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Unmanned Air Systems and Regulating Navigable Airspace[1]

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Introduction:

Unmanned Aerial Vehicles (UAVs) and Unmanned Aerial Systems (UAS)[2], pejoratively called "drones," have long been used in military contexts. The military's use of UAVs in the hunt for al Qaeda operatives created an indelible public image of mindless beasts carrying out a distant programmers' messy bidding. Moreover, reports of UAVs being developed for purposes like hiding from and sneaking up on people have not generated an enthusiastic reception for domestic use of the technology. Civil demand for domestic UAVs thus finds itself colliding with a culture of wariness, creating difficult barriers to domestic UAV use and slowing regulatory response.

[1] Much of the information regarding legal issues in this paper is derived from a thorough, well written Congressional Research Service "White Paper" written by Alissa Dolan and Richard Thompson entitled: ***Integration of Drones into Domestic Airspace: Selected Legal Issues April 2013,*** available at http://www.fas.org/sgp/crs/natsec/R42940.pdf. This document referred to in this paper as "CRS White Paper".

[2] For convenience, both are referred to as UAVs in this paper because most people are familiar with it. The authors acknowledge that the term "UAV" is viewed by the FAA as outdated. The FAA states on its website: "Currently the FAA and most of the international community uses the term 'UA' or 'UAS' for UA System. Previously used terms to identify unmanned aircraft are ROA, RPV, and UAV." http://www.faa.gov/about/initiatives/uas/uas_faq/#Qn3

Nevertheless, UAV technology is here. According to the Government Accountability Office (GAO),[3] *current* domestic use of UAVs includes law enforcement, monitoring or fighting forest fires, border security, weather research and scientific data collection by the federal government. The FAA predicts that by 2020, U.S. Airspace will be home to 30,000 UAVs in active use at any given moment. In 2012, Congress directed the Federal Aviation Administration (FAA) to establish a comprehensive plan for fully integrating UAVs into U.S. airspace by September 30, 2015 in the "FAA Modernization and Reform Act" or FMRA. The ease, convenience, economy and effectiveness of UAVs in a variety of applications (limited only by the human imagination), portends ubiquitous domestic civilian UAV use.

Against the background, federal, state and local law has seemingly been caught by surprise, lagging well behind the technology and scrambling to establish a regulatory framework. The Congressional Research Service in April 2013[4] succinctly explained:

> "The legal issues * * * will likely remain unresolved until the civilian use of drones becomes more widespread. To that end, the FAA has been tasked with developing 'a comprehensive plan to safely accelerate the integration' of drones into the national airspace, which focuses on the safety of the drone technology and operator certification. While the deadline for development of the plan has already elapsed, the FAA has until the end of FY2015 to implement such a plan. *See* P.L. 112-95, §332(a) (requiring development of a plan within 270 days of enactment of the act, falling in November 2012). Additionally, the FAA must identify six test ranges where it will integrate drones into the national airspace. This deadline, 180 days after enactment of the act, has also elapsed without FAA compliance. Once these regulations are tested and promulgated, the unique legal challenges that could arise based on the

[3] GAO Congressional Testimony: "Unmanned Aircraft Systems: Use in the National Airspace System and the Role of the Department of Homeland Security" July 19, 2012, p 4 (referred to in this paper as GAO Testimony.)
[4] CRS White Paper p 30.

> operational differences between drones and already ubiquitous fixed-wing aircraft and helicopters may come into sharper focus."

A recent statement by Congressional Rep. Ed Markey frames the culture of concern:

> Drones are already flying in U.S. airspace – with thousands more to come – but with no privacy protections or transparency measures in place. We are entering a brave new world, and just because a company soon will be able to register a drone license shouldn't mean that company can turn it into a cash register by selling consumer information. Currently, there are no privacy protections or guidelines and no way for the public to know who is flying drones, where, and why. The time to implement privacy protections is now."[5]

An effective, comprehensive, regulatory response from all levels of government is necessary to protect both the nascent UAV industry and citizens. The regulatory program must avoid overreaction that stifles the technology, but also adequately protects civilians from abusive practices. Crimes committed using UAVs like wiretapping, stalking, harassment, and trespass, will still be crimes. But lawyers will be challenged to apply familiar legal principles in the context of the unique issues posed by UAV technology. In addition, lawyers will have to understand basic aviation law in order to provide effective advice to clients, regardless of where a client is situated on the UAV issues spectrum.

The regulatory realm for UAVs is logically occupied by the Federal Aviation Administration (FAA). But state and local governments will have important land use roles to play. There is no federal agency with a specific regulatory charge to protect community values and UAVs implicate community values. Land use planning and regulation is a principle regulatory tool designed to shape and protect community values. Moreover, until the federal government evinces an intention to completely occupy the field of UAV regulation, it is evident that other levels of government have

[5] "Markey Releases Discussion Draft of Drone Privacy and Transparency Legislation" (August 1, 2012), *available at* http://markey.house.gov/press-release/markey-releases-discussion-draftdrone-privacy-and-transparency-legislation

roles to play. Further, as discussed later in this paper, there is reason to believe the federal government anticipates state and local regulatory programs will play a role in the overall plan for UAV regulation.

Accordingly, should local governments plan for specialized "UAV Airports" or for specialized testing zones? Conversely, should local government require that commercial UAV activity in urban areas *not* be centralized? Should there be local franchises for some types of UAV use -- akin to solid waste, ambulance and taxi franchises? Should there be limits on the hours in which UAVs may operate in residential or other zones? Should they be prohibited in parks and playgrounds? Issues governmental entities will struggle with include:

1. Calls by UAV operators for private property height and use restrictions to facilitate UAV testing and deployment.
2. Inverse condemnation, trespass and nuisance. For example, the military does not view unrestricted military UAV intrusion as a physical occupation of private property where the military claims some airspace rights prior to December 1967. The logic the military employs could apply to any federal agency wishing to use or authorize use of any pre December 1967 designated airspace.
3. Civil rights group, community and individual calls for UAV use restrictions to mitigate noise, security, safety, and privacy issues.
4. Conversely, calls for protections so UAVs are exposed to uniform but limited requirements for mitigation of noise, security, safety and privacy issues.
5. Calls to open up airspace to commercial uses of UAVs.
6. Calls to ensure the safety of U.S. airspace given UAVs lack capacity to "see and avoid."
7. Are weaponized UAVs "arms" for which there is a right to bear?

<u>We Have Been Walking this Direction</u>

There is a Chinese proverb:

> "If we don't change our direction, we're likely to end up where we're headed."

UAVs have been around a long time. As early as the American Civil war, unmanned balloons laden with bombs were floated over enemy territory in the hopes that they would explode at the right time and place. The accuracy of these balloons relied on the providence of air currents to reach enemy quarry. The results were unpredictable and thus unfortunate when the wind changed course and the automated cargo found its way back home.

Military ordinance was launched with balloons on August 12th, 1849 by Austrians against Venetian forces who sought the return of the independent Republic of Venice which had been conquered by Napoleon in 1797. However, as with the American Civil War experience, wind proved an imperfect military asset. "(Venetians "abandoning their homes, crowded into the streets and squares to enjoy the strange spectacle").

With the advent of winged aircraft, more precise military operations were possible and the invention of the airplane marked the dawn of the UAV. The first pilotless aircraft was designed for use in the United Kingdom during World War I -- the radio controlled "Aerial Target" of 1916 and the "automatic airplane" named the "flying bomb" of the same period. While neither was used in the battlefield, the promise of pilotless warcraft controlled by gyroscopes, encouraged further explorations into the technology.

Figure 1- The Flying Bomb

The first large scale production of a UAV (Unmanned Aerial Vehicle) also known as RPV (Remotely Piloted Vehicle), or UAS (Unmanned Aerial System) was a product of British actor and Royal Flying Corps member Reginald Denny. Denny developed these aircraft as aerial target for artillery gunners and he later became a successful remote controlled (RC) aircraft enthusiast.

Figure 2- Reginald Denny's Radio plane

The U.S. Navy and the U.S. Air Force were intrigued by the unmanned aircraft technology and began researching remote pilotless aircraft to fly precise missions otherwise impossible for piloted aircraft due to limitations of pilot safety and maneuverability. During the Cold War, UAV's were used to fly reconnaissance

missions to test for radioactivity after a nuclear blast. Piloted aircraft were unable to approach radioactive hot zones.

The great impetus to improving UAV military technology occurred on May 1, 1960 when a United States U-2 engaged in covert cold war surveillance was shot down in Russia. Political embarrassment over this type of operation the U.S. government denied existed was the great motivator.

Figure 3 - U-2 Aircraft

A drone might never have been detected and, if it were, plausible deniability was intact while, on the other hand, there was no denying a captured U.S. pilot.

Accordingly, exactly three months after this incident, the U.S. developed an unmanned reconnaissance platform in a program code-named "Red Wagon". Resulting from the successes of this program, UAV aerial missions were flown and, soon after, data was coming back from North Vietnam, Communist China, and North Korea.

The limits of satellite technology during the Vietnam War era (cloud cover and camera resolution from space) buoyed the UAV program. This, together with the craving for close up reconnaissance, led to the highly classified program called "lightning bug".

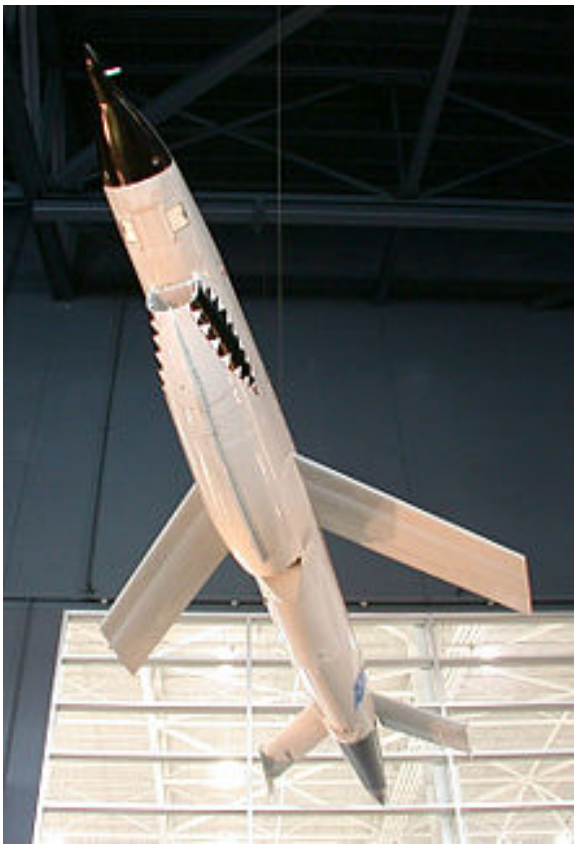


Figure 4- Lightning Bug

In the 11 years of the Vietnam War, 3,435 drones were deployed and just 554 were lost, demonstrating the usefulness of the aircraft and potentially saving 554 pilots' lives.

