Implementing Unmanned Aircraft System (UAS) technology in North Carolina: Land surveying

NCSS Johnston County Chapter

Workforce Development Center/Johnston Community College

Clayton, NC

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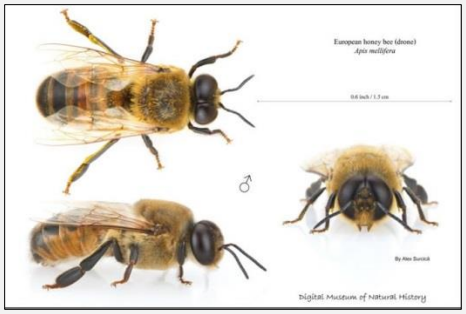
Terms

- **UAV**: Unmanned aerial vehicle
- **UA**: Unmanned aircraft
- **UAS**: Unmanned aircraft **system**, which according to the FAA includes *"the unmanned aircraft (UA) and all of the associated support equipment, control station, data links, telemetry, communications and navigation equipment, etc., necessary to operate the unmanned aircraft"*

Misnomer

- **Drone**:
  - a stingless male bee (as of the honeybee) that has the role of mating with the queen and does not gather nectar or pollen



  - an unmanned aircraft or ship guided by remote control or onboard computers

http://www.merriam-webster.com/dictionary/drone

http://www.communitygreenhouse.org/workers-and-drones/

UAS in land surveying

- Study the "*UAS: The Next Quantum Leap in Surveying Technology*" article in *The Tarheel Surveyor* by Darshan Divakaran and Kyle Snyder

  Once UAS are cleared for commercial use by the FAA, surveyors and engineers will have the ability to deploy low-cost survey-grade solutions that will fly over a site and collect vast amounts of topographic data including photography or other remote-sensing data.

  - *With such a huge increase in the amount of topographic data being collected, this will mean an increase in office time spent processing, analyzing & utilizing this data.*
  - *However, the increased post-collection time spent on geospatial analysis is cancelled out many times over by the huge time-savings UAS are expected to produce during the actual collection process.*
    - *Large survey jobs that once took weeks could potentially be completed in just a few days*
    - *A week's worth of traditional data collection may be accomplished in just one day.*

http://www.ncsurveyors.com/files/tarheel_surveyor/15.1-Spring_2015.pdf

UAS provided surveying products

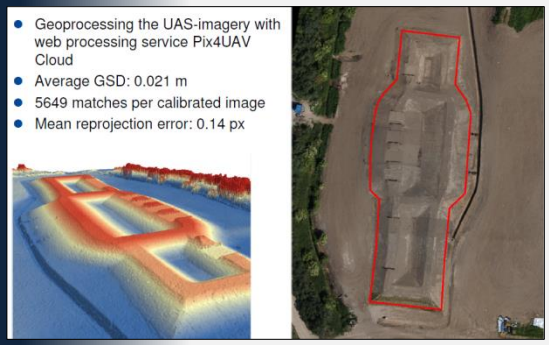
- Scaled orthophotos

http://www.uav-g.org/Presentations/UAS_derived_DSM_and_DEM/Gehrke_R-Aspects_of_DEM_Generation.pdf

- Point clouds

Presentations from the UAV-Geomatics 2013 Conference (www.uav-g.org/presentations_online.htm)

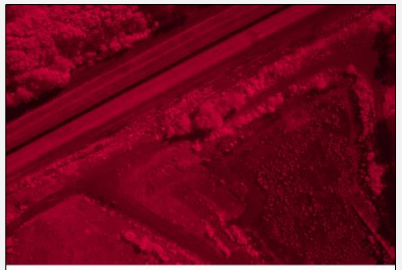
- Digital Elevation Models (DEMs) and Digital Surface Models (DSMs)



http://www.uav-g.org/Presentations/UAS_derived_DSM_and_DEM/Naumann_M-Accuracy_comparison_of_DSM.pdf

- Multispectral analyses

RGB image



IR image

http://www.uav-g.org/Presentations/UAS_Imaging_Sensors/Gehrke_R-Multispectral_Image_Capturing.pdf

UAS provided surveying products

Conference	http://www.uav-g-2015.ca/
Program	http://www.uav-g-2015.ca/forms/Conference%20Program_UAVg2015-26AUG2015-f.pdf
Proceedings – Annals (5 papers)	http://www.isprs-ann-photogramm-remote-sens-spatial-inf-sci.net/II-1-W1/index.html
Proceedings – Archives (64 papers)	http://www.int-arch-photogramm-remote-sens-spatial-inf-sci.net/XL-1-W4/index.html
Facebook	https://www.facebook.com/uavg2015

UAS for geospatial: MAPPS Fall Policy Conference at Drone World Expo

- **Drone World Expo**

  November 17-18, 2015

  San Jose Convention Center

  San Jose, CA

MAPPS (an association of photogrammetry, mapping, and geospatial firms) will host sessions for firms exploring entry into the geospatial market using UAS:

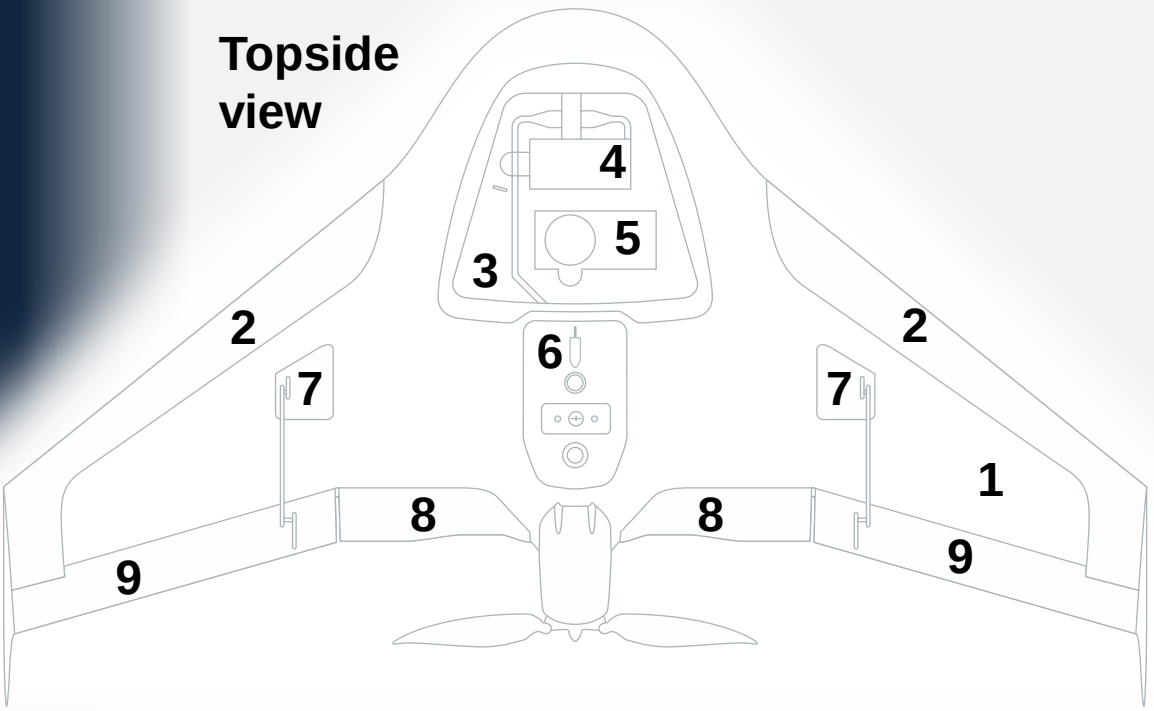
– *What you need to know before starting up your UAS dept:*
  - System operating limitations
  - Flight training
  - Crew responsibilities
  - Operator authority
  - Client expectations

– UNNAMED SESSION
  - UAS standards
  - UAS applications
  - UAS markets

http://www.droneworldexpo.com/

https://mapps.site-ym.com/news/247922/UAS-for-Geospatial-MAPPS-Fall-Policy-Conference-at-Drone-World-Expo.htm

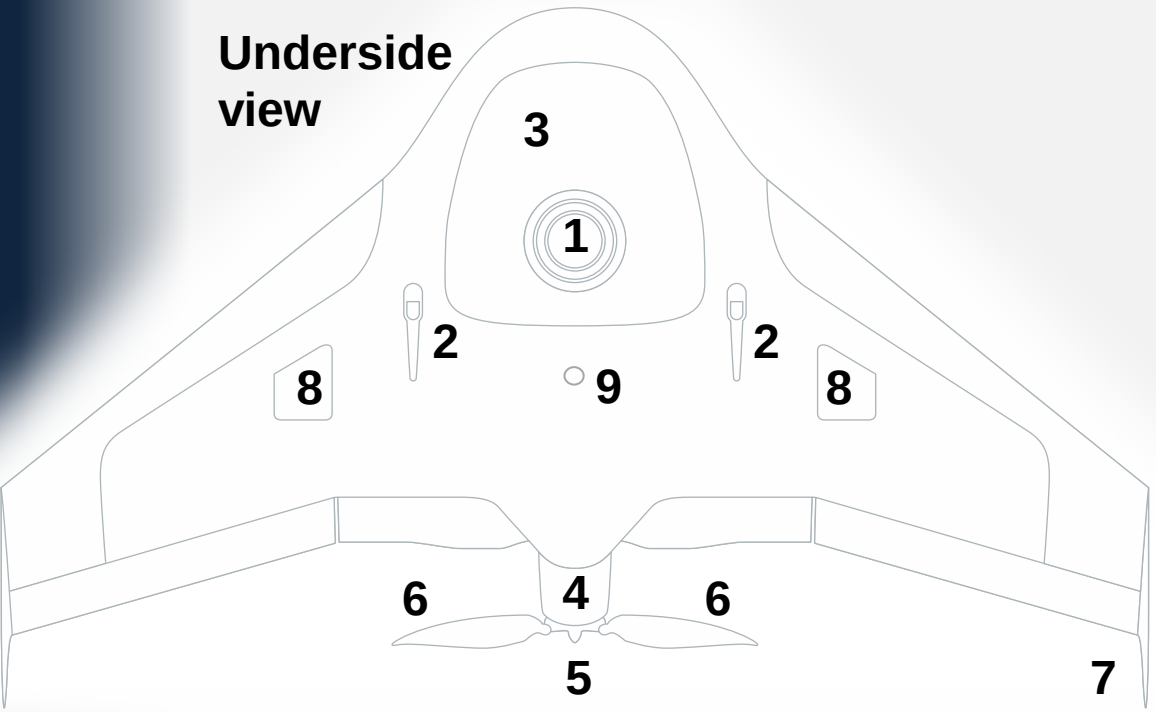
UAS components: Fixed-wing UA



Note: Although the various UAS models are built and operated differently, this presentation will use the Trimble UX5 (http://uas.trimble.com/ux5) fixed-wing UAS to illustrate the following UAS parameters: subcomponents of a UAV, ground control station, flight monitoring, and clearances (e.g. take off, cruise, descent, and landing).

1. Expanded polypropylene (EPP) body
2. Leading edges
3. Payload bay
4. Battery
5. Sensor
6. eBox (GPS ant, Mode, & Pitot tube)
7. Servos
8. Inboard elevons
9. Outboard elevons

UAS components: Fixed-wing UA



1. Lens filter
2. Launcher slats
3. Belly plate
4. Drive unit
5. Propeller holder
6. Propellers
7. Winglets
8. Servos
9. RF antenna (part of eBox)

http://uas.trimble.com/ux5

UAS components: GSC for a fixed-wing

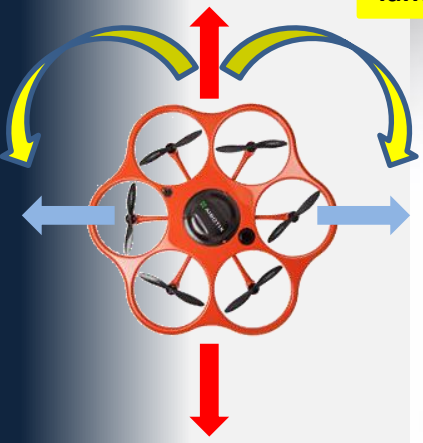
Ground control station (GSC)

Trimble Yuma 2 tablet running the Trimble Access Aerial Imaging software

UX5 ground modem (2.4 GHz) straps to the tablet, connects to the tablet via its USB cable, and communicates with the aircraft via its RF antenna.

http://uas.trimble.com/ux5

UAS components: GSC for a multirotor



Automatic take-off & landing

Automatic altitude control

Motor on or off

Alignment from the pilot's perspective

Dynamic set of a Point of Interest (POI)

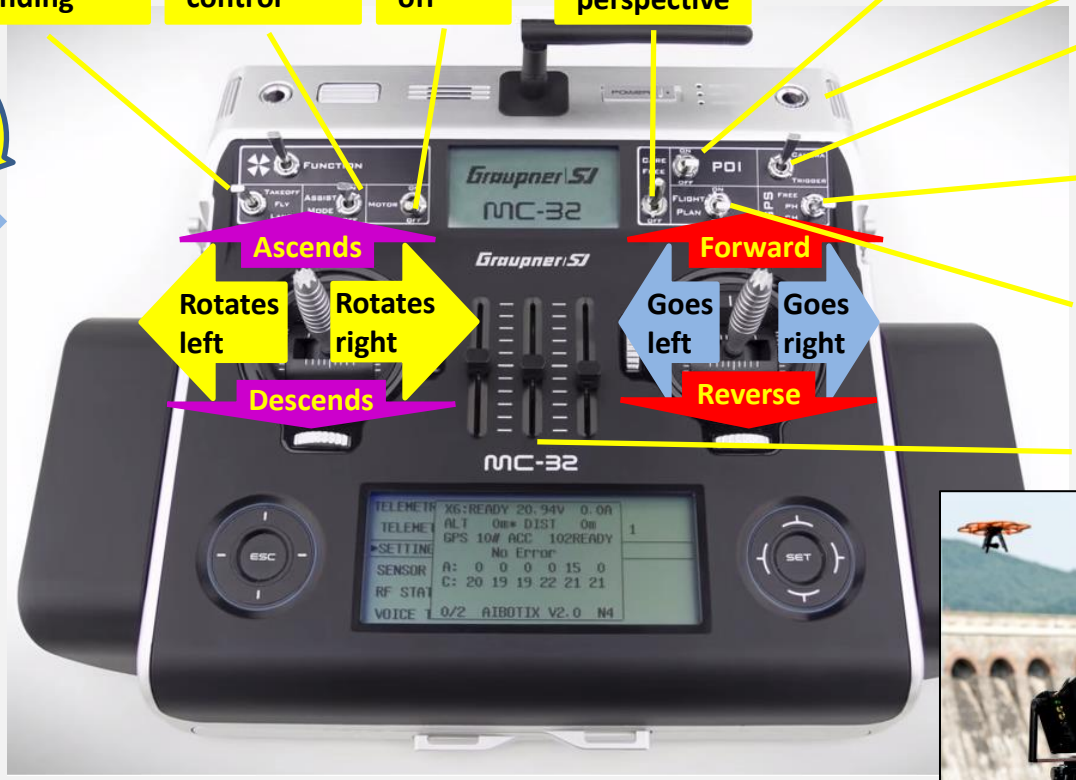
Camera roll function

Manual triggering of the connected camera

GPS coming home & Position hold functions

Waypoint navigation start & stop

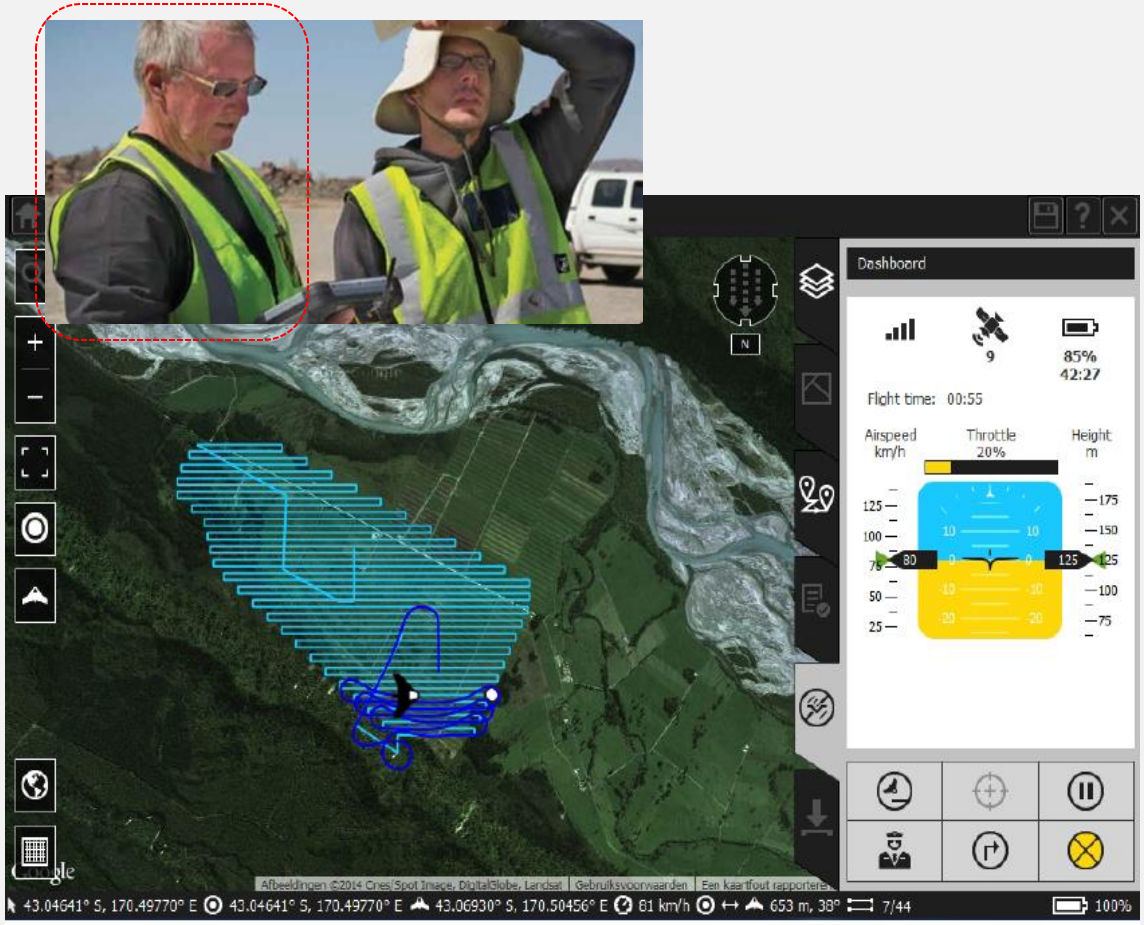
Camera pitch function



https://www.aibotix.com/en/overview-aibot-uav.html https://www.youtube.com/watch?v=P3Kbd8LEKqI http://uas.leica-geosystems.us/uas.html

