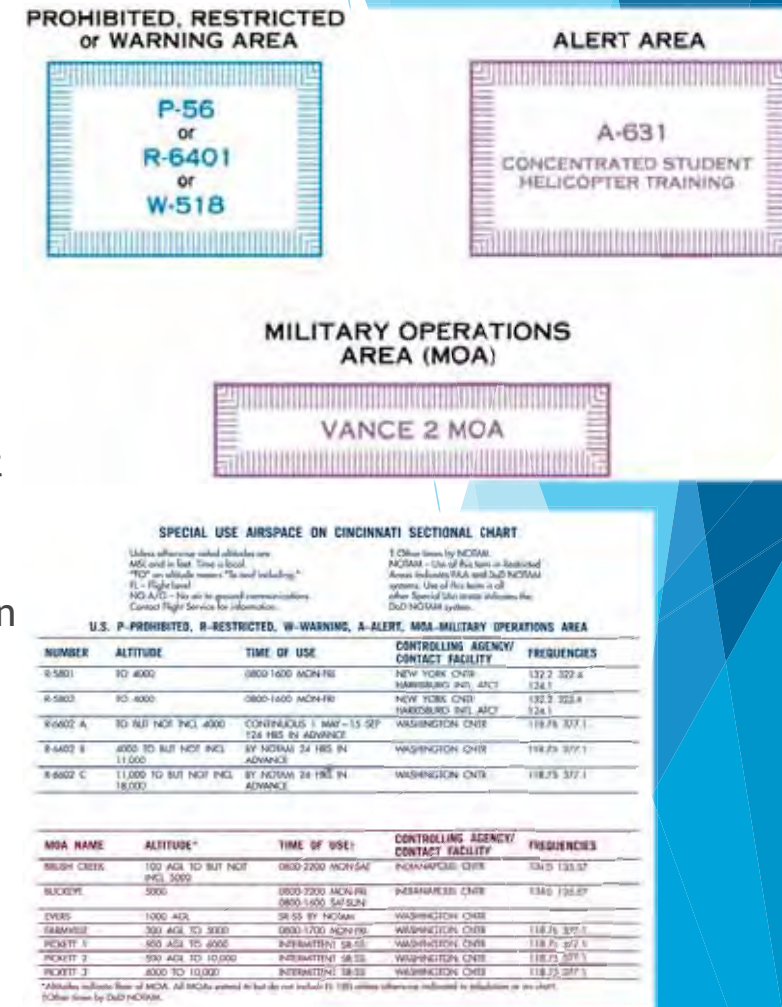


Special Use Airspace (SUA)

- ▶ There are 5 types of special airspace.
- ▶ All types of SUA are marked on charts and may be changed via NOTAM. Information about these areas can be found in tables on the chart.
- ▶ Prohibited Areas - Areas that aircraft are not permitted in at any time.
 - ▶ National security or invisible dangers such as artillery ranges.
 - ▶ Violating a prohibited area may end with a military escort.
- ▶ Restricted Areas - Like prohibited areas, but they are only “on” at certain times.
- ▶ Military Operation Areas (MOA) - Locations where high levels of military training is authorized. Vigilance is required when flying in MOAs, but civil aircraft have right of way.
 - ▶ UAS operators should check in with the controlling agency.
- ▶ Alert Areas - Locations where high levels of training or other unusual aviation activities are held.
- ▶ Warning Area - Areas that extend outward from 3 NM from the U.S. coast where hazards to aircraft may exist.