While the drones of this era were successful in performing reconnaissance missions, it was not until the 1980's when drones would be successfully used to deliver military ordinance. The 1980's was the age of great discovery for UAV aircraft and, in the end of that decade, ballistic weapons and countermeasure tactics were installed and tested on drones. The Balkans, Afghanistan, and Iraq all were the proving grounds for the famous "Predator Drone". This is the aircraft that gave the American public its first real-time, up close view of drone capabilities.

Figure 5-Predator Drone

The military saw other important uses for UAV technology and began testing and using UAV's in non-battlefield contexts such as atmospheric research, earth and weather observation, endurance operations using photovoltaic cells (designed in the 1950's but never used aloft), and policing remote areas.

Civil UAVs

Most of the funding for American UAV development comes from an arm of the Department of Defense or the "DARPA", self-described on its website as follows:

> "The Defense Advanced Research Projects Agency (DARPA) was established in 1958 to prevent strategic surprise from negatively impacting U.S. national security and create strategic surprise for U.S. adversaries by maintaining the technological superiority of the U.S. military.
>
> To fulfill its mission, the Agency relies on diverse performers to apply multi-disciplinary approaches to both advance knowledge through basic research and create innovative technologies that address current practical problems through applied research. DARPA's scientific investigations span the gamut from laboratory efforts to the creation of full-scale technology demonstrations in the fields of biology, medicine, computer science, chemistry, physics, engineering, mathematics, material sciences, social sciences, neurosciences and more. As the DoD's primary innovation engine, DARPA undertakes projects that are finite in duration but that create lasting revolutionary change."

Without the assistance of DARPA, civil U.S. UAV technology would likely be wholly owned and understood only by private developers.

UAVs have been designed as small as a three inch wingspan and weighing in at ten grams and will inevitable get smaller over time as the need arises. Very small UAV prototypes also called Nano Air Vehicles include AreoVironment's 80 gram, six inch Black Widow and Prox Dynamics' four inch, 20 gram Black Hornet.

Figure 6 - AeroVironment's concept Nano UAV

UAVs come in all shapes and sizes and they don't all look like aircraft. Some look like hummingbirds, for example.

Figure 6a AreoVironment's Nano Hummingbird named by Time Magazine as one of the "50 Best Inventions of 2011"

The Nano Hummingbird is an example of a DARPA funded project. The Hummingbird is equipped with a small video camera for surveillance and reconnaissance purposes and at present can stay aloft for up to 11 minutes either indoors or out.

Currently, the largest UAV manufactured -- the "Global Hawk" – is used by NASA for high altitude long endurance environmental science missions. It's

wingspan in 131 feet, length of 48 feet, has a take-off weight of 32250 pounds, and can stay aloft for 28 hours.

Figure 7 - NASA's Dryden Global Hawk UAV

Differences in UAV size correspond only to the mission of the aircraft; there is no need to consider accommodating a pilot. UAV size flexibility allows endless tailoring of UAVs to circumstances. Along with size variations, there are different "platforms" or systems that may be installed on the UAV. UAVs can be equipped with complex onboard navigation systems allowing long distance endurance missions, out of sight of a ground operator. Especially important to the success of these long distance craft, UAVs often include programmed maneuvers to be automatically deployed if a command and control link is disrupted ("lost-link scenario").

UAVs can be equipped with a variety of mission specific instruments depending on the project. For example, the most basic UAV can be fitted with a simple camera or camcorder and used for video surveillance. Additionally, a platform may be installed employing high resolution cameras, infrared systems, laser systems, and radio retransmission and microphones, and echo location devices. Infrared sensors are another platform that allows radiation, or thermal heat imaging from up to 2000nm away. Cameras installed on a UAV have demonstrated a resolution of 1.8

giga-pixels, with a capability to detect something as small as six inches from an altitude of 17,500 feet while streaming the image in real time to a ground based station. Currently, up to one terabyte of information per day can be transmitted this way.

UAVs may evaluate crop health by measuring the contrast of water in the leaves compared to other plants nearby, or even mites on a leaf. For search and rescue, a body otherwise concealed can be quickly discovered. Hyperspectral (a word not yet in the dictionary), infrared imaging takes this one step further. While using traditional detection methods, a green camouflage cover over a green jeep in a green jungle may go unseen as long as there is no heat signature from the vehicle, hyperspectral technology changes everything. With this technology, a UAV can detect the presence of the jeep by comparing differences in material makeup. So, in essence it will pick up the fabric covering the jeep.

This could be particularly useful during a disaster, where there are fatalities such as the tsunami that hit Indonesia. While infrared can pick up a signature from a recently deceased individual, as the body cools to water or ground temperature it can be lost to the scanner. Hyperspectral infrared can easily detect the difference in light refraction of a body versus water or ground and recovery is simplified with this technology.

UAVs may be very light, can carry significant payload, and can reliably and accurately access areas that are not possible with manned flight. UAVs have no physiological needs and may stay aloft for days or even longer depending on the fuel source. This allows real time monitoring with no down time which, depending on the mission, can be critical.

Specific Applications - Search and Rescue

Search and rescue operations using UAVs could be operated day and night, increasing the ground covered and greatly increasing the probability of finding the target. The capabilities of UAV's for recovery are not solely dependent on any factor such as weather. Recently, on Mt. Hood just outside of Portland, Oregon a dentist made a solo ascent to the summit of the mountain. He never returned. The search and rescue operation was ineffective because foul weather made it impossible for manned aircraft to approach the area. UAVs could be developed that do not have this limitation, enabling faster recovery missions and potentially saving lives.

Specific Applications - Communications and Broadcast Services

Radio communication is severely limited by obstructions to the line of sight needed for radio relay to work. In remote regions where radio communication is necessary, this can pose a serious problem to maintaining adequate communication. The UAV can be used for communication and broadcast services and can relay or transmit signals over a great period of time. Having a UAV aloft to assist with imagery and communications in remote areas, allows precise operations that would otherwise be impossible. This is particularly important in military operations where UAVs are employed to precisely target and coordinate air strikes either by the UAV or manned aircraft. Journalists like UAV technology as a way to gain access to news as it is breaking, where the news is in dangerous or inaccessible territory.

Specific Applications - Fire Detection and Suppression

Fire detection and suppression can be accomplished day and night using UAV technology. UAVs can get into spots that would pose unacceptable risk to manned aircraft or require ground support that would be dangerous to fire personnel. Piloted

aircraft is of limited utility because the pilot must fly the airplane and also keep an eye out for smoke. A UAV's onboard sensors can detect the first whiff of smoke leading to a quicker response time for fire crews. Further, once a forest fire is established, UAVs can assist in delivering fire retardants. For example, the NASA Global Hawk described above is being tested as a tanker platform that can get into the heat of the fire and deliver fire suppressing agents in situations that manned craft simply cannot mechanically or safely achieve.

Specific Applications - Land Use Planning and Management

UAV's will play a role in land use planning by aiding municipal governments and developers in planning street grids and development sites; planning public infrastructure, assisting in code enforcement, monitoring compliance with conditions of approval and recording natural resource data including erosion and soil control. UAVs can also assist in survey work, making this work less expensive and faster to produce.

Specific Applications - Ground Transportation Monitoring

Uses for the UAV by transportation engineers, state and local governments as well as the federal Department of Transportation include "ground truthing" transportation impact analyses; speed studies (for sight distance controversies), monitoring the condition and congestion of roadways; security inspections for bridges and other critical transportation infrastructure especially in rural areas, hazardous material spill and cleanup monitoring, construction data collection, aerial surveillance, and. avalanche control upslope from a roadway, crash scene photography, and surveying. Technology is emerging that will allow a UAV to detect a traffic problem such as congestion, stalled vehicles or accidents and then compute a new route, and even remotely change traffic lights and highway signage to reroute traffic, if needed.

Specific Applications - Agricultural Uses

Farmers are challenged by pests, funguses, mold, different soil qualities, rough terrain, and water supply. Farming efficiencies are critical in times of water shortage and by increasingly prevalent restrictions on pesticides, fungicides and herbicides. To be viable, commercial scale agriculture must be efficient and this requires applying water only where it is needed, and applying the right chemical treatment to the right portion of a crop as needed. Yet, hiring people for this task is expensive and only marginally effective. Moreover, market acceptance of current chemical and GMO applications for large scale crop production is poor.

While seed coated with herbicides, fungicides or pesticides or a combination of these to ensure germination can avoid fungal, plant and animal pests from diminishing crop yields, consumers are wary of products grown this way. Chemicals are blamed for honey bee "colony collapse", where entire hives die off leaving farmers without critical bee pollination. Moreover, pests can quickly adapt to chemical deterrents, making it difficult to develop and apply useful, affordable chemicals with demonstrated human and environmental safety records. Enter a UAV that can detect a nest or concentration of unwanted pests and place it on a digital image that can be downloaded to a computer. With this technology, the farmer may target chemical spray to the area of the infestation. The UAV can also download images of wet or dry spots so watering can target dry areas, reducing water waste.

UAV's are anticipated to be an inexpensive alternative to satellite technology currently employed by commercial farmers. UAVs can operate at much lower altitudes, are not impaired by cloud cover, do not lose sight of the field as the earth rotates, and can stay aloft collecting data for an extended period of time, with accurate results.

Small UAV's are being developed that can be launched by the farmer directly and flown throughout a farm holding with high resolution cameras and infrared sensors to detect even the smallest pest or organism or dry parts of the land. Oregon State University at its Hermiston Agricultural Research and Extension Center (HAREC) is a leading university experimenting with UAV technology for the purpose of improving crop yields. One of the UAVs OSU is testing is the Tetracam "Hawkeye. The Hawkeye's advantage is it is easy to use, low cost, and reasonably safe because it is easy to spot and keep an eye on and "with its chute continually deployed, if a malfunction occurs while the craft is airborne, the Hawkeye is designed to simply float to the ground protecting the craft and its camera cargo from damage." The Hawkeye is about the size of a suitcase and weighs 8 lbs. http://www.tetracam.com/ProductHawkeyewindow2.htm.

Figure 8-Hawkeye in Hermiston, Oregon

OSU's project, located in farm and ranch country, has strong local and regional acceptance:

> "'Allaying concerns about privacy, [OSU UAV Research Director Phil] Hamm said, 'These unmanned aircraft are for agricultural research only and will be used to do nothing more than that. This is about helping our local growers do a better job of growing crops, something HAREC has been doing for the past 102 years."

