DRONE SIGHTINGS ANALYSIS AND RECOMMENDATIONS

UNMANNED AIRCRAFT SAFETY TEAM DRONE SIGHTINGS WORKING GROUP
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EXECUTIVE SUMMARY

The Unmanned Aircraft Safety Team (UAST) is charged with acquiring and analyzing data in order to identify and advance safety improvements for both manned and unmanned aircraft operations. As part of that effort, a multi-stakeholder working group was formed to review and analyze the FAA's UAS sightings reports and the current system for reporting sightings of unmanned aircraft. These reports and associated information have been periodically released by the FAA to the general public, at times heightening general concerns about the risk unmanned aircraft pose to manned aviation. The working group undertook to review and better qualify and quantify informative data for 3,417 reports spanning August 2015 through March 2017.

Initial review of the data showed widespread variance on a number of critical parameters. The working group undertook to at least partially mitigate these shortcomings through a consensus-based data analysis methodology that sought to provide reliable and potentially actionable insights. This methodology is more fully described below, but was designed to use a variety of parameters that may enhance the veracity and informative nature of the reports. Data points—such as whether the report was filed by a pilot and whether evasive action was taken—were questions the working group felt improved the quality of the overall analysis. Data that could potentially be excised was included in order to assure an informative sample size. Examples of this include sightings where there was no violation of regulations or the sighting was of an object other than a drone, such as a bird or balloon.

While we believe the working group's methodology helped provide valuable insights, ultimately the data set is too inconsistent and unstandardized to extract concrete conclusions. The current structure, inconsistency and unrefined nature of the sightings reports disproportionately exacerbate concerns about manned-unmanned interactions and do not provide industry or government with actionable data on which to base safety enhancements and regulatory or operational decision-making. As noted in our findings, some valuable data can be extracted, but we believe a concerted effort to define the scope can significantly improve the quality of sightings, and that enhanced and continuing education in both the manned and unmanned community will provide a measurable improvement for all aircraft operating in the National Airspace System (NAS).

REVIEW METHODOLOGY

At the outset, the working group selected specific criteria to elicit more informative data points from the sightings reports. The group agreed to apply the following six criteria to all 3,417 sightings:

1. Was the sighting by a pilot?
2. What was the drone altitude (in feet)?
3. How far away was the drone from the manned aircraft (in feet)?
4. Did the pilot describe the sighting as a near miss?
5. Did the pilot take evasive action?
6. Was the sighting near an airport during takeoff or landing?

For each sighting, the methodology in Table 1 was followed to answer each of these questions. Emphasis was placed on ensuring that all entries contained consistent data, if available. For example, all drone altitudes were converted, if possible, to feet. Consistency in the data was necessary to draw any informative analysis. The information obtained from each sighting was included in a revised Excel spreadsheet which lists all 3,417 sightings using the above criteria. That spreadsheet is included as an attachment to this report.

Table 1. Methodology for Revised UAS Sightings Report Data.

Sighting by Pilot	Goal:	Determine if the sighting was by a pilot.
	Format:	YES or NO
Drone Altitude	Goal:	Determine the altitude of the UAS in feet.
	Format:	Numeric with no special characters or UNK.
	Methodology:	Some data required deduction or judgment calls. Data was not normalized and inconsistent (e.g. MSL vs AGL). No assumptions were made; if the report stated, “drone passed beneath aircraft,” listed as UNK (unknown).
Proximity to Manned Aircraft	Goal:	Determine how close the UAS was to the manned aircraft in feet.
	Format:	Numeric with no special characters or UNK.
	Methodology:	The team tried to be as scientific as possible, including using Pythagorean Theorem to determine proximity. No assumptions were made, if the report stated, “OFF RIGHT SIDE 500 BELOW

		ACFT" listed as UNK (unknown) since there is no data to confirm how far off the right side.
Near Midair Collision (NMAC)	Goal:	Did the pilot specifically refer to the sighting as a NMAC or express concerns about UAS being too close?
	Format:	YES or NO
	Methodology:	Accepted similar terms such as "POSSIBLE NEAR MISS," "UNSAFE PROXIMITY," or "FAIRLY CLOSE."
Sighting Occurring During Takeoff or Landing	Goal:	Did the sighting occur during takeoff, landing, or within five miles of destination airport?
	Format:	YES or NO
	Methodology:	Sighting described as a takeoff or landing included phrases such as, "ON FINAL," "CLIMBING OUT OF RWY 25," or "WAS IN OMN'S PATTERN." Also includes sightings described as occurring near destination airport.
Whether Evasive Action Taken	Goal:	Did the pilot have to maneuver or change course?
	Format:	YES or NO
	Methodology:	Some data required deduction or judgment calls. While some pilots stated "NO EVASIVE ACTION" was required, the team still included reports that required a pilot to "delay departure" or "slow down rate of climb."

