

Navigating the Legal Landscape for Environmental Monitoring by Unmanned Aerial Vehicles

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Since their inception, regulatory agencies have had to navigate a delicate balance between public interest and private rights. Agencies have the authority to require individuals or entities to cease certain defined environmentally damaging activities and to affirmatively engage in activities that improve the public welfare, such as installing pollution abatement equipment. The long-term success of most environmental regulation ultimately depends on the ability of a regulatory agency to effectively monitor for compliance. Without any credible threat of detection, environmental monitoring becomes a “cat and mouse” game for both agencies that must deploy their limited inspection resources strategically and regulated entities that may intentionally foster conditions of “un-inspectability” to avoid regulatory costs.¹ Recent technological advancements in unmanned aerial vehicles (“UAVs”) could enable government regulators to achieve more efficient monitoring options than existing environmental enforcement programs.² Researchers, design firms, and basement tinkerers are rapidly advancing technologies to address the challenges inherent in environmental monitoring. The question that this Article engages is whether the law needs to innovate to keep pace with the technical advances of UAVs if deployed for systematic and comprehensive environmental monitoring by either federal or state agencies.

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1. Anthony Heyes, *Implementing Environmental Regulation: Enforcement and Compliance*, 17 J. REG. ECON. 107, 110–11 (2000) (describing how some regulated entities have purchased lands in order to buffer their operations from potential fence-line monitoring or invested in setting up “sanitized areas” for inspection which are “operationally redundant but environmentally-benign parts of the plant”); see generally Anthony Heyes, *Environmental Enforcement When “Inspectability” Is Endogenous: A Model With Overshooting Properties*, 4 ENVTL. & RESOURCE ECON. 479 (1994).
2. UAVs are also referred to in the literature and in some state laws as unmanned aerial systems (“UASs”). The term UAS refers to both the vehicle and the ground control station. This Article uses UAV and UAS synonymously.

This Article briefly reviews existing and emerging UAV technologies that are deployed to assist with environmental monitoring and then examines a number of legal issues relevant to a UAV-supported monitoring program ranging from the highly probable risk of minor accidents to the less likely threat of malicious hacking. The conclusion offers several legal suggestions for agencies contemplating a UAV enhanced monitoring program.

I. Enhanced Monitoring Potential With Unmanned Aerial Vehicles

Colloquially known as “drones,” UAVs are no longer the secret of the military or the pet project of a hobbyist. UAVs have been mainstreamed into a number of government functions including the collection of weather data, mapping marine debris, and monitoring illegal fishing practices.³ The vehicles are already used to track poaching, illegal logging, and illegal mining activity.⁴ UAVs have great potential for enhancing the delivery of rapid environmental monitoring from identifying the trajectory of an oil spill to tracking toxic algae blooms. UAVs are also capable of carrying sophisticated sensors including thermal infrared radiometers to measure temperature differences, hyperspectral radiometers to measure chemical composition and vegetation health, and Synthetic Aperture Radars.⁵

3. Carla Garcia Zendejas, *What do Drones Have to do With Sea Turtles?*, OCEAN FOUND. (Oct. 10, 2013), <http://oceanfdn.org/blog/what-do-drones-have-do-sea-turtles> (measuring incidental catch of sea turtles); *Unmanned Aircraft Systems Program*, U.S. NAT'L OCEANIC & ATMOSPHERIC ADMIN., <http://uas.noaa.gov> (last visited Jan. 10, 2016) (detailing a number of data collection programs including drones to map marine debris, assemble polar data, and measure ozone).
4. UNITED NATIONS ENV'T PROGRAMME, *A NEW EYE IN THE SKY: ECO-DRONES* 7 (2013).
5. *Id.* at 4; Voon C. Koo et al., *A New Unmanned Aerial Vehicle Synthetic Aperture Radar for Environmental Monitoring*, 122 PROGRESS ELECTROMAGNETICS RES. 245, 245–46 (2012) (describing a SAR system that will be used for system will be used for “monitoring and management of earth resources such as paddy fields, oil palm plantation and soil surface”); *Hyperspectral Airborne Terrestrial Imager (HATI)*, NORTHROP GRUMMAN, <http://www.northropgrumman.com/Capabilities/HATI/Pages/default.aspx> (last visited Jan. 10, 2016).

As compact data collection platforms, UAVs can offer a number of unique services including: (1) on demand data through detectors; (2) environmental sampling in difficult to reach locations; (3) high resolution aerial surveys; and (4) mapping of pollutants across a landscape including sub-surface contamination.⁶ Unlike other technologies, such as satellites, UAVs are easy to transport, produce low-cost high resolution images, and quickly process raw data.⁷ These advantages afford a cost-effective solution for providing routine data and the capacity to identify cross-border pollution sources. Existing use of UAVs in the agricultural sector already suggests substantial savings in time. For example, remote sensing of a 1000 hectare field can apparently be done in forty-five minutes rather than several hours or days.⁸

Evidence collected from UAVs might be used to trigger a legal investigation into potentially environmentally destructive corporate activity. For example, in Houston, Texas, a private drone user captured images of the Columbia Packing Company illegally releasing large quantities of untreated blood into a water body and shared the image with regulators. In response, the U.S. Environmental Protection Agency (“EPA”), Texas Commission on Environmental Quality, and the Texas Parks and Wildlife Department requested a search warrant and began an investigation of the meatpacking company.⁹

In other parts of the world, government actors are designing UAVs to assist with environmental monitoring. In Taiwan, joint collaboration between a university and a government office created a type of UAV that effectively moni-

tors pollution by first detecting ozone, nitrogen dioxide, or non-methane hydrocarbons, and then transmitting pertinent information back to land. These UAVs are relatively small with only a 10 kilogram payload and a 40 kilogram payload for holding equipment and samples.¹⁰ China similarly uses drones to visually inspect pollution in the City of Beijing, Shanxi Province, and Hebei Province, where many high polluting industries are located. Government officers have used data from these drone flights to bring environmental charges.¹¹

In addition to participating in monitoring, drones are being tested to perform mitigation. Although China already uses fixed-wing aircraft to deploy smog-clearing chemicals, the Chinese Meteorological Administration is pursuing development of a drone with the capacity to deploy a 700 kilogram payload of smog-clearing chemicals over a 5 kilometer radius.¹² UAVs are not only easier to operate but offer a ninety percent savings over fixed-wing aircraft.¹³

The development of UAV technology, though ongoing, is advancing far more quickly than legal frameworks seem prepared to embrace. For example, the innovative “swarm” of UAVs developed by the Massachusetts Institute of Technology monitors and even samples water quality. Each UAV in the swarm uses cameras to monitor water quality and identify locations where additional water samples can be taken for further content verification.¹⁴ “Swarms” also show promise for the tracking aerial plumes.¹⁵ These swarms of UAVs, which facilitate communication across individual UAVs,¹⁶ accentuate the legal issues already seen with the operation of individual UAVs. For example, can UAVs operate safely and not cause physical harm to property by crashing? Depending on whether there are malfunctions in computer hardware or software regarding feedback, the operation of “swarms” could result in UAVs within the “swarm” crashing into each other. Will UAVs operating on feedback from other UAVs located within a swarm result in invasion to privacy, including invasions that were never intended as part of the original deployment?

6. See, e.g., Alesandra Capolup et al., *Photogrammetry for Environmental Monitoring: The Use of Drones and Hydrological Models for Detection of Soil Contaminated by Copper*, 514 SCI. TOTAL ENV'T 298, 299 (2015) (describing how UAV imaging can be used to measure accumulation of anthropogenic pollution at the landscape level); Jeff McMahon, *Drones to Be Deployed as Nuclear Fallout Detectors*, FORBES (Mar. 13, 2013, 8:56 AM), <http://www.forbes.com/sites/jeffmcmahon/2013/03/13/feds-to-use-drones-to-detect-radiation> (describing the Harvester UAV that could be used to monitor fallout from accidents at nuclear reactors such as Fukushima in Japan); *Precisionhawk*, PRECISIONHAWK, precisionhawk.com (last visited Jan. 10, 2016) (detailing the products of a UAV start-up company that includes UAVs with multispectral and hyperspectral sensors for water quality assessment and thermal sensors for water temperature detection and water source identification that are capable of flying to a specific set of global position system (“GPS”) coordinates, landing on a water body, taking water samples, and returning to initial launch site); Andrew Rosenblum, *Drones That Can Suck Up Water, Hunt Oil Leaks, Invasive Species*, MIT TECH. REV. (Jan. 20, 2015), <http://www.technologyreview.com/news/534271/drones-that-can-suck-up-water-hunt-oil-leaks-invasive-species> (describing a UAV—the Co-Aerial Ecologist—that removes and processes water samples on board for toxic algae reducing the data collection from 12–24 hours for humans to 2 hours for the UAV); Laura Winiarskyj, *Drone Technology and Business Monitoring*, CONN. BUS. & INDUSTRY ASS'N (Nov. 1, 2013), <http://www5.cbiam.com/cbiamnews/article/drone-technology-and-business-monitoring/> (suggesting potential uses of drones including detection of subsurface contamination, monitoring of solid waste landfills through aerial infrared thermography, measurement of heavy metals, and real-time process monitoring of wastewater).

7. UNITED NATIONS ENV'T PROGRAMME, *supra* note 4, at 3.

8. P.K. Freeman & R.S. Freeland, *Politics & Technology: U.S. Polices Restricting Unmanned Aerial Systems in Agriculture*, 49 FOOD POL'Y 302, 303 (2014).