> "The Federal Aviation Administration has authorized the flights of the aircraft, which aren't allowed to fly higher than 400 feet and must stay within sight of the operator, typically less than a mile away." http://oregonstate.edu/dept/hermiston/unmanned-aircraft-research

Specific Applications - Forestry

UAV's can be deployed to monitor vast rangelands, as well as watching for and fighting forest fires. This allows government agencies such as the USDA, Department of the Interior, and the U.S. Forestry Department to make appropriate management decisions for local, regional and even national assessments. UAVs can provide non-intrusive real time imagery for forest inventory, vegetation management and other types of environmental monitoring for forest operations, by private industry as well as "watchdog" groups. Since UAV's can navigate very tight spaces, and forests are by definition hazardous for low flying manned aircraft, UAV use in forest environments collects data that is otherwise unavailable. While aerial survey of forest lands give a good picture of overall forest health and habitat, a UAV can collect detailed information about disease, insect infestation, drought and unwanted trespasses such as illegal marijuana fields hidden in public forests.

UAVs are being developed to address pine bark beetle infestations that have resulted thousands of acres of dead trees leaving decimated forests and a tinder box of flammable forest fire material. Spraying for these beetles is costly, has poor public acceptance, and may be harmful to the environment. The hope is that UAVs can be deployed to locate and track the female beetle as she flies to a new tree where she will release a pheromone to attract a mate; and then the UAV will kill the pair with targeted chemical application, before the female bores into the tree to lay her eggs.

Specific Applications - Environmental Assessment, Research and Monitoring

UAVs are tireless, undistracted, have no needs for restrooms, food or water, have no political point of view, are not inclined to fudge, and their outputs can be independently evaluated by others. As such, they are a perfect tool to provide credible evaluation of environmental conditions for a variety of applications. These include environmental assessments (EAs), EIS', wind farm monitoring for bird and bat kills, counts of threatened or endangered populations like sage grouse, wetland delineation; fish and wildlife habitat evaluation, and evaluation of geologic features and stability to predict or assess landslide and earthquakes.

UAVs successfully monitor fragile ecosystems. For example, in Alaska, the use of UAV's to monitor sea life has proved useful, since many forms of marine life dive from the surface with the noise of traditional manned aircraft, making them invisible when approached. UAV technology is quieter and becoming virtually silent, allowing researchers to monitor aquatic or other wildlife with minimal environmental impact.

UAV's are useful to monitor air quality over populated areas as well as downstream from smog producing power and manufacturing plants. They are useful in evaluating natural phenomenon as well, volcanic plumes. An example of a UAV geologic application is NASA's recent launch of a UAV named the "Dragon Eye" into an active volcanic ash plume on Mt. Turrialba near San Jose, Costa Rica. The flight's mission was designed to gather information on the chemical reach and composition of the plume, something that was impossible to gather using manned aircraft. In this regard, a volcanic plume is particularly dangerous to manned aircraft. The silica created by the volcano enters any conventional gas engine and will render it completely useless in a matter of minutes, as the silica is reheated from combustion and "gluing" itself to everything beyond the combustion chamber. This causes catastrophic failure of the power plant and creates an emergency with an often unappealing ending for the pilot. However, UAVs are more durable as they run on

electric motors so the rate of silica accumulation is greatly reduced. UAVs can send real time data streams to the operator so even if the UAV is lost (perhaps it is even disposable in this context), the critical data is obtained. Moreover, if there is a failure, then because they are by definition unmanned, there is no threat to a pilot.

Specific Applications - Digital Mapping

UAV's are currently used in other countries for digital surface models and volumetric assessments and quantity surveys of open topped mines and quarries. HELImetrix in Australia utilizes UAV's to access the most remote mining sites for survey. In addition, there is testing to enable a UAV to carry explosives and set in predrilled holes reducing the human risk associated with this activity.

Figure 9 - HELImetrix copter

Specific Applications - Asset Management

UAVs are a cost effective aerial survey tool for data collection for asset management of private estates. For example, a UAV can detect trespass or other problems, alerting ground personnel enabling targeted, efficient response.

Specific Applications - Disaster Impact Assessment and Insurance

UAVs are an ideal survey tool for impact assessment, such as storm damage in inaccessible areas. For example, a UAV can detect a log jam in a river after a storm that left alone, can and breaks free and cause flooding to areas already compromised by disaster. With early detection of potential hazards after an event, further damage can be minimized.

Specific Applications - Power Transmission and Pipeline Monitoring

UAVs can be deployed to monitor electrical transmission facilities in remote areas for electricity losses as well as downed lines or other problems and can also monitor oil and gas pipelines for leaks. Currently, manned aircraft is tasked with monitoring power transmission and gas lines. However, it is thought that upwards of 20% of data is missed by manned flight operations. Human beings get tired, bored or distracted, especially since the pilot is asked to safely fly the airplane as well as monitor these externalities. Additionally, long before an issue arises, UAV's can detect such problems as a leaning tree that threatens to fall into a transmission line or a pipeline.

Specific Applications - Other Commercial Uses:

Commercial uses are being investigated by companies such as Fed Ex, UPS, Caterpillar, and John Deere for transporting goods such as parts to remote repair facilities and even the movement of mail. FedEx for example, is researching using large drone aircraft to transport packages on select overseas routes that require multiple crews to fly using manned aircraft. It is also possible to see your FedEx package delivered to your doorstep via UAV someday.

Specific Applications - Medical Uses

Companies are developing small UAVs to deliver medicines to remote areas of the developing world, as well as being equipped with two way cameras and telecommunication devices as to enable doctors to check in with patients as well as potentially walking local healers through procedures.

Non-Civil Applications on Domestic Soil - Law Enforcement Uses

The most widespread law enforcement use of UAVs today is Border, Coastal, and Homeland Security patrolling and monitoring. Port authorities, Coast Guard, DOE, and the National Law Enforcement lab are the key players in utilizing UAV's for such purposes. People crossing the Arizona border from Mexico for example are easily located. Such imagery, coupled with the ability for a UAV to stay on station for extended periods of time, allow for the policing agencies to track illegal border activity.

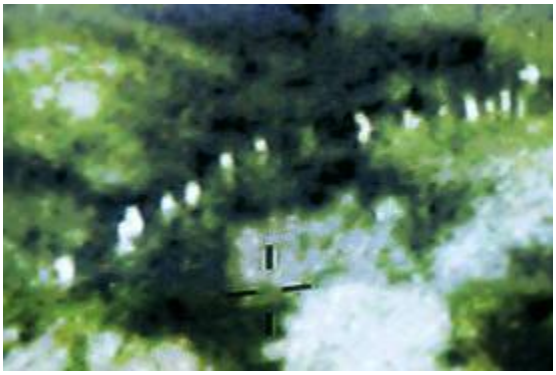


Figure 10 - UAV Image - Border Patrol

Moreover, we are all painfully aware of the bombs that exploded near the finish line of the Boston Marathon causing countless suffering, injury and death. UAV technology will someday monitor large gatherings and detect bombs like those that exploded on April 15, 2013 and get rid of them before they cause harm. To achieve this, the UAV's can be outfitted with logic software that searches out wiring where it

should not be and couples it with both above surface and ground penetrating radar that searches out the signature of bomb material and compares it to the proximity of the suspect wiring. The military has reported that the use of UAV's to find roadside bombs has led to a huge decrease in soldier injury or death and, in addition, the UAV's can pick up and track the people responsible for laying the bomb through infrared technology.

Non-Civil Applications on Domestic Soil - Military Uses:

UAV use on foreign soil is well known. But there is ongoing military use of UAV's domestically and more of the same to come. Many types of military UAV's, while unmanned in the air, require a pilot to operate them remotely from the ground. UAV pilots must train to acquire the skillset to operate these UAVs. Training new pilots and keeping existing pilots current on new UAV technology, requires airspaces to accommodate these types of domestic training operations. Many routes claimed for this purpose now exist and testing bombing ranges are scattered throughout the USA. As we will see later in this paper, the military's view is that its use of "airspace" for this purpose is akin to "land use regulation" and is not viewed as the physical occupation of private property necessitating compensation.

UAVs -- the Legal Context

The laws governing UAV testing and use are emerging and poorly defined. *See* CRS While Paper; GAO Testimony. Lawyers must understand, however, that no understanding of the laws affecting and governing UAVs can be understood without a basic understanding of aviation law. A general review of applicable law and emerging law is summarized below.

Challenging Federal Agency Airspace Use is Tricky and Expensive

Federal agency interference with private property through improper or ostensibly legitimate use of airspace is tricky business for clients and lawyers to deal with. Because of the inherent uncertainty surrounding these kinds of claims, they will be expensive to bring and the successful legal theories are not yet known. Some of the usual suspects follow.

For "torts", the Federal Tort Claims Act (FTCA) 28 USC 2674 is the exclusive grant of subject matter jurisdiction for torts against the federal government and provides:

> "The United States shall be liable, respecting the provisions of this title relating to tort claims, in the same manner and to the same extent as a private individual under like circumstances, but shall not be liable for interest prior to judgment or for punitive damages."

Torts may include invasion of privacy. *Birnbaum v. United States*, 588 F2d 319, 328 (2nd Cir 1978). Torts may also include trespass. *Ira Bushey & Sons v. United States*, 276 F. Supp 518, 526 (E.D. N.Y. 1967, *aff'd* 398 F2d 167 (2nd Cir 1968). The FTCA's main limiter is that only monetary damages are recoverable and no injunctive relief is available. Plaintiffs may be most interested in being left alone.

Also important in the UAV context, no FTCA claim is cognizable unless administrative remedies are exhausted. 28 USC 2675(a). Exactly what administrative claims must be exhausted and how, is unclear; but litigators do have experience with perhaps similar issues under unconstitutional takings law. Because finality and exhaustion defenses have the proven ability to frustrate claims against the government, making them prohibitively expensive and hard to win, they are likely to be preferred governmental defenses to UAV tort cases.

The statute of limitations for FTCA cases is two years from the date the claim accrues. 28 USC 2401(b).

Relatedly, a property owner may have an inverse condemnation claim actionable under the Tucker Act, which supplies federal subject matter jurisdiction over inverse condemnation claims brought against the United States. 28 U.S.C. §§ 1346(a)(2) (Little Tucker Act), 1491(a)(1) (Tucker Act). Claims under the Tucker Act are subject to a six year statute of limitations with an accrual rule. 28 U.S.C. § 2501. The statute of limitations begins to run when the plaintiff knew, or should have known, that "the requisite factual predicates establishing the government's alleged liability" have occurred. The U.S. Court of Federal Claims has exclusive jurisdiction over Tucker Act claims seeking more than $10,000. 28 U.S.C. §§ 1346(a)(2), 1491(a)(1). Similar to the FTCA, there is no injunctive relief available.