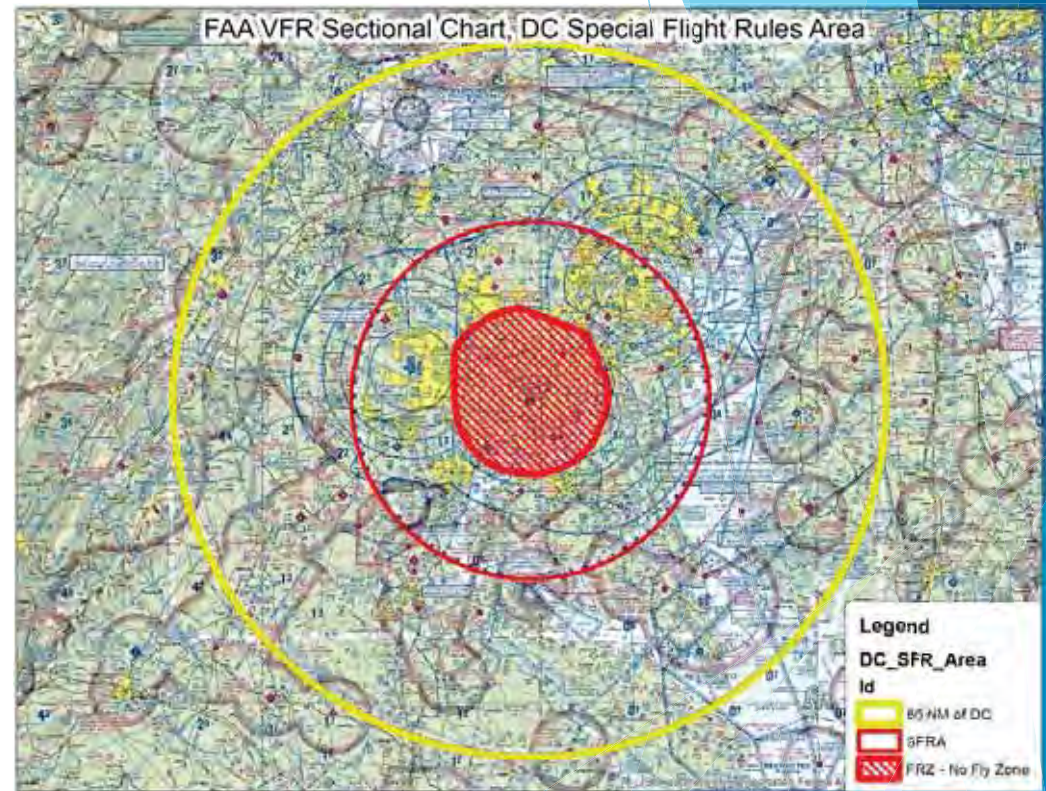
Temporary Flight Restrictions

- ▶ TFRs are restricted or “no-fly zones” that are announced by NOTAMS.
- ▶ TFRs are placed around sports events, concerts, fires, volcanic eruptions, local/state/national emergencies, and VIPs such as the President.
- ▶ TFRs can pop up with little or no warning, so if possible keep checking for them throughout the day.
- ▶ You can fly in a TFR but you must have permission.
 - ▶ Some only require permission from local ATC, some require permission from higher authority.
 - ▶ To operate a UAV around fires, spills, or other disasters you will need written permission from the onsite authority, both FAA and issuing agency, and a special waiver or COA from the FAA.



Washington DC

- ▶ There is a permanent TFR surrounding Washington DC.
- ▶ These rule may change by NOTAM
- ▶ These are on VFR sectional charts.
- ▶ DC Flight Restricted Zone (FRZ)
 - ▶ Inner red zone.
 - ▶ No UAS operations, period. Not even hobbyists.
- ▶ DC Special Flight Rules Area (SFRA)
 - ▶ Outer red zone.
 - ▶ Circle with a 39 NM radius from the DCA VOR/DME
 - ▶ Must have an exemption (333, I guess this has not been updated for Part 107)
 - ▶ Must notify the FAA 1 hour before flight.
 - ▶ 1-866-598-9522
- ▶ 60 NM from DCA VOR/DME
 - ▶ Before Part 107 you needed to take an online course to fly here.
 - ▶ Still a good idea to take the course (its free) at www.faa.gov