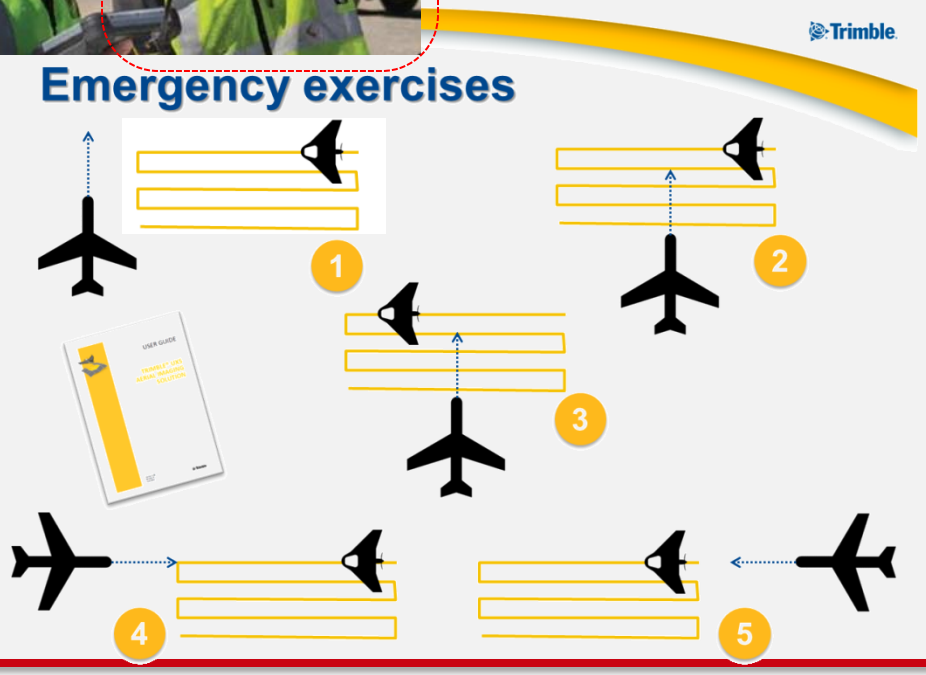
UAS flight monitoring: The pilot & the flight observer

- **The pilot:**
  - Monitors the GSC display
    - Battery (%) & estimated battery life
    - Radio status
    - GPS status
    - Trajectory (turns, level flight)
    - Airspeed (kph)
    - Throttle
    - Height (m)



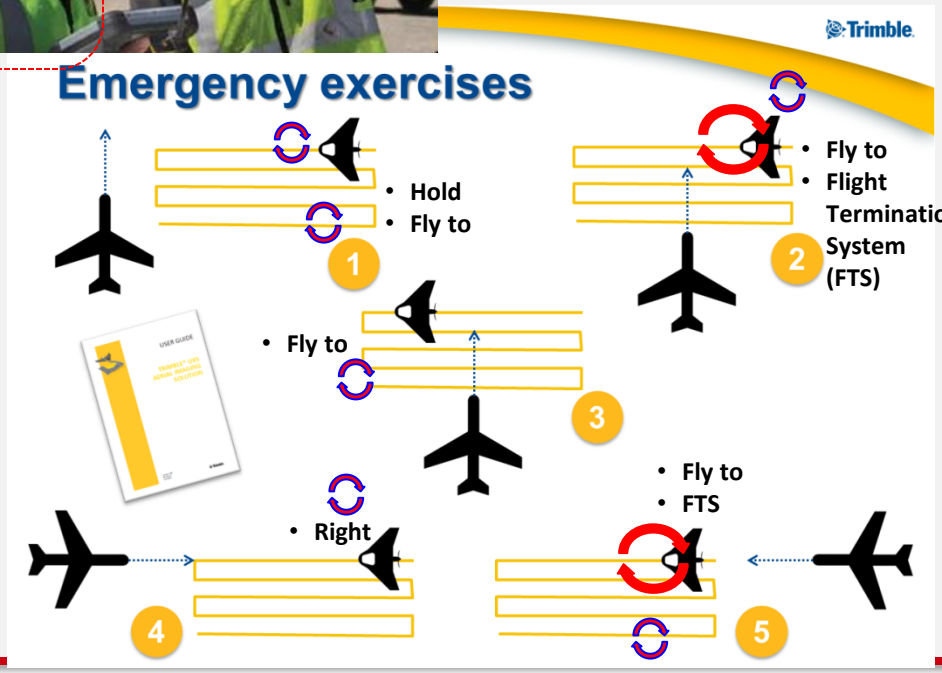
UAS flight monitoring: The pilot & the flight observer

- **The flight observer:**
  - Monitors the UA
  - Monitors the sky for approaching aircraft
  - Communicates the situation to the pilot



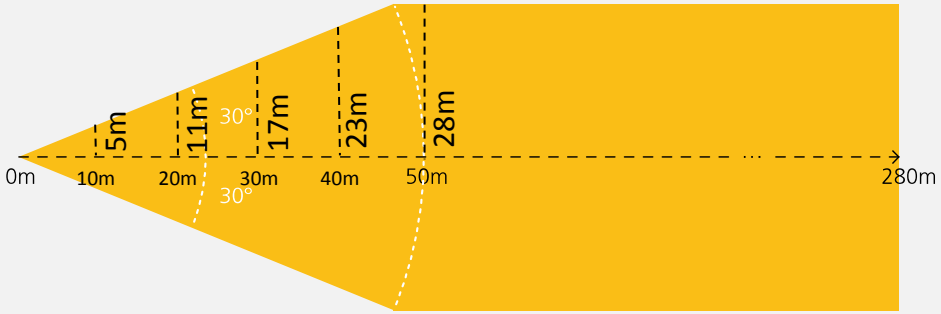
UAS flight monitoring: The pilot & the flight observer

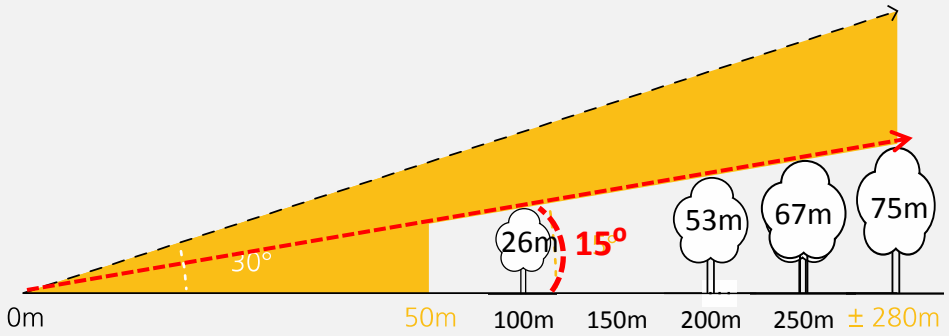
- **The pilot:**
  - Executes evasive actions:
    - Hold (100 m radius)
    - Right (300 m to the right & then 100 m radius)
    - Fly to (flies to the selected position & then 100 m radius)
    - Here (flies to the GSC location & then 100 m radius)
    - Flight Termination System (FTS) (forced landing in 100 m radius descending orbits)



UAS clearances: Fixed-wing take-off

- **Obstacle clearances for takeoff**
  - **HORIZONTAL CLEARANCE:** Within the first 50 m (164 ft), there must be a clear area free of obstacles within 30º to the left and to the right of the launch direction
  - **VERTICAL CLEARANCE:** Within 280 m (919 ft) of the launch direction, no obstacles can be above a 15º safety angle

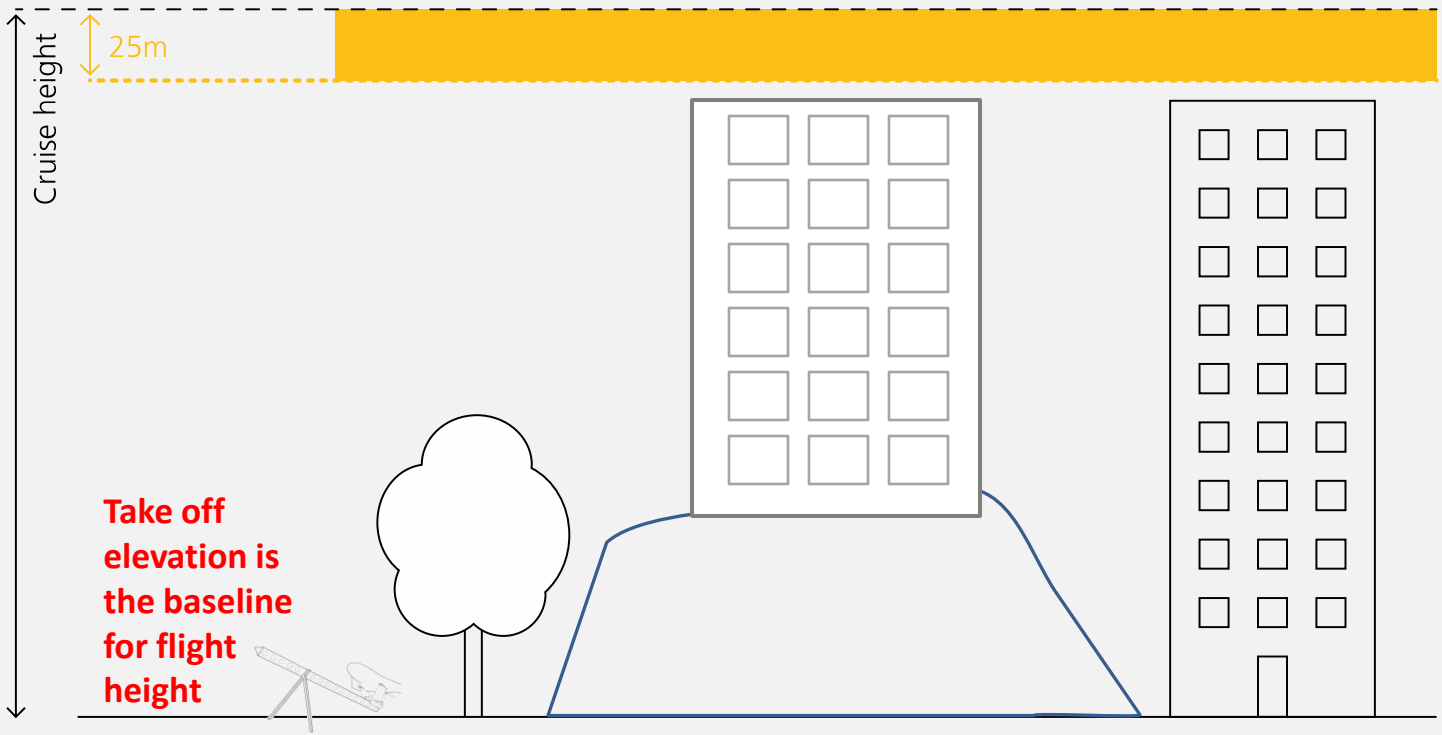




http://uas.trimble.com/ux5

UAS clearances: Fixed-wing cruise

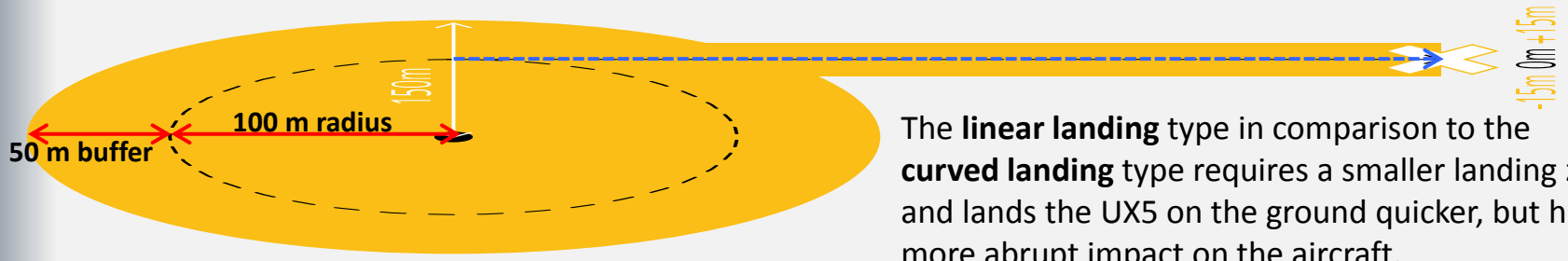
- **Obstacle clearances for cruise**
  - Flight height needs to be at least 25 m higher than all obstacles



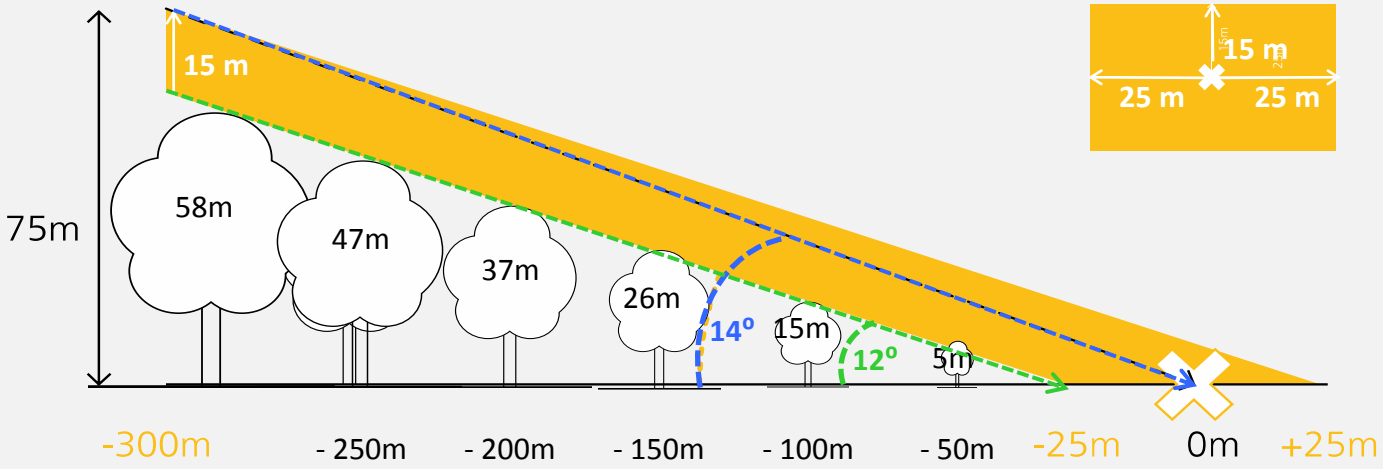
http://uas.trimble.com/ux5

UAS clearances: Fixed-wing landing

- **Obstacle clearances for landing**
  - **Linear landing**:

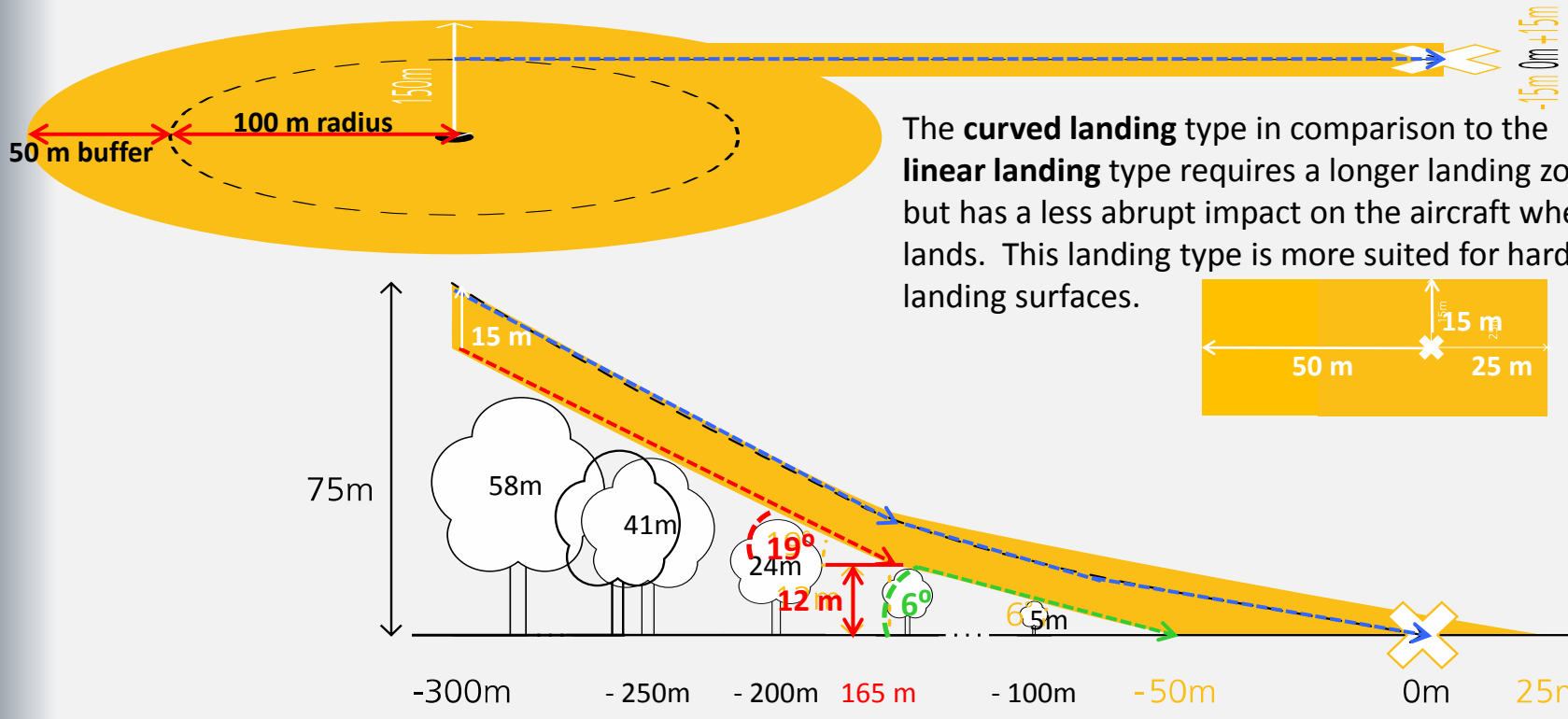


The **linear landing** type in comparison to the **curved landing** type requires a smaller landing zone and lands the UX5 on the ground quicker, but has a more abrupt impact on the aircraft.