For airspace intrusion cases, a property owner may also have a claim under the federal Quiet Title Act. Here, 28 U.S.C. § 2409a(a) authorizes courts "to adjudicate a disputed title to real property in which the United States claims an interest". A claim under the Quiet Title Act must plead "with particularity the nature of the right, title, or interest which the plaintiff claims in the real property, the circumstance under which it was acquired, and the right, title, or interest claimed by the United States." 28 U.S.C. § 2409a(d). For a court to have subject matter jurisdiction under the Quiet Title Act, there must be *a disputed title* to real property. It appears that at least the military is setting up airspace claims as *regulatory* not *title* disputes.

A property owner might rely on APA processes to either directly challenge airspace designations in rulemaking or bring an APA Section 702 claim for injunctive relief after the fact.

Directly challenging rulemaking is likely illusory because property owners are unlikely to know about rulemaking or if they do know it is going on, will be unlikely to know whether it affects them and if so how.

An APA Section 702 claim is available so long as (1) there is no adequate other remedy available, and (2) the APA claims do not seek relief of a type that is prohibited by another statute either express or implied. *Tuscon Airport Authority v. Gen'l Dynamics Corp.*, 136 F.3d 641, 645 (9th Cir. 1998). Therefore, in situations for which the federal government claims no title authority, but only regulatory authority such that the Quiet Title Act is unavailable, an APA claim may be the best available option. APA actions are six years from the date the cause of action accrues. 28 U.S.C. § 2401(a).

Finally, the Declaratory Judgment Act, 28 U.S.C. § 2201(a) might provide relief regarding the appropriate federal government's rights regarding its use of airspace. However, in all cases, government will argue FAA has authorized its use of airspace and plaintiffs will argue that such use is contrary to law in fact or a compensable taking. Courts have few useful guideposts for resolving these claims and new law will surely be made.

Airspace and Takings Law

Under the Tucker Act, cited above, federal taking claims are cognizable against the federal government. Because these types of claims are likely to be triggered under any UAV regulatory program, a closer look at the benchmark legal principles is warranted. As we will see, airspace is designated by the FAA and governs where aircraft can fly and the type of aircraft that can fly in the particular type of airspace. However, just because aircraft flies in designated airspace, this should not insulate government against Fifth Amendment and equivalent state law taking claims. To a

property owner, low altitude UAV occupation of the airspace over private property looks and feels like a physical occupation.

In *Griggs v. Allegheny County* 369 U.S. 84, 90 (1962), low flying aircraft, flying as allowed by FAA regulations, in navigable airspace, while taking off and landing at a public airport, constituted a compensable taking under the Fifth Amendment. This case relies on *United States v. Causby*, 328 U.S. 256, 258(1946), the seminal airspace taking case.

In *Causby*, the government claimed, among other things, a property owner does not own any airspace adjacent to the surface "which he has not subjected to possession by the erection of structures or other occupancy." The Supreme Court in *Causby* rejected the government's claim deciding that "the landowner owns at least as much space above the ground as he can occupy or use in connection with the land. The fact that he does not occupy it in a physical sense—by the erection of building and the like—is not material." The court explained that the area around the surface of the ground was necessary to use and enjoy one's property and invasions thereof and that these "are in the same category as invasions of the surface."

In *Causby*, the government also argued that flights within navigable airspace are immune from taking liability. At the time take offs and landings were not specifically designated as navigable airspace, but were a reasonably a necessary part of it. The Court nevertheless concluded that "flights over private land are not a taking, unless they are so low and so frequent to be a direct and immediate interference with the enjoyment and use of the land." The Court concluded that the flights at issue imposed a servitude similar to an easement, that interfered with the use and enjoyment of the property. Although all economically beneficial use was not lost, there was a compensable diminution in the value of the property because the property could not be used as for chicken farming as the owner intended.

In dicta, in *Braniff Airways v. Nebraska State Board of Equalization & Assessment* 347 U.S. 590 (1954), the United States Supreme Court summarized *Causby* to hold "that the owner of land might recover for a taking by national use of navigable air space, resulting in destruction in whole or in part of the usefulness of the land property."

The military relies on FAA's authority to designate "Special Use Airspace" or SUAs to designate "drone tracks" on private property. Specifically, the military relies on FAA's Order: "Procedures for handling Airspace Matters" Order JO 7400.2J 21-3-3 "SUA Proposals" "Proposal Content"

"* * * * *

> "f. Environmental and land use information.
>
> "* * *
>
> "3 Proposals to designate the surface as the floor of a prohibited or restricted area *shall include a statement explaining how the proponent will exercise control of the underlying surface (i.e., by ownership, lease, or agreement with the property owner).* Do not submit a copy of the deed, lease, or control agreement.
>
> "NOTE *Restricted areas that were designated with the surface as the floor prior to December 1, 1967, are exempt from the "own, lease, or control" requirement.* The exemption status remains valid until amendment actions are taken which would expand the dimensions or times of use, or change the designated purpose of the area.
>
> "* * *

Also "Restricted Areas"

> "23-1-4. RESTRICTED AREA FLOOR
>
> "a. The restricted area floor may be established to the surface only when the using agency owns, leases, or by agreement, controls the underlying surface.
>
> "NOTE *Existing restricted areas established from the surface before December 1, 1967, are exempt from the 'own, lease, or control' requirement*. This remains valid until amendment action is taken which would expand the boundaries, altitudes, or times of use, or changes the designated purpose of the area. Nevertheless, using agencies of such restricted areas are encouraged to acquire sufficient control of the property to prevent possible disruption of that agency's activities."

In a specific case, under these provisions regarding the information any agency must provide FAA when it wants FAA to designate airspace, the military claims a 1949 federal register Civil Aeronautics Board rule about "Danger Areas" -- areas that have an "invisible hazard" to "aircraft in flight" at the surface to 6,000 feet --- is sufficient to support in 2013 establishing a "drone track" on a ranch with the corresponding insults of annoying and frightening activities. The military also claims the right to interfere with private property beneficial use and enjoyment such as wind turbine development on the ranch. On the latter, the client obtained from the FAA a "Determination of No Hazard" or DNH to navigation for 17 wind turbines, yet the military claimed controls of the surface to 6,000 feet for its drone track. Of particular interest to lawyers, the military's claimed rights in fact relate to property more than 6 miles from the clients' ranch.

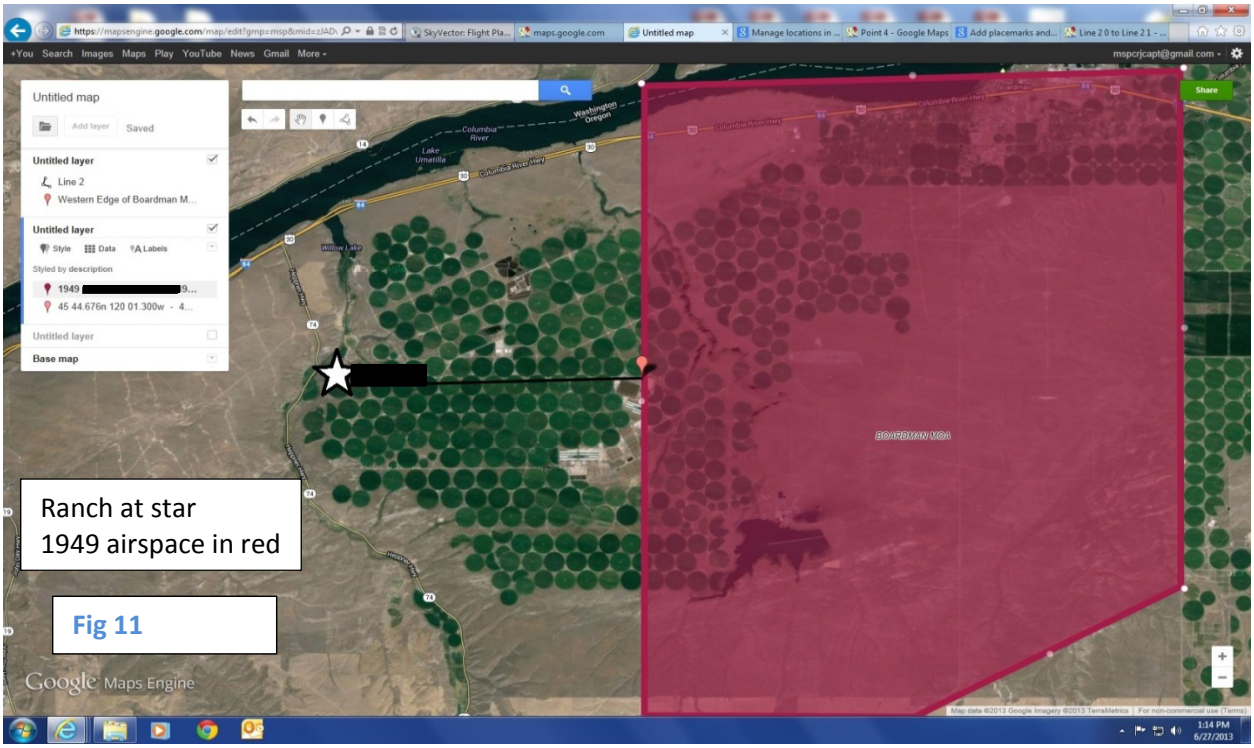
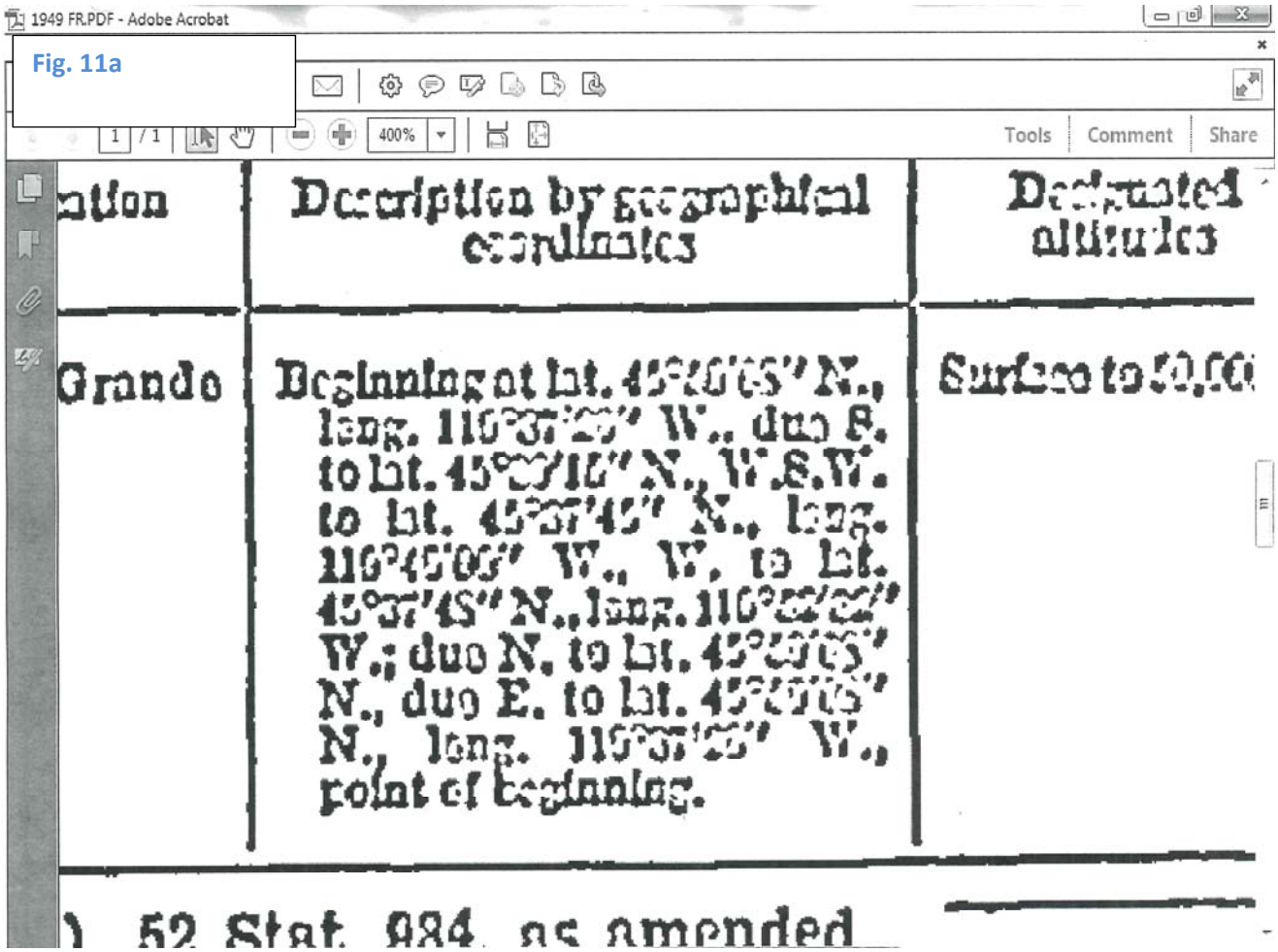