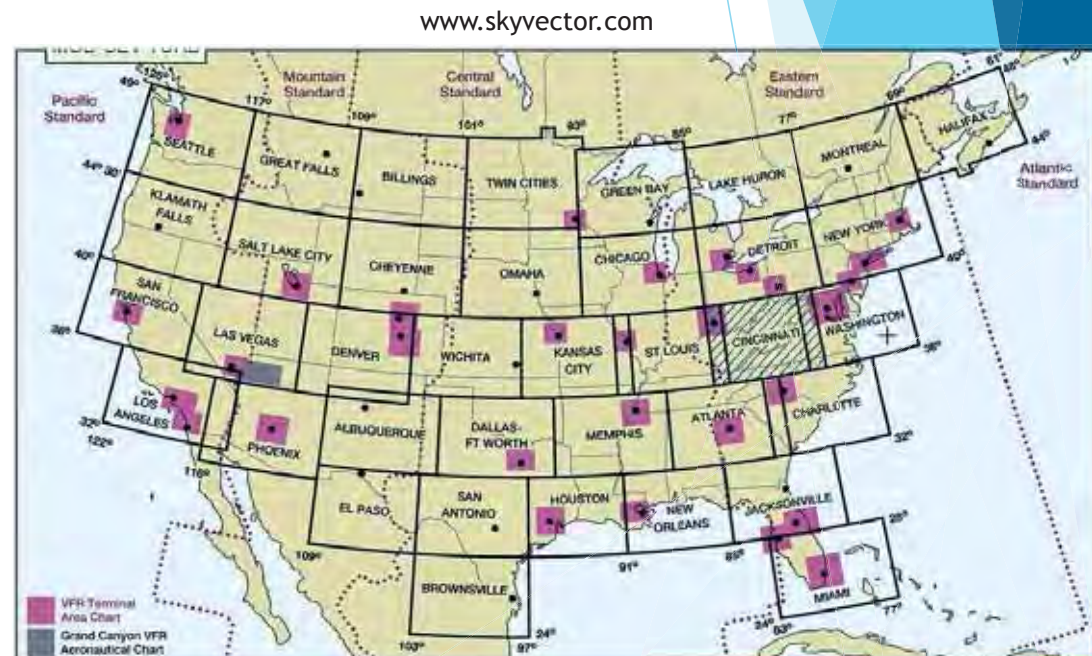
Military Training Routes

- ▶ Military Training Routes (MTR) are corridors where military aircraft can fly faster than 250 kts. when below 10,000 ft.
- ▶ Many MTRs allow for military flight as low as 100 ft. AGL. This means UAS can be a serious hazard.
- ▶ MTRs are marked on VFR sectional charts with a grey line and extent 5 statute miles to either side of the line.
- ▶ MTR names are 2 letters follow by 2 - 3 numbers.
 - ▶ VR = Visual and IR = Instrument
 - ▶ 4 digit IDs = has no segment above 1,500 ft. AGL.
 - ▶ 3 digit IDs = one or more segments above 1,500 ft. AGL.
- ▶ You should contact the controlling agency of the MTR to inform them of your UAS ops.
 - ▶ AP/1B - List of all MTRs with contact information. There is a PDF copy in your digital handout package.
 - ▶ Don't be surprised when the person you contact has no idea what you are talking about. Just do your best to get the information to the right person.



VFR Sectional Charts

- ▶ There are many different types of aeronautical chart, but the main one we will use is the FAA VFR Sectional.
- ▶ These charts are only current (i.e. legally usable) for 6 month. After that you need to replace it, or pen-in every single change made.
- ▶ There are a number of good sources for the charts.
 - ▶ Hard Copy - Any online pilot store such as MyPilotStore or Jeppesen.
 - ▶ www.skyvector.com - Great online sources.
 - ▶ ArcGIS Server - <http://maps7.arcgisonline.com/arcgis/services>
 - ▶ Great for making planning maps, or for FAA waivers.
 - ▶ Be warned that you cannot verify the currency of these charts.
 - ▶ Also, these are not projected correctly, so do not use them for navigation.



Notice to Airmen

- ▶ Notice to Airmen (NOTAM) - How the FAA delivers important information that is not listed on charts, the FAR, or other official source of information.
- ▶ These notices include, but are not limited too:
 - ▶ Hazards such as airshows, laser operation, and weather balloon launches.
 - ▶ TFRs for fires, or VIPs.
 - ▶ Military operations.
 - ▶ Airport closures.
 - ▶ Large flocks of migrating birds.
- ▶ Always check for NOTAMS before each flight operation. If you can do so in the field, check for updates between flights.
- ▶ Sources of NOTAM
 - ▶ DUATS - <https://www.duats.com/> - This is the best source since it leave a paper trail.
 - ▶ <https://pilotweb.nas.faa.gov/PilotWeb/>
 - ▶ Some are displayed on SkyVector, but don't rely on this.

What does a NOTAM Look Like?

Runway NOTAMs

Blacksburg VA [BCB]: January NOTAM #26

Runway 12 approach lighting system OUT of SERVICE January 23rd, 2017 at 11:52 AM EDT (1701231552) - July 23rd, 2018 at 05:00 PM EDT (1807232100)

Aerodrome NOTAMs

Pulaski [PSK VOR]: April NOTAM #10

Aerodrome airport aerodrome beacon OUT of SERVICE April 17th, 2017 at 08:20 AM EDT (1704171220) - April 27th, 2017 at 11:00 AM EDT (1704271500)

Obstruction NOTAMs

Atlanta Center (Hampton GA) [ZTL]: April NOTAM #184 issued by Macon [MCN VOR]

Obstruction POWER lines {within, Wisconsin} AN area DEFINED as .25NM EITHER side of a line {from, fan marker} 32 nautical miles on the 111° radial of Rocket [RQZ VOR] to 32 nautical miles on the 112° radial of Rocket [RQZ VOR] .8 UNKNOWN (289FT above ground level) not lighted April 05th, 2017 at 09:11 AM EDT (1704051311) - May 05th, 2017 at 09:11 AM EDT (1705051311)

Drone Notice to Airmen

- ▶ These are NOTAMS just for UAS operations - DROTAM
- ▶ You are not required to file these, but it is a REALLY good idea to do so.
- ▶ These now are optionally displayed on SkyVector.
- ▶ How to file a DROTAM
 - ▶ You will need an account with <https://www.1800wxbrief.com>.
 - ▶ You will also need to use www.skyvector.com.
 - ▶ First use SkyVector to plot a “course” from the closest NAVAID (VOR).
 - ▶ Then Enter that information to 1-800-WX-Brief’s DROTAM form under UAS and UAS Planning.



Weather Forecasts and Briefings

- ▶ Official sources - Even if you are relying on something like www.weather.com, you also need to get a weather briefing from an official source.
- ▶ Official Sources
 - ▶ <https://www.aviationweather.gov/> - Is the definitive source of aviation weather.
 - ▶ Flight Services - <https://www.1800wxbrief.com> - This is the best source, but there are some drawbacks.
 - ▶ Give you LOTS of info. Sometime it can be data overload.
 - ▶ You can save it to keep as proof that you did your due diligence with weather and NOTAMS.
 - ▶ Local Automated Weather Reporting Stations (AWOS) - At many airports.
 - ▶ Calling - Find this information for each airport here: <https://www.airnav.com/airports/> or in the Airport Directory. Blacksburg is - 540-231-4837
 - ▶ Aviation Radio - Find this information on your VFR sectional chart. Blacksburg is - 133.325.
- ▶ Unofficial sources - I use Weather Underground and AccuWeather mostly.
 - ▶ These often use weather stations closer to where you will be working.
 - ▶ Often missing important information, such as ceiling and wings aloft.