UAS clearances: Fixed-wing landing

- **Obstacle clearances for landing**
  - **Curved landing:**



The **curved landing** type in comparison to the **linear landing** type requires a longer landing zone, but has a less abrupt impact on the aircraft when it lands. This landing type is more suited for hard landing surfaces.

NCEM is partnering with NGAT

- **NextGen Air Transportation (NGAT)**
  - An NCSU institute that focuses on **developing and evaluating improvements** to existing and anticipated air traffic control, airspace management, airport and airspace system capacity, surface traffic management, and flight safety, specifically as it relates to the integration of **Unmanned Aircraft Systems (UAS)** into **domestic airspace**.
  - NGAT has led the State of North Carolina's UAS efforts for the last four years.

http://www.itre.ncsu.edu/ngat/

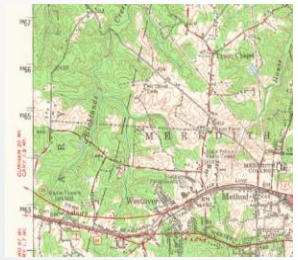
NCEM is partnering with NGAT

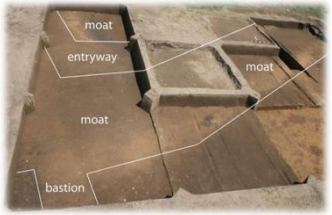
- **NextGen Air Transportation (NGAT)**
  - The Federal Aviation Administration (FAA) has selected the **ASSURE (Alliance for System Safety of UAS through Research Excellence) team**, which is a Mississippi State University led coalition of research universities that includes **NGAT**, as the **Center of Excellence for Unmanned Aircraft Systems (UAS)**.
    - **NGAT will be the national team's lead for Command and Control (C2) communications research** (i.e. development of an appropriate link between the unmanned aircraft and the control station to support the required performance of the unmanned aircraft and to ensure that the pilot always maintains a threshold level of control of the aircraft).
    - NGAT will lead all University of North Carolina system research about the safe integration of UAS into the national airspace

https://www.faa.gov/news/press_releases/news_story.cfm?newsId=18794

https://news.ncsu.edu/2015/05/nc-state-team-selected-for-faa-unmanned-aircraft-center-of-excellence/

Hundreds of potential applications





- Emergency response
- Mapping / aerial photography
- Homeland Security
- Civil Air Patrol
- Agriculture
- Mining
- Forestry
- Wildlife resources
- Transportation
- Investigation
- Drug enforcement
- Anti-terrorism
- Law enforcement
- First responder support
- Weather research
- Disaster analysis
- Airport planning
- Entertainment (filming a movie)

Emergency response

Fire management

Infrastructure management

Watch out!

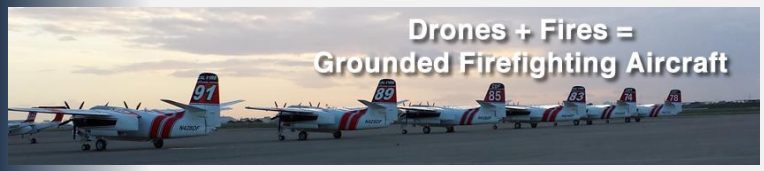
Cases of drone near-misses are soaring:

Pilots have reported an alarming spike in near-misses with drones at New York City airports and across the nation over the past year, the feds disclosed on Wednesday.

11-22-2014

http://www.nydailynews.com/news/national/watch-cases-drone-near-misses-soaring-article-1.2025608

Federal Aviation Administration (FAA): Report



- **Pilot reports of close calls with drones soar in 2015**

August 12- Pilot reports of unmanned aircraft have increased dramatically over the past year, from a total of **238** sightings in all of **2014**, to **more than 650 by August 9 of this year**. The FAA wants to send out a clear message that operating drones around airplanes and helicopters is dangerous and illegal. Unauthorized operators may be subject to stiff fines and criminal charges, including possible jail time.

Pilots of a variety of different types of aircraft – including many large, commercial air carriers – reported spotting 16 unmanned aircraft in June of 2014, and 36 the following month. This year, **138 pilots reported seeing drones at altitudes of up to 10,000 feet during the month of June**, and another 137 in July.

Meanwhile, **firefighters battling wildfire blazes** in the western part of the country have **been forced to ground their operations** on several occasions for safety reasons **when they spotted one or more unmanned aircraft in their immediate vicinity**.

The **FAA will continue to work closely with industry partners through the "Know Before You Fly" campaign to educate unmanned aircraft users about where they can operate within the rules**. The agency is also **supporting the National Interagency Fire Center's** "**If You Fly, We Can't**" efforts **to help reduce interference with firefighting operations**.

However, the **FAA** also is **working closely with the law enforcement community to identify and investigate unauthorized unmanned aircraft operations. The FAA has levied civil penalties** for a number of unauthorized flights in various parts of the country, and has dozens of **open enforcement cases**.

The FAA encourages the public to report unauthorized drone operations to local law enforcement and to help discourage this dangerous, illegal activity.

https://www.faa.gov/news/updates/?newsId=83445 http://fireaviation.com/2015/07/29/faa-wildfires-and-drones-dont-mix/ https://www.facebook.com/nodronesinfirezones?fref=nf

Academy of Model Aeronautics (AMA):

Respectfully asked the FAA to categorize the sightings data

- **The AMA compared the FAA's data of 764 sightings with the actual pilot reports and discovered:**
  - Only 27 cases were a near miss & only 10 of which involved the pilot taking evasive action.
  - Military UA were the drones sighted at high altitude sightings.
  - Several cases involved commercial operators flying UA over a stadium or near an airport.
  - One case involved a police dept flying a UA over a crime scene 2 miles from an airport.
  - Six cases involved UA enthusiasts who may have been following proper recreational rules (<400 ft AGL), but were reported anyway by a bystander or by a pilot.
  - At least 26 cases involved UA flying over stadiums, wildfires, power plants, & the White House.
  - Almost 20% of the cases were not reported to law enforcement
- **The AMA requested the FAA to:**
  - Refer all reports to local law enforcement to identify the truly careless and reckless operators
  - Enforce existing rules against careless and reckless behavior, as well as violations of restricted airspace

www.modelaircraft.org/gov/docs/AMAAnalysis-PressRelease09-11-2015.pdf www.modelaircraft.org/gov/docs/AMAAnalysis-Closer-Look-at-FAA-Drone-Data_091415.pdf

FAA launches a UAS registration program task force

- **U.S. Transportation Secretary announced UA registration requirement**

The FAA launched a task force on 10-19-2015 to develop recommendations for a UAS registration program

- Will be composed of 25 to 30 diverse representatives from the UAS and manned aviation industries, the federal government, and other stakeholders
- To advise the Department on which aircraft should be exempt from registration due to a low safety risk, including toys and certain other small UAS.
- Will explore options for a streamlined system that would make registration less burdensome for commercial UAS operators.

"Registration will help make sure that operators know the rules and remain accountable to the public for flying their unmanned aircraft responsibly. When they don't fly safely, they'll know there will be consequences." - FAA Administrator Michael Huerta

- The FAA will continue its aggressive education and outreach efforts, including the "Know Before You Fly" campaign and "No Drone Zone" initiatives with the nation's busiest airports.
- The agency also will continue to take strong enforcement action against egregious violators.
- It will continue working with stakeholders to improve safety to ensure further integration and innovation in this promising segment of aviation.

http://www.faa.gov/news/press_releases/news_story.cfm?newsid=19594

FAA launches a UAS registration program task force

- **U.S. Transportation Secretary announced UA registration requirement**

The following stakeholder groups participated in the announcement:

– **Association for Unmanned Vehicle Systems International (AUVSI)**

"AUVSI welcomes the opportunity to join this task force of government and industry stakeholders. This collaborative effort to develop an efficient process for UAS registration should lead to increased accountability across the entire aviation community. Because safe operations are essential for all users of the national airspace, AUVSI is also looking forward to continuing its work with the FAA and other supporters of the 'Know Before You Fly' campaign to educate newcomers to UAS technology about where they should and shouldn't fly."

– **American Association of Airport Executives:** Looking forward to working with our partners, "*…to develop workable, common-sense approaches that protect both public safety and …. an important and growing industry.*"

– **Air Line Pilots Association:** Looking forward to "*…developing the procedures necessary to ensure we maintain the highest levels of safety of our aviation system.*"

– Academy of Model Aircraft
– Helicopter Association International
– PrecisionHawk
– AirMap
– Small UAV Coalition
– Consumer Electronics Association

http://www.faa.gov/news/press_releases/news_story.cfm?newsid=19594

https://www.transportation.gov/briefing-room/statements-of-support-uas-registration

Federal Aviation Administration (FAA): Regulations

- **Unmanned aircraft systems (UAS)**

  UAS are inherently different from manned aircraft. Introducing UAS into the nation's airspace is challenging for both the FAA and aviation community, because the U.S. has the busiest, most complex airspace in the world. The FAA is taking an incremental approach to safe UAS integration.

- **Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap**
- **Different types of UAS operations**
  - **Public operations** (governmental)
  - **Civil operations** (non-governmental)
  - **Model aircraft** (hobby or recreation *only*)

https://www.faa.gov/uas/

Federal Aviation Administration (FAA): Regulations

- **Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap**

  The first annual UAS Roadmap addresses current and future policies, regulations, technologies and procedures that will be required as UAS operations increase in the nation's airspace.

https://www.faa.gov/uas/media/UAS_Roadmap_2013.pdf

Federal Aviation Administration (FAA): Regulations

- **Public operations (governmental)**

  Public aircraft operations are limited by federal statue to certain government operations within U.S. airspace. Title 49 U.S.C. § 40102(a)(41) provides the definition of "Public Aircraft" and § 40125 provides the qualifications for public aircraft status. **Whether an operation qualifies as a public aircraft operation is determined on a flight-by-flight basis, under the terms of the statute**. The considerations when making this determination are:

  - Aircraft ownership
  - Operator
  - Purpose of the flight
  - Persons on board the aircraft

http://www.faa.gov/uas/public_operations/

Federal Aviation Administration (FAA): Regulations

- **Public operations (governmental)**

  The **FAA Modernization and Reform Act of 2012** directed the FAA to:

  "*allow a government public safety agency to operate unmanned aircraft* ***weighing 4.4 pounds or less****, if operated*

  i. Within the **line of sight of the operator**

  ii. **Less than 400 feet [122 m] above the ground**

  iii. **During daylight conditions**

  iv. Within **Class G airspace [uncontrolled]**

  v. **Outside of 5 statute miles from any airport**, heliport, seaplane base, spaceport, or other location with aviation activities."

https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=14153 http://www.gpo.gov/fdsys/pkg/CRPT-112hrpt381/pdf/CRPT-112hrpt381.pdf

Federal Aviation Administration (FAA): Regulations

- **Public COAs**

  For public aircraft operations (PAOs), the FAA issues a Certificate of Waiver or Authorization (COA) that permits public agencies and organizations to:

  - Operate a particular aircraft,
    - For a particular purpose
    - In a particular area
  - Allows an operator to use a defined block of airspace
  - Includes special safety provisions unique to the proposed operation
  - Usually issued for a specific period (up to two years)

http://www.faa.gov/uas/public_operations/

Federal Aviation Administration (FAA): Regulations

- **Public COAs**

  The FAA works with these organizations to develop conditions and limitations for UAS operations to ensure they do not jeopardize the safety of other aviation operations.

  – The objective is to issue a COA with parameters that ensure a level of safety equivalent to manned aircraft.
    - UAS does not operate in a populated area
    - Aircraft is observed, either by someone in a manned aircraft or someone on the ground, to ensure separation from other aircraft in accordance with right-of-way rules.

  – Common public uses today include:
    - Law enforcement
    - Firefighting
    - Border patrol
    - Disaster relief
    - Search and rescue
    - Military training
    - Other operations

http://www.faa.gov/uas/public_operations/

Federal Aviation Administration (FAA): Regulations

- **Public COAs**

  The FAA manages public aircraft COAs through its COA Online system (https://ioeaaa.faa.gov/oeaaa/):

  – Agency must submit a "**declaration letter**" from the city, county, or state attorney's office assuring the FAA that:

    - The proponent is recognized as a political subdivision of the government of the State
    - The proponent will operate its unmanned aircraft in accordance with 49 USC. § 40125(b) (not for commercial purposes)

      Note: An agency's accountable executive cannot self-certify their agency is a "public" agency.

  – The typical COA application approval process is completed within 60 business days of receipt, provided there are no submittal errors, missing information, or safety or airspace issues.

  – Email the **FAA/UAS Integration Office** (9-AJR-36-UAS@faa.gov) to get started.

http://www.faa.gov/uas/public_operations/media/Decision_Flowcharts_for_PAO.pdf

Federal Aviation Administration (FAA): Regulations

- **Civil operations (non-governmental)**

  Any operation that does not meet the statutory criteria for a public aircraft operation is considered a civil aircraft operation and must be conducted in accordance with all FAA regulations applicable to the operation.

  There are two methods of gaining FAA authorization to fly civil (non-governmental) UAS:

  – Section 333 Exemption – a grant of exemption in accordance with Section 333 AND a civil Certificate of Waiver or Authorization (COA);
    - To perform commercial operations in low-risk, controlled environments.
    - Instructions for filing a petition for exemption.
  – Special Airworthiness Certificate (SAC) – applicants must be able to describe how their system is designed, constructed, and manufactured, including engineering processes, software development and control, configuration management, and quality assurance procedures used, along with how and where they intend to fly.

https://www.faa.gov/uas/civil_operations/

Federal Aviation Administration (FAA): Regulations

- **Civil operations (non-governmental)**
  - Section 333 Exemption

    By law, any aircraft operation in the national airspace requires a certificated and registered aircraft, a **licensed pilot**, and operational approval. Section 333 of the FAA Modernization and Reform Act of 2012 (FMRA) grants the Secretary of Transportation the authority to determine whether an airworthiness certificate is required for a UAS to operate safely in the National Airspace System (NAS).

    - This authority is being leveraged to grant case-by-case authorization for certain unmanned aircraft to perform commercial operations prior to the finalization of the Small UAS Rule, which will be the primary method for authorizing small UAS operations once it is complete.
    - The Section 333 Exemption process provides operators who wish to pursue safe and legal entry into the NAS a competitive advantage in the UAS marketplace, thus discouraging illegal operations and improving safety. It is anticipated that this activity will result in significant economic benefits. The FAA Administrator has identified this as a high priority project to address demand for civil operation of UAS for commercial purposes.

http://www.faa.gov/uas/legislative_programs/section_333/

Federal Aviation Administration (FAA): Regulations

- **Civil operations (non-governmental)**
  - Petitioning for Exemption under Section 333

    1. Review the FAA's *Guidelines for Submitting a Petition for Exemption*.

       This website details the **general** exemption process for filing **any** petition for exemption, and it provides answers to frequently asked questions.

    2. Review the Section 333 Guidance from the FAA's UAS Integration Office.

       This document describes what information petitioners should submit specifically to request FAA authorization to operate a UAS in the National Airspace System (NAS).

    3. Prepare your petition for filing. Before filing your petition, review the Section 333 Checklist and Guidance to ensure your petition contains all the necessary information.

    4. When you have verified that all the necessary information is included, file your petition for exemption on the public docket.

http://www.faa.gov/uas/legislative_programs/section_333/how_to_file_a_petition/ http://aes.faa.gov/Petition/
http://www.faa.gov/uas/legislative_programs/section_333/how_to_file_a_petition/media/section333_public_guidance.pdf
http://www.faa.gov/uas/legislative_programs/section_333/how_to_file_a_petition/media/Section-333-Petition-Checklist.pdf
http://www.regulations.gov/#!submitComment;D=FAA-2007-0001-0001

Federal Aviation Administration (FAA): Regulations

- **Civil operations (non-governmental)**
  - Petitioning for Exemption under Section 333 (continued from previous slide)

    5. **As of 3-23-2015, the FAA will automatically grant a "blanket" COA for flights ≤200 ft** to any UAS operator with a Section 333 exemption, provided the aircraft weighs <55 lbs, operations are conducted during daytime Visual Flight Rules (VFR) conditions within visual-line-of-sight (VLOS) of the pilot, and certain distances away from airports or heliports.

       AFTER receiving a grant of exemption, petitioners who want to fly outside these blanket parameters will be eligible to apply for a separate COA specific to the airspace required for their operation. Applications MUST be submitted through the UAS Civil COA Portal. DO NOT submit the COA application to the public docket. The FAA will ONLY accept and process complete COA applications.