Fig 11

Understanding Airspace is Important

As can be seen from the above case, lawyers have to understand airspace to effectively represent clients in UAV issues. At present, airspace for testing and flying UAVs is designated on a case-by-case basis, but UAVs will be officially "integrated" into U.S. airspace by 2015. However, the official "integration" of UAVs and the airspaces into which they are "integrated" or specially designated to fly, whether on a case-by-case basis or universally established, are not now and will not be accompanied by notice, other than that rather unhelpful variety found in the federal register. Owners of private property may be affected by airspace designations and never know it. Airspace designations are not recorded in any real property records, are not reflected on any deeds, are not easily researched, and require a pilot, surveyor or similarly skilled person to map out locations in which it exists.

As is also evident from the above discussion, FAA regulations are interpreted to now and presumably moving forward, allow designation of "Special Use Airspace" (SUA) at the surface of private property for whatever purpose requested, including presumably for drones, with no property owner notice, no opportunity to contest any agency claim of right, with no requirement for any documentation of rights claimed by an agency. Merely an agency's representation that before December 1, 1967 there were surface airspace rights is an adequate basis to designate surface airspace on private property. An agency claim in this regard is never subjected to an evidentiary test. Airspace designations before December 1, 1967 are tough for any lawyer to track, and once found, can be very hard to physically read. For example, looking at the 1949 FR airspace coordinates that the DOD relies on in the case described above, tells the story:



1949 FR.PDF - Adobe Acrobat

Fig. 11a

ation	Description by geographical coordinates	Designated altitudes
Grande	Beginning at lat. 45°26'05" N., long. 116°37'25" W., due S. to lat. 45°23'16" N., W.S.W. to lat. 45°37'45" N., long. 116°45'05" W., W. to lat. 45°37'45" N., long. 116°52'22" W.; due N. to lat. 45°50'05" N., due E. to lat. 45°50'05" N., long. 116°37'25" W., point of beginning.	Surface to 10,00

) 52 Stat. 984, as amended

FAA - Types of airspace:

The Federal Aviation Act of 1958 established the Federal Aviation Administration (FAA) and made it responsible for the control and use of navigable airspace within the United States. Before the FAA, there was the Civil Aeronautics Board and before that, a branch within the Department of Commerce called the Aeronautics Branch, and various Department of Commerce sub-agencies. If ever there is a need to trace airspace rights, attorneys will be tasked to have a basic understanding of the archival records within which to look.

The FAA created the National Airspace System (NAS) to protect persons and property on the ground, and to establish a safe and efficient airspace environment for

civil, commercial, and military aviation. The chart below gives a pictorial of the six controlled airspace components (AGL means Above Ground Level; FL means Flight Level in thousands of feet).

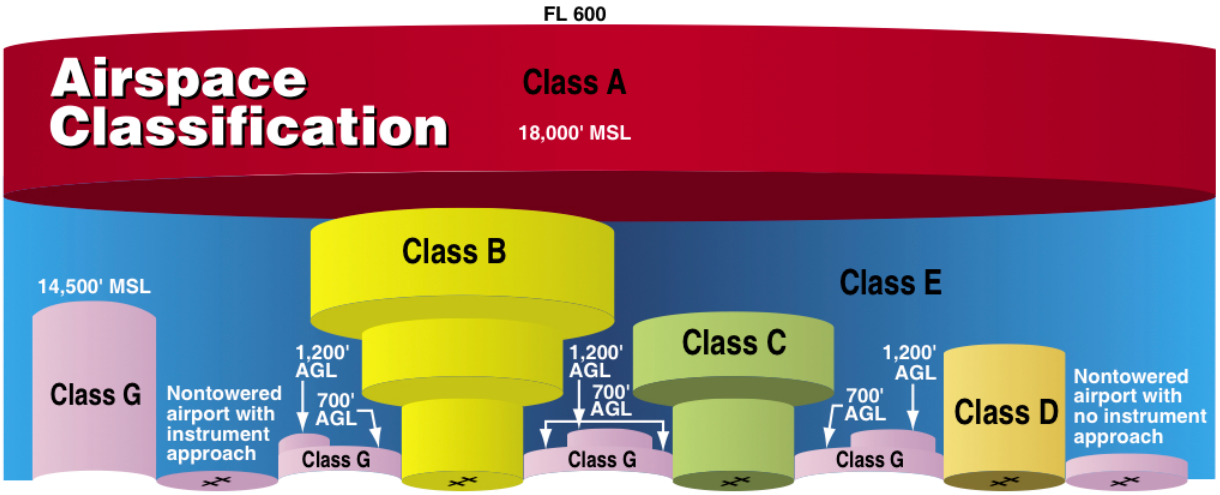


Figure 11 - FAA airspace classification

The civil airspace designations within which the FAA may decide to authorize (or limit) UAVs are listed below:

1. Class A: Encompasses the en route, high-altitude environment used by aircraft to transit from one area of the country to another. Class A airspace exists within the United States from 18,000 feet MSL to and including 60,000 feet Mean Sea Level (MSL). Mean sea level is the average datum of the ocean level as it rises and falls on a regular interval.

2. Class B: All aircraft in Class B airspace are subject to positive control from ATC. Class B airspace exists at 29 high-density airports in the United States as a means of managing air traffic activity around the airport. For example LAX, SFO, SEA, DEN, JFK, and BOS.

This airspace is designed to regulate the flow of air traffic above, around, and below the arrival and departure routes used by air carrier aircraft at major airports. Class B airspace generally includes all airspace from an airport's established elevation up to 12,000 feet MSL, and, at varying altitudes, out to a distance of about 30 nautical miles from the center of the airport.

1. Class C: Airspace is defined around airports with airport traffic control towers and radar approach control. It normally has two concentric circular areas with a diameter of 10 and 20 nautical miles. Variations in the shape are often made to accommodate other airports or terrain. The top of Class C airspace is normally set at 4,000 feet AGL. Examples of Class C airports include BUR, SJC, OAK, PDX, and OMA.

2. Class D: Under the jurisdiction of a local Air Traffic Control Tower (ATCT). The purpose of an ATCT is to sequence arriving and departing aircraft and direct aircraft on the ground; the purpose of Class D airspace is to provide airspace within which the ATCT can manage aircraft in and around the immediate vicinity of an airport. The area is a circular area with a radius of five miles around the primary airport. This controlled airspace extends upward from the surface to about 2,500 feet AGL.

3. Class E: A general category of controlled that is intended to provide air traffic service and adequate separation for IFR (Instrument Flight Rules) aircraft from other aircraft. Although Class E is controlled airspace, VFR (Visual Flight Rules) aircraft are not required to maintain contact with ATC (Aircraft Control Tower), but are only permitted to operate in VMC (Visual Meteorological Conditions). In the eastern United States, Class E airspace generally exists

from 700/1200 feet AGL to the bottom of Class A airspace at 18,000 feet MSL. It generally fills in the gaps between Class B, C, and D airspace at altitudes below 18,000 feet MSL. Federal Airways, including Victor Airways, below 18,000 feet MSL are classified as Class E airspace.

4. Class F: This airspace is classified by other countries as "restricted". The U.S. utilizes its own restricted classification explained below, so this classification does not exist in the United States.

5. Class G: Airspace is airspace that is not designated as Class A, B, C, D, or E, is considered uncontrolled. It is thought that this is the airspace into which UAVs will primarily be integrated. ATC does not have the authority or responsibility to manage of air traffic within this airspace. In the Eastern U.S., Class G airspace lies between the surface and 700/1200 feet AGL.

The right of way in airspace conflict situations goes to the "least maneuverable" aircraft. How this will be interpreted and applied in UAV versus manned aircraft contexts is as yet unknown.

Special Use Airspace:

Within the above airspace categories, large segments of controlled and uncontrolled airspace have been, and may in the future be, designated as Special Use Airspace or SUA. Operations within SUA are considered hazardous to civil aircraft operating in the area. Consequently, civil aircraft operations may be limited or even prohibited, depending on the area. Moreover, in SUA, the right of way goes to the aircraft for which the SUA is designated. As explained above, the FAA's position is that UAVs will not be subject to designated SUA, but rather will be integrated into all airspace (which may include SUA:

> "Currently there are no actions being taken to establish a 'special UAS airspace'. This 'special UAS airspace' would be counter to the idea of integrating unmanned aircraft into the NAS because it would be segregating, not integrating."
> http://www.faa.gov/about/initiatives/uas/uas_faq/#Qn3

But we've seen in the case discussed above, the SUA is in fact used now as a means to designate UAV low altitude tracks.