Weather Reporting - METAR

- ▶ METAR = Meteorological Terminal Aviation Routine Weather Report.
- ▶ METAR's are the basic weather report used for pre-flight weather briefings.
- ▶ They use their own abbreviated language to reduce the amount of data to be transmitted.
- ▶ Officially, you should be using non-translated METARs.

BKN	Broken
CLR	Clear at or below 12,000 feet (AWOS/ASOS report)
COR	Correction to the observation
DSNT	Weather phenomena beyond 10sm of the observation point
FEW	1 or 2 octas (eighths) cloud coverage
FM	From (4 digit beginning time in hours and minutes)
LDG	Landing
M	In temperature field means "minus" or below zero
M	In RVR listing indicates visibility less than lowest reportable sensor value (e.g. M600)

Weather Reporting - METAR

▶ Example METAR:

- ▶ METAR: KBCB 211755Z AUTO 26006KT 200V300 10SM {} SCT 045 BKN050 BKN 060 25/15 A3000 RMK AO2 TO2510145 10252 20177
- ▶ This indicates it is a routine hourly report, SPECI would indicate a special report.
- ▶ The airport which is making the report. K = U.S. airport.
- ▶ Time and date in Z. In this case it means the report was made on the 21st of the month at 1755Z (5:55 pm UTC).
- ▶ Indicates this is an automated report. COR would indicate it has been corrected by a human.
- ▶ This indicates wind direction and speed. Winds are from 260° at 6 kts, but variable from 200° to 300°.
- ▶ Visibility range in statute miles.
- ▶ Present weather would go here, i.e. smoke, fog, showers, snow, etc.
- ▶ Cloud layers. A Ceiling is a cloud layer that covers more than 5/8 of the sky (BKN).
 - ▶ Scattered at 4,500ft, broken at 5,000 ft., and broken at 6,000 ft. AGL.
- ▶ Temperature/dew point in Celsius. When the temperature reaches the dew point condensation will form.
- ▶ Special remarks such as thunderstorm start/stop times.
 - ▶ In this case it is talking about maximum temperatures.

Weather Reporting - Terminal Area Forecasts

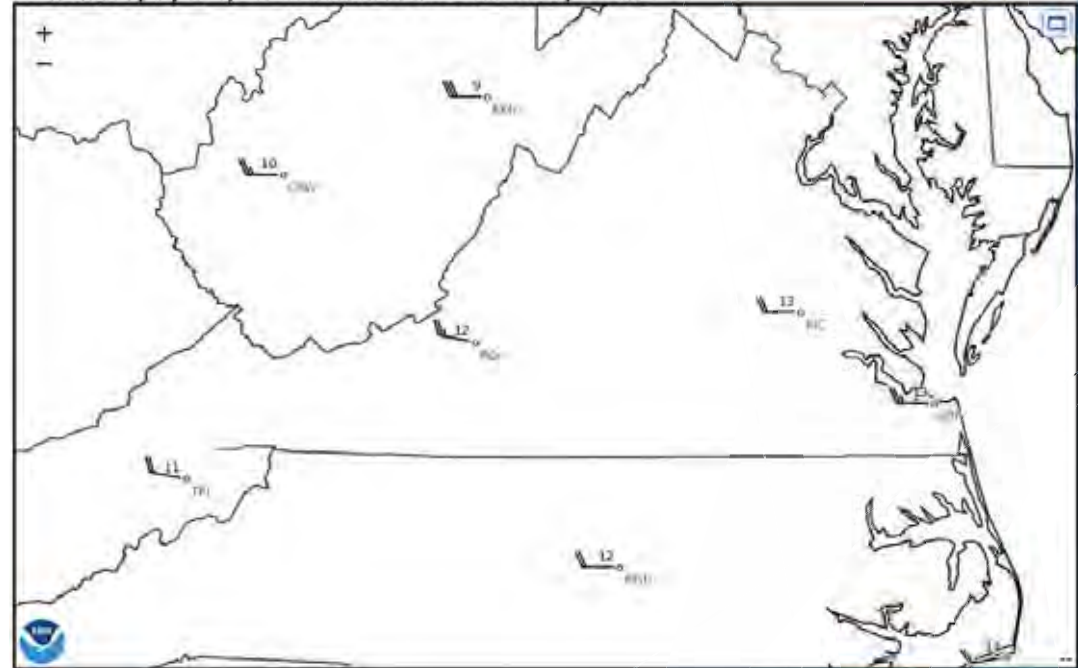
- ▶ Terminal Area Forecast - TAF
- ▶ Sometime called terminal aerodrome forecasts.
- ▶ TAFs are the FAA's official forecast for aviation activities for U.S. Airports.
- ▶ Use the same formatting as METARs, but are often translated to something understandable.
- ▶ When in the field you will rarely be near an TFR reporting airport.
- ▶ Best to find 2 or 3 airports around your AO and use them to estimate the forecast for your location.