       COA applications MUST include:

       a. An exemption number – corresponding to the Federal Register Docket ID for your petition for exemption
       b. A registration number – all aircraft must be registered with the FAA to be issued a COA

       http://www.faa.gov/uas/legislative_programs/section_333/how_to_file_a_petition/

Federal Aviation Administration (FAA): Regulations

- **Civil operations (non-governmental)**
  - Petitioning for Exemption under Section 333 (continued from previous slide)

    5. **As of 3-23-2015, the FAA will automatically grant a "blanket" COA for flights ≤200 ft** to any UAS operator with a Section 333 exemption, provided the aircraft weighs <55 lbs, operations are conducted during daytime Visual Flight Rules (VFR) conditions within visual-line-of-sight (VLOS) of the pilot, and certain distances away from airports or heliports.

       The COA application process is separate from the petition for exemption process. The COA process:

       1. Makes applicable FAA Air Traffic Control facilities aware of proposed UAS operations
       2. Provides the FAA the ability to consider airspace issues unique to UAS operations.

       Both the COA application and the petition for exemption should be submitted under the same name/company name.

http://www.faa.gov/uas/legislative_programs/section_333/how_to_file_a_petition/

Federal Aviation Administration (FAA): Regulations

- **Model aircraft operations**
  - Model aircraft operations are for hobby or recreational purposes only.
  - The FAA has partnered with several industry associations to promote the Know Before You Fly campaign to educate the public about using unmanned aircraft safely and responsibly.
    - Founded by the Association for Unmanned Vehicle Systems International (AUVSI), the Academy of Model Aeronautics (AMA), and the Small UAV Coalition in partnership with the Federal Aviation Administration (FAA) to educate prospective users about the safe and responsible operation of unmanned aircraft systems (UAS).
    - Prospective UAS operators want to fly, and fly safely, but many don't realize that, just because you can buy a UAS, doesn't mean you can fly it anywhere, or for any purpose. Know Before You Fly provides prospective users with the information and guidance they need to fly safely and responsibly.

https://www.faa.gov/uas/model_aircraft/ http://knowbeforeyoufly.org/about-us/

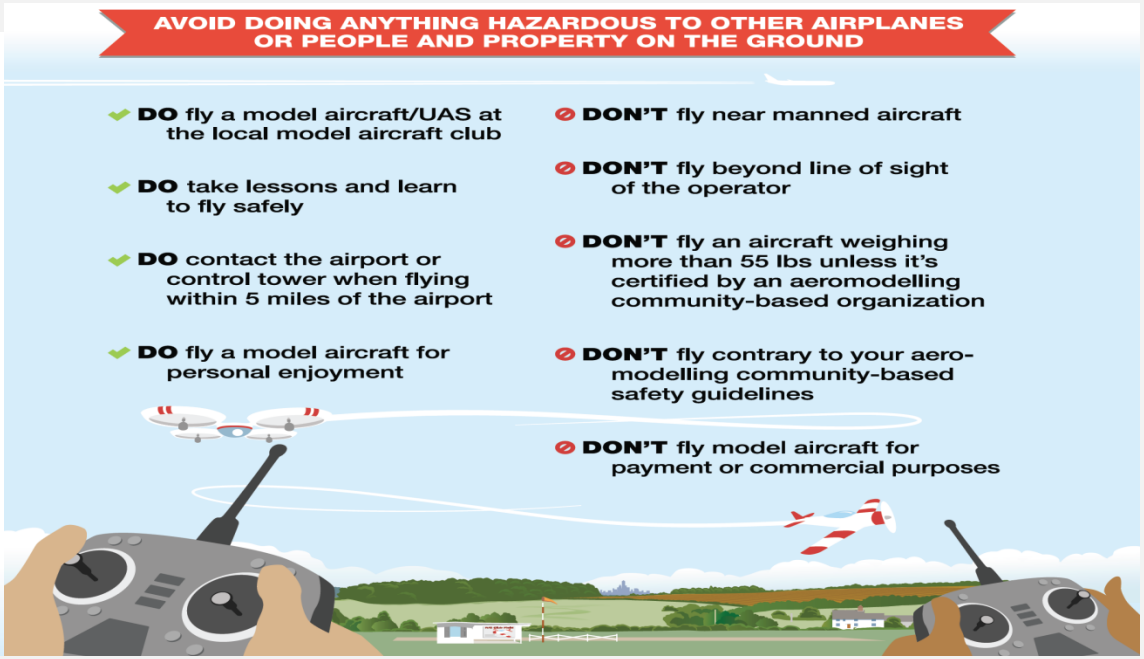
Federal Aviation Administration (FAA): Regulations

- **Model aircraft operations**
  - Individuals flying for hobby or recreation are strongly encouraged to adhere to the following safety guidelines:
    - Fly below 400 feet and remain clear of surrounding obstacles
    - Keep the aircraft within visual line of sight at all times
    - Remain well clear of and do not interfere with manned aircraft operations
    - Don't fly within 5 miles of an airport unless you contact the airport and control tower before flying
    - Don't fly near people or stadiums
    - Don't fly an aircraft that weighs more than 55 lbs
    - Don't be careless or reckless with your unmanned aircraft – you could be fined for endangering people or other aircraft

https://www.faa.gov/uas/model_aircraft/

Federal Aviation Administration (FAA): Regulations

- **Model aircraft operations**
  - Having fun means flying safely! Hobby or recreational flying doesn't require FAA approval, but you must follow safety guidelines. Any other use requires FAA authorization.



https://www.faa.gov/uas/publications/model_aircraft_operators/

Federal Aviation Administration (FAA): Regulations

- **Model aircraft operations**
  - The statutory parameters of a model aircraft operation are outlined in Section 336 of Public Law 112-95 (the FAA Modernization and Reform Act of 2012).
    - An individual who flies his/her UAS **within the scope of these parameters** does not require permission to operate a UAS.
    - Any flight **outside these parameters** (including any non-hobby, non-recreational operation) requires FAA authorization.
    - For example, using a UAS to take photos
      - **Recreational:** If for your personal use
      - **Non-recreational:** If for compensation or sale to another individual

https://www.faa.gov/uas/civil_operations/

Federal Aviation Administration (FAA): **Proposed** regulations

- **Small UAS Notice of Proposed Rulemaking (NPRM)**

  The FAA has proposed a framework of regulations that would allow routine use of certain small UAS in today's aviation system, while maintaining flexibility to accommodate future technological innovations. Note: The Public comment period ended 4-24-2015.

  – Operational limitations for small UAS (under 55 pounds) conducting non-recreational operations
    - Limit flights to daylight, visual-line-of-sight operations, height ≤500 ft, and speed ≤100 mph
    - Must yield right-of-way to other aircraft (manned or unmanned)
    - Optional use of a visual observer
  – Operator certification
    - **Pass an aeronautical knowledge test**
    - Be vetted by the Transportation Security Administration (TSA)
  – Aircraft registration and marking

Please read the handout *"Overview of Small UAS Notice of Proposed Rulemaking"*

https://www.faa.gov/uas/nprm/

Overview of Small UAS Notice of Proposed Rulemaking

Summary of Major Provisions of Proposed Part 107 The following provisions are being proposed in the FAA's Small UAS NPRM.	
Operational Limitations	• Unmanned aircraft must weigh less than 55 lbs. (25 kg). • Visual line-of-sight (VLOS) only; the unmanned aircraft must remain within VLOS of the operator or visual observer. • At all times the small unmanned aircraft must remain close enough to the operator for the operator to be capable of seeing the aircraft with vision unaided by any device other than corrective lenses. • Small unmanned aircraft may not operate over any persons not directly involved in the operation. • Daylight-only operations (official sunrise to official sunset, local time). • Must yield right-of-way to other aircraft, manned or unmanned. • May use visual observer (VO) but not required. • First-person view camera cannot satisfy "see-and-avoid" requirement but can be used as long as requirement is satisfied in other ways. • Maximum airspeed of 100 mph (87 knots). • Maximum altitude of 500 feet above ground level. • Minimum weather visibility of 3 miles from control station. • No operations are allowed in Class A (18,000 feet & above) airspace. • Operations in Class B, C, D and E airspace are allowed with the required ATC permission. • Operations in Class G airspace are allowed without ATC permission • No person may act as an operator or VO for more than one unmanned aircraft operation at one time. • No careless or reckless operations. • Requires preflight inspection by the operator. • A person may not operate a small unmanned aircraft if he or she knows or has reason to know of any physical or mental condition that would interfere with the safe operation of a small UAS. • Proposes a microUAS option that would allow operations in Class G airspace, over people not involved in the operation, provided the operator certifies he or she has the requisite aeronautical knowledge to perform the operation.

Operator Certification and Responsibilities	• Pilots of a small UAS would be considered "operators".
	• Operators would be required to:
	  o Pass an initial aeronautical knowledge test at an FAA-approved knowledge testing center.
	  o Be vetted by the Transportation Security Administration.

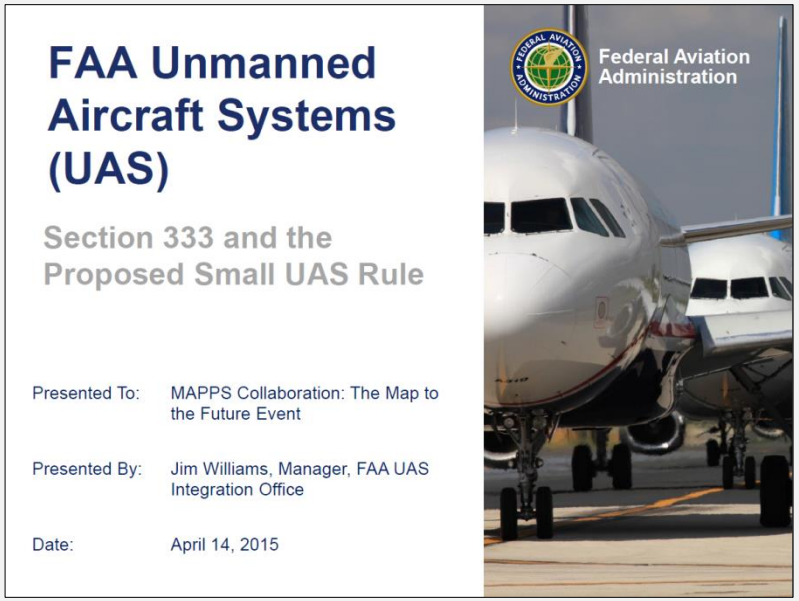
	○ Obtain an unmanned aircraft operator certificate with a small UAS rating (like existing pilot airman certificates, never expires). ○ Pass a recurrent aeronautical knowledge test every 24 months. ○ Be at least 17 years old. ○ Make available to the FAA, upon request, the small UAS for inspection or testing, and any associated documents/records required to be kept under the proposed rule. ○ Report an accident to the FAA within 10 days of any operation that results in injury or property damage. ○ Conduct a preflight inspection, to include specific aircraft and control station systems checks, to ensure the small UAS is safe for operation.
Aircraft Requirements	• FAA airworthiness certification not required. However, operator must maintain a small UAS in condition for safe operation and prior to flight must inspect the UAS to ensure that it is in a condition for safe operation. Aircraft Registration required (same requirements that apply to all other aircraft). • Aircraft markings required (same requirements that apply to all other aircraft). If aircraft is too small to display markings in standard size, then the aircraft simply needs to display markings in the largest practicable manner.
Model Aircraft	• Proposed rule would not apply to model aircraft that satisfy all of the criteria specified in Section 336 of Public Law 112-95. • The proposed rule would codify the FAA's enforcement authority in part 101 by prohibiting model aircraft operators from endangering the safety of the NAS.

Federal Aviation Administration (FAA): **Proposed** regulations

- **Small UAS Notice of Proposed Rulemaking (NPRM)**

  Study the "FAA Unmanned Aircraft Systems (UAS): Section 333 and the Proposed Small UAS Rule" presentation by Jim Williams, Manager, FAA UAS Integration Office

  - Could be revised after the close of the public comment period
  - Until the final rule is issued, all civil non-recreational/hobby operations (i.e. other than model aircraft) must be authorized on a case-by-case basis, either through airworthiness certification or granting of "Section 333" exemption



http://www.surveyingandmapping.net/federal-programs-conference--mapps---nsps.html

Federal Aviation Administration (FAA): **Proposed** regulations

- **Areas of knowledge tested on the initial Aeronautical Knowledge Test**
  1. **Federal UAS regulations:** To ensure that the applicant (i.e. the potential small UAS operator) understands what those regulations require and does not violate them through ignorance.
     a. The **proposed** small UAS regulations (Part 107) are listed in the back (pp. 173-194) of the "**Small UAS NPRM**"
     b. When enacted, **§ 107 Small Unmanned Aircraft Systems** will be posted:
        1). **FAA Regulations** (www.faa.gov/regulations_policies/faa_regulations/)
        2). **Electronic Code of Federal Regulations** (http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&tpl=/ecfrbrowse/Title14/14tab_02.tpl)

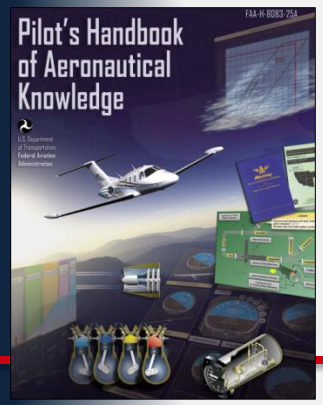
www.faa.gov/regulations_policies/rulemaking/recently_published/media/2120-AJ60_NPRM_2-15-2015_joint_signature.pdf

Federal Aviation Administration (FAA): **Proposed** regulations

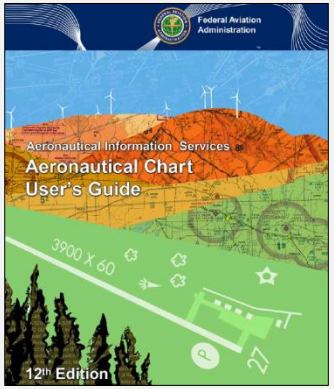
- **Areas of knowledge tested on the initial Aeronautical Knowledge Test**

  2. **Airspace classification and the requirements for operating in that airspace:** To ensure that the applicant knows how to determine the classification of the airspace in which he/she would like to operate.

  a. **Chapter 14** "Airspace" (www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2014.pdf) of the "**Pilot's Handbook of Aeronautical Knowledge**" (www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/)



  b. "**Aeronautical Chart User's Guide**" (www.faa.gov/air_traffic/flight_info/aeronav/digital_products/aero_guide/)

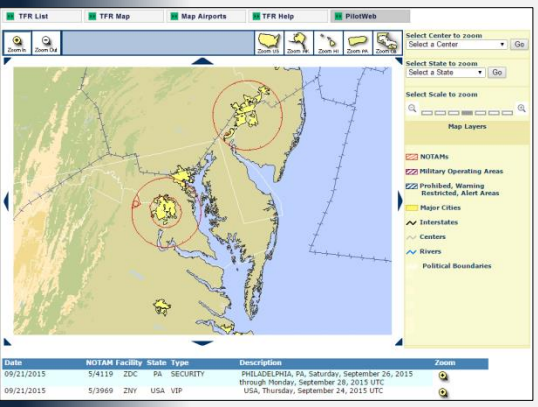


www.faa.gov/regulations_policies/rulemaking/recently_published/media/2120-AJ60_NPRM_2-15-2015_joint_signature.pdf

Federal Aviation Administration (FAA): **Proposed** regulations

- **Areas of knowledge tested on the initial Aeronautical Knowledge Test**

  3. **Flight restrictions affecting small unmanned aircraft operations:** To ensure that the applicant knows how to determine which areas are **prohibited**, **restricted**, or subject to a **Temporary Flight Restriction (TFR)** in order to comply with the **proposed** flight restrictions in § 107.45 (Operation in prohibited or restricted areas) and § 107.47 [Flight restrictions in the proximity of certain areas designated by notice to airmen (NOTAM)].

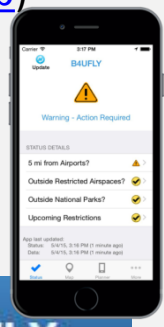


a. "**How do I operate the TFR site?**" (http://tfr.faa.gov/tfr2/about.jsp)

b. "**Pilot Web**" (https://pilotweb.nas.faa.gov/PilotWeb/help.jsp)

c. "**NOTAM Search**" (https://notams.aim.faa.gov/notamSearch/nsapp.html#/help)

d. "**B4UFLY**" smartphone app (still in Beta testing) (http://www.faa.gov/uas/b4ufly/)



www.faa.gov/regulations_policies/rulemaking/recently_published/media/2120-AJ60_NPRM_2-15-2015_joint_signature.pdf

Federal Aviation Administration (FAA): **Proposed** regulations

- **Areas of knowledge tested on the initial Aeronautical Knowledge Test**

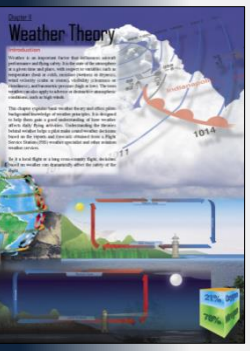
  4. **How to clear an obstacle during flight:** To ensure that the applicant understands what types of small UA maneuvers would create a collision hazard with a ground structure.
     Note: The NPRM did not elaborate on this topic nor list any hazardous maneuvers.

www.faa.gov/regulations_policies/rulemaking/recently_published/media/2120-AJ60_NPRM_2-15-2015_joint_signature.pdf

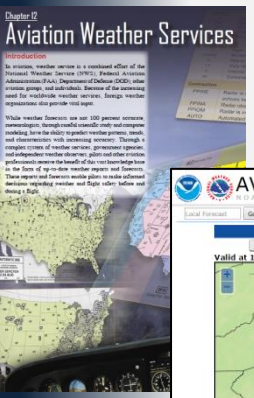
Federal Aviation Administration (FAA): **Proposed** regulations

- **Areas of knowledge tested on the initial Aeronautical Knowledge Test**

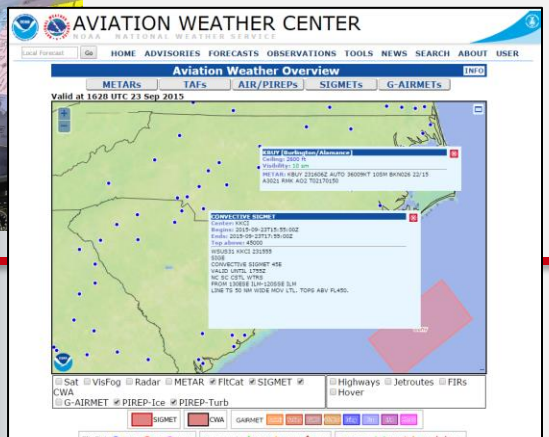
5. Effects of weather and micrometeorology (weather on a localized and small scale) on small UA operations: Due to the light weight of small UA, weather could have a significant impact on the flight of that aircraft. For example, on a calm day, it may be safe to operate around a building, smokestack, or tree. In contrast, these areas could easily become hazardous on a windy day.



a. Ch 11 "[Weather Theory]" (www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2011.pdf)]



b. How to obtain weather info & predictions from official sources in order to plan the operation of a sUAS.



