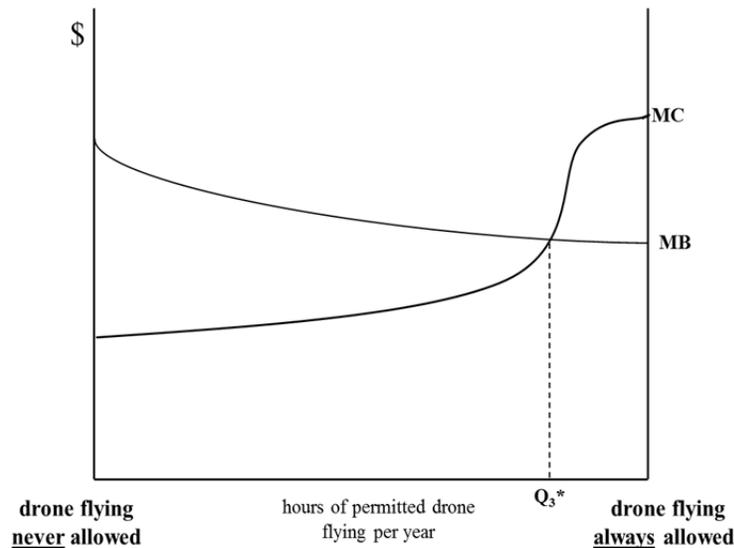
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291. See *supra* Section IV.B.

292. Many major downtown cores throughout the world are notorious for having severe congestion challenges. See, e.g., Josh Cohen, *Dublin City Council Poised to Ban Cars in City Center*, NEXT CITY (June 12, 2015), <https://nextcity.org/daily/entry/dublin-ban-cars-city-center-city-council-vote> [<https://perma.cc/JX64-NYHG>] (reporting that “congestion is a major problem in Dublin” and that congestion problems are “nearly standard in modern cities”).

most of the time. Accordingly, an optimal set of drone use rules in these sorts of zones would broadly sanction drone activity during daylight hours.

**Figure D: Social Marginal Costs and Benefits of Drone Use in a Hypothetical “Open Drone Zone”**



Even though drone use would be liberally allowed in D-3 zones, municipalities could still craft special provisions to restrict drone activity on specified occasions. For instance, the downtown cores of many major cities serve as the sites of outdoor festivals, parades, and marathons, and they often feature concert halls and open-air professional sports stadiums that regularly draw crowds. Drone activity might be especially hazardous to safety in downtown areas during these sorts of events. The steep upward slope of the marginal cost curve on the right side of the graph in Figure D reflects these heightened costs. Like traffic signs near elementary schools that require motorists to observe lower speed limits during school hours, rules that prohibit or severely limit drone activity during such major events could easily address these sorts of issues.

A few government entities have already begun imposing special temporary drone restrictions during public events when they

anticipate temporary spikes in the social costs of drone use.<sup>293</sup> For example, the Augusta-Richmond County Commission in Georgia adopted an ordinance prohibiting the use of drones within the county from April 2 to April 13, 2015—roughly the same time as the Professional Golfers Association’s prestigious Masters Tournament.<sup>294</sup> Such approaches can help to preserve public safety and security during major events without precluding valuable drone activities during other periods.

#### 4. The Sky Is the Limit

The simple drone zoning concepts outlined in Part IV barely scratch the surface of what could eventually develop into a robust and sophisticated area of local government law. Countless other possibilities for drone zoning remain unexplored. Cities could someday engage in more detailed three-dimensional drone zoning—zoning that delineates different sets of rules based on whether a drone is hovering 50, 150, or 300 feet above the ground. Cities could likewise vary drone speed limits by altitude and zone, provide for seasonal variations in drone restrictions across zones, create a far greater diversity of drone zones, and pursue limitless other strategies.

In addition, rapidly developing geofence systems and related technologies could substantially reduce municipalities’ costs of establishing and enforcing the sorts of drone use restrictions described in this Article.<sup>295</sup> Imagine a not-too-distant future day when cities that have enacted or amended drone zoning ordinances can simply submit GPS coordinates, time restrictions, and related information to a centralized geofence system database to create new geofences reflecting the city’s new ordinance provisions. The city would then make wireless updates to the software embedded in all drones registered to operate within the jurisdiction, ensuring that the

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293. See, e.g., Susan McCord, *Drone Ban in Effect April 2-13*, AUGUSTA CHRON. (Mar. 17, 2015), <http://chronicle.augusta.com/news/metro/2015-03-17/drone-ban-effect-april-2-13#> [<https://perma.cc/AF63-RRHP>] (demonstrating an example of a government entity imposing temporary drone restrictions during public events); Alex Miceli, *Drones Banned Over Augusta During Masters*, GOLFWEEK.COM (March 20, 2015), <http://golfweek.com/news/2015/mar/20/masters-2015-augusta-national-drones-banned/> [<https://perma.cc/9EZM-UGED>] (noting that, “[w]ith the Masters being the biggest golf event on the calendar, the commission understandably wants to protect the event and the largess that it brings to the community each year”).