9. Gary Mortimer, *Dallas Meat Packing Plant Investigated After Drone Images Reveal Pollution*, sUASNEWS (Jan. 23, 2012), <http://www.suasnews.com/2012/01/11389/dallas-meat-packing-plant-investigated-after-drone-images-reveal-pollution>.

10. Gary Mortimer, *Taiwan Showcases Pollution-Monitoring UAVs*, sUAS NEWS (Nov. 9, 2010), <http://www.suasnews.com/2010/11/2691/taiwan-showcases-pollution-monitoring-uavs/> (describing a UAV developed jointly by the Joint Technology Center for Atmosphere Monitoring at Fooyin University and the Kaohsiung City government Environmental Pollution Bureau).

11. *China Uses Drones to Check Pollution*, CHINADAILY EUR., http://europe.chinadaily.com.cn/business/2014-03/08/content_17332678.htm (last updated Mar. 8, 2014).

12. Victoria Woollaston, *China Successfully Tests Smog-Fighting Drones That Spray Chemicals to Capture Air Pollution*, DAILYMAIL.COM, <http://www.dailymail.co.uk/sciencetech/article-2577347/China-successfully-tests-smog-fighting-drones-spray-chemicals-capture-air-pollution.html> (last updated Mar. 10, 2014, 8:13 AM).

13. *Id.*

14. Heather Kelly, *These Drones Have a Higher Calling*, CNN MONEY (Feb. 4, 2015, 2:56 PM), <http://money.cnn.com/2015/02/04/technology/drones-for-good>.

15. See generally Martin Saska et al., *Plume Tracking by a Self-Stabilized Group of Micro Aerial Vehicles*, in MODELLING AND SIMULATION FOR AUTONOMOUS SYSTEMS 44, 44–55 (2014).

16. *Id.* at 44.

Federal and state agencies have broad inspection authority under environmental laws, but exercising these powers requires a large body of trained inspectors.¹⁷ UAVs offer a tantalizing possibility of automating time-intensive inspections and reducing the time it takes to conduct an inspection. Agencies that are contemplating using UAVs for routine environmental monitoring have a number of important decisions ahead of them. First, agencies must decide whom to monitor with UAVs. From one perspective, it may make the most sense to monitor those companies that already have an excellent track record. These companies are more likely to give consent to operating UAVs at their plants. This approach may contribute to an industry culture of monitoring by UAVs. A second perspective suggests that UAV monitoring should be largely focused on collecting data from parties who are generally less cooperative about working with environmental inspectors. Programs focused on non-cooperating parties are likely to create some legal resistance centered on privacy and trespass concerns. Second, regardless of who regulators monitor, agencies must decide how to monitor in light of existing concerns over operational liability of UAVs, constitutional privacy concerns, and a growing patchwork of state laws regarding UAV usage by state government bodies.

Part II of this Article will examine an array of legal issues that federal and state agencies will need to confront in the years to come if UAV environmental monitoring is mainstreamed into enforcement and compliance efforts.

II. Legal Issues With Achieving the Potential of UAVs for Environmental Monitoring

As aerial vehicles, the National Transportation Safety Board recognizes UAVs as “aircraft” that are subject to regulation by the Federal Aviation Agency (“FAA”).¹⁸ Some of these existing FAA regulations, including “minimum safe altitudes,” may pose problems for UAV environmental monitoring programs. According to the regulations, aircraft in any “congested area” must operate 1000 feet above the highest obstacle, and in other areas no closer than 500 feet to any structure.¹⁹ These rules seem to contemplate manned aircraft and may not have the same applicability to a backpack-sized UAV that briefly operates below the 500 foot ceiling in order to collect adequate monitoring data.

Most environmental monitoring UAVs will likely require heavy sensors and other equipment such as cameras to be loaded onto a platform. The FAA has issued an interim final

rule requiring that individuals operating unmanned aircraft weighing less than 55.0 pounds and more than 0.55 pounds (250.00 grams) on takeoff must register with the FAA or face penalties.²⁰ This regulation may have implications for commercial drone users who might offer environmental monitoring services. Public entities that intend to use a UAV are expected to obtain a Certificate of Authorization that permits them to use a defined amount of airspace.²¹ The FAA has also issued a set of proposed regulations that are likely to spark some controversy, particularly among potential commercial UAV users. The FAA regulations, once adopted, will be significant in terms of helping define “due care” because from a safety perspective, UAV operators may be required to operate 55 pounds or lighter UAVs, use visual line-of-sight to keep track of the UAV, operate below 100 miles per hour, and only operate during the day.²² While the small UAV regulations are still pending, commercial drone users are expected to apply for an exemption certificate from the FAA—which comes with conditions and limitations on UAV operations—and for a Certificate of Authorization if operating flights above 200 feet.²³ From the perspective of government agencies potentially deploying UAVs for environmental monitoring, the rules may need to reflect existing practices associated with agency inspections. For example, a complete limitation of operation to daylight hours may prevent agencies from monitoring polluting entities that may be engaged in nighttime pollution releases.

These regulations, once finalized, will provide parameters for potential environmental monitoring by drones. Yet, these parameters alone will not define the exclusive legal regime for UAVs but are rules that will become embedded within a wider legal framework. The remainder of this Article highlights, in order of legal risk, the types of legal questions that may become significant areas of conflict if an environmental monitoring program using UAVs is further developed to enhance enforcement of federal and state environmental statutes and regulations designed to reduce air and water pollution associated with mobile sources, stationary sources, point sources, and nonpoint sources. The widespread use of drones for environmental monitoring holds great promise for reducing costs associated with traditional monitoring efforts. Yet, there are numerous legal issues ranging from common law liability for drones damaging property or persons during operations to privacy concerns to limitations imposed on operations by state law.

17. See, e.g., 33 U.S.C. § 1318(a) (2012) (providing authority under Clean Water Act to collect samples of effluent); 42 U.S.C. § 7414 (2012) (providing authority under Clean Air Act to collect air emissions); 42 U.S.C. § 9604(e) (2012) (providing authority under Comprehensive Environmental Response, Compensation, and Liability Act to collect samples of hazardous substances).
 18. *Huerta v. Pirker*, No. CP-217, 2014 WL 6630986 (C.C.H. Nov. 17, 2014). (involving UAV pilot who at the request of the University of Virginia flew a UAV over the University of Virginia campus). The pilot, Mr. Pirker, received a \$10,000 civil penalty for flying an “aircraft” recklessly under the FAA’s Rule 91.13. *Id.* Although the case on remand was eventually settled by the parties, the finding that a UAV is an “aircraft” for purposes of FAA regulations remains good law. *Id.*
 19. 14 C.F.R. § 91.119 (2015).

20. Registration and Marking Requirements for Small Unmanned Aircraft, 80 Fed. Reg. 78,593, 78,595, tbl.1 (Dec. 16, 2015).
 21. At least seventy-five public entities have applied and received Certificates of Authorization including the U.S. Department of Agriculture, National Oceanic and Atmospheric Administration, and the California Department of Forestry and Fire Protection. See *Freedom of Information Act Responses*, FED. AVIATION ADMIN., http://www.faa.gov/uas/public_operations/foia_responses/ (last modified Nov. 3, 2015).
 22. Operation and Certification of Small Unmanned Aircraft Systems, 80 Fed. Reg. 9543 (proposed Feb. 23, 2015).
 23. *FAA Streamlines UAS COAs for Section 333*, FED. AVIATION ADMIN., <http://www.faa.gov/news/updates/?newsId=82245> (last modified Mar. 24, 2015); *Section 333*, FED. AVIATION ADMIN., http://www.faa.gov/uas/legislative_programs/section_333 (last updated Feb. 18, 2016) (noting 3459 granted petitions for exemptions to FAA rules).

A. Liability and Safety Issues

Frequently, UAVs fail to function as designed.²⁴ A number of accidents have been documented including crashes resulting in injuries and property damage, as well as a number of close calls.²⁵ This uncertainty about the safety record of operating drones is a legitimate concern for any environmental agency considering UAV deployment to assist in monitoring operations.

Although more than 70,000 flights operate in U.S. airspace each day, there is unlikely to be any conflict between environmental monitoring UAVs and the traffic in domestic airspace that starts above 500 feet.²⁶ To collect information that would be useful to an agency, such as water samples or sensory data on the chemical content of emissions, most UAVs would need to operate below 500 feet.²⁷ Where a conflict might emerge is between monitoring UAVs and aircraft that are either taking off or landing in the vicinity. Small UAVs may not have transponders that signal to other aircraft either their position or altitude because this equipment is too large and heavy.²⁸ In the near future, UAV users may need to install some form of “sense and avoid” technology to offset existing safety concerns.

What are the legal implications if an agency UAV collides with another aircraft or with something or someone on the ground? For the most part, state courts are likely to treat UAV collisions similarly to other aircraft collisions.²⁹ State tort law will govern liability issues unless the federal government indicates that it clearly intends to establish a specific damages regime. FAA efforts to regulate UAVs are focused on safety.³⁰ Although the proposed regulations do not establish liability standards, they are significant nonetheless, as they define safe UAV operation.³¹

Different liability standards may be appropriate depending on how the UAV is operated. UAVs can be operated by

an adjacent human pilot who must maintain a visual line of sight, by a remote pilot who will rely on footage taken by the UAV, or autonomously with little or no oversight by a human pilot, as is the case with “swarms.”³² In the case of autonomous “swarms,” the liability regime must determine who is held liable for accidents and collisions—the agencies deploying these “swarms” or the software programmers who negligently failed to take into account certain known hazards.