1). **Ch 12** "[Aviation Weather Services]" (www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2012.pdf)

2). "[Aviation Weather Center]" (http://www.aviationweather.gov/ http://www.aviationweather.gov/help)

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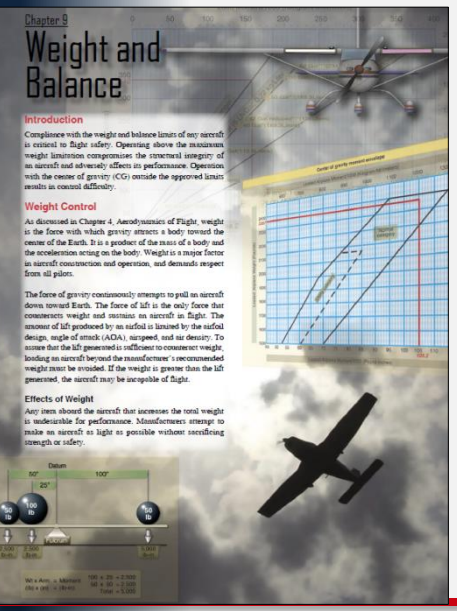
Federal Aviation Administration (FAA): **Proposed** regulations

- **Areas of knowledge tested on the initial Aeronautical Knowledge Test**

6. **How to calculate the weight and balance of the small unmanned aircraft to determine impacts on performance:** To ensure that the applicant understands some fundamental aircraft performance issues, which include load balancing, weight distribution, and available power for the operation.



a. **Ch. 9** "Weight and Balance" (http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2009.pdf)

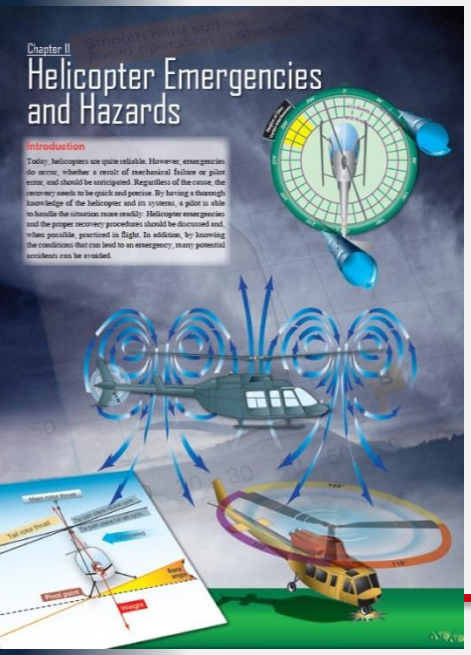
www.faa.gov/regulations_policies/rulemaking/recently_published/media/2120-AJ60_NPRM_2-15-2015_joint_signature.pdf

Federal Aviation Administration (FAA): **Proposed** regulations

- **Areas of knowledge tested on the initial Aeronautical Knowledge Test**

  7. **How to properly respond to an emergency:** This section was not explained in the NPRM.

     a. **Chapter 6** "**Emergency Procedures**" of the "**Aeronautical Information Manual: Official Guide to Basic Flight Information and ATC Procedures**" (https://www.faa.gov/air_traffic/publications/media/aim.pdf)



     b. **Ch 11 "Helicopter Emergencies and Hazards"** (https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/helicopter_flying_handbook/media/hfh_ch11.pdf) of the "**Helicopter Flying Handbook**" (https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/helicopter_flying_handbook/)

     c. **Ch 16 "Emergency Procedures"** (http://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/airplane_handbook/media/faa-h-8083-3a-7of7.pdf) of the **"Airplane Flying Handbook"** (https://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/airplane_handbook/)

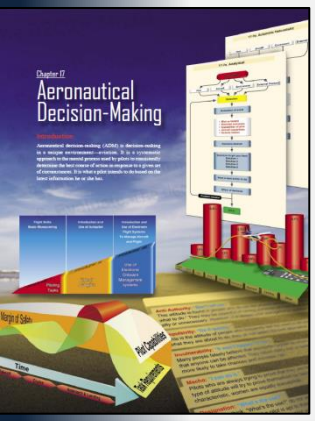
www.faa.gov/regulations_policies/rulemaking/recently_published/media/2120-AJ60_NPRM_2-15-2015_joint_signature.pdf

Federal Aviation Administration (FAA): **Proposed** regulations

- **Areas of knowledge tested on the initial Aeronautical Knowledge Test**

  8. **Aeronautical decision-making/judgment and crew resource management:** To ensure that the applicant understands

     - The **aeronautical decision-making [ADM] and judgment that manned-aircraft pilots utilize** in order to anticipate how a pilot of an approaching aircraft would react when confronted with a small UA.
     - **How to function in a team environment** [i.e. crew resource management (CRM)] in order to manage any supporting visual observers (VOs).



Ch 17 "**Aeronautical Decision-Making**" (http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2017.pdf)

Note: This chapter cover two major decision making processes. It does not cover how a pilot should react to specific hazards (e.g. a small UA flying back and forth across the passenger plane's path)

www.faa.gov/regulations_policies/rulemaking/recently_published/media/2120-AJ60_NPRM_2-15-2015_joint_signature.pdf

Federal Aviation Administration (FAA): **Proposed** regulations

- **Areas of knowledge tested on the initial Aeronautical Knowledge Test**

  8. Aeronautical decision-making/judgment and crew resource management:

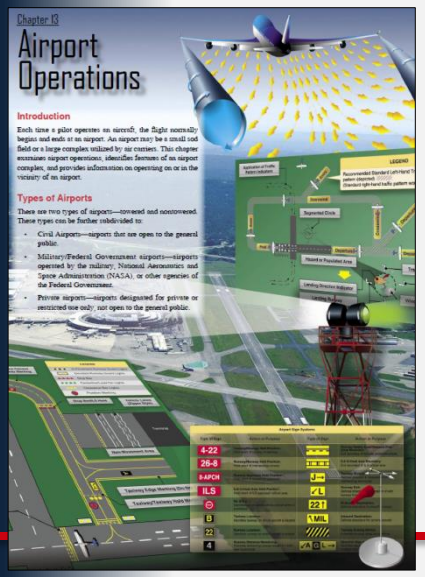
  a. Ch 7-5-5 "**Safety of Flight: Unmanned Aircraft Systems**" of the of the "**Aeronautical Information Manual: Official Guide to Basic Flight Information and ATC Procedures**" (https://www.faa.gov/air_traffic/publications/media/aim.pdf)

UAS pilot in command	Manned aircraft pilot
In all cases, approved UAS operations must comply with all applicable regulations and/or special provisions specified in the COA or in the operating limitations of the special airworthiness certificate. At uncontrolled airports, UAS operations are advised to operate well clear of all known manned aircraft operations. [Always file a Notice to Airman (NOTAM) for your upcoming UAS activity.]	Always check NOTAMs for potential UAS activity along the intended route of flight and exercise increased vigilance in areas specified in the NOTAM. Pilots of manned aircraft are advised to follow normal operating procedures and are urged to monitor the [Common Traffic Advisory Frequency] CTAF [,which is the VHF frequency used for air-to-air communication at non-towered airports] for any potential UAS activity.
Military can fly UA in Class G airspace <1,200 ft AGL without issuing a NOTAM as long as within the boundaries of the installation, which may not be depicted on an aeronautical chart	Exercise increased vigilance when operating in the vicinity of restricted or other special use airspace, military operations areas, and any military installation
Since the size of a UA can be very small, they may be difficult to see and track [by a pilot of a manned aircraft]. [Thus, never assume that a pilot of an approaching manned aircraft can see your UA.]	If a UA is encountered during flight, as with manned aircraft, - Never assume that the pilot or crew of the UAS can see you - Maintain increased vigilance with the UA - Always be prepared for evasive action if necessary

Federal Aviation Administration (FAA): **Proposed** regulations

- **Areas of knowledge tested on the initial Aeronautical Knowledge Test**

9. Airport operations and radio communication procedures: While this proposed rule would limit small UAS operations in the vicinity of an airport, there are some instances where these operations would be permitted (e.g. The proposed rule would permit a UA to be flown in Class B, C, or D airspace if the operator obtains prior ATC authorization). Thus, an applicant would need to have knowledge of:



- ➢ Airport operations in order to not interfere with those operations
- ➢ Radio communication procedures in order to communicate with ATC

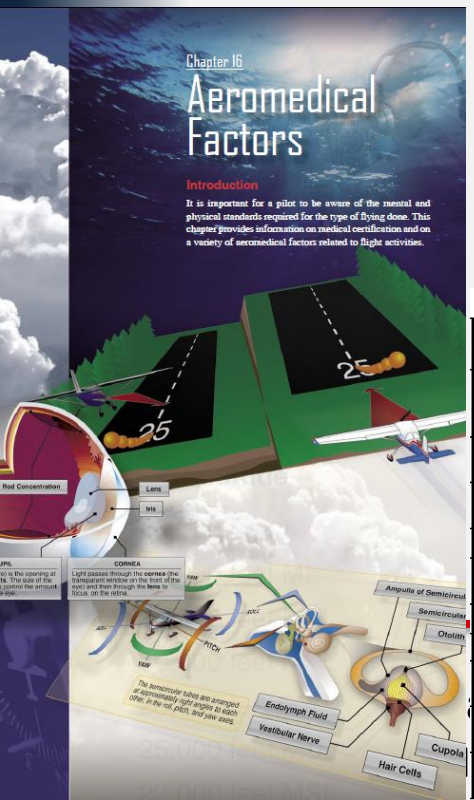
a. Ch 13 "**Airport Operations**" (http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2013.pdf)

www.faa.gov/regulations_policies/rulemaking/recently_published/media/2120-AJ60_NPRM_2-15-2015_joint_signature.pdf

Federal Aviation Administration (FAA): **Proposed** regulations

- **Areas of knowledge tested on the initial Aeronautical Knowledge Test**

10. Physiological effects of drugs and alcohol: Many prescription and over-the-counter medications can significantly reduce an individual's cognitive ability to process and determine what is happening around him or her. Accordingly, an operator needs to understand how drugs and alcohol can impact his or her ability to safely operate a small UAS.



a. **Ch 16 "[Aeromedical Factors](http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2016.pdf)"** (http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2016.pdf)

b. "**[Medications and Flying](https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/Meds_brochure.pdf)**" (https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/Meds_brochure.pdf)

Common side effects of frequently used OTC medications

Problem	Type of Medication	Example	Potential side effects
Colds, congestion, and allergies	- Decongestant - Antihistamine	Pseudoephedrine (Sudaphed®) Diphenhydramine Benadryl®) [Cetirizine (Zyrtec®)]	Palpitations, jitteriness, anxiety, drowsiness
Cough	- Cough suppressant	Dextromethorphan (Robitussin DM®)	Dizziness, drowsiness
Fever	- Antipyretic	Aspirin	Ringing in ears, upset stomach
Pain	- Analgesic	Ibuprofen (Motrin®)	Dizziness, upset stomach
Nausea / Vomiting	- Antinauseant	Dimenhydranate (Dramamine®)	Drowsiness
Diarrhea	- Antidiarrheal	Loperamide (Imodium®)	Drowsiness
Acid reflux	- Antacid	Ranitidine (Zantac®)	Headache, nausea
Constipation	- Laxative	Various	Abdominal cramping, diarrhea
Overweight	- Diet pill	Ephedrine (Ephedra)	Palpitations, jitteriness, anxiety, heart attack, stroke
Insomnia	- Sleeping pills	Diphenhydramine (Tylenol PM®)	Prolonged drowsiness and impairment of reaction times

NC UAS legislation

- **Enacted as part of the Appropriations Act of 2013 (S.L. 2013-360)**
  - **Ratified:** by the NC General Assembly on 7-25-2013
  - **Signed:** by Governor Pat McCrory on 7-26-2013

    http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2013&BillID=s402
  - **Sections:**

Session law: Section 7.16(e) and (f) of S.L. 2013-360	

NC UAS legislation

- **Enacted as part of the Appropriations Act of 2014 (S.L. 2014-100)**
  - **Ratified:** by the NC General Assembly on 8-2-2014
  - **Signed:** by Governor Pat McCrory on 8-7-2014

    http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2013&BillID=s744
  - **Sections:**

Session law:	Section 7.16(e) of S.L. 2013-360
Session law:	Section 34.30(j) of S.L. 2014-100
§ 63-95:	Training required for operation of unmanned aircraft systems
§ 63-96:	License required for commercial operation of unmanned aircraft systems
§ 15A-300.1:	Restrictions on use of unmanned aircraft systems
§ 15A-300.2:	Regulation of launch and recovery sites

§ 14-7.45:	Crimes committed by use of unmanned aircraft systems
§ 14-280.3:	Interference with manned craft by unmanned aircraft systems
§ 14-401.24:	Unlawful possession and use of unmanned aircraft systems
§ 14-401.25:	Unlawful distribution of images
§ 113-295:	Unlawful harassment of persons taking wildlife resources

NC UAS legislation

- **Senate Bill 446 / S.L. 2015-232** *Dealer Loaners/Unmanned Aircraft/Brunswick Co.*
  - **Purpose:**
    - To clarify that State agencies have authority to procure & operate UAS upon approval of the State CIO
    - To modify NC UAS regulation to conform to FAA guidelines
  - **Status:** Ratified by the NCGA on 8-20-2015 & signed by Gov McCrory on 8-25-2015

    http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2015&BillID=s446

Session law:	Section 7.16(e) of S.L. 2013-360
Session law:	Section 34.30(j) of S.L. 2014-100
§ 63-95:	Training required for operation of unmanned aircraft systems
§ 63-96:	License required for commercial operation of unmanned aircraft systems
§ 15A-300.1:	Restrictions on use of unmanned aircraft systems
§ 15A-300.2:	Regulation of launch and recovery sites
§ 14-7.45:	Crimes committed by use of unmanned aircraft systems
§ 14-280.3:	Interference with manned craft by unmanned aircraft systems
§ 14-401.24:	Unlawful possession and use of unmanned aircraft systems
§ 14-401.25:	Unlawful distribution of images
§ 113-295:	Unlawful harassment of persons taking wildlife resources

NC UAS legislation

- The details of this legislation are too important to be presented in a single summary slide.
- Format:
  - Underlined: Text added by Session Law 2015-232 (Senate Bill 446)
  - Not included: Text deleted by Session Law 2015-232 (Senate Bill 446)
  - **RED FONT**: What you **cannot** do (e.g. take pictures of people without consent)
  - **GREEN FONT**: What you are **allowed** to do (e.g. use infrared for mapping purposes)
  - **BLUE FONT**: What you are **required** to do (e.g. pass a knowledge test)

NC UAS legislation

- **Section 7.16(e) of S.L. 2013-360, as amended by Section 7.11(a) of S.L. 2014-100, reads as rewritten:**

  Until December 31, 2015, the State [Chief Information Officer] CIO shall have the authority to approve or disapprove

  (i) the procurement or operation of an unmanned aircraft system by agents or agencies of the State or a political subdivision of the State and

  (ii) the disclosure of personal information about any person acquired through the operation of an unmanned aircraft system by agents or agencies of the State or a political subdivision of the State.

  When making a decision under this subsection, the State CIO may consult with the Division of Aviation of the Department of Transportation. The State CIO shall immediately report to the Joint Legislative Oversight Committee on Information Technology and the Fiscal Research Division on all decisions made under this subsection.

http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2015&BillID=s446

NC UAS legislation

- **§ 63-95. Training required for operation of unmanned aircraft systems**

  (b) The **Division [Division of Aviation/NCDOT] shall develop a knowledge test for operating an unmanned aircraft system that complies with all applicable State and federal regulations and shall provide for administration of the test**.

  - **The test shall ensure that the operator of an unmanned aircraft system is knowledgeable of the State statutes and regulations regarding the operation of unmanned aircraft systems.**
  - The Division may permit a person, including an agency of this State, an agency of a political subdivision of this State, an employer, or a private training facility, to administer the test developed pursuant to this subsection, provided the test is the same as that administered by the Division and complies with all applicable State and federal regulations.

  (c) **No agent or agency of the State, or agent or agency of a political subdivision of the State, may operate an unmanned aircraft system within the State without completion of the test set forth in subsection (b) of this section**. (2014-100, s. 34.30(g).)

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-95.html http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2015&BillID=s446

NC UAS legislation

- **§ 63-96. Permit required for commercial operation of unmanned aircraft systems**

  (a) **No person shall operate an unmanned aircraft system, as defined in G.S. 15A-300.1, in this State for commercial purposes unless the person is in possession of a permit issued by the Division [Division of Aviation/NCDOT] valid for the unmanned aircraft system being operated**. Application for the permit shall be made in the manner provided by the Division. Unless suspended or revoked, the permit shall be effective for a period to be established by the Division not exceeding eight years.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-96.html http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2015&BillID=s446

NC UAS legislation

- **§ 63-96. Permit required for commercial operation of unmanned aircraft systems**

(b) **No person shall be issued a permit under this section unless all of the following apply:**

(1) The person is at least 17 years of age.