SUA is divided into prohibited, restricted, warning, military operations, and alert areas.

Prohibited Airspace

Figure 12 - Camp David Prohibited Airspace

Prohibited airspace is an areas where, for reasons of national security, the flight of an aircraft is not permitted. Prohibited areas are depicted on aeronautical charts. For example, a prohibited area (P-56) exists over the White House and U.S. Capitol.

Restricted Airspace

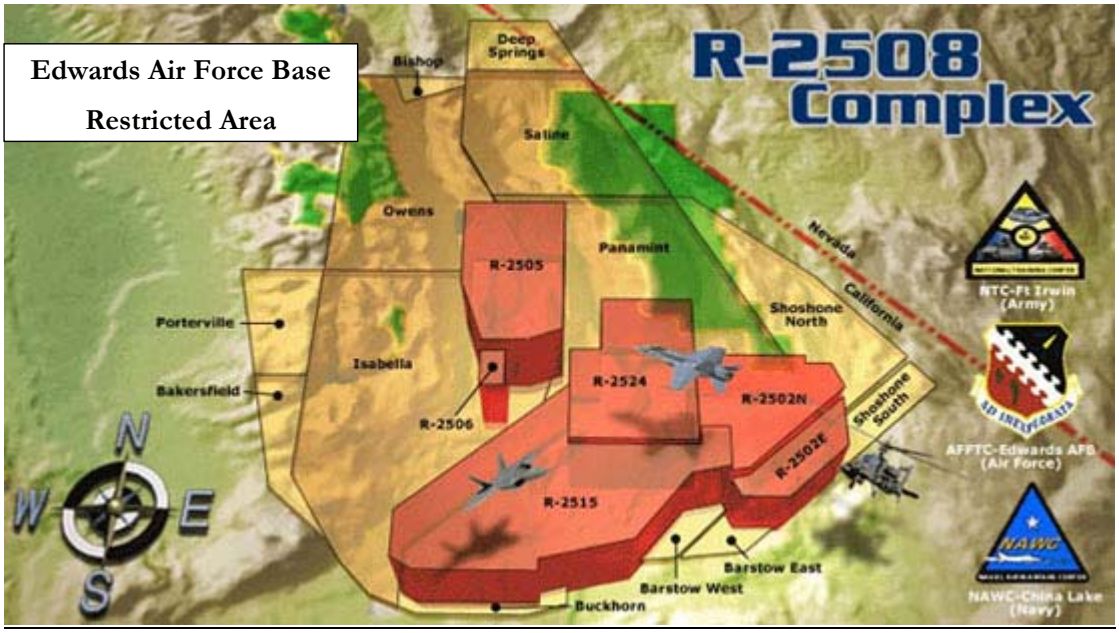


Figure 13 - Edwards Air Force Base Restricted Airspace

In certain areas, the flight of aircraft, while not wholly prohibited is subject to restrictions. These areas often have invisible hazards to aircraft, such as artillery firing, aerial gunnery, or guided missiles. Non authorized aircraft operations in these areas are prohibited during times when the airspace is "active." Shown above is the Edwards Air Force Base and surrounding areas.

Warning Airspace

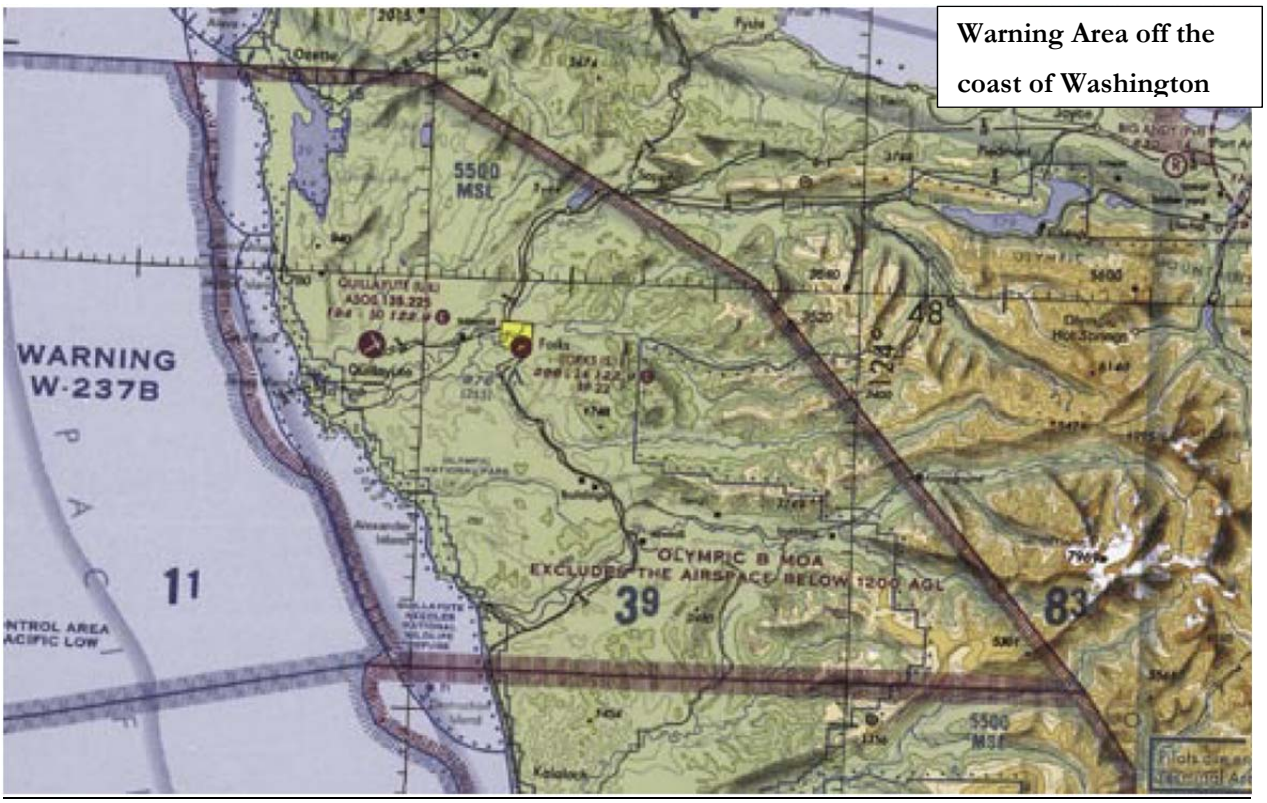


Figure 14 - Warning Area off the Coast of Washington

A warning area contains many of the same hazards as a restricted area, but because it occurs outside of U.S. airspace, domestic aircraft including UAV operations cannot be legally restricted within the area. Warning areas are typically established over international waters along the coastline of the United States. Although, the Air Defense Identification Zone (ADIZ) protects the United States from any foreign air threat. These areas are usually located six miles off any given coast or border. Warning areas lie within this zone to ensure domestic aircraft do not penetrate this area.

Military Operations Area

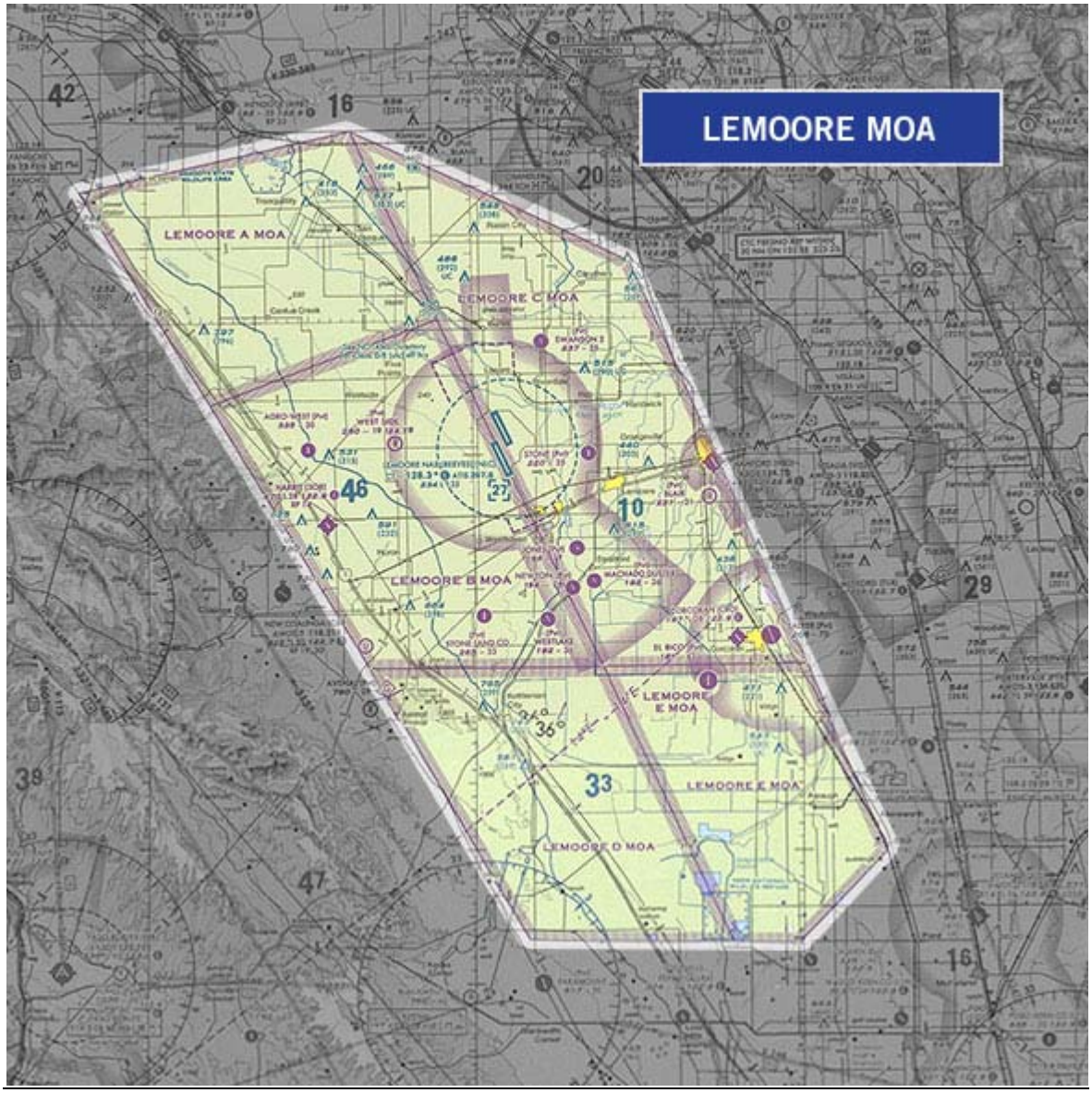


Figure 15 - Lemoore MOA in California

Military operations areas (MOA) are blocks of airspace in which military training and other military maneuvers are conducted. MOA's have specified floors and ceilings for containing military activities. VFR aircraft are not restricted from flying through MOAs while they are in operation, but are encouraged to remain

outside of the area. Military aircraft have the right of way and are under no obligation to avoid other aircraft (or anything else not within the scope of the mission) in these areas.