An important question for the viability of an environmental monitoring UAV program is what standard of liability will apply to the operations. Because UAVs run the gamut from large military equipment that is similar in size to a fighter jet to miniature platforms that fit into backpacks, generic arguments can be made for applying either strict liability or negligence depending on the nature of the UAV. Because most environmental monitoring UAVs would tend to be smaller, are not inherently dangerous, and are less likely to cause catastrophic damage when they crash, strict liability would not provide an appropriate liability standard in a tort action involving personal injury or property damage. If strict liability was applied, an environmental monitoring program based on UAVs may simply be too expensive to deploy.

Instead, fault liability would provide sufficient deterrence for agencies to ensure that UAVs are operated by skilled users within existing aviation rules and regulations. Under a common law framework of negligence, an agency alleged to have caused damage through the use of a drone will be held liable only if the agency failed to exercise reasonable or due care at a standard that has yet to be determined by the law or by the court.³³ The FAA regulations would likely be considered probative in terms of whether an agency exercised reasonable care.

Though there is technological promise in the development of “the world’s first collision-tolerant [drone],” there is still a great deal of risk in operating existing drone technology.³⁴ For any agency contemplating using UAVs, some sort of liability insurance to protect third-parties will become essential until the technology becomes more “accident-proof.” Insurance companies will provide an additional degree of private regulation to ensure that operators of UAVs receiving insurance coverage have the proper training.

Agencies may also want to purchase first-party insurance to protect their investment in environmental monitoring UAVs to minimize financial risks when a unit becomes either irretrievable or severely damaged. While costs are elastic,

24. Freeman & Freeland, *supra* note 8, at 304 (noting both that UASs are the most “accident prone” of all U.S. Air Force aircrafts and that there is no technology to ensure that UAS can recognize and avoid other aircraft).

25. Craig Whitlock, *Near Mid-Air Collisions With Drones*, WASH. POST (Nov. 26, 2014), <http://www.washingtonpost.com/wp-srv/special/national/faa-drones>.

26. See BART ELIAS, CONG. RESEARCH SERV., R42718, UNMANNED AIRCRAFT OPERATIONS IN THE NATIONAL AIRSPACE SYSTEM 8, 20 (2012).

27. *Id.* at 20.

28. *See id.* at 8.

29. *See, e.g.*, IDAHO CODE § 21-205 (2015) (describing assignments of damages on land to owner, operator, or lessor of an aircraft “in accordance with the rules of law applicable to torts on land in this state”); MD. CODE ANN., TRANSP. § gtr-5-1005 (LexisNexis 2015) (“The owner and lessee of an aircraft operated above the lands and waters of this State are each prima facie liable, jointly and severally, for any injury to persons or property on the land or water beneath them that is caused by the operation of the aircraft or by the falling of any object from the aircraft, unless: (1) The injury is caused in whole or in part by the negligence of the injured person or of the owner or bailee of the injured property; or (2) At the time of the injury, the aircraft is being used without consent of the owner or the lessee, as the case may be.”).

30. Operation and Certification of Small Unmanned Aircraft Systems, 80 Fed. Reg. 9543, 9546 (proposed Feb. 23, 2015) (describing safety limitations on operation of UAVs, including “daylight-only operations, confined areas of operation, and visual-line-of-sight operations”).

31. *Id.* at 9557. The proposed rule contains a chart comparing U.S. proposed regulations to Canadian rules for micro-UAV. *Id.* The Canadian rules provide for \$100,000 of liability insurance whereas the U.S. federal laws require no insurance. *Id.*

32. Roger Clarke & Lyria Bennett Moses, *The Regulation of Civilian Drones’ Impact on Public Safety*, 30 COMPUTER L. & SECURITY REV. 263, 265–66 (2014).

33. Although eighteen states have laws involving UAV usages, *see infra* Section II.C, the issue of liability has not been a subject of primary focus. Under a number of state laws, civil liability may be available when a “law enforcement agency” has failed to obtain a warrant. The Idaho law is unique in providing very specific language about liability, providing that no state agency may use a UAV to “gather evidence or collect information about . . . [a] farm, dairy, ranch or other agricultural industry without the written consent of the owner of such farm, dairy, ranch or other agricultural industry.” IDAHO CODE § 21-213(2)(a) (ii) (2015). A failure to obtain written consent would subject a state agency to a minimum of \$1000 of damages. *Id.* § 21-213(3)(b).

34. *Introducing Gimball, the Collision-Tolerant Drone*, FLYABILITY, <http://www.flyability.com/product/> (last visited Feb. 21, 2016) (describing a drone capable of colliding with objects without losing its stability).

agencies should protect their investment into UAVs whose platforms might cost approximately \$50,000 plus the cost of sensors.³⁵ As of 2015, insurers are offering coverage for liability insurance as well as loss of UAV equipment.³⁶

B. Protecting Fourth Amendment Interests From UAVs—Rights of Privacy

Much of the UAV legal literature focuses on the issue of privacy and the concern that UAVs widen the potential scope of surveillance because they can constantly collect information.³⁷ Do individuals or companies have rights of privacy that would prevent the deployment of an environmental monitoring program that uses UAVs? Case law suggests that there are different privacy rights for corporate operations in contrast to private operations.

Corporations have reduced levels of protection for privacy. The United States Supreme Court has already decided that Dow Chemical could not prevent the EPA from using photos of its chemical plants that were taken from navigable airspace.³⁸ Even though Dow Chemical refused to admit the EPA inspector for a second inspection and had deliberately fenced its plant to prevent certain kinds of physical intrusions, the Court ultimately found “that the taking of aerial photographs of an industrial plant complex from navigable airspace is not a search prohibited by the Fourth Amendment.”³⁹ Exposed manufacturing buildings on Dow Chemical’s property “are not analogous to the ‘curtilage’ of a dwelling for purposes of aerial surveillance.”⁴⁰

Instead, the exposed buildings were deemed “more comparable to an open field and as such . . . open to the view and observation of persons in aircraft lawfully in the public airspace immediately above or sufficiently near the area for the reach of cameras.”⁴¹ The majority in *Dow Chemical Co. v. United States*⁴² seemed persuaded that the quality of the pho-

tos would not allow for “highly sophisticated surveillance.”⁴³ Instead the photos remained “limited to an outline of the facility’s buildings and equipment” and raised no constitutional privacy concerns.⁴⁴ The *Dow Chemical* decision was a split 5-4 decision with four dissenting Justices arguing that EPA should have obtained a warrant.⁴⁵ Although environmental monitoring agencies may clearly take aerial photos from the public airspace, there is no specific indication from the Court about determining the extent of public airspace.⁴⁶

In light of the *Dow Chemical* decision, one argument that supports the use of UAVs without warrants to collect monitoring data is the “open fields” exception to the Fourth Amendment.⁴⁷ Under this exception, a warrant may not be required where an inspector does not specifically enter a regulated plant and is observing from a space where the public has not been specifically excluded.⁴⁸ This exception has been applied to areas that are not obviously “open fields” such as “a thickly wooded forest.”⁴⁹ Could this exception potentially be extended to be an “open skies” exception and whatever airspace the FAA ultimately decides that regulated entities have a right to operate UAVs? Are skies navigable by UAVs (including miniaturized UAVs) reasonable public vantage points? The Court has not grappled with this issue, but it is possible that it might extend an “open skies” exception to the Fourth Amendment jurisprudence to define public and private air space as a baseline for privacy rights analysis.

Significantly, Fourth Amendment protections do not attach to places but to people.⁵⁰ Both corporations and private individuals do not have a reasonable, legitimate, or objective expectation of privacy at certain aerial distances particularly for anything that is knowingly exposed to plain view.⁵¹ What privacy protections are there for a corporation emitting or discharging into areas that would not be easily accessible to the public? The Fourth Amendment has protected a variety of structures and items.⁵² Is it possible for a corporation to protect itself from UAV inspection on the basis that there is a legitimate expectation of privacy in its emissions and effluent if those releases are in an area that may not qualify as navigable public airspace? This would be a somewhat novel argument to be advanced by a company. Precedent indicates that courts may not be favorably disposed to finding privacy interests in industrial waste products even when the products are in private sewers.⁵³ Similar logic may apply in the case of air emissions. Just as there is no reasonable expectation of privacy in sewer water that enters a public sewer, there should be no expectation of privacy in emissions that will mix with

35. Peter Finn, *Domestic Use of Aerial Drones by Law Enforcement Likely to Prompt Privacy Debate*, WASH. POST (Jan. 23, 2011, 12:56 AM), http://www.washingtonpost.com/wp-dyn/content/article/2011/01/22/AR20110122041111_pf.html (indicating that a UAV and ground operating computer can cost less than \$50,000 in contrast to a \$1,000,000 investment in a helicopter).

36. See, e.g., Am. Int’l Grp., Inc., *Unmanned Aircraft Liability Endorsement—Value-Added Coverage for Public Entities*, AIG, http://www.aig.com/uav_3171_659652.html (last visited Sept. 20, 2015) (describing public entity coverage for UAVs of up to 5 pounds); Am. Int’l Grp., Inc., *Unmanned Aircraft Solutions*, AIG, http://www.aig.com/unmanned-aircraft_3171_659651.html (last visited Sept. 20, 2015) (covering losses arising from electronic malfunctions, third party liability, and hijacking).