FINDINGS & RECOMMENDATIONS

Findings. After applying the above methodology and reviewing all 3,417 attached sightings, the working group derived valuable insights and high-level observations. First, perhaps most significant, a relatively small percentage of analyzed sightings were categorized as being of risk. There is general consensus that some of the sightings are potentially high risk and need to be mitigated, but the majority of sightings are not necessarily high risk. This finding is consistent with two other studies conducted on the UAS sightings reports.[1] Several specific findings from the working group include:

- 16.01% of the UAS sightings were described as being less than 500' away from the aircraft.
- 3.29% of the above sightings resulted in the manned aircraft changing flight or course.
- 70.41% of the sightings indicated the drone was over 400' AGL.
- 68% of the sightings could not determine proximity to manned aircraft.

Second, the data is too inconsistent and not standardized to make concrete conclusions. The data makes clear that each sighting or event did not pose the same level of risk to the NAS. In fact, a sighting may even represent completely legal, FAA-authorized operations. A sighting may also be benign, represent a possible FAR violation, or reflect an actual risk occurrence to the NAS. However, making a determinative conclusion on the level of risk for each event is difficult for a large majority of the sightings because the data contains a notable amount of inconsistencies and unknowns. These underlying observations formed the basis for recommendations below to improve the quality of data reported and education of the aviation community in this area.

Finally, the underlying data provided in the UAS sightings reports must be considered within its appropriate context. While it's important to ensure serious consideration and a thorough review of every report, the derived data from the reports come from eyewitness reports and only represent what he or she saw or experienced. The FAA made note of these subjective challenges in the context of reporting a NMAC:

- "A report does not necessarily involve the violation of regulations or error by the air traffic control system, nor does it necessarily represent an unsafe condition."

- "The fact that pilots and/or crew members initiate NMAC reports raises two important issues for the user of this information. First, to some degree the data likely will be subjective. This necessitates that considerable caution be exercised when evaluating individual NMAC reports."

[1] Academy of Model Aeronautics, *An Analysis of the FAA's March 2016 UAS Sightings* (2016); Arthur Holland Michel & Dan Gettinger, *Drone Sightings and Close Encounters: An Analysis*, Center for the Study of the Drone at Bard College (2015).

- "[A]t higher altitudes, in the absence of visual reference points, even the most highly trained and experienced pilots may experience difficulty when reporting such critical information as missed distance, particularly when the NMAC encounter may have lasted only a fraction of a second."[2]

Recommendations. After reviewing the currently available data and based on its findings, the working group developed consensus recommendations meant to improve the quality and integrity of sightings data so that future safety and policy enhancements can be drawn from high level-of-confidence analytical conclusions. The working group also developed recommendations meant to reduce the likelihood of serious incidents:

1. We need better datasets in the future to prepare more meaningful recommendations on safety enhancements. We ask the UAST to create a working group to review the sightings and make recommendations on standardizing and improving the quality of the reports. This effort should include reviewing and preparing recommendations to modify, where necessary, the FAA protocols for reporting these types of events. Improvements could include:

    a. Defining what data and information should be included in all future reports (e.g., altitude, proximity of UAS to aircraft, location to airport).
    b. Defining the thresholds to submit a report. Certain events reported were simply sightings of an authorized UAS operation and/or not necessarily a risk or violation of regulations.
    c. Defining consistent standards (e.g. MSL vs. AGL).
    d. Determining the criteria necessary to classify events into different risk categories, as opposed to creating a perception that each sighting represents a dangerous occurrence.

2. We believe the advancement of remote identification and a UAS traffic management (UTM) system will improve airspace integration of UAS and manned aviation by providing more accurate and critical data on these kinds of potential risks.

3. We recommend manned aircraft pilots continue to receive education about UAS to improve the quality of reports provided to the FAA. Future sightings need more definitive information to avoid reports such as: "THE PILOT WAS NOT FAMILIAR WITH WHAT DRONES LOOK LIKE." This will become more important as the number of UAS operations continue to grow. Recommendations regarding the type and scope of this education should be the subject of review by the work group described in the first recommendation.

[2] Federal Aviation Admin., FAA Aviation Safety Information Analysis and Sharing (ASIAS): FAA Near Midair Collision System (NMACS), http://www.asias.faa.gov/pls/apex/f?p=100:35:0::NO::P35_REGION_VAR:1.

4. We recommend the UAST continue to educate the unmanned community to reduce potential high-risk operations. Examples of how this kind of education could be implemented include:

a. Consider leveraging existing tools such as FAA registration email rosters with monthly informational pushes.
b. Build upon or support other industry efforts such as Know Before You Fly and the FAA Safety Team's WINGS program.
c. Examine manufacturing efforts as possible solutions to improve education.