Blacksburg VA [KBCB] terminal forecast issued on the 21st at 1:30pm EDT (1730Z), valid from the 21st at 2pm EDT (18Z) through the 22nd at 2pm EDT (18Z)	
2pm EDT (18Z)	wind 270° at 9 knots, visibility greater than 6 miles, thunderstorms in the vicinity, broken cumulonimbus at 5,000 feet
4:00pm EDT (2000Z)	wind 280° at 8 knots, visibility 5 miles, thunderstorms with light rain, broken cumulonimbus at 4,000 feet
6:00pm EDT (2200Z)	wind 290° at 7 knots, visibility 3 miles, rain showers, thunderstorms in the vicinity, broken cumulonimbus at 3,500 feet
8:00pm EDT (0000Z)	wind 290° at 4 knots, visibility greater than 6 miles, showers in the vicinity, 5,000 feet overcast
10:00pm EDT (0200Z)	wind variable at 3 knots, visibility 4 miles, rain showers, 4,000 feet overcast
5:00am EDT (0900Z)	wind calm, visibility 2 miles, light rain showers, mist, 2,000 feet overcast.

Weather Reporting - Winds

- ▶ Winds are one of the most important pieces of weather information, but also one of the easiest to get wrong!
- ▶ Most weather stations only report wind ground speeds. This can be very deceptive.
- ▶ Wind speeds change at different altitudes.
- ▶ For UAS operations check winds at the ground, 3,000 ft. (lowest reported), and 6,000 ft.
 - ▶ This can give you an idea of how the winds are changing as altitude increases.
 - ▶ Use this to estimate winds aloft at altitudes lower than 3,000.
- ▶ Like TAFs use the closest airports, more than one if you can (hard here is SW VA) to estimate your local conditions.

FB Wind Display at 6,000 feet valid at 1800 UTC 21 Apr 2017



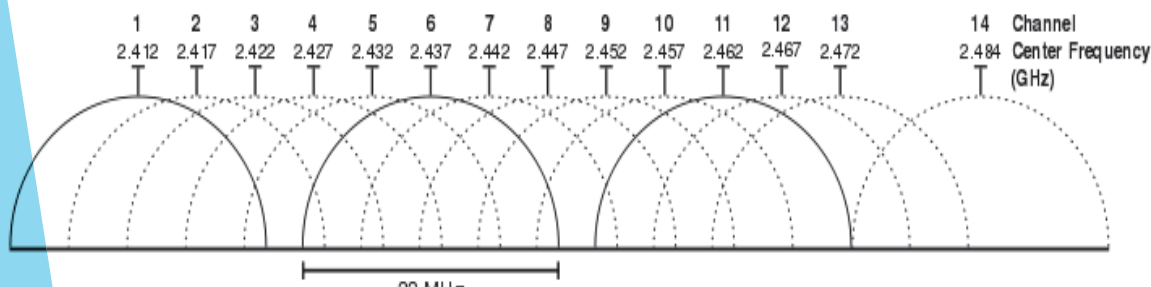
Weather Reporting - Significant Weather

- ▶ Significant Meteorological Information - SIGMET
- ▶ SIGMETs are for phenomena that cover more than 40% of a 3,000 square mile, or large, area.
- ▶ Convective SIGMET -
 - ▶ Thunders storms
 - ▶ Surface wind in excess of 50 kts.
 - ▶ TORNADOS
 - ▶ Hail
- ▶ Non-convective SIGMET -
 - ▶ Dust storms
 - ▶ Volcanic ash
 - ▶ Severe icing
 - ▶ Turbulence



Communications - UAV

- ▶ Most sUAS use 2.4 GHz range .
 - ▶ Unlicensed.
 - ▶ Also used by Wi-Fi, wireless phones, handheld radios, pretty much every other electronic device out there.
 - ▶ Many devices, such as microwaves, emit “noise” on this frequency for non-communication reasons.
 - ▶ Many sUAS controllers/ground stations using signal hopping for grater reliability.
- ▶ Antenna
 - ▶ Omni directional - Dipole (what comes with most sUAS)
 - ▶ Shorter range, but transmit 360°.
 - ▶ “Dead zone” above and bellow. Often overcome buy using two dipole antenna pointed in different directions.
 - ▶ Directional - Panel and yagi.
 - ▶ Focus energy in a single direction giving greater range/signal quality, but must be pointed at the sUAS at all times.
 - ▶ “Dead zone” in most directions. Strongest signal is in front, with a weak signal behind.