37. See generally ALISSA DOLAN & RICHARD THOMPSON II, CONG. RESEARCH SERV., R42940, *INTEGRATION OF DRONES INTO DOMESTIC AIRSPACE: SELECTED LEGAL ISSUES* (2013); Clarke & Moses, *supra* note 32; Hillary Farber, *Eyes in the Sky: Constitutional and Regulatory Approaches to Domestic Drone Deployment*, 64 SYRACUSE L. REV. 1 (2014); David James, *The Fourth Amendment, Future Methods of Environmental Enforcement and Warrantless Inspections*, 33 REV. LITIG. 183 (2014); Joseph J. Vacek, *Big Brother Will Soon Be Watching—Or Will He? Constitutional, Regulatory, and Operational Issues Surrounding the Use of Unmanned Aerial Vehicles in Law Enforcement*, 85 N.D. L. REV. 673 (2009); John Villasenor, *Observations From Above: Unmanned Aircraft Systems and Privacy*, 36 HARV. J.L. & PUB. POL’Y 457 (2013).

38. *Dow Chem. Co. v. United States*, 476 U.S. 227, 234, 239 (1986).

39. *Id.* at 239.

40. *Id.*

41. *Id.*

42. *Dow Chem. Co. v. United States*, 476 U.S. 227 (1986).

43. *Id.* at 238.

44. *Id.*

45. *Id.* at 240 (Powell, J., dissenting).

46. *Id.* at 239 (majority opinion).

47. *Hester v. United States*, 265 U.S. 57, 59 (1924).

48. *Air Pollution Variance Bd. v. W. Alfalfa Corp.*, 416 U.S. 861 (1974).

49. *Oliver v. United States*, 466 U.S. 170, 180 n.1 (1984).

50. *Katz v. United States*, 389 U.S. 347, 351 (1967).

51. See *id.* at 361 (Harlan, J., concurring).

52. See generally *Arkansas v. Sanders*, 442 U.S. 753 (1979) (luggage); *United States v. Chadwick*, 433 U.S. 1 (1977) (footlocker); *See v. City of Seattle*, 387 U.S. 541 (1967) (warehouse); *Katz*, 389 U.S. 347 (telephone booth).

53. See *Riverdale Mills Corp. v. Pimpare*, 392 F.3d 55, 64 (1st Cir. 2004).

public airsheds.⁵⁴ It is unclear what the exact boundaries are for aerial distances that will not trigger privacy concerns. The Court has provided some limited guidance for manned aircraft. In *California v. Ciraolo*,⁵⁵ the police were willing to recognize a public interest in navigable airspace 1000 feet above a defendant's home.⁵⁶ In a case a few years later, the U.S. Supreme Court did not find privacy concerns of aerial surveillance by a manned helicopter 400 feet above a defendant's partially covered greenhouse because the aircraft was also operating in navigable airspace.⁵⁷ It is less clear how a court would rule regarding a low-flying UAV collecting data specific to environmental monitoring. A court may find that a warrant would be necessary to protect against other types of potential surveillance that might expose trade secrets.

One of the recurring issues for entities concerned with protecting their privacy is that it is difficult to know what information is being collected by a UAV because UAVs have the capacity not just to sample emissions and take visual images but also to intercept cell phone communications and potentially hack into Wi-Fi networks.⁵⁸ In order to avoid any concerns raised by privacy rights, federal and state agencies that intend to use UAVs should provide a public operating policy that specifically indicates the type of information that a given UAV is capable of collecting so potential regulated parties are provided notice.

A final privacy issue merits mentioning. Although an environmental monitoring UAV's collection of emission data at 400 feet may not violate the Fourth Amendment of the U.S. Constitution,⁵⁹ this activity could theoretically trigger state constitutional issues. In *State v. Davis*,⁶⁰ a 2014 case from the New Mexico Court of Appeals, the court observed that an "interstitial approach" might be applied where a party alleges violation of both the U.S. Constitution and a state constitution.⁶¹ When the Federal Constitution does not provide a particular protection, the court will evaluate whether the state constitution offers the protection.⁶² In this particular instance, the New Mexico Constitution was found to offer greater privacy protections than the U.S. Constitution so that aerial surveillance without a warrant was in violation of the state constitution.⁶³

C. State Laws Directed at Regulating UAVs and Questions of Preemption

Cooperative federalism plays a significant role in the implementation of key federal statutes. Under the Clean Air Act,⁶⁴

Clean Water Act,⁶⁵ and the Comprehensive Environmental Response, Compensation, and Liability Act,⁶⁶ the EPA has delegated much of its federal authority over compliance and enforcement actions to state, local, or tribal entities. In terms of enforcement actions, states are responsible for the lion's share.⁶⁷ This practice is significant in thinking about deployment of UAVs because many of the agencies most likely to operate a UAV program are state environmental agencies.

The federal government has yet to legislate specifically on the use of UAVs by environmental agencies, so state law, under a presumption against preemption, would control until there is either clear effort by Congress or an executive agency to occupy the field. The only federal guidance on environmental monitoring by UAVs concerns the certification of operators, limitations on operations, and requirements for marking of aircraft.⁶⁸

In reaction to the recent proliferation of UAVs and, particularly, their use for law enforcement surveillance, states have been quick to adopt laws regarding use of UAVs. As of January 2016, eighteen states have enacted legislation on UAVs that define how this technology is used by both law enforcement agencies and other state agencies. The following Subsections address those state laws and briefly comment on their respective content for environmental monitoring programs.

I. Alaska

Designed to regulate the use of UAVs by law enforcement agencies, Alaska law applies to any "public agency that performs as one of its principal functions an activity relating to crime prevention, control, or reduction or relating to the enforcement of the criminal law."⁶⁹ Specifically, the law requires "law enforcement agencies," before operating UAVs, to have a procedure in place to ensure that agencies have (1) obtained any necessary FAA documentation;⁷⁰ (2) trained UAV pilots to operate the UAVs;⁷¹ (3) obtained approval from "the commissioner or deputy commissioner of public safety or the chief administrative officer of the law enforcement agency or officer's designee;"⁷² (4) ensured the flight is "for a public purpose;"⁷³ (5) maintained a log of the flight including "the identity of the authorizing official;"⁷⁴ (6) established an auditable flight record system;⁷⁵ (7) estab-

54. *Id.*

55. *California v. Ciraolo*, 476 U.S. 207 (1986).

56. *Id.* at 215.

57. *Florida v. Riley*, 488 U.S. 445, 449 (1989).

58. Freeman & Freeland, *supra* note 8, at 305.

59. See U.S. CONST. amend. IV.

60. *State v. Davis*, 321 P.3d 955 (N.M. Ct. App.), cert. granted, 324 P.3d 376 (N.M. 2014).

61. *Id.* at 958.

62. *Id.*

63. *Id.* at 962.

64. Clean Air Act, Pub. L. No. 88-206, 77 Stat. 392 (1963) (codified as amended at 42 U.S.C. §§ 7401-7671q (2012)).

65. Clean Water Act of 1977, Pub. L. No. 95-217, 91 Stat. 1566 (codified as amended at 33 U.S.C. §§ 1251-1387 (2012)).

66. Comprehensive Environmental Response, Compensation, and Liability Act of 1980, Pub. L. No. 96-510, 94 Stat. 2767 (codified as amended at 42 U.S.C. §§ 9601-9675 (2012)).

67. See *Enforcement and Compliance History Online: Analyze Trends*, U.S. ENVTL. PROTECTION AGENCY, <https://echo.epa.gov> (last visited Sept. 21, 2015) (providing an overview of enforcement actions for air, drinking water, and hazardous waste).

68. H.R. 658, 112th Cong. § 332(a)(2) (2012).

69. ALASKA STAT. § 12.36.090 (2014).

70. *Id.* § 18.65.901(a)(1).

71. *Id.* § 18.65.901(a)(2).

72. *Id.* § 18.65.901(a)(3).

73. *Id.* § 18.65.901(a)(4).

74. *Id.* § 18.65.901(a)(5).

75. *Id.* § 18.65.901(a)(6).

lished a method of notifying the public of the UAV flights,⁷⁶ and (8) provided for community participation in the development of policies.⁷⁷

If UAVs are gathering evidence for a criminal investigation, then the law enforcement agency must be prepared to obtain a warrant.⁷⁸ If the intent of the investigation is not to produce evidence in a criminal investigation, then a law enforcement agency may use UAVs as long as there is no “unwarranted invasion of personal privacy” and the collection of information is in keeping with agencies’ pre-determined procedures on UAVs.⁷⁹ Images obtained by UAV may not be retained unless needed in an investigation, prosecution, or required by federal, state or municipal law.⁸⁰

Even though there is no mention of environmental agencies in the statute, this law could have implications for environmental monitoring. Agencies considering the deployment of a UAV, including the Alaska Department of Environmental Conservation, should develop procedures to address operations sensitive to privacy concerns.

2. Florida

The Florida’s Freedom from Unwarranted Surveillance Act defines law enforcement agencies as state or local agencies responsible for the “enforcement of penal, traffic, regulatory, game, or controlled substance laws.”⁸¹ Generally these agencies may not use a UAV to “gather evidence or other information”⁸² unless officials obtain a search warrant or “swift action is needed to prevent imminent danger to life or serious damage to property, to forestall . . . the destruction of evidence, or to achieve purposes including, but not limited to, facilitating the search for a missing person.”⁸³ Evidence obtained contrary to the Act is not admissible for criminal prosecutions.⁸⁴

Florida, by including agencies responsible for “enforcement of . . . regulatory . . . laws,” contemplates environmental agencies potentially being covered under the legislation.⁸⁵ It is unclear whether this statute, which is situated in the section of the Florida Code on Criminal Procedure and Corrections, is intended to apply beyond criminal investigations. The language prohibiting agencies from collecting “other information” without a warrant seems broad enough to encompass routine monitoring checks by UAVs, though the statute also provides for a warrantless UAV search to achieve public purposes such as searching for a missing person.⁸⁶ As the statute is currently drafted and without additional interpretation, it is unclear how this law might impact the ability of the

Florida Department of Environmental Protection to engage in environmental monitoring and enforcement using UAVs.