Alert Area

Figure 16 - Alert Area in Arkansas

Alert areas are shown on aeronautical charts to provide information of unusual types of aerial activities such as parachute jumping areas or high concentrations of student pilot training.

<u>Federal Law and "Opening Up" Airspace to UAVs:</u>

As noted in the beginning of this paper, in 2012, Congress passed the "FAA Modernization and Reform Act" (FMRA) which contains a seven page provision known as the "Drone Act". Among other things, FMRA requires the FAA to (1) issue a final rule on integrating "small unmanned aircraft systems" into the national airspace system by September 30, 2015, and (2) develop a "comprehensive plan to

safely accelerate the integration of civil unmanned aircraft systems into the national airspace system." These are tough charges. UAVs do not meet the required tests for aircraft allowed in U.S. airspace. The primary problem is that UAVs are lack "tried and true" testing and, critically, cannot "see and avoid" other aircraft.

Thus, UAVs operated by federal, state, or local agencies are authorized by FAA only on a case by case basis, through approval of certificates of authorization or waiver (COA). *See* FAA, "Unmanned Aircraft Operations in the National Airspace System," 72 Fed. Reg. 6689 (Feb. 13, 2007). In FMRA, Congress ordered FAA to improve and expedite its UAV COA process –specifically to establish "guidance regarding the operation of public unmanned aircraft systems to * * * expedite the issuance of a certificate of authorization process * * *"). FMRA P.L. 112-95, § 334(a).

After receiving a COA application, the FAA conducts a comprehensive operational and technical review of the UAV specifications and if approved, the COA will include strict limits on its operation to ensure its safe use in airspace. *See generally* FAA "Unmanned Aircraft Systems," *available at* http://www.faa.gov/about/initiatives/uas/cert/. While FAA still thoroughly processes CAO applications for UAVs, per FMRA's command, it has streamlined the process for obtaining COAs, including by making it easier to apply on the agency's website. *See* P.L. 112-95, § 334(a) (*see also* "Certificates of Authorization or Waiver (COA)," *available at* http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/systemops/aaim/organizations/uas/coa/. FAA is also now willing to temporarily approve COAs for time sensitive missions. *See* "FAA makes progress with UAS integration," *available at* http://www.faa.gov/news/updates/?newsId=68004

Even under FMRA's directive, FAA will *only* issue COAs for UAVs to *public organizations*. Commercial operators who wish to test or use UAVs must either find a

public organizational sponsor that will accept complete responsibility for the craft and for compliance with the terms of a COA or obtain an experimental certificate. There is no other way for commercial operators to obtain FAA permission to test or use UAVs. *See* FAA National Policy Order 8130.34A October 27, 2010 "Airworthiness Certification of Unmanned Aircraft Systems and Optionally Piloted Aircraft"; 72 Fed. Reg. 6689; *see* 14 C.F.R. §§ 21.191, 21.193 (experimental certificates); 14 C.F.R. § 91.319 (experimental certificate aircraft operating restrictions and requirements). FAA has issued only a handful of experimental certificates for very limited flight tests, demonstrations, and training. FAA states on its website that it will not issue experimental certificates for UAVs except in very limited circumstances:

> "Currently, there are no means to obtain an authorization for commercial UAS operations in the [National Air Space]. However, manufacturers may apply for an experimental certificate for the purposes of R&D, market survey and crew training." http://www.faa.gov/about/initiatives/uas/uas_faq/#Qn3

These current restrictions on private commercial UAVs will give way when FAA comes up with its FMRA required "comprehensive plan" for integration of UAVs into U.S. airspace by the end of FY 2015.

Recreational Users

The personal use of UAVs solely for recreational or hobby use has long been allowed and regulated "lightly" under the terms of a June, 1981 FAA advisory circular "Model Aircraft Operating Standards" 72 Fed Reg 6689; Advisory Circular 91-57. FMRA carries forward much of the regulatory scope of this circular. Specifically, FMRA Sec. 336, prohibits the FAA from issuing rules limiting or prohibiting model hobby or recreational use aircraft so long as:

1. The aircraft is less than 55 pounds "unless otherwise certified through a design, construction, inspection, flight test, and operational safety program administered by a community-based organization";
2. The aircraft "does not interfere with and gives way to any manned aircraft",

3. The aircraft is "operated in accordance with a community-based set of safety guidelines and within the programming of a nationwide community based organization";
4. The aircraft is flown within the line of sight of the operator and used solely for hobby or recreational purposes.
5. The operator of the model aircraft notifies both the airport operator and air traffic control tower is flown in an area within 5 miles of an airport.

However FMRA at Sec. 336(b) also provides that the FAA maintains its authority to take enforcement action against operators who "endanger the safety of the national airspace system."

FAA Designated Test Ranges

Under FRMA, the FAA is required, in consultation with NASA and the Department of Defense, to identify and designated by fall 2013, six (6) test ranges for UAVs in the national airspace system, based on the following principles:

"(A) Safely designate airspace for integrated manned and unmanned flight operations in the national airspace system;
"(B) Develop certification standards and air traffic requirements for unmanned flight operations at test ranges;
"(C) Coordinate with and leverage the resources of the National Aeronautics and Space Administration and the Department of Defense;
"(D) Address both civil and public unmanned aircraft systems;
"(E) Ensure that the program is coordinated with the Next Generation Air Transportation System; and
"(F) Provide for verification of the safety of unmanned aircraft systems and related navigation procedures before integration into the national airspace system." FMRA § 332(c)(2).

In addition to the above requirements, this test range airspace must be selected based on:

(A) Geographic and climatic diversity;

(B) The location of ground infrastructure and research needs.

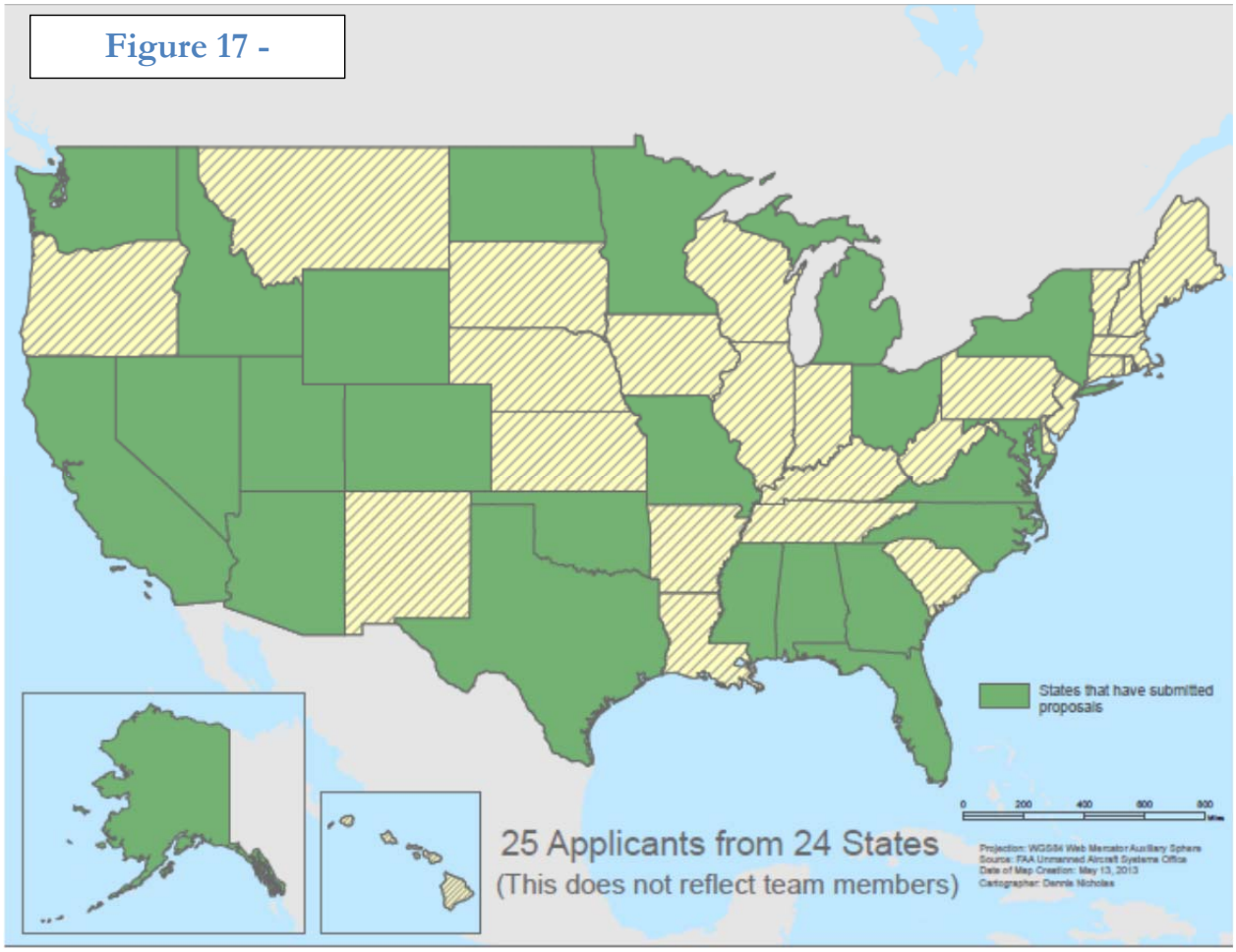
On February 22, 2013, the FAA announced the process for selecting FMRA required six UAV test sites. "Unmanned Aircraft System Test Site Program 78 Fed. Reg. 12259.