Logs and Records

- ▶ It is important to keep records of your UAS flight, UAV maintenance, pilot hours, accidents and other events, and battery usage.
- ▶ Reasons
 - ▶ Record keeping, incase you need to prove what/when/how you were doing something.
 - ▶ For FAA reports.
 - ▶ Tracking of preventive maintenance and troubleshooting.
 - ▶ RPIC experience and training.
 - ▶ Budgeting.
- ▶ Excel sheet, online service, hard-copy logs.
 - ▶ www.dronebook.com - Free and paid plans.



The screenshot displays the 'Drone & sUAS Pilot Logbook' interface. At the top, it says 'Drone & sUAS Pilot Logbook' and 'Drone & sUAS Pilot Logbook'. The main title is 'Flight Log'. Below the title is a table with the following columns: FL#, Flight Date, Location, Airframe, (Pilot/Observer), Camera, LOS/FPV, Battery, Day/Night, FO, and Notes/Logbook Legend. The table has 12 rows, numbered 1 to 12. Each row has a yellow circle in the Day/Night column and a black circle in the FO column. At the bottom of the table, there is a legend: 'FL# Fixed Wing / RW Rotors Wing / SIM Simulator', 'FL Flight Number / Logbook Legend / FO Flight Duration', 'Airframe Airframe Number', 'LOS Line of Sight / FPV First Person View', and 'Day/Night Day/Night'.

FL#	Flight Date	Location	Airframe	(Pilot/Observer)	Camera	LOS/FPV	Battery	Day/Night	FO	Notes/Logbook Legend
1								●	●	
2								●	●	
3								●	●	
4								●	●	
5								●	●	
6								●	●	
7								●	●	
8								●	●	
9								●	●	
10								●	●	
11								●	●	
12								●	●	

Risk Management

- ▶ Everything we do, on some level, is risk management.
 - ▶ Safety checks, scouting, reviewing policy and regulations, etc.
- ▶ Phases of Risk Management.
 - ▶ Hazard identification
 - ▶ Risk assessment
 - ▶ Risk Mitigation
 - ▶ Documentation



Risk Management, Continued

- ▶ How to Identify Hazards.
 - ▶ Flight and maintenance logs.
 - ▶ Event reports.
 - ▶ Safety checks.
 - ▶ Scouting, in the office and field.
- ▶ Contacting MTR's.
- ▶ NOTAMs and DROTAMs.
- ▶ Weather briefings.

- ▶ Risk Assessment.
 - ▶ Create a risk matrix (found in AC 107-2).
 - ▶ How “bad” are the potential consequences.
 - ▶ How likely is the “X”- risk will happen.
 - ▶ Ex. 1 - You know that you rarely have issues with the video link that doesn't pose a threat to people or property.
 - ▶ Warrant's and 2E, acceptable.
 - ▶ Ex. 2 - You last 2 flights your ground sensor did not work.
 - ▶ Warrants a 4C or 4D. Acceptable but only if you don't fly low and are able to land without the sensor.

AC 107-2, FAA

Risk		Risk Severity				
		Catastrophic A	Hazardous B	Major C	Minor D	Negligible E
Frequent	5	5A	5B	5C	5D	5E
Occasional	4	4A	4B	4C	4D	4E
Remote	3	3A	3B	3C	3D	3E
Improbable	2	2A	2B	2C	2D	2E
Extremely Improbable	1	1A	1B	1C	1D	1E

Risk Management - People

Safety starts with you and your crew, so does risk.

- ▶ There are 2 main risks when it comes to people.
- ▶ 1st - You can be your own worst enemy. Your (and your crews) attitude can make all the difference when it comes to safety. Watch out for:
 - ▶ Antiauthority - Acting like the rules don't apply, very easy to justify.
 - ▶ "You don't tell me..."
 - ▶ Impulsivity - Sometimes you need to act quickly, but never act without thought.
 - ▶ "Do something, NOW!"
 - ▶ Invulnerability - Accidents only happen to other people, not me!
 - ▶ "We'll be fine."
 - ▶ Machismo - We work in a challenging field, don't let your confidence outstrip your ability. This can be, "Let's just get it done" to those who seem to have a need to prove their prowess. Anywhere on the macho spectrum can lead to taking foolish risks.
 - ▶ "Hey ya'll, watch this!"
 - ▶ Resignation - Stress can cause you to feel like you have no control over what is happening. This can cause you to become overwhelmed or just to give up.
 - ▶ "There is nothing I can do."
- ▶ Self-honesty is the key here. Take time to reflect on your thoughts and attitudes.
- ▶ If they in anyway are unsafe, don't fly.

Risk Management - People, Continued

- ▶ 2nd - Those you work with.
- ▶ People tend to think of UAS as “just toys”.
- ▶ You may be pressured by supervisors, clients, members of your flight crew, or the public to do something you feel is unsafe.
- ▶ If you feel something is not safe or breaks the rules
 - ▶ Say “no”.
 - ▶ Hold your ground.
 - ▶ As a RPIC only you are responsible, not them.