3. Idaho

The Idaho statute on UAVs is broad and provides that “absent a warrant,” no state agency may “gather evidence or collect information about . . . [a] farm, dairy, ranch or other agricultural industry without the written consent of the owner of such farm, dairy, ranch or other agricultural industry.”⁸⁷ If a warrant or written consent is not obtained, the state agency may be subject to a minimum of \$1000 of civil liability.⁸⁸ However, there is an important exception providing that the statute does not apply to UAVs used in “resource management.”⁸⁹

The statute clearly applies to environmental agencies such as the Idaho Department of Environmental Quality, but it is unclear whether an environmental monitoring program might qualify as a “resource management” program and not be subject to requirements for warrants or written consent. The Idaho aviation laws drafted during the 1930s raise some questions about the ability for contemporary UAVs such as the PrecisionHawk to operate as environmental monitoring tools to support, for example, water quality monitoring efforts.⁹⁰ The Idaho law provides that “the landing of an aircraft on the lands or waters of another, without his consent, is unlawful except in the case of a forced landing.”⁹¹

4. Illinois

The Illinois “Freedom from Drone Surveillance Act” applies to law enforcement agencies defined as “any agency of this State which is vested by law with the duty to maintain public order and to enforce criminal laws.”⁹² Under the Act, agencies “may not use a drone to gather information.”⁹³ Exceptions are available when an agency has obtained a warrant, action is needed to prevent an imminent harm, or the drone is being operated on lands, highways, roadways, or areas belonging to Illinois or municipal authorities for the purpose of collecting information about a crime scene.⁹⁴ Information obtained from UAV searches cannot be retained or shared unless it pertains to a reasonable suspicion that the data will prove criminal activity, or is relevant to an ongoing investigation or criminal proceeding.⁹⁵ Information obtained in contravention of the Act is presumed to

76. *Id.* § 18.65.901(a)(7).

77. *Id.* § 18.65.901(a)(8).

78. *Id.* § 18.65.902(1)(A)–(B).

79. *Id.* § 18.65.902(2).

80. *Id.* § 18.65.903.

81. FLA. STAT. ANN. § 934.50(2)(b) (2015).

82. *Id.* § 934.50(3)(a).

83. *Id.* § 934.50(4)(b)–(c).

84. *Id.* § 934.50(6).

85. *Id.* § 934.50(2)(d).

86. Compare *id.* § 934.50(3)(a), with *id.* § 934.50(4)(c).

87. IDAHO CODE § 21-213(2)(a)(ii) (2014).

88. *Id.* § 21-213(3)(b).

89. *Id.* § 21-213(1)(b)(ii).

90. See PrecisionHawk, *Using a PrecisionHawk UAV for Water Sampling/Surveying*, YOUTUBE (Oct. 28, 2013), <https://www.youtube.com/watch?v=gQvBDzcp7Ds> (UAVs may operate from the water to collect water samples by flying to a GPS site, landing, taxiing to specific coordinates to collect sample before taking off and returning to the base).

91. IDAHO CODE § 21-204.

92. 2013 Ill. Laws, Pub. Act No. 098-0569, § 5.

93. *Id.* § 10.

94. *Id.* § 15.

95. *Id.* §§ 20, 25.

be inadmissible.⁹⁶ Law enforcement agencies must make it public if they own drones.⁹⁷

As drafted, it is not clear that the Act was intended to apply to the Illinois Environmental Protection Agency because there is no indication that the agency was created to “maintain public order;” though the Agency does enforce criminal laws.⁹⁸ Presuming the state surveillance law would apply to an environmental monitoring program, the agency would need to obtain a warrant for any potential criminal investigation or risk not being able to introduce evidence gathered from UAV operation.

5. Indiana

Indiana’s law generally prohibits the use of UAVs without a search warrant or consent of the landowner.⁹⁹ Indiana does permit the use of UAVs by a governmental entity without a search warrant if it is required “to perform a geographical, an environmental, or any other survey for a purpose that is not a criminal justice purpose.”¹⁰⁰

It is unclear whether routine environmental monitoring or occasional inspections of property would qualify as “an environmental survey.” A reasonable argument can be made that if the same air pollution data was collected from a number of entities, it might qualify as a survey. Indiana, like Idaho, restricts the landing of aircraft without consent and applies ordinary tort law, which would have potential implications for water quality sampling drones.¹⁰¹

6. Iowa

Iowa passed a law requiring law enforcement to obtain warrants before obtaining any evidence from UAVs that is used in criminal or civil proceedings.¹⁰² A search warrant may not be necessary if the information is “otherwise obtained in a manner that is consistent with state and federal law.”¹⁰³

7. Louisiana

In 2014, Louisiana passed one of the most stringent UAV regulation laws, which primarily impacts private activities.¹⁰⁴ It provides for a prohibition on the “intentional use of an unmanned aircraft system to conduct surveillance of, gather evidence or collect information about, or photographically or electronically record a targeted facility without the prior written consent of the owner of the targeted facility.”¹⁰⁵ Targeted facilities include petroleum and aluminum refineries and chemical and rubber manufacturing facilities.¹⁰⁶ The

term “unmanned aircraft system” does not apply to uses by the federal or state government or any person “acting pursuant to contract” with either the federal or state government.¹⁰⁷

This law clearly restricts the ability of environmental citizen groups to use drones for collecting of information without prior written consent.

8. Maine

Maine requires law enforcement agencies to obtain a warrant for any criminal investigations.¹⁰⁸ Drones may be used without a warrant for aerial photography for purposes other than criminal investigation “including, but not limited to . . . the assessment of accidents, forest fires and other fire scenes, flood stages and storm damage.”¹⁰⁹ This language that refers to individual catastrophic events does not seem to contemplate an unwarranted routine use of drones for environmental monitoring. If an environmental agency were to apply for a warrant for a drone, they would have to comply with minimum standards of use, including restrictions on high-powered zoom lens, night vision technology, thermal imaging, and “other such enhancement technology.”¹¹⁰ This language could restrict the types of sensors that are deployable by an environmental compliance and enforcement office.

9. Maryland

Currently, the Maryland Code does not provide much guidance about UAV deployment. It does, however, indicate that federal law may preempt state law on UAVs, and that state law will preempt any county or municipal law or ordinance that “prohibits, restricts, or regulates the testing or operation of unmanned aircraft systems.”¹¹¹ In Maryland, UAVs seem to be an available technology for remote environmental monitoring by government officials that would not require additional permits or warrants.

10. Montana

The Montana Code prohibits the admission of evidence obtained from a UAV unless the information was either obtained pursuant to a warrant or it was obtained “in accordance with judicially recognized exceptions to the warrant requirement.”¹¹² Information obtained from a UAV may not be used to establish the requisite probable cause needed to obtain a warrant with a couple limited exceptions.¹¹³ The Montana law could have implications for agencies attempting to prosecute individuals on the basis of UAV data unless the agency can demonstrate either that it has a warrant or its activities are excepted

96. *Id.* § 30.

97. *Id.* § 35.

98. 415 ILL. COMP. STAT. ANN. 5/44 (West 2014).

99. IND. CODE § 35-33-5-9(a), (b)(2) (2014).

100. *Id.* § 35-33-5-9(b)(1)(E).

101. *Id.* § 8-21-4-4.

102. IOWA CODE § 808.15 (2015).

103. *Id.*

104. See LA. STAT. ANN. § 14:337 (2015).

105. *Id.* § 14:337(A).

106. *Id.* § 14:337(B)(3).

107. *Id.* § 14:337(B)(4)(b)–(c).

108. ME. REV. STAT. ANN. tit. 25, § 4501(4)(B) (2015).

109. *Id.* § 4501(4)(D).

110. *Id.* § 4501(5)(D).

111. MD. CODE ANN., ECON. DEV. § 14-301 (West 2015).

112. MONT. CODE ANN. § 46-5-109 (West 2014).

113. See *id.* (stating that UAV information from monitoring public lands or international borders may be used to contribute to an affidavit of probable cause).

form the requirement to obtain a warrant. The challenge for environmental agencies that desire a warrant is timing. For opportunistic polluters, the time that it might take for an agency to acquire a warrant may be sufficient time to shut down certain emission sources.