(2) The person possesses a valid drivers license issued by any state or territory of the United States or the District of Columbia.

(3) **The person has passed the knowledge test for operating an unmanned aircraft system as prescribed in G.S. 63-95(b).**

(4) **The person has satisfied all other applicable requirements of this Article or federal regulation.**

(c) **A permit to operate an unmanned aircraft system for commercial purposes shall not be issued to a person while the person's license or permit to operate an unmanned aircraft system is suspended, revoked, or cancelled in any state.**

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-96.html http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2015&BillID=s446

NC UAS legislation

- **§ 63-96. Permit required for commercial operation of unmanned aircraft systems**

(d) **The Division shall develop and administer a program that complies with all applicable federal regulations to issue permits to operators of unmanned aircraft systems for commercial purposes**. The program must include the following components:

(1) A system for classifying unmanned aircraft systems based on characteristics determined to be appropriate by the Division.

(2) A fee structure for permits.

(3) A permit application process, which shall include a requirement that the Division provide notice to an applicant of the Division's decision on issuance of a permit no later than 10 days from the date the Division receives the applicant's application.

(4) **Technical guidance for complying with program requirements.**

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-96.html http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2015&BillID=s446

NC UAS legislation

- **§ 63-96. Permit required for commercial operation of unmanned aircraft systems**

  (d) **The Division shall develop and administer a program that complies with all applicable federal regulations to issue permits to operators of unmanned aircraft systems for commercial purposes**. The program must include the following components:

  (5) **Criteria under which the Division may suspend or revoke a permit**

  (6) **Criteria** under which the **Division may waive permitting requirements for applicants currently holding a valid license or permit to operate unmanned aircraft systems issued by another state** or territory of the United States, the District of Columbia, **or the United States**.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-96.html http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2015&BillID=s446

NC UAS legislation

- **§ 63-96. Permit required for commercial operation of unmanned aircraft systems**

  (d) **The Division shall develop and administer a program that complies with all applicable federal regulations to issue permits to operators of unmanned aircraft systems for commercial purposes**. The program must include the following components:

  (7) A **designation of the geographic area within which a permittee shall be authorized to operate** an unmanned aircraft system. The rules adopted by the Division for designating a geographic area pursuant to this subdivision shall be no more restrictive than the rules or regulations adopted by the Federal Aviation Administration for designating a geographic area for the commercial operation of unmanned aircraft systems.

  (8) **Requirements** pertaining to the **collection, use, and retention of data by permitees obtained through the operation of unmanned aircraft systems**, to be established in consultation with the State Chief Information Officer.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-96.html http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2015&BillID=s446

NC UAS legislation

- **§ 63-96. Permit required for commercial operation of unmanned aircraft systems**

  (d) **The Division shall develop and administer a program that complies with all applicable federal regulations to issue permits to operators of unmanned aircraft systems for commercial purposes**. The program must include the following components:

  (9) **Requirements for the marking of each unmanned aircraft system operated pursuant to a permit** issued under this section sufficient **to allow identification of the owner of the system and the person issued a permit to operate it**.

  (10) A **system for providing agencies that conduct** other **operations within regulated airspace** with the **identity and contact information of permittees** and the **geographic areas within which the permittee is authorized to operate** an unmanned aircraft system.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-96.html http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2015&BillID=s446

NC UAS legislation

- **§ 63-96. Permit required for commercial operation of unmanned aircraft systems**

  (e) **A person** who **operates an unmanned aircraft system for commercial purposes other than as authorized** under this section shall be **guilty of a Class 1 misdemeanor**.

The NC Court System lists the following **sentences (days)** for a **Class 1 misdemeanor** based on the convicted person's prior conviction level (http://www.nccourts.org/Courts/CRS/Councils/spac/Documents/Misd_Chart_120113.pdf).

	Prior conviction level		
Class	I (No prior convictions)	II (1-4 prior convictions)	III (≥5 prior convictions)
1	1-45 days community punishment	1-45 days community / intermediate / active punishment	1-120 days community / intermediate / active punishment

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-96.html http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2015&BillID=s446

NC UAS legislation

- **§ 63-96. <u>Permit</u> required for commercial operation of unmanned aircraft systems**

  (f) The Division may issue rules and regulations to implement the provisions of this section. (2014-100, s. 34.30(g).)

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_63/gs_63-96.html http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2015&BillID=s446

NC UAS legislation

- **SECTION 34.30.(i) of S.L. 2014-100 (S.B. 744)**

  The **Division of Aviation** of the Department of Transportation **shall immediately begin developing the licensing system for commercial operation** required by G.S. 63-96, as enacted in subsection (g) of this section, and **shall ensure that the system complies with Federal Aviation Administration (FAA) guidelines on commercial operation**, as those guidelines become available. **Within 60 days of issuance of the FAA guidelines and authorization by the FAA for commercial operations** to begin, the **Division shall implement the licensing system** required by G.S. 63-96, as enacted in subsection (g) of this section.

http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2013&BillID=s744

NC UAS legislation

- **SECTION 2.5 of S.L. 2015-232 (S.B. 446)**

Prior to the implementation of the knowledge test and permitting process required by G.S. 63-96, any person authorized by the FAA for commercial operation of an UAS in this State shall not be in violation of that statute, provided that the person:

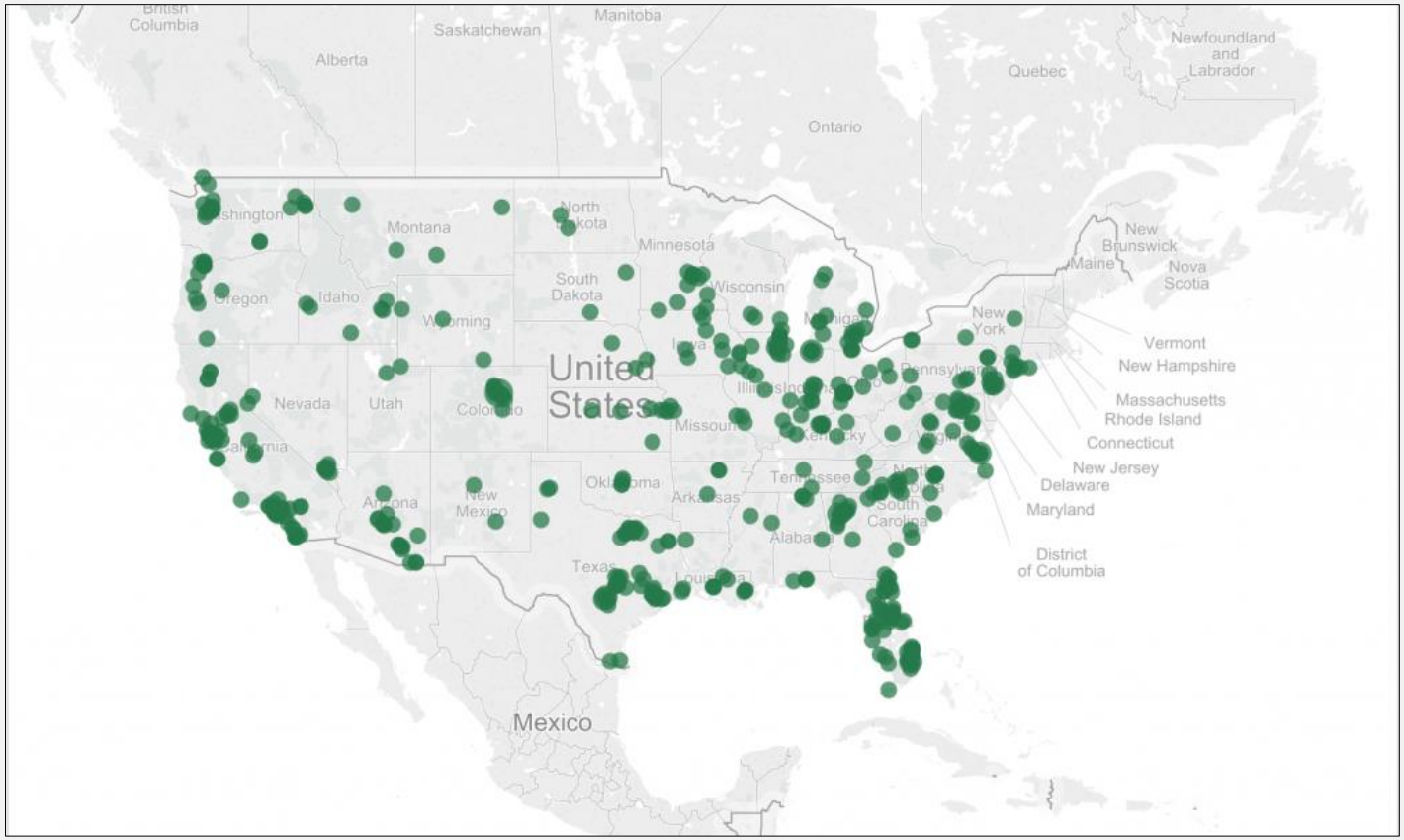
- Makes application for a State permit for commercial operation within 60 days of the full implementation of the permitting process and
- Is issued a State commercial operation permit in due course.

In other words, the State of NC will allow your company to conduct commercial UAS operations in NC before the NC Division of Aviation establishes its commercial permitting system if both of the following conditions apply:

1. The FAA has issued your company either a 333 Exemption or a commercial UAS license, which has not yet been implemented, to conduct commercial UAS operations in NC.
2. Your company applies to the NC Division of Aviation for an NC commercial UAS permit within 60 days of the implementation of the system and the NC Division of Aviation issues a commercial UAS permit to your company.

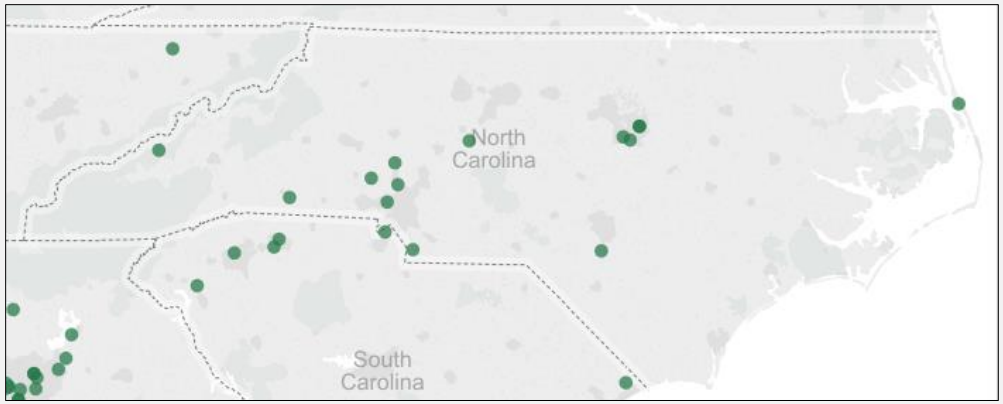
http://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2015&BillID=s446

Distribution of 333 Exemptions as of 7-31-2015



http://dronecenter.bard.edu/mapping-the-drone-industry/

Distribution of 333 Exemptions in NC as of 7-31-2015



http://dronecenter.bard.edu/mapping-the-drone-industry/

Company	Ag	Conservation	Construction	Govt contracting	Photo/Film	Real estate	Scientific studies	Utilities/Energy/Infrastructure
AgWorx	Y	Y					Y	
AirRaid Aerials, LLC								Y
ETAK Systems, Inc	Y							Y
Extreme Aerial Works, LLC					Y			
Jason Sanko						Y		
John Keller					Y	Y		Y
Leading Edge Associates, Inc	Y			Y			Y	
Littlebirds VIEW					Y			
Mark Wages						Y		
McKim & Creed Inc			Y					Y
Special Forces Parachute Team			Y		Y	Y		
William K. Pedersen			Y			Y		
Wilson Securities Agency				Y			Y	
Total (13 companies)	**3**	**1**	**3**	**2**	**4**	**5**	**3**	**4**

NC UAS legislation

- **§ 15A-300.1. Restrictions on use of unmanned aircraft systems**

(b) General Prohibitions. – Except as otherwise provided in this section, **no person, entity, or State agency shall use an unmanned aircraft system to do any of the following:**

(1) **Conduct surveillance** of:

a. A **person or a dwelling** occupied by a person and that dwelling's **curtilage without the person's consent**.

b. **Private real property without the consent of the owner, easement holder, or lessee of the property**.

(2) **Photograph an individual, without the individual's consent, for the purpose of publishing** or otherwise publicly disseminating the photograph. **This subdivision shall not apply to newsgathering, newsworthy events, or events or places to which the general public is invited**.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.1.html

- - Curtilage - -

- Searching areas outside home/building
  - If there is an expectation of privacy, then the Fourth Amendment applies
  - **Curtilage** has an expectation of privacy. Courts use a 4-part test to determine whether something is in a dwelling's curtilage:
    1. Proximity to the home
    2. Whether within an enclosure surrounding the home
    3. Nature and use of the area
    4. Effort made to protect the area from observation
  - Open fields and woods outside curtilage have no expectation of privacy even if surrounded by fence or posted.
- Surveillance

http://www.ncleg.net/documentsites/committees/BCCI-6624/2014-1-21%20Meeting/Potentially%20Relevant%20Current%20NC%20Laws/Powerpoint%20Current%20NC%20Laws.pdf

  - Aircraft
    - Generally permitted over open fields and curtilage to view with unaided vision
    - However, use of zooming lenses or other equipment to improve vision into curtilage may require a search warrant.

NC UAS legislation

- **§ 15A-300.1. Restrictions on use of unmanned aircraft systems**

(b) General Prohibitions. – Except as otherwise provided in this section, **no person, entity, or State agency shall use an unmanned aircraft system to do any of the following:**

(1) **Conduct surveillance** of:

a. A **person or a dwelling** occupied by a person and that dwelling's **curtilage without the person's consent**.

b. **Private real property without the consent of the owner, easement holder, or lessee of the property**.

(2) **Photograph an individual, without the individual's consent, for the purpose of publishing** or otherwise publicly disseminating the photograph. **This subdivision shall not apply to newsgathering, newsworthy events, or events or places to which the general public is invited**.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.1.html

NC UAS legislation

- **§ 15A-300.1. Restrictions on use of unmanned aircraft systems**

(c) **Law Enforcement Exceptions**. – Notwithstanding the provisions of subsection (b) of this section, the use of unmanned aircraft systems by **law enforcement agencies of the State or a political subdivision of the State is not prohibited** in the following instances:

(1) **To counter a high risk of a terrorist attack** by a specific individual or organization if the United States Secretary of Homeland Security or the Secretary of the North Carolina Department of Public Safety determines that **credible intelligence indicates that such a risk exists**.

(2) **To conduct surveillance in an area** that is within a law enforcement officer's plain view when the officer is **in a location the officer has a legal right to be**.

(3) **If the law enforcement agency first obtains a search warrant authorizing the use of an unmanned aircraft system**.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.1.html

NC UAS legislation

- **§ 15A-300.1. Restrictions on use of unmanned aircraft systems**

(c) **Law Enforcement Exceptions**. – Notwithstanding the provisions of subsection (b) of this section, the use of unmanned aircraft systems by **law enforcement agencies of the State or a political subdivision of the State is not prohibited** in the following instances:

(4) If the law enforcement agency possesses reasonable suspicion that, under particular circumstances, **swift action is needed to prevent imminent danger to life** or **serious damage to property**, **to forestall the imminent escape of a suspect** or the **destruction of evidence**, **to conduct pursuit of an escapee or suspect**, or to facilitate the **search for a missing person**.

(5) **To photograph gatherings to which the general public is invited on public or private land**.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.1.html

NC UAS legislation

- **§ 15A-300.1. Restrictions on use of unmanned aircraft systems**

  (d) Limitations on Use of Special Imaging Technology. – **Commercial and private unmanned aircraft systems may be equipped with infrared or other thermal imaging technology subject to the provisions of this subsection**. Infrared or other similar thermal imaging technology equipment shall be **for the sole purpose of scientific investigation**; **scientific research; mapping and evaluating the earth's surface, including terrain and surface water bodies** and other features**; investigation or evaluation of crops**, **livestock**, or **farming operations; investigation of forests and forest management;** and other similar **investigations of vegetation or wildlife**.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.1.html

NC UAS legislation

- **§ 15A-300.1. Restrictions on use of unmanned aircraft systems**

  (e) **Any person who is the subject of unwarranted surveillance**, or **whose photograph is taken** in violation of the provisions of this section, **shall have a civil cause of action against the person, entity, or State agency that conducts the surveillance** or that uses an unmanned aircraft system to photograph for the purpose of publishing or otherwise disseminating the photograph. In lieu of actual damages, **the person whose photograph is taken may elect to recover five thousand dollars ($5,000) for each photograph or video that is published** or otherwise disseminated, **as well as reasonable costs and attorneys' fees and injunctive or other relief as determined by the court**.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.1.html

NC UAS legislation

- **§ 15A-300.1. Restrictions on use of unmanned aircraft systems**

  (f) **Evidence obtained or collected in violation of this section is not admissible as evidence in a criminal prosecution in any court of law in this State except when obtained or collected under the objectively reasonable, good-faith belief that the actions were lawful.**

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.1.html

NC UAS legislation

- **§ 15A-300.2. Regulation of launch and recovery sites**

  (a) **No unmanned aircraft system may be launched or recovered from any State or private property without consent.**

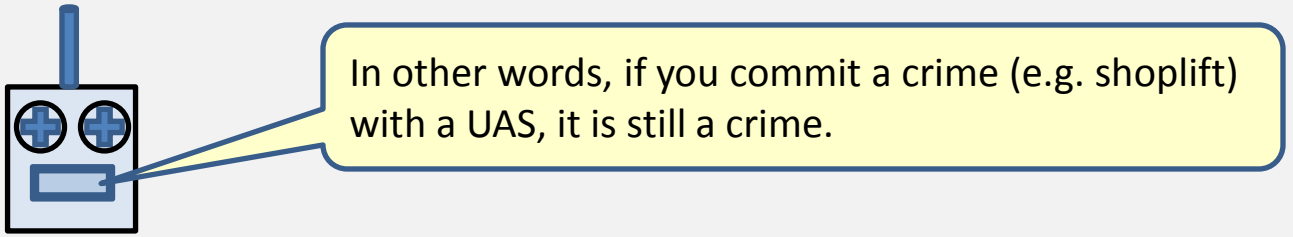
  (b) **A unit of local government may adopt an ordinance to regulate the use of the local government's property for the launch or recovery of unmanned aircraft systems.** (2014-100, s. 34.30(a).)