294. See Miceli, *supra* note 293.

295. For more details regarding geofence technologies, see *supra* notes 149–53 and accompanying text.

devices automatically recognize and obey the new ordinance rules.<sup>296</sup> As these sorts of technologies continue to mature and become even more cost-effective, they will only increase the appeal of local drone zoning ordinances and temporal drone restrictions.

Unfortunately, the ultimate richness of drone policy depends heavily on the degree to which states and local governments are able to participate. Basic public choice theory principles suggest that powerful corporations with highly concentrated benefits at stake, such as Amazon and Alphabet, could well have the upper hand in battles over federal preemption of state and local drone laws.<sup>297</sup> If these corporations succeed in persuading Congress and the FAA to largely block the development of state and municipal drone regulation, most of the policy innovations described in this Article will never come to fruition, and imprecise federal drone rules will occupy this regulatory space.<sup>298</sup> There is a reason for optimism that a coordinated federal, state, and local drone regulatory structure could still ultimately emerge, however: the FAA's new Small UAS Rule (Part 107), effective as of August 2016, did not provide for blanket preemption of state and local drone laws.<sup>299</sup> Hopefully, federal policymakers will recognize what is at stake and embrace policies that promote the state and municipal involvement needed to facilitate a more efficient evolution of drone law.

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296. Some drones are already capable of being updated to obey additional geofence restrictions. For example, DJI released a 2015 update downloadable by Phantom 2 drone owners that prevented those drones from entering airspace near the White House after a highly publicized drone incident above that property. See Nick Lavars, *DJI Firmware Update Makes the White House a Drone No-Fly Zone*, NEW ATLAS (Feb. 2, 2015), <http://newatlas.com/dji-firmware-drones-white-house/35890/> [<https://perma.cc/UMP8-RN2Y>].

297. The notion that powerful stakeholders with highly concentrated benefits at stake tend to more easily secure desired policy outcomes than masses of individuals with highly diffused costs at stake is foundational in public choice theory. See, e.g., John O. McGinnis, *The Original Constitution and Its Decline: A Public Choice Perspective*, 21 HARV. J.L. & PUB. POL'Y 195, 202 (1997) (noting that “[p]ublic choice theory suggests and observations confirm that political entrepreneurs . . . favor legislative programs with concentrated benefits and diffuse costs” (citation omitted)); Nathan B. Oman, *A Pragmatic Defense of Contract Law*, 98 GEO. L.J. 77, 90 (2009) (discussing the “public choice theory” that “[g]overnment institutions . . . are prone to capture by special interests that have an incentive to obtain concentrated benefits by imposing diffuse costs on the general public” (citation omitted)).

298. As of July 2016, a bill had cleared the United States Senate that, if enacted, would preempt most state and local drone regulation. See Federal Aviation Administration Reauthorization Act of 2016, S. 2658, 114th Cong. § 2142(a) (2016). For the author's own description of the preemption provisions in the bill and their potential impacts, see Troy A. Rule, *Take Cover Against This Drone Attack*, WALL ST. J., Mar. 30, 2016, at A13.

299. See *supra* notes 51, 97–98 and accompanying text.

## CONCLUSION

Drone technologies have the potential to enhance productivity and benefit lives in a diverse array of settings throughout the world. However, these benefits to society could also be unduly limited if outmoded or ill-suited regulatory structures get in their way. Engineers' exceptional ingenuity and vision has driven rapid advancements in drone technologies in recent years. Now policymakers must exhibit an equal degree of inventiveness in their efforts to build regulatory systems capable of effectively governing these powerful devices.

Although drones bear many similarities to the airplanes and manned helicopters that the FAA has long regulated, drones are also distinct in ways that necessitate a more coordinated federal, state, and local regulatory framework. Drone zoning ordinances could be an important local-level component of that framework, enabling municipalities to vary drone use restrictions based on the unique attributes of specific neighborhoods within their jurisdictions. As drone activity grows ever more common, such ordinances could become a vital means of supplying the flexibility and local participation needed to optimally balance drone use with landowner safety and privacy in communities across the globe.