11. North Carolina

North Carolina generally prohibits any state agency from using an unmanned aircraft system to “[c]onduct surveillance of: [p]rivate real property without the consent of the owner, easement holder, or lessee of the property.”¹¹⁴ Provided, however, that state law enforcement agencies may use UAVs if they obtain a warrant or are conducting surveillance in an area that is within “plain view” when the officer has a legal right to be in a particular location.¹¹⁵ A law enforcement agency may also deploy a UAV “to prevent imminent danger to life or serious damage to property,” or “to forestall . . . the destruction of evidence.”¹¹⁶ “Any person” subjected to unwarranted surveillance may pursue a civil action against the state agency.¹¹⁷ Additionally, if a state agency loses a UAV on private property, it must obtain consent from the private property owner before recovering it.¹¹⁸

Where most states with UAV legislation have one or two provisions, North Carolina has provided a more extensive legal framework that also includes requirements for licensing under state aviation laws.¹¹⁹ Yet there are a number of ambiguities in how the law might be applied to efforts by the North Carolina Department of Environment and Natural Resources to inspect regulated entities. It is unclear how the “plain view” exception might apply to a UAV operated for environmental monitoring purposes. Does “plain view” only apply to what an officer can see from his or her vantage point on the ground, or does the concept also include whatever he or she might be able to see from a computer screen linked to a UAV operating at 500 feet above an individual’s private property and operating legally in terms of aviation law? Equally unclear is what the consequences might be for monitoring a corporation. The statute only provides a remedy for “any person who is the subject” but not necessarily for “any entity.”¹²⁰ Although a plant manager may be able to invoke this statute for photographs taken of himself or herself at a plant, would it also be applied more generically to the plant as private property?

While UAVs are most easily deployed to provide additional monitoring for already cooperating corporate entities that are willing to give consent, UAVs might prove most useful in informing agencies about the activities of parties that are reluctant to share environmental data or are suspected of doctoring data. If a UAV malfunctions over the private property of a non-cooperating party or is maliciously shot

down, then the current North Carolina law limits the ability of the government to recover its equipment unless it receives consent from the landowner.

12. North Dakota

North Dakota passed a law requiring law enforcement agencies to obtain a warrant before deploying UAVs for surveillance purposes with a handful of exceptions for border patrol, reasonable suspicion of imminent harm, and “environmental or weather-related catastrophe.”¹²¹ Agencies using UAVs must not use drones to conduct “[s]urveillance of the lawful exercise of constitutional rights” and are expected to document any surveillance activities.¹²² It is unclear whether this language permits an environmental agency to conduct regular aerial inspections of a refinery. The North Dakota law does not specifically define law enforcement agency, but rather refers to a “law enforcement officer” who is defined in the North Dakota Code as any “public servant authorized by law or by a government agency or branch to enforce the law and to conduct or engage in investigations or prosecutions for violations of law.”¹²³ This would presumably encompass staff working for North Dakota’s Department of Environmental Health.

13. Oregon

Oregon law provides a general prohibition on the operation of UAVs, acquisition of data from UAVs, and the disclosure of this data.¹²⁴ Any public body that wants to operate a UAV must register the UAV or face a \$10,000 fine.¹²⁵ Each year, public agencies must release a report indicating how frequently officials used UAVs and for what purposes.¹²⁶ Images acquired in violation of the law are not admissible in administrative proceedings and cannot be used “to establish reasonable suspicion or probable cause to believe that an offense has been committed.”¹²⁷ Law enforcement agencies are only permitted to use UAVs if officials obtain a warrant, have probable cause to believe that a crime has been committed or will be committed, or the landowner has given written consent to permit an agency to acquire information about the individual or the individual’s property.¹²⁸ During a “state of emergency,” an agency may operate drones without a warrant to assess and evaluate environmental damage or contamination.¹²⁹ The Oregon law permits a property owner to recover injunctive relief when a drone operator flies a drone less than 400 feet above an owner’s property and the owner requested

114. N.C. GEN. STAT. § 15A-300.1(b)(1)(b) (2014).

115. *Id.* § 15A-300.1(c)(2)–(3).

116. *Id.* § 15A-300.1(c)(4).

117. *Id.* § 15A-300.1(e).

118. *Id.* § 15A-300.2(a).

119. *Id.* § 63–95.

120. *See id.* § 15A-300.1(e).

121. N.D. CENT. CODE §§ 29-29.4-03, 29-29.4-04 (2015).

122. *Id.* §§ 29-29.4-05(b), 29-29.4-06.

123. *Id.* § 12.01-01-04.

124. OR. REV. STAT. § 837.310(1) (2013).

125. *Id.* § 837.360(1)–(2).

126. *Id.* § 837.360(6).

127. *Id.* § 837.310(2).

128. *Id.* §§ 837.320(1), 837.330.

129. *Id.* § 837.335(3)(a)–(b).

that low-flying drone activity cease.¹³⁰ The Oregon Attorney General may bring a case for nuisance or trespass.¹³¹

The Oregon law, with no specific exception for environmental monitoring, creates an obstacle for a state agency using UAVs to obtain environmental data because the state needs to obtain consent or a warrant. Though consent may be available from entities that are largely in compliance with environmental laws, it may be very difficult to obtain from other entities.

14. Texas

The Texas Privacy Act provides that UAVs may not be used to capture images of an individual or privately owned real property with the intent to conduct surveillance.¹³² An image is defined broadly as “any capturing of sound waves, thermal, infrared, ultraviolet, visible light, or other electromagnetic waves, odor, or other conditions existing on or about real property.”¹³³ Texas law provides an explicit exemption for images that are captured by state law enforcement officers for the purpose of “conducting routine air quality sampling and monitoring, as provided by state or local law.”¹³⁴ Any individual who collects images in violation of the Act may be subject to civil penalties.¹³⁵ Each state law enforcement agency using UAVs is expected to release a report with information including how many times a UAV was used, justification for using the UAV, information collected from the UAV operations, and the cost of using UAVs.¹³⁶

As one of the only state laws specifically contemplating the possibility of UAVs being deployed for environmental monitoring, the law is limited in its scope. It only permits UAV deployment without a warrant by state law enforcement officers for the purpose of routine air monitoring as required under state law—which in this case would be the Texas Clear Air Act implementing Texas’ obligations under the Clean Air Act.¹³⁷ Under the Texas Act, the Texas Natural Resource Conservation Commission is empowered to create “reasonable” requirements for “measuring and monitoring the emissions of air contaminants from a source or from an activity causing or resulting in the emission of air contaminants.”¹³⁸ Texas does not contemplate federal law environmental enforcement efforts without a warrant. The monitoring focus is entirely on air. Routine water quality inspection by UAVs is not incorporated within the UAV law.

15. Tennessee

The Tennessee law introduces a new section to the criminal code making it a crime to use a UAV to collect images for

surveillance of a property.¹³⁹ The law shares the definition of image with the Texas law and covers “any capturing of sound waves, thermal, infrared, ultraviolet, visible light, or other electromagnetic waves, odor, or other conditions existing on or about real property in this state.”¹⁴⁰ The Tennessee Code includes the same environmental monitoring exceptions as Texas, providing that state or local law enforcement officers may collect images for the purpose of “conducting routine air quality sampling and monitoring, as provided by state or local law” and images may be collected “at the scene of a spill, or a suspected spill, of hazardous materials.”¹⁴¹ Unlawfully obtained images may not be used in civil proceedings or administrative hearings.¹⁴² Parties that violate the Act may be charged with a misdemeanor offense.¹⁴³

The same comments regarding the scope of the Texas law apply to the Tennessee law. No environmental monitoring activity by federal agencies is specifically provided within the Tennessee UAV regulatory statute. Only routine air monitoring by state agencies and emergency water monitoring are contemplated. What this means depends on the air pollution control board’s promulgating rules for inspection of contaminant sources under the Tennessee Air Quality Act.¹⁴⁴ The use of UAVs for other environmental monitoring, such as water contamination, is outside of the scope of exceptions within the UAV legislation and would presumably require a warrant by a state agency.

16. Utah

In 2014, Utah passed the Government Use of Unmanned Aerial Vehicles Act.¹⁴⁵ This Act prohibits a law enforcement agency from obtaining, receiving or using data from a UAV unless the agency either obtained a warrant or the acquisition was “in accordance with judicially recognized exceptions to warrant requirements.”¹⁴⁶ A law enforcement agency includes any “entity of a state . . . that exists primarily to prevent, detect, or prosecute crime and enforce criminal statutes or ordinances.”¹⁴⁷ The Utah Department of Environmental Quality has criminal enforcement capabilities and would be covered by this Act.

17. Wisconsin

Under the police chapter, Wisconsin has prohibited law enforcement agency use of UAVs to collect evidence or information for a criminal investigation.¹⁴⁸ Here, a law enforcement agency is defined broadly: a “governmental unit of one or more persons employed full time by this state or a political subdivision of this state for the pur-

130. *Id.* § 837.380(1), (3).

131. *Id.* § 837.380(5).

132. TEX. GOV’T CODE ANN. § 423.003 (West 2015).

133. *Id.* § 423.001.

134. *Id.* § 423.002(a)(9)(C).

135. *Id.* § 423.006(a).

136. *Id.* § 423.008.

137. TEX. HEALTH & SAFETY CODE ANN. § 382.001 (West 2015).

138. *Id.* § 382.016(a).

139. TENN. CODE ANN. § 39-13-903(a)(1) (2014).

140. *Id.* § 39-13-901.

141. *Id.* § 39-13-902(a)(8)(C), 39-13-902(a)(9).

142. *Id.* § 39-13-905(a)(1).

143. *Id.* § 39-13-904.

144. *Id.* § 68-201-105.

145. UTAH CODE ANN. § 63G-18-101 (West 2014).

146. *Id.* § 63G-18-103(1).

147. *Id.* § 63G-18-102(1).

148. WIS. STAT. ANN. § 175.55(b)(2) (West 2002).

pose of preventing and detecting crime and enforcing state laws or local ordinances.¹⁴⁹ The Wisconsin Department of Natural Resources Bureau of Law Enforcement is one such law enforcement agency and thus must obtain a warrant before using a UAV to secure evidence in an environmental investigation.