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_15a/gs_15a-300.2.html

NC UAS legislation

- **§ 14-7.45. Crimes committed by use of unmanned aircraft systems**

  All crimes committed by use of an unmanned aircraft system, as defined in G.S. 15A-300.1, while in flight over this State shall be governed by the laws of this State, and the **question of whether the conduct by an unmanned aircraft system while in flight over this State constitutes a crime by the owner of the unmanned aircraft system shall be determined by the laws of this State**. (2014-100, s. 34.30(b).)



http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_14/gs_14-7.45.html

NC UAS legislation

- **§ 14-280.3. Interference with manned aircraft by unmanned aircraft systems**

  (a) **Any person who willfully damages**, **disrupts the operation of**, or otherwise **interferes with a manned aircraft** through **use of an unmanned aircraft system**, **while the manned aircraft** is taking off, landing, in flight, or otherwise **in motion**, is **guilty of a Class H felony**.

The NC Court System lists the following **sentences (months)** for a **Class H felony** based on the convicted person's prior record level (http://www.nccourts.org/Courts/CRS/Councils/spac/Documents/FelonyChart_1013MaxChart.pdf).

	Prior record level					
Felony class	I (0-1 pt)	II (2-5 pts)	III (6-9 pts)	IV (10-13 pts)	V (14-17 pts)	VI (18+ pts)
H	5-6 months	6-8 months	8-10 months	9-11 months	12-15 months	16-20 months

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_14/gs_14-280.3.html

NC UAS legislation

- **§ 14-401.24. Unlawful possession and use of unmanned aircraft systems**

(a) It shall be a **Class E felony for any person to possess or use an unmanned aircraft or unmanned aircraft system that has a weapon attached**.

	Prior record level					
Felony class	I (0-1 pt)	II (2-5 pts)	III (6-9 pts)	IV (10-13 pts)	V (14-17 pts)	VI (18+ pts)
E	20-25 mons	23-29 mons	26-33 mons	30-38 mons	35-44 mons	40-50 mons

http://www.nccourts.org/Courts/CRS/Councils/spac/Documents/FelonyChart_1013MaxChart.pdf

(b) It shall be a **Class 1 misdemeanor for any person to fish or to hunt using an unmanned aircraft system**. [Class 1 misdemeanor: 1-45 days community punishment]

(c) The following definitions apply to this section:

(1) To fish: As defined in G.S. 113-130.

(2) To hunt: As defined in G.S. 113-130.

(3) Unmanned aircraft: As defined in G.S. 15A-300.1.

(4) Unmanned aircraft system: As defined in G.S. 15A-300.1

(5) Weapon. - Those weapons specified in G.S. 14-269, 14-269.2, 14-284.1, or 14-288.8 and any other object capable of inflicting serious bodily injury or death when used as a weapon.

NC UAS legislation

- **§ 14-401.24. Unlawful possession and use of unmanned aircraft systems**

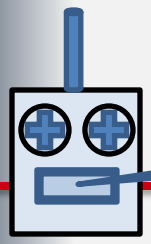
  (d) This section **shall not prohibit possession or usage of an unmanned aircraft or unmanned aircraft system that is authorized by federal law or regulation.** (2014-100, s. 34.30(d).)

A Raven, which is a surveillance and recon UA that the Army trains with at Fort Bragg, being launched in Afghanistan.

http://www.fayobserver.com/military/officials-larger-drones-to-be-added-to-fort-bragg-arsenal/article_b2043156-d1dc-5bf5-a113-8c68570689e6.html

An MQ-1C Gray Eagle (Sky Warrior), which is a combat UA capable of carrying missiles and laser-guided bombs, that will be added to Fort Bragg's arsenal and fly over sparsely populated areas of NC.

http://www.militaryfactory.com/imageviewer/ac/gallery-ac.asp?aircraft_id=785



Presumably, this article was included so that North Carolina regulations would not prohibit the U.S. military from flying unmanned aircraft over the state.

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_14/gs_14-401.24.html

NC UAS legislation

- **§ 14-401.25. Unlawful distribution of images**

  It shall be a **Class A1 misdemeanor to publish or disseminate, for any purpose, recorded images taken by a person or non-law enforcement entity through the use of infrared or other similar thermal imaging technology attached to an unmanned aircraft system**, as defined in G.S. 15A-300.1**, and revealing individuals, materials, or activities inside of a structure without the consent of the property owner.** (2014-100, s. 34.30(e).)

The NC Court System lists the following **sentences (days)** for a **Class A1 misdemeanor** based on the convicted person's prior conviction level (http://www.nccourts.org/Courts/CRS/Councils/spac/Documents/Misd_Chart_120113.pdf).

	Prior conviction level		
Class	I (No prior convictions)	II (1-4 prior convictions)	III (≥5 prior convictions)
1	1-60 days community / intermediate / active punishment	1-75 days community / intermediate / active punishment	1-150 days community / intermediate / active punishment

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_14/gs_14-401.25.html

NC UAS legislation

- **§ 113-295. Unlawful harassment of persons taking wildlife resources**

(a) It is **unlawful** for a person **to interfere intentionally with the lawful taking of wildlife resources or to drive, harass, or intentionally disturb any wildlife resources for the purpose of disrupting the lawful taking of wildlife resources.**

It is **unlawful to take or abuse property, equipment, or hunting dogs that are being used for the lawful taking of wildlife resources**.

This subsection **does not apply to a person who incidentally interferes with the taking of wildlife resources while using the land for other lawful activity such as agriculture, mining, or recreation**.

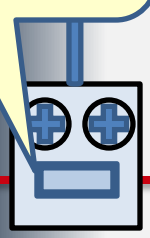
This subsection also does not apply to activity by a person on land he owns or leases. **Violation of this subsection is a Class 2 misdemeanor for a first conviction** and a **Class 1 misdemeanor for a second or subsequent conviction**.

(a1) It is **unlawful to use an unmanned aircraft system**, as defined in G.S. 15A-300.1, **to violate subsection (a) of this section. Violation of this subsection is a Class 1 misdemeanor.**

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_113/gs_113-295.html

This statute was originally enacted in 1987, which was well before UAS technology emerged.

Article **(a1)** was added to specify that using a UAS to harass hunters would qualify as interference.



NC UAS legislation

- **§ 113-295. Unlawful harassment of persons taking wildlife resources**

(b) The Wildlife Resources Commission may, either before or after the institution of any other action or proceeding authorized by this section, institute a civil action for injunctive relief to restrain a violation or threatened violation of subsection (a) of this section pursuant to G.S. 113-131.

The action shall be brought in the superior court of the county in which the violation or threatened violation is occurring or about to occur and shall be in the name of the State upon the relation of the Wildlife Resources Commission.

The court, in issuing any final order in any action brought pursuant to this subsection may, in its discretion, award costs of litigation including reasonable attorney and expert-witness fees to any party. (1987, c. 636, s. 3; 1993, c. 539, s. 864; 1994, Ex. Sess., c. 24, s. 14(c); 2014-100, s. 34.30(f).)

http://www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_113/gs_113-295.html

Path to a UAS program

Obtain Support

- Leadership
- Key Community Partners
- Expertise / Knowledge Source

Initial Research

- Anticipated Missions
- Potential locations
- Airspace
- Staffing impact
- Risk Management
- Product options

Develop Integration Plan

- Familiarization
- Training
- Community education
- Identify initial missions
- Timelines

Obtain Funding and Purchase

- Aircraft
- Ground support equipment
- Maintenance supplies
- Training
- Staffing

Obtain FAA Certificate of Authorization (CoA)

- Specific to aircraft type and location
- Follow prescribed SOPs and command & control (C2) requirements
- Require FAA approved training
- Line of sight monitoring
- Not to be used for commercial benefit

Start Flight Ops

- On-location familiarization
- Scenario-based training
- Mission authorizations (warrants, DoD deconfliction, land owner approval)
- FAA reporting

Steps to implementing UAS technology into your enterprise

1. How would you use it?:
   a. If you want to map large areas (e.g. fields, surface mines, large construction sites, or pipelines) that have open areas for launching and landing, then get a fixed-wing UAS.
   b. If you want to map small areas (e.g. home parcels or small construction sites) or conduct a close-up inspect of infrastructure items (e.g. bridges, power poles, or dams) that may or may not have large open areas for launching and landing, then get a multirotor UAS.

Steps to implementing UAS technology into your enterprise

2. Would it be profitable?: Conduct a cost-benefit analysis
   a. **Costs:**
      1). Equipment and software
      2). Training on equipment and software
      3). Administrative costs for applying for:
         a). An FAA Section 333 Exemption, which will eventually be replaced by an FAA commercial license, and an NC commercial permit.
         b). An FAA civil Certificate of Waiver or Authorization (COA)
      4). Time spent preparing for the FAA aeronautical test & the NC UAS regs test
   b. **Benefits:**
      1). Scaled aerial imagery in RGB and infrared
      2). Point clouds, TINs, DEMs, and DSMs
      3). Sensor readings (thermal, multispectral, LiDAR, gas) and streaming live video

Steps to implementing UAS technology into your enterprise

2. Would it be profitable?: Conduct a cost-benefit analysis
   c. Study the "***UAS – Business Decision in Private Practice***" presentation by Joe Bruno, PLS

http://www.ncgs.state.nc.us/Documents/UAS%20Business.pdf

Steps to implementing UAS technology into your enterprise

3. Research various UAS models for the UAS type (fixed-wing or multirotor) that would best fit your needs
   a. Take your time, because:
      1). Equipment costs will get cheaper each year.
      2). Equipment capabilities will increase each year.
   b. Study the presentations from the UAV-Geomatics conferences:
      1). 2013 conference (http:// www.uav-g.org/presentations_online.htm)
      2). 2015 conference

Conference	http://www.uav-g-2015.ca/
Program	http://www.uav-g-2015.ca/forms/Conference%20Program_UAVg2015-26AUG2015-f.pdf
Proceedings – Annals (5 papers)	http://www.isprs-ann-photogramm-remote-sens-spatial-inf-sci.net/II-1-W1/index.html
Proceedings – Archives (64 papers)	http://www.int-arch-photogramm-remote-sens-spatial-inf-sci.net/XL-1-W4/index.html
Facebook	https://www.facebook.com/uavg2015

Steps to implementing UAS technology into your enterprise

4. Get a recreational version and practice on it

   a. Although this advice is far more important for potential multirotor users than for fixed-wing users, because the fixed-wing UAS models basically fly themselves along preset routes, it is still a good idea to familiarize yourself with flying a small aircraft that costs $100 rather than with an aircraft costing tens of thousands of dollars.

      Hint: Watch the Extreme Drone Crashes - Compilation 2015 video (https://www.youtube.com/watch?v=P9rnTk6FBzs).

   b. Buy from a local hobby store rather than from an online source. Why?

      1). You can ask for advice on which model to purchase as a trainer model:

- Blade Nano QX (http://www.bladehelis.com/Products/Default.aspx?ProdID=BLH7600) for indoor practicing
- Dromida Ominus (http://dromida.com/air/dide01xx-ominus/index.html) for outdoor practicing

Steps to implementing UAS technology into your enterprise

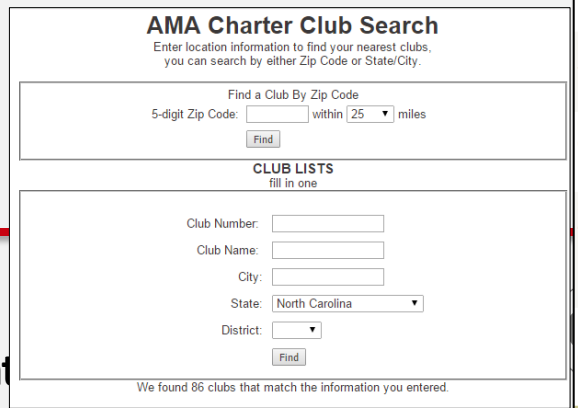
4. Get a recreational version and practice on it

   b. Buy from a local hobby store rather than from an online source. Why?

      2). You can ask about local sites to fly your aircraft and meet other people who really know their stuff!

         a). I practice flying my recreational multirotor on a large field on the Dorothea Dix campus (35.768411, -78.664090), which is located near downtown Raleigh, with other radio control enthusiasts and have gotten a lot of advice.

         b). The Academy of Model Aeronautics (www.modelaircraft.org/clubsearch.aspx) lists 10 AMA Charter Club sites within 25 miles of Clayton (zip code: 27520) and a total of 86 sites in North Carolina.



Name	Number	Members	Contact	Info	District	*Intro Pilots
JOHNSTON COUNTY AEROMODELING CLUB Flying Site Details **9.77 miles**	1163	36	ROBERT WILHELMY Email Contact	Phone: 919-669-0570 Visit Website	4	
PILOT RC FLYING CLUB Flying Site Details **10.68 miles**	2396	18	ALFRED LAMBERT Email Contact	Phone: 919.217-1281	4	
HARNETT MINI AERO CLUB Flying Site Details **13.04 miles**	5061	13	DWAYNE BLACKMON Email Contact	Phone:	4	
FIRST IN FLIGHT JETS **15.34 miles**	5074	11	LAWRENCE LEWIS Email Contact	Phone: 919.231.4983	4	
RC HELI'S ONLY **16.45 miles**	5014	21	SAMUEL HARRIS Email Contact	Phone: 919-341-2463 Visit Website	4	
RALEIGH AERO MASTERS INC **16.48 miles**	1540	33	JOSE ARMSTRONG Email Contact	Phone: 919-848-9118 Visit Website	4	
FLYING TIGERS OF JORDAN LAKE Flying Site Details **20.66 miles**	3162	16	FREDERICK KOZLOF Email Contact	Phone: 919/233-6632 Visit Website	4	
PROP NUTS RC CLUB Flying Site Details **20.68 miles**	2014	8	JAMES DAGGERHART Email Contact	Phone: 919-632-8378	4	
SOUTHERN WAKE AERO MODELING PILOTS SOCIETY - Email Club Flying Site Details **21.93 miles**	4416	43	RALPH TUTOR Email Contact	Phone: 919.552.6048 Visit Website	4	Yes
HOLLY SPRINGS SKYHAWK RC GROUP Flying Site Details **21.93 miles**	5291	12	DOUGLAS LEROY Email Contact	Phone: 984-789-7333	4	

North Carolina
Emergency Management

Steps to implementing UAS technology into your enterprise

4. Get a recreational version and practice on it

   b. Buy from a local hobby store rather than from an online source. Why?

      3). You can ask for advice on which battery charger to purchase.

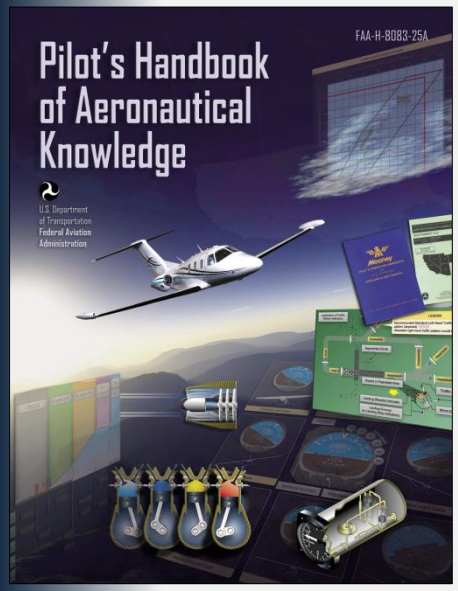
Most recreational multirotors and planes will come with a USB battery charger, which you can plug into computer or a phone charger. Unfortunately, a phone charger's amperage is generally higher than what your aircraft's battery can handle. In addition, my computer seemed hotter than normal when I used it to charge my batteries.