Risk Management – Risk Mitigation

- ▶ The best tool you have at your disposal is your knowledge and experience.
 - ▶ As RPIC you are the only person who can make the judgment calls necessary to respond to, or preferably avoid, an emergency.
- ▶ Follow the FAA rules and regulations. These are designed with safety in mind.
- ▶ Use your check lists and risk management skills.
- ▶ Know your limits and that of your crew.
- ▶ Know the quarks and limits of your UAV.
- ▶ Know your AO.
 - ▶ Scouting the area in the office and in the field.
 - ▶ Be aware of the airspace, MTRs, areas of low flying aircraft, and locations of people and property.
 - ▶ Find any obstacles in and around your AO. Create your own no-fly zones.
 - ▶ Communicate so everyone knows what is going on and is on the same page.
- ▶ Maintain situational awareness. Beware of any intrusion into your AO, be it ground or air and have a plan in place. Be proactive.
- ▶ Create safety sheets - Locations and contact info of and directions to the nearest hospital, fire department, police depart, and FSDO.

Emergency Procedures

- ▶ There are an infinite number of possible emergency's. Some you can foresee and prepare for, but others will require the RPIC to make a judgment call.
- ▶ Follow the emergency procedure of the UAV manufacture, your organization, or create your own.
- ▶ The most likely emergencies you will encounter are:
 - ▶ Lost Link - Losing the telemetry link to the UAS is probably the most common emergency.
 - ▶ Causes - Flying to far, flying behind obstacles, equipment failure, and electronic interference.
 - ▶ Results - Crash, automated emergency landing or RTL, or flyway.
 - ▶ Mitigation
 - ▶ If the UAS has a lost link RTL setting, us it! Always remember to set a minimum safe altitude.
 - ▶ Plan your flights so that nothing comes between the ground station and the UAV.
 - ▶ Beware of your communications range and don't exceed it.
 - ▶ Use a virtual fence, a set boundary that if crossed will cause the UAS to RTL.

Emergency Procedures, Continued

- ▶ Loss of Navigation or GPS
 - ▶ Cause - Weather, LOS to satellites obscured, poor satellite signal, bad satellite constellation, electronic interface, equipment failure.
 - ▶ Results - Manual flight control, emergency automated landing, crash, or fly-away.
 - ▶ Mitigation -
 - ▶ Don't fly in poor weather.
 - ▶ Be prepared to take manual control.
 - ▶ Radio tracking for UAVs that cannot be controlled manually.
- ▶ Loss of Power
 - ▶ Cause - Bad battery or fuel, low battery or fuel, equipment failure, poor flight planning.
 - ▶ Results - Probably going to crash.
 - ▶ Mitigation
 - ▶ Always check and double check your power system.
 - ▶ Fixed wing - Possible to glide to a landing.
 - ▶ Rotary wing - Get out of the way! Some may auto-rotate to a landing.

Emergency Procedures, Continued, Again

- ▶ Fly Away
 - ▶ Cause - Lost link, equipment failure, “hijacked” communications.
 - ▶ Results - The UAV fly's away our of your control.
 - ▶ Mitigation
 - ▶ Us password protected communications or for automated UAVs tell them to ignore RC commands.
 - ▶ Use a radio tracker so that you may recover the UAV.
 - ▶ If available, use the last known location and orientation on your ground station to estimate a flight path.
 - ▶ Try to follow it on foot or in a vehicle (do drive safely).
 - ▶ Make sure you have your registration number on the UAV, and if possible your contact info should someone find it.

Safety Checks

- ▶ This covers a wide variety of check lists, some may be in the user manual of your UAV and some you will need to make.
- ▶ Using these lists will ensure that you, your crew, and your UAS are safe to fly.
- ▶ You should make check lists that not provided by the UAV manufacture or your organization.
- ▶ At a minimum you should have check list for:
 - ▶ Personnel (This one can be a mental list)
 - ▶ Pre-operation
 - ▶ Pre-flight
 - ▶ Post-flight
 - ▶ Post-operation
 - ▶ Emergency



Safety Checks - Personnel

- ▶ Safety starts with YOU (and your crew)!
- ▶ Self Check
 - ▶ Before you fly ask yourself if you are physically, mentally, and emotionally ready.
- ▶ Do you need a VO and/or RSO?
- ▶ Is your VO, PMC, and/or RSO, physically, mentally, and emotionally ready to fly?
 - ▶ Make sure your VO is ready to work.
- ▶ Who else will be there?
 - ▶ Are other people going to be present?
 - ▶ Are you flying somewhere people are likely to wander over to watch?
 - ▶ How will you deal with these people?
 - ▶ Secure the AO or have someone ready to answer questions and keep them out of the way.

Drones, ducks, and weddings. We do it all!