18. Virginia

Virginia had a complete moratorium on the use of UAVs until mid-2015, even if there was a search warrant.¹⁵⁰ In 2015, the Commonwealth passed a law requiring police and state agencies to obtain a warrant before using a UAV for investigating any regulatory violation.¹⁵¹ Agencies do not require a warrant for “damage assessment.” What constitutes a “damage assessment” is ambiguous and could in theory include damage to a state resource such as a watershed.

19. Implications and Predictions

As of early 2016, only the Texas Privacy Law and the Tennessee Criminal Code address the potential for environmental monitoring by UAVs directly. As explained above, these laws are limited to air quality inspections and do not contemplate the possibility of water sampling unless there is a spill or a warrant is obtained. An important issue for agencies thinking about using UAVs will be the legal distinction in state law between routine monitoring activities and surveillance activities. Many of the existing laws focus on prohibiting UAV images that contribute to “surveillance.” The term surveillance has been defined by the statutes and would be given a plain language meaning by an interpretive body.

D. State Law Regarding Aerial Trespass and Nuisance

In addition to the eighteen state specific laws involving UAVs, there is a reasonable argument that UAVs operated by either the federal government or by a state agency might commit an “aerial” trespass or nuisance under state aviation laws. Based on common law, trespass law is usually codified as either tortious trespass against land or criminal trespass. In either case, a party alleging a violation must demonstrate an intent by the trespasser to interfere with the party’s exclusive rights of use over the property. A party alleging trespass may have little to no burden to prove damages.¹⁵² The situation of trespass in relation to UAVs might arise in one of two scenarios. In the first scenario, a UAV may pass over a property taking measurements of emissions without ever landing on the property. In a second scenario, an environmental enforcement agency

might use a UAV to sample detention pond waters located on private property to determine the chemical composition which might require a UAV to land before collecting the sample. The outcome of the first scenario is uncertain in terms of whether this might constitute a trespass. It is possible that a UAV might be operated at a sufficiently low altitude as to be trespass. The UAV could be considered a nuisance depending on its noise level. The outcome of the second scenario is likely to constitute a trespass unless prior consent is obtained. In most cases, trespass is prosecuted under common law. While most states have a criminal trespass statute, relatively few have a separate trespass law based on tort liability.¹⁵³

The following section details the language from aviation statutes that suggest a potential claim for aerial trespass or nuisance. In the area of aviation, trespass law has blended with nuisance law.¹⁵⁴ Most states follow the Uniform State Law for Aeronautics,¹⁵⁵ drafted prior to 1930, which assigns rights over airspace to private owners. The language used by almost every state aviation code provides that “[t]he ownership of the space above the lands and waters of this State is declared to be vested in the several owners of the surface beneath, subject to the right of flight.”¹⁵⁶ Georgia’s law provides for a particularly expansive view of airspace ownership such that private owners have a right where the estate “extends downward indefinitely and upward indefinitely.”¹⁵⁷

Many state aviation laws recognize that private landowners have the right against flights that “interfere [] with the existing use to which land, water or space over the land or water is put by the owner.”¹⁵⁸ A number of codes also

153. Some states do have separate laws. *See, e.g.*, ALA. CODE § 6-5-262 (2014) (defining tortious liability for trespass as any “abuse of or damage done to the personal property of another”).

154. Colin Cahoon, *Low Altitude Airspace: A Property Right’s No-Man’s Land*, 56 J. AIR L. & COM. 157, 176 (1990).

155. UNIF. STATE LAW FOR AERONAUTICS, in STATE AERONAUTICAL LEGISLATION DIGEST AND UNIFORM STATE LAWS 2, 104–05 (1938).

156. UNIF. STATE LAW FOR AERONAUTICS, § 4; *see, e.g.*, ARIZ. REV. STAT. § 28–8207 (LexisNexis 2015); ARK. CODE ANN. § 27-116-102(a) (2010); CAL. PUB. UTIL. CODE § 21402 (West 2015); COLO. REV. STAT. § 41-1-107 (2015); DEL. CODE ANN. tit. 2, § 303 (West 2015); HAW. REV. STAT. § 263-3 (2015); IDAHO CODE § 21-203 (2015); IND. CODE § 8-21-4-3 (2009); MD. CODE ANN., TRANSP. § gtr-5-104 (LexisNexis 2015) (assigning ownership subject to right of flight and zoning restrictions); MINN. STAT. § 360.012 (2015); MO. REV. STAT. § 305.020 (2015); MONT. CODE ANN. § 67-1-203 (West 2014); NEV. ADMIN. CODE § 493.040 (2015); N.J. STAT. ANN. § 6:2-5 (West 2015); N.C. GEN. STAT. § 63-12 (2014); N.D. CENT. CODE § 2-03-03 (2008); 74 PA. STAT. AND CONS. STAT. ANN. § 5501(a) (West 2008); S.D. CODIFIED LAWS § 50-13-3 (2015); TENN. CODE ANN. § 42-1-103 (2015); VT. STAT. ANN. tit. 5, § 402 (West 2015); WIS. STAT. ANN. § 114.03 (West 2002); WYO. STAT. ANN. § 10-4-302 (LexisNexis through 2015 Legis. Sess.).

157. GA. CODE ANN. § 51-9-9 (2000).

158. *E.g.*, ARIZ. REV. STAT. § 28-8277; ARK. CODE ANN. § 27-116-102(c); CAL. PUB. UTIL. CODE § 21403 (the right of flight exists at all altitudes recognized by FAA at appropriate altitudes or “unless so conducted as to be imminently dangerous to persons or property lawfully on the land”); DEL. CODE ANN. tit. 2, § 304; HAW. REV. STAT. § 263-4; IDAHO CODE § 21-204; IND. CODE § 8-21-4-4; MD. CODE ANN., TRANSP. § gtr-5-1001; MASS. GEN. LAWS ch. 90, § 46 (2015); MO. REV. STAT. § 305.030; N.C. GEN. STAT. § 63-13 (“Flight in aircraft over the lands and waters of this State is lawful . . . unless so conducted as to be injurious to the health and happiness, or imminently dangerous to persons or property lawfully on the land or water beneath.”); N.D. CENT. CODE § 2-03-04; 74 PA. STAT. AND CONS. STAT. ANN. § 5501 (“Flight through the space over and above land or water, at a sufficient height and without interference to the enjoyment and use of the land or water beneath, is not an action-

149. *Id.* § 165.77(1)(c).

150. Andrea Noble, *Virginia Police Can’t Use Drones for Search Warrants, Gathering Evidence*, AG, WASH. TIMES (Oct. 10, 2014), <http://www.washingtontimes.com/news/2014/oct/10/drones-cant-be-used-va-search-warrants-ag>.

151. VA. CODE ANN. § 19.2-60.1 (West, Westlaw through 2016 Legis. Sess.).

152. *See, e.g.*, Coastal Oil & Gas Corp. v. Garza Energy Tr., 268 S.W.3d 1, 12 n.36 (Tex. 2008) (noting injury may be slight or no damage at all). *But cf.* Borland v. Sanders Lead Co., 396 So. 2d 523, 529 (Ala. 1979) (suggesting the need to demonstrate substantial damage).

provide that landing an aircraft without permission on the lands or waters of another is prohibited.¹⁵⁹ These portions of aviation codes may have direct implication on the operation of environmental monitoring UAVs, particularly water-sampling UAVs.

However, there is debate over whether a property owner must be using airspace in order to assert a cognizable legal interest. At least one federal court has noted that the property owner must be using the airspace in order to assert a property interest.¹⁶⁰ The Nevada Supreme Court, in a regulatory takings case, has suggested that a Nevada property owner is entitled to ownership interest of up to 500 feet above the property “subject to intrusion by lawful air flight.”¹⁶¹ A California State court held fifty years ago that any aircraft within the private space of another is a trespasser and any temporary invasion of airspace must be regarded as a privilege and must not interfere with the “enjoyment of the land.”¹⁶² This type of precedent could be problematic for UAV operations if parties subject to regulation were able to make arguments that UAV environmental monitoring was somehow interfering with their “enjoyment of the land.”

Looking at a broad sample of state aviation laws suggests a need for states to revisit these laws and explicitly decide what constitutes aerial trespass and nuisance, particularly now that UAVs have been operated at relatively low altitudes—and are expected to operate at these altitudes—so as not to interfere with the airspace where manned aircraft are operating. What rights of flight does a UAV have? What rights does a property owner retain? The state laws specific to UAVs define generally some of the airspace rights but have not specifically indicated the extent of rights retained by surface owners in airspace.