The locations for the six UAV test ranges will be diverse, so the data collected can give an accurate picture of what functional, technical, airspace, and operational issues must be addressed when airspace is finally established. The FAA is looking to the six test range sites to supply opportunities to test UAV including as to:

(1) Take-off and landing capabilities
(2) High speed flight
(3) Maritime (launch/maneuverability/recovery) capabilities
(4) Operations at extremely high altitudes, and
(5) Evaluation of dissimilar aircraft at multiple altitudes;
(6) Each site would not necessarily need to be identical, nor

Other considerations include evaluating UAV operations in mountainous terrain, hot weather locations, locations near busy airports, and other circumstances that will test the dependability of the UAV's onboard systems, and specific operator's needs. The map below shows the 24 states where applications have been submitted

for being one of the 6 selected UAV test range sites:



FMRA, FAA and Privacy

In addition to selecting these six test ranges based on the specific FRMA requirements, FAA stated that privacy requirements will be applicable to operations at the selected test sites.

FAA's effort to impose UAV restrictions to protect privacy will no doubt face challenge. It is axiomatic that agencies have no inherent authority, but rather only the authority that is delegated to them. *See Louisiana Pub. Serv. Comm'n v. FCC*, 476 U.S. 355, 374 (1986). In what seems to be a stunning oversight, Congress did not expressly provide FAA authority to regulate privacy. Congress did, however, direct

FAA to "define the acceptable standards for operation and certification of civil unmanned aircraft systems. FMRA section 332. This language may create sufficient ambiguity that FAA can interpret its own jurisdiction to decide it has the authority to regulate UAVs for privacy considerations and gain deference regarding its interpretation. *See City of Arlington v. FCC* 569 U. S. ____ (May 20, 2013). Or a court could hold there is no ambiguity and hence no need for interpretation, leaving with FAA no authority to impose privacy rules on UAVs. This issue is important because privacy is a number one issue that must be resolved for public acceptance of UAV technology.

There are guideposts that inform the discussion about the scope of UAV privacy rules. Thus, in *California v. Ciraolo* 476 U.S. 207 (1986) the Supreme Court decided that viewing otherwise concealed and fenced in marijuana plants from navigable airspace is not an unreasonable search under the Fourth Amendment. At the other end of the spectrum is *Kyllo v. United States*, 533 U.S. 27 (2001), holding (in a 5-4 decision) that thermal imaging inside a house is an unreasonable search because inside their homes, people have a reasonable expectation of privacy. The Supreme Court has also held that the First Amendment does not authorize ridiculous access to news. Specifically, in *Zemel v. Rusk*, 381 U.S. 1, 16-17 (1965) the Supreme Court explained:

> "There are few restrictions on action which could not be clothed by ingenious argument in the garb of decreased data flow. For example, the prohibition of unauthorized entry into the White House diminishes the citizen's opportunities to gather information he might find relevant to his opinion of the way the country is being run, but that does not make entry into the White House a First Amendment right."

UAVs, however, are a very different animal than what American citizens are accustomed to. In the United States, no one reasonably contemplates being followed around by a surreptitious drone. UAV imagery resolution is remarkable, and the

amount of data collected on one mission can be significant. The fear is that government will spy on its own citizens, eviscerating laws about searches and seizures and a citizen's right to be left alone. Clearly, not everyone wants to be televised or on YouTube when they venture outside or, worse while they are inside; and not every human activity seeks a public announcement.

One solution under consideration is to establish limits on the scope of camera / microphone infiltration beyond a defined "fence". Where FAA fails, land use laws could establish these "fences." Theoretically, "fences" allow the operator to fly the UAV in a defined route with specific camera, microphone and other parameters, and if it strays outside of these parameters, an automated program kills the power and the UAV lands. Another is to require UAV owners and operators to enter into agreement with the federal government with specified consequences for breach. The efficacy of such programs is obviously untested, but it is easy to imagine deficits.

In any case, protections to balance UAV use with the protection of privacy establish a legal challenge that will consume the time and energies of legal and policy experts for years to come. Once the FAA selects the six UAV test range sites, privacy protections of some scale will be in place and certainly by the 2015 UAV integration date, a UAV privacy program of some sort will likely be adopted. But whether the FAA restrictions will be adequate or even lawful will be the stuff of legal dramas for years to come.

State Laws

The usual assortment of statutory and common law will apply to UAVs. This includes the constitutional guarantee against unreasonable searches and seizures; the law of trespass, nuisance, stalking, harassment and wiretapping. Under the federal wiretap statute, it is unlawful to intentionally intercept an "oral communication" by a person "exhibiting an expectation that such communication is not subject to

interception under circumstances justifying such expectation * * *." 18 U.S.C. §2511(1)(a); 18 U.S.C. §2510(2). The difficulty is it is as yet unknown how far the law goes to protect an individual's expectation of privacy. Legal protection of privacy is shaped by community notions of what an individual reasonably expects in the world in which he lives. Our world and individual expectations regarding privacy in it have evolved and will continue to evolve with technology. How the issue ultimately shakes out, no one knows. UAVs pose unique issues because they can be difficult to detect and are capable of being particularly invasive. They are the Paparazzi dream. According to the CRS White Paper at p 29:

> "currently commercial microphones can record sounds upwards of 300 feet. Use of such a microphone on a drone to record private conversations could implicate the federal wiretap statute."

As more police departments acquire UAVs to assist with law enforcement, more than 40 states are considering legislation to regulate use of domestic UAVs. However, so far, no land use regulations have been adopted regarding UAVs and the most common theme of the state legislation that has been adopted to date, requires that no UAV be launched for surveillance without a warrant, often with exceptions for an "emergency." These laws obviously offer little comfort in private contexts where there are no governmental actors. However, a new Texas law makes it a misdemeanor to use a drone to capture an image without the consent of the owner. H.B. 912, Texas Legislature, 83rd Session, *available at* http://www.capitol.state.tx.us/BillLookup/History.aspx?LegSess=83R&Bill=HB912.

An example of a state law affecting law enforcement UAV operations is Oregon House Bill 2710, passed summer 2013, and summarized as follows:

(1) Provides drone may be used by law enforcement agency for purpose of surveillance of person only with a warrant or in "emergency circumstances."

(2) Provides that law enforcement agency may use drone to intercept communications only as provided under laws relating to wiretaps and other interceptions of communications.
(3) Requires destruction of images and other information acquired by use of drone within 30 days unless information is needed as evidence in criminal prosecution.
(4) Requires public bodies using drones adopt policies on use of drones.
(5) Requires procedure for notifying the public of public bodies' policies on use of drones.
(6) Prohibits use of weaponized drones by public bodies.

This legislation leaves many unanswered questions and, of course because it is focused on law enforcement, does not address private surveillance where warrants are not required in the first place. States that have worked to address UAVs are listed below:

State	Status	Notes
Alabama	Passed Senate committee	
Alaska	Resolution adopted creating drone task force; legislature adjourned without taking up other proposed legislation	Task force is to recommend drone policies and legislation
Arizona	Passed House	Only protects U.S. citizens & includes carve-outs for drug crimes & human smuggling.
Arkansas	Legislature adjourned without taking up proposed legislation	
California	Introduced	
Florida	Legislation enacted, goes into effect July 1, 2013.	
Georgia	Legislature adjourned without taking up proposed legislation	Resolutions honoring the aerospace/drones industry also passed in both houses.
Hawaii	Introduced	
Idaho	Legislation enacted, goes into effect July 1, 2013	
Illinois	Passed in House & Senate, on governor's desk	

Indiana	"Study group" resolution passed Senate committee; bill introduced	
Iowa	Introduced	
Kansas	Introduced	
Kentucky	Introduced	
Maine	Passed both chambers, on governor's desk	
Maryland	Introduced	
Massachusetts	Introduced	
Michigan	Introduced	
Minnesota	Introduced	
Missouri	Passed House	
Montana	Legislation enacted, goes into effect Oct. 1, 2013	
Nebraska	Introduced	
Nevada	Introduced	
New Hampshire	Dead for this year	Passed House committee; tabled in House.
New Jersey	Introduced	

New Mexico	Died in committee	
New York	Introduced	
North Carolina	Introduced	
North Dakota	Dead for this year	Passed House, defeated in Senate.
Ohio	Introduced	
Oklahoma	Dead for this year	Bill held over until next session, replaced with call for interim study on drone privacy issues.
Oregon	Passed both chambers, on governor's desk	
Pennsylvania	Introduced	
Rhode Island	Introduced	
South Carolina	Passed House Committee	
Tennessee	Legislation enacted, goes into effect July 1	
Texas	Legislation enacted, goes into effect Sept. 1	
Vermont	Introduced	
Virginia	Legislation enacted, goes into effect July 1, 2013.	

Washington	Not brought up for full House vote before deadline, so dead for this session.	
West Virginia	Introduced	
Wyoming	Died in committee	

Land Use Regulation

States and their subdivisions that have attempted to impose restrictions on general aviation safety, airspace, or aviation noise at public airports have often found such laws to be preempted by federal aviation law. Accordingly, in *City of Burbank v. Lockheed Air Terminal, Inc.*, 411 U.S. 624 (1988), the Supreme Court determined a city ordinance prohibiting aircraft takeoff and landing during particular hours at a public airport was preempted by the federal regulatory scheme governing public airports. The Supreme Court explained that if such local laws were allowed to stand, that they would "severely limit the flexibility of the FAA in controlling air traffic flow."

However, carefully considered local land use restrictions on UAVs are likely to fare better. For starters, federal UAV regulation is different in kind because UAVs do not require a network in which to function (in the main UAVs are designed to fly *outside* of any network) and do not require specialized takeoff and landing facilities. Local restrictions are less likely to interfere with the federal interest in controlling air traffic flow because UAVs are a wholly different kind of air traffic.

Also, importantly, FMRA does not contain a specific preemption clause applicable to UAVs. To the contrary, FMRA specifically introduces the concept of "community-based organization" regulation of certain UAVs and "a community-based set of safety guidelines and within the programming of a nationwide community based organization". This is a strong signal that Congress anticipates community values will inform the regulation of UAVs.

Finally, local governments have recognized land use authority to restrict areas zoned for public or private airports, or where private hangers may be maintained, runways and the like or indeed the use of aircraft on private property. UAVs are likely to be dominated by private interests, and launched by private commercial entities from commercial facilities for commercial purposes. In this respect, UAV land use regulation is very much like any other type of land use regulation governing the "time place and manner" (to borrow an ironically relevant First Amendment phrase) of commercial operations.

Summary

In a short time, civil UAVs will have a ubiquitous, legitimate place in U.S. airspace. UAV airspace rights and designations will implicate commercial rights of UAV operators, private property rights, and citizens' privacy and safety values. All levels of government will be working to strike the right balance between UAV deployment and these rights and values. Attorneys will have a leading role to play to protect the UAV industry (both public and private), protect clients affected by the UAV industry and to guide governmental entities in appropriate regulatory programs. In all cases, an understanding of traditional legal concepts is not enough. Attorneys must also possess an understanding of basic aviation law to successfully represent clients in these controversies.