Safety Checks - Pre-Operation

- ▶ Before you go out into the field make sure you are properly equipped!
- ▶ Know your mission objectives.
- ▶ Know what local and state laws are regarding UAS.
- ▶ Check the weather forecast and NOTAMS.
- ▶ File a DROTAM.
- ▶ Digitally scout out the AO.
 - ▶ Know the airspace.
 - ▶ Identify and mark your AO, targets, obstacles, areas to avoid, alternate landing sites, no-fly zones, and other points of interest.
- ▶ Use Google Earth to get a feel for the AO in 3D.
- ▶ Do a full, power-on, check of your UAV.
- ▶ Charge the batteries, then check to make sure they actually are charged with a voltmeter.
- ▶ Contact any MTRs you are near.
- ▶ Make sure you have permission to fly over people property and notify the local authorities.



Safety Checks - Pre-Flight

- ▶ Preflight checks ensure that the UAS is ready to fly and nothing is forgotten.
- ▶ Most UAVs come with a basic pre-flight check list, found in the manual.
- ▶ Basics of a preflight check are:
 - ▶ Observer local conditions and scout the AO.
 - ▶ Secure the AO.
 - ▶ Check the UAV for damage.
 - ▶ Check that all control surfaces move freely.
 - ▶ Make sure your batteries are fully charged and safe to use.
 - ▶ Secure the props to the UAV.
 - ▶ Make sure your sensor is clean, secured, and ready for use. Don't forget the SD card.
 - ▶ Check your communication equipment and make sure you have extra batteries/a way to charge.
 - ▶ Safety briefing.



researchgate.net

Safety Checks - Post-Flight

- ▶ Post-flight checks are similar to pre-flight checks, with a few tweaks.
- ▶ Basics of a preflight check are:
 - ▶ Check the UAV for damage.
 - ▶ Clean the UAV and remove any debris from wings, motors, gimbals, sensors, etc.
 - ▶ Make sure your batteries are not overheated or overly discharged.
 - ▶ Secure the props to the UAV.
 - ▶ Download the data and check it!
 - ▶ Make sure your sensor is clean, secured, and ready for use. Don't forget the SD card.
 - ▶ Immediately store anything that will not be in continued use.
 - ▶ Fill out any logs.
 - ▶ Review the flight and discuss how to improve your performance a flight crew.



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Safety Checks - Post-Operation

- ▶ Before you leave the field
 - ▶ Take inventory, make sure you didn't leave anything behind.
 - ▶ Clean up your work area.
 - ▶ Properly store you UAV, ground station, and tools.
- ▶ Close any unnecessary, open, DROTAMs.
- ▶ Check the UAV for damage or defect.
- ▶ Repair any minor damage detected.
- ▶ Backup your original data.
- ▶ Process the data.



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Maintenance

- ▶ It is very important that you maintain your UAS to the highest standards possible.
- ▶ Always perform all manufacturer recommended maintenance.
- ▶ After each operation make any minor repairs necessary.
 - ▶ Dents or punctures in wings.
 - ▶ Spin motors to feel for hot motors or sticking/rough movement that may indicate a bad bearing.
 - ▶ Some bearings will need to be lubricated every so often.
- ▶ Keeping a log of all preventative maintenance and repairs is highly recommended.
 - ▶ Good to have records should something happen that gets the FAA involved.
 - ▶ Useful in identifying chronic issues or trends.
- ▶ Every so often check the tightness of screws, bolts, or other fittings.
- ▶ Keep everything clean. Flight ops tend to be dirty and dust/grime can cause issues with moving parts, sensors, and electronics.

Safety - Lithium-Polymer Batteries

- ▶ LIPO batteries are fickle beasts.
- ▶ Don't over charge, undercharge ($\approx 30\%$), or charge too quickly. Don't allow them to get too cold or too hot.
- ▶ Improper use can lead to loss of power, inflation, and FIRE!
 - ▶ Keep fire proof LiPo bags on hand, and not the cheap ones!
 - ▶ Always keep a class ABC fire extinguisher with you.
 - ▶ LiPo fire can only be put out with large amount of sand, dirt, or low pressure CO2.
 - ▶ Use the extinguisher to contain the flames and let the fire burn itself out.
 - ▶ *If a LiPo is breached, fire or no, don't inhale the fumes. Acidic hydrogen fluoride will reek havoc with your lungs and eyes.*
- ▶ DON'T DO THIS - > <https://www.youtube.com/watch?v=ic-4aN1nMWs>
 - ▶ Thermal runaway - when a LiPo shorts or is damaged a chemical reaction may occur that leads to a surprisingly large fire.
- ▶ Battery Logs are useful for tracking the number of charge/discharge cycles.
 - ▶ After 300 cycles a battery should be retired... assuming it makes it that long.
- ▶ Always check the voltage of the battery before and after use to make sure it is at the proper voltage

Questions?

- ▶ Home Work for tonight:

- ▶ Watch the Americaview series of videos “Mastering the Aeronautical Chart for UAS”.

- ▶ Feel free to watch the other series, they are very informative!

- ▶ <https://www.youtube.com/watch?v=JB-rrdtpFKs&list=PLEHyYp32cIJH3E-4mPIbg6DxUCVxHnixs>

- ▶ Write down any questions you have, we will go over them first thing in the morning.