There are a number of possibilities for how states might define airspace rights. States like Nevada have proposed defining a fixed limit for airspace rights with private owners having property interests up to 500 feet.¹⁶³ This is a reasonable approach in terms of clarifying property interests but could interfere with the ability of environmental enforcement agencies to readily deploy UAVs unless officials either receive an exception as with the Texas Privacy Act or are operated above the height limit. In many instances, UAVs will need to operate at a low altitude if collecting useful data from emissions or effluent.¹⁶⁴ Another approach is to recognize private

ownership rights as long as there is no interference with lawful UAV flights. This theory could be articulated based on either a property easement theory or a tort defense theory.¹⁶⁵

The aviation statutes flag an important question that states need to answer in the coming years as they grapple with the legality of UAV operations and the issuance of FAA regulations. What is the relationship between federal aviation law and state aviation law? Will FAA regulations preempt state governance interests or is it possible to apply federal and state law simultaneously to the regulation of UAVs? Some states have directly addressed the relationship between their laws and federal laws. For example, Arkansas has indicated its intent to establish minimum safe altitude for flights that are consistent with federal legislation.¹⁶⁶ The FAA issued a memo in December 2015 expressing concern that a “patchwork” of state and municipal laws must not interfere with safety or air traffic flow and indicated that it expects States to consult with the federal government on “any regulation of the navigable airspace.”¹⁶⁷

A review of the state laws on trespass and nuisance suggests that a large degree of uncertainty remains regarding how these trespass laws are ultimately applied to UAVs. At the outset, if a UAV was deployed by a federal environmental agency under a federal regulation authorizing environmental monitoring, there is a reasonable argument for immunity from a trespass claim under the Federal Tort Claims Act.¹⁶⁸ Federal government officials exercising due care in execution of a regulation are generally not subject to tort liability.¹⁶⁹ The extent of a claim against a state agency will hinge largely on how private airspace is ultimately defined by a given state and what regulations a state might pass to enable environmental monitoring. A variety of Federal Tort Claims Act defenses exist across the various states that may also provide immunity for state environmental officials operating a state approved UAV environmental monitoring program.

A related question regarding aerial trespass is what law might govern if a UAV proves faulty and must perform an emergency landing on private property. What right would a state agency have to enter a non-cooperating landowner’s property to recover the UAV? Would a state agency have to bring an action of legal recovery to prevent a private individual or company from confiscating government property?

Ultimately, state legislatures will have to make decisions about how states will define the airspace for which private landowners may have a cognizable claim. The current open-

able wrong unless the flight results in actual damage to the land or water, or property thereon or therein, or use of the land or water beneath.”); S.C. CODE ANN. § 55-3-50 (2015); S.D. CODIFIED LAWS § 50-13-4 (2015); TENN. CODE ANN. § 42-1-104; VT. STAT. ANN. tit. 5, § 403; WIS. STAT. ANN. § 114.04.

159. ARK. CODE ANN. § 27-116-102(d); HAW. REV. STAT. § 263-4; IND. CODE § 8-21-4-4; MD. CODE ANN., TRANSP. § 5-1001; N.J. STAT. ANN. § 6:2-6; N.C. GEN. STAT. § 63-13; N.D. CENT. CODE § 2-03-04; S.C. CODE ANN. § 55-3-50; TENN. CODE ANN. § 42-1-104; VT. STAT. ANN. tit. 5, § 403; WIS. STAT. ANN. § 114.04.

160. *Hinman v. Pac. Air Lines Trans. Co.*, 84 F.2d 755, 758 (9th Cir. 1936) (“The owner of land owns as much of the space above him as he uses, but only so long as he uses it. All that lies beyond belongs to the world.”).

161. *McCarran Airport v. Sisolak*, 137 P.3d 1110, 1120 (2006) (concluding that “Nevadans hold a property right in the useable airspace above their property up to 500 feet”).

162. *La Com v. Pac. Gas & Elec. Co.*, 281 P.2d 894, 895 (Cal. Ct. App. 1955).

163. *McCarran Airport*, 137 P.3d at 1120.

164. See Francesco Mancini et al., *Using Unmanned Aerial Vehicles (UAV) for High-Resolution Reconstruction of Topography: The Structure From Motion Approach on*

Coastal Environments, 2013 REMOTE SENSING.

165. Cahoon, *supra* note 154, at 164.

166. ARK. CODE ANN. § 27-115-108(b).

167. *State and Local Regulation of Unmanned Aircraft Systems (UAS) Fact Sheet*, FED. AVIATION ADMIN. 3 (Dec. 17, 2015), https://www.faa.gov/uas/regulations_policies/media/UAS_Fact_Sheet_Final.pdf.

168. 28 U.S.C. § 1346(b) (2012).

169. *Id.* § 2680(a) (providing an exception to the Federal Tort Claims Act: “Any claim based upon an act or omission of an employee of the Government, exercising due care, in the execution of a statute or regulation, whether or not such statute or regulation be valid, or based upon the exercise or performance or the failure to exercise or perform a discretionary function or duty on the part of a federal agency or an employee of the Government, whether or not the discretion involved be abused.”).

ended ownership language in state statutes is drawn largely from the 1922 Uniform State Law for Aeronautics.¹⁷⁰ Scholars have been calling for clarification of airspace rights in statutes.¹⁷¹ Consideration of any revised statutes should take into account the potential for environmental monitoring drones to improve environmental compliance. Environmental monitoring drones may require more flexibility in terms of what constitutes an appropriate altitude where private rights exceed public rights. Since a recurring challenge with environmental monitoring is dissipation, measuring at a uniform 500 foot altitude ceiling may not be sufficient for detecting concentrations in an emission plume with off-site impacts.

E. Malicious Direct Attacks on UAVs or Hijacking of UAVs

There are already some indications that legally operated UAVs will be subject to attack by disgruntled individuals.¹⁷² Similar incidents might be imaginable with non-cooperating entities that resist environmental inspections and become subject to inspection from the air. In addition to potential physical attacks on UAVs, there are concerns about malicious interference with UAVs through hacking.¹⁷³ A number of concerns have been expressed regarding UAVs going “rogue” if a third-party jams communications and interferes with global positioning system navigation systems through spoofing of signals.¹⁷⁴ This has the potential to lead to additional accidents and increases in the liability associated with UAV operation. This could also theoretically lead to a loss of data or data pirating. Concerns have also been raised about the availability of insurance protection to protect against invasions of privacy due to cyber leaks.¹⁷⁵

At least one state has contemplated the possibility of interference with UAVs and has created a liability statute. In

Oregon, the statute assigns civil penalties of at least \$5000 against “a person who intentionally interferes with, or gains unauthorized control over, a drone licensed by the [FAA] . . . [or] an agency of the United States or a federal, state[,] or local law enforcement agency.”¹⁷⁶ Similar legislation may be appropriate for other states contemplating the deployment of UAVs for environmental monitoring.

III. Conclusion and Recommendations to Improve Legal Framework

Will environmental monitoring using UAVs be tenable? The technology is certainly attractive in light of its relative ease and low cost of deployment with the possibility of collecting and processing large amounts of data quickly. The answer largely depends not on innovations in technology but rather on innovations in legal frameworks to address the myriad of issues posed by UAV operations—including potential liability, invasion of privacy, and aerial trespass or nuisance. The existing legal system has not been fully tested to understand how existing common law and statutory law will apply to UAV operations particularly by authorized government agencies with a mission to protect public health and the environment. The review of the legal system presented in this Article suggests that agencies serious about pursuing any monitoring and enforcement programs that use UAVs should closely follow certain legal developments with specific implications.

First, an agency should develop awareness of the risk associated with deploying UAVs and carry appropriate levels of insurance to protect against potential injuries to property or persons caused by either a malfunctioning UAV or a negligently operated UAV. Second, environmental enforcement agencies should ask state legislatures to be more explicit about the application of UAV legislation to routine environmental monitoring programs that are otherwise conducted by inspectors. Third, environmental enforcement agencies should also request state legislatures to be explicit in their legislation about the extent of airspace rights for private entities and any public exceptions that might exist to that right. Fourth, it is currently unclear to what degree the federal government intends to occupy the field in terms of UAV regulation. Environmental agencies should request that both federal and state lawmakers be as clear as possible about the relationship between federal and state laws. Finally, environmental agencies that are designing UAV based environmental programs should be explicit about how they will be protecting constitutionally derived privacy interests.

170. See Andrew Boone, *Aircraft Operations Law*, POPULAR AVIATION, Nov. 1928, at 32–34 (providing language from the Uniform Act).

171. See Troy Rule, *Airspace in an Age of Drones*, 95 B.U. L. REV. 155, 202 (2015) (urging adoption of a uniform or model state law based on nuisance laws to recognize the right of landowners to exclude UAVs “up to the navigable airspace line above their property”).

172. Joseph Serna, *As Hobby Drone Use Increases, So do Concerns About Privacy, Security*, L.A. TIMES (June 21, 2014), <http://www.latimes.com/local/la-me-drone-hobbyist-20140622-story.html> (describing 2014 incident in which Los Angeles hockey fans destroyed a quadcopter that was deemed to be operating legally); Amy Worden, *Activist Group’s Drone Shot While Filming PA Pigeon Shoot*, PHILA. INQUIRER BLOG (Oct. 17, 2013, 3:52 PM), <http://www.philly.com/philly/blogs/pets/Activist-groups-drone-shot-while-filming-PA-pigeon-shoot.html> (describing a group of hunters who shot a UAV doing environmental monitoring).

173. The most notorious of these incidents is the capture of data from a U.S. military Predator UAV by Iraqi militants using a cheap software tool called Sky Software. Siobhan Gorman et al., *Insurgents Hack U.S. Drones*, WALL ST. J. (Dec. 17, 2009), <http://www.wsj.com/articles/SB126102247889095011>.

174. *Using Unmanned Aerial Systems Within the Homeland: Hearing Before the Subcomm. on Oversight, Investigations, & Mgmt. of the H. Comm. on Homeland Sec.*, 112th Cong. 107 (2012) (statement of Todd Humphreys).

175. Vikki Stone, *Rise of the Drones: Insuring Unmanned Aircraft Systems Is Going to Be Complicated*, RISK & INS. (Mar. 3, 2014), <http://www.riskandinsurance.com/rise-drones>.

176. OR. REV. STAT. § 837.375 (2013).