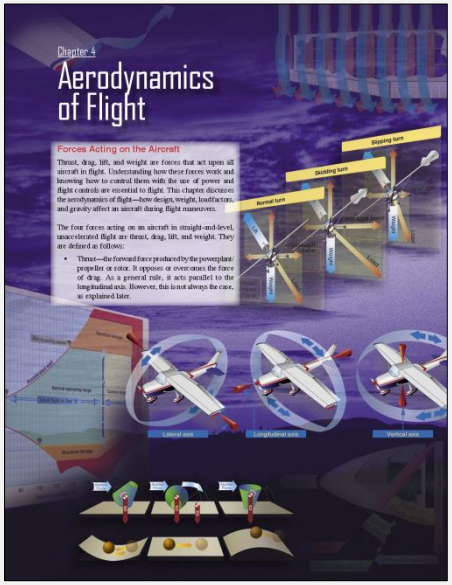
Fortunately, a hobby store staff person recommended purchasing:

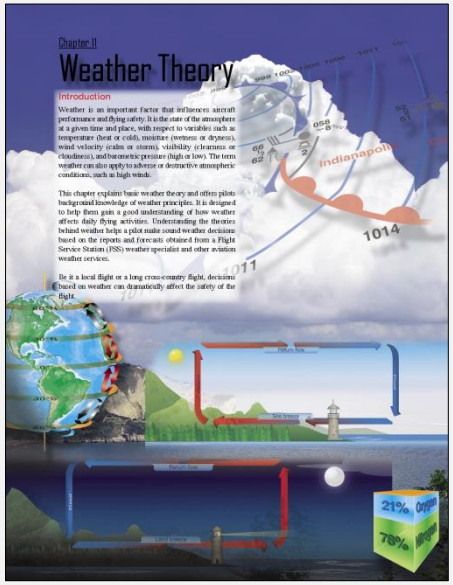
- A good battery charger, such as a Venom Pro 3 (http://www.atomikrc.com/products/venom-pro-charger-3-lipo-and-nimh-battery-charger), that can charge multiple battery types
- An adapter that can charge multiple batteries at a time (http://www.atomikrc.com/products/venom-1-cell-battery-charge-adapter-micro-jst-jst-ph)

Steps to implementing UAS technology into your enterprise

5. Start studying for the FAA aeronautical test
   a. Study the [Pilot's Handbook of Aeronautical Knowledge]





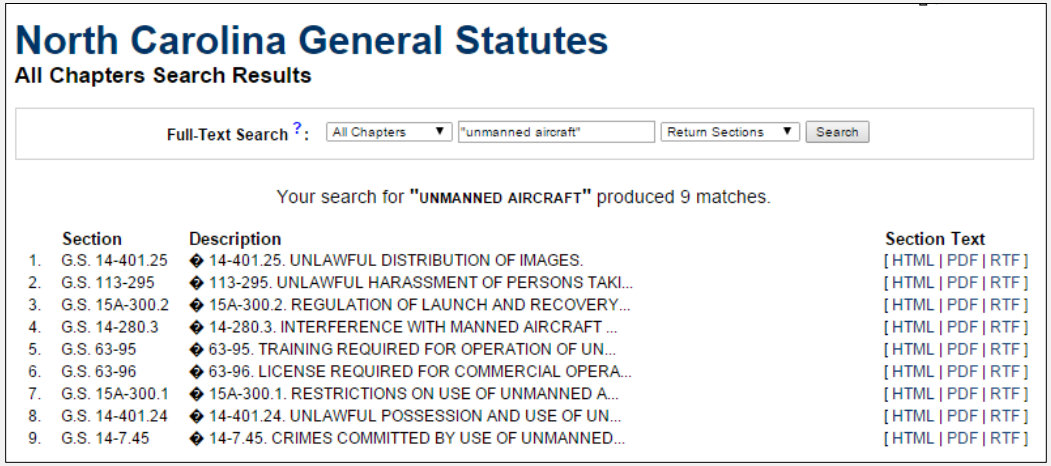


http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/

Steps to implementing UAS technology into your enterprise

6. Start studying for the NC UAS regulations test
   a. Review the NC regulations section of this presentation
   b. Check for updates on each listed UAS regulation as well as for any new UAS legislation (http://www.ncleg.net/gascripts/Statutes/StatutesSearch.asp?searchScope=All&searchCriteria=%22**unmanned**+**aircraft**%22&returnType=Section)

NCGA
NORTH CAROLINA GENERAL ASSEMBLY



North Carolina General Statutes

All Chapters Search Results

Full-Text Search ?: All Chapters | "unmanned aircraft" | Return Sections | Search

Your search for "UNMANNED AIRCRAFT" produced 9 matches.

	Section	Description	Section Text
1.	G.S. 14-401.25	14-401.25. UNLAWFUL DISTRIBUTION OF IMAGES.	[HTML | PDF | RTF]
2.	G.S. 113-295	113-295. UNLAWFUL HARASSMENT OF PERSONS TAKI...	[HTML | PDF | RTF]
3.	G.S. 15A-300.2	15A-300.2. REGULATION OF LAUNCH AND RECOVERY...	[HTML | PDF | RTF]
4.	G.S. 14-280.3	14-280.3. INTERFERENCE WITH MANNED AIRCRAFT ...	[HTML | PDF | RTF]
5.	G.S. 63-95	63-95. TRAINING REQUIRED FOR OPERATION OF UN...	[HTML | PDF | RTF]
6.	G.S. 63-96	63-96. LICENSE REQUIRED FOR COMMERCIAL OPERA...	[HTML | PDF | RTF]
7.	G.S. 15A-300.1	15A-300.1. RESTRICTIONS ON USE OF UNMANNED A...	[HTML | PDF | RTF]
8.	G.S. 14-401.24	14-401.24. UNLAWFUL POSSESSION AND USE OF UN...	[HTML | PDF | RTF]
9.	G.S. 14-7.45	14-7.45. CRIMES COMMITTED BY USE OF UNMANNED...	[HTML | PDF | RTF]

http://www.ncleg.net/gascripts/Statutes/StatutesSearch.asp?searchScope=All&searchCriteria=%22**unmanned**+**aircraft**%22&returnType=Section/

Steps to implementing UAS technology into your enterprise

7. Become familiar with NC airspace
   a. Request the following items from the NCDOT Division of Aviation (http://www.ncdot.gov/aviation/products/):
      1). North Carolina Aeronautical Chart
      2). North Carolina 2015-16 Airport Guide (www.ncdot.gov/aviation/download/AirportGuide.pdf)

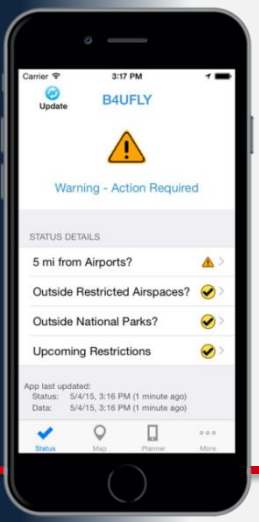
http://www.ncdot.gov/aviation/products/

Steps to implementing UAS technology into your enterprise

7. Become familiar with NC airspace

   b. Install the **B4UFLY app**, which is an easy way to determine whether there are any restrictions or requirements in effect at the location where you want to fly a UAV.

   – FAA released the iOS app to ~1,000 beta testers on August 28, 2015. If you want to be put on a wait list for testing, visit (www.faa.gov/uas/b4ufly/). Eventually, the agency will release the app to the general public and make an Android version.

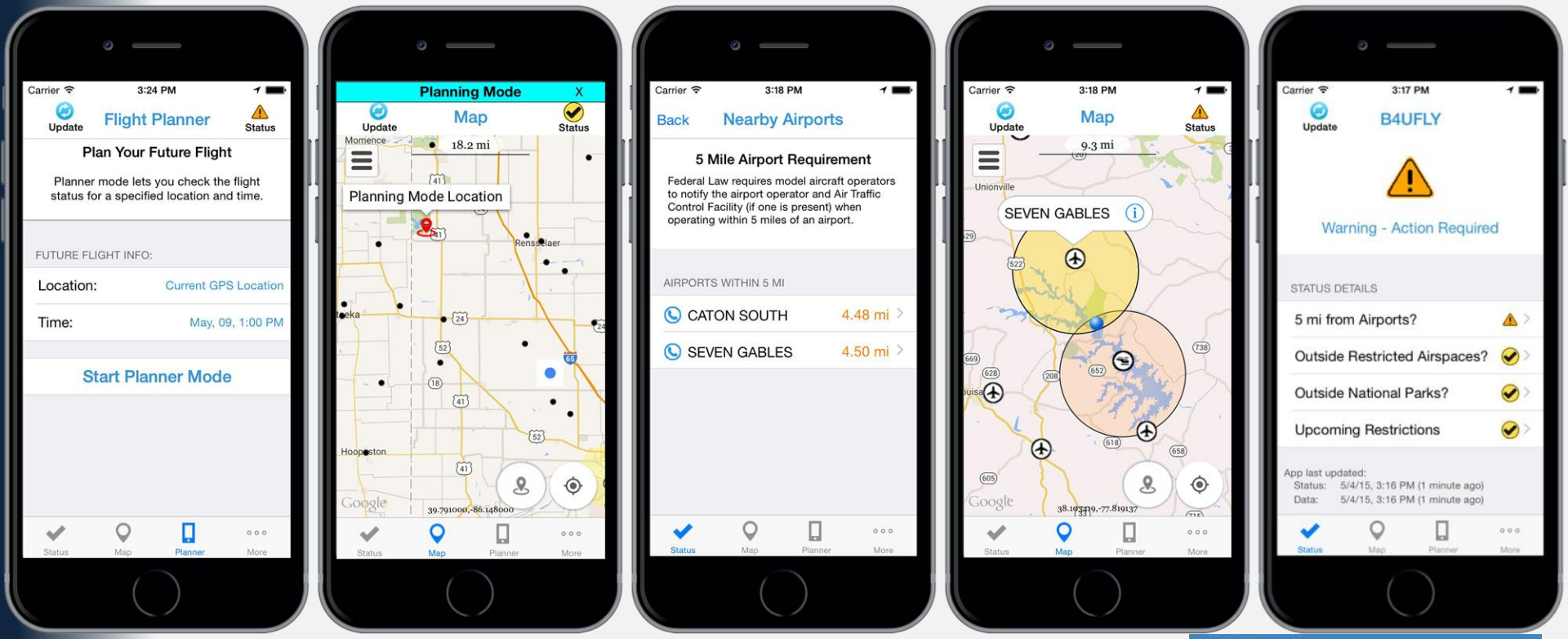


   – Key features:

   - A "Planner Mode" for future flights in different locations
   - A clear "status" indicator that immediately informs the operator about his/her current or planned location. Information on the parameters that drive the status indicator
   - Informative, interactive maps with filtering options
   - Contact information for nearby airports and links to other FAA UAS resources

http://www.faa.gov/uas/b4ufly/

FAA: B4UFLY Smartphone App



FAA B4UFLY Smartphone App

http://www.faa.gov/uas/b4ufly/

North Carolina
Emergency Management

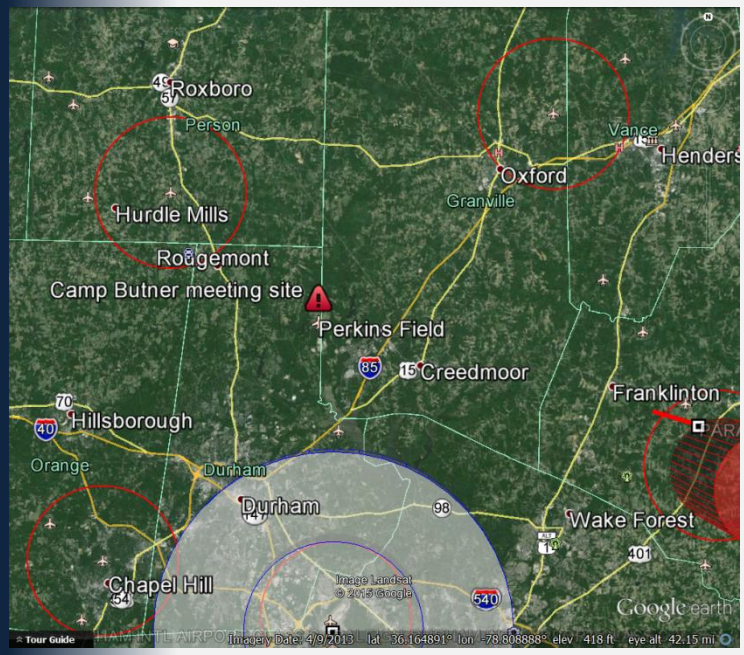
EMERGENCY MANAGEMENT EMAP Accredited ACCREDITATION PROGRAM

N C DPS DEPARTMENT OF PUBLIC SAFETY

Steps to implementing UAS technology into your enterprise

7. Become familiar with NC airspace

   c. Install Google Earth Pro (http://www.google.com/earth/), which is now free using your email address as your username and “GEPFREE” as the license key, onto your computer



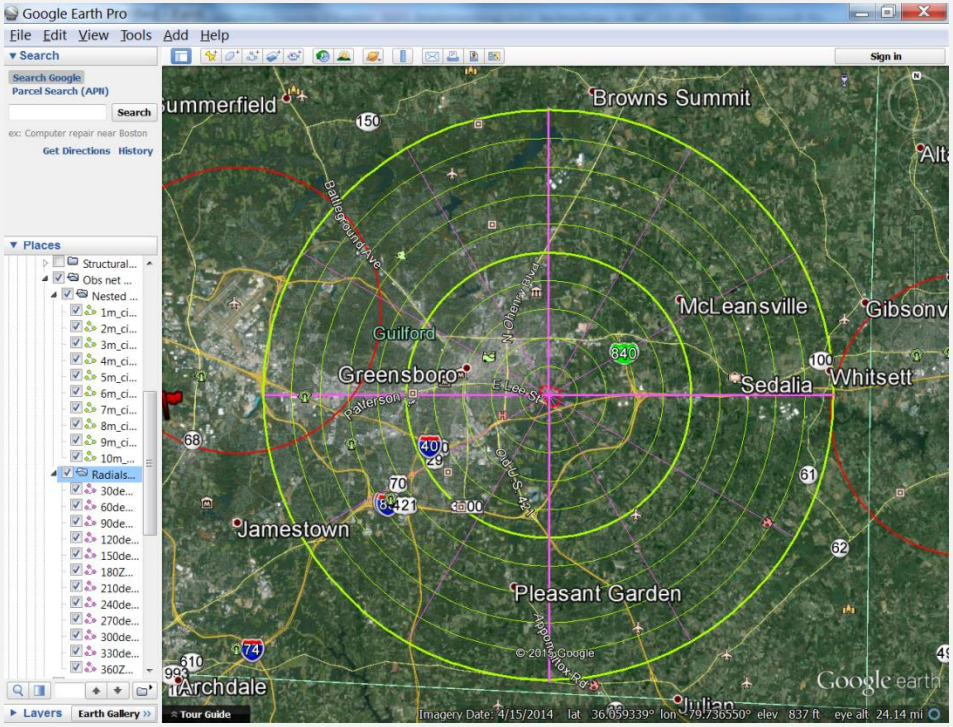
1). Load the “All of US” airspace KMZ file from the Worldwide Soaring Turnpoint Exchange (http://soaringweb.org/Airspace/NA/HomePage.html)

2). Draw a 5-mile radius around all the airports listed on the FAA aeronautical charts, because if your desired mapping site is within 5 miles of an airport, then you will need to contact that airport to request permission to use a UAS.

http://www.ncdot.gov/aviation/products/

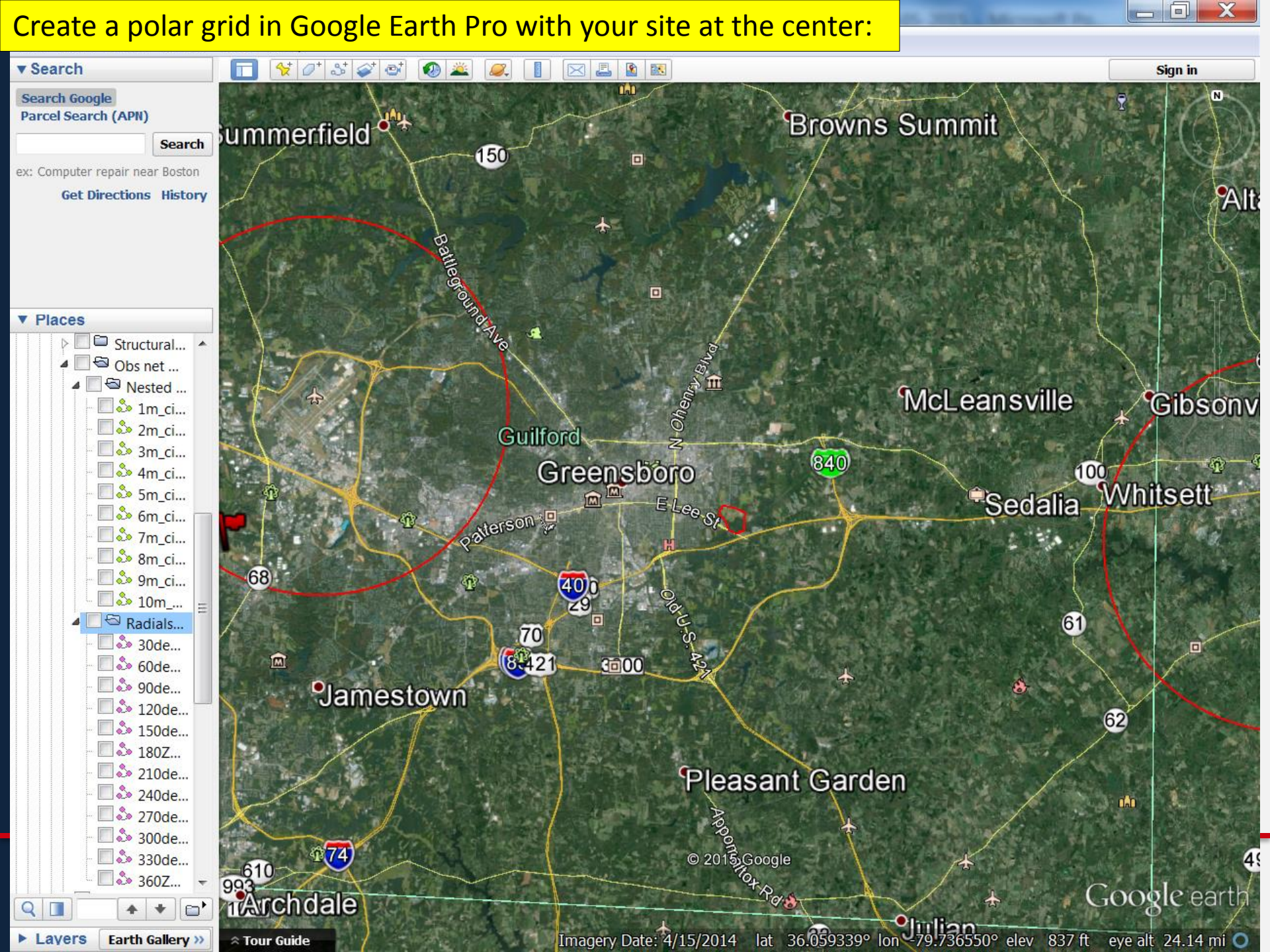
Steps to implementing UAS technology into your enterprise

8. Practice determining the flight path of an approaching aircraft
   a. Create a polar grid in Google Earth Pro with your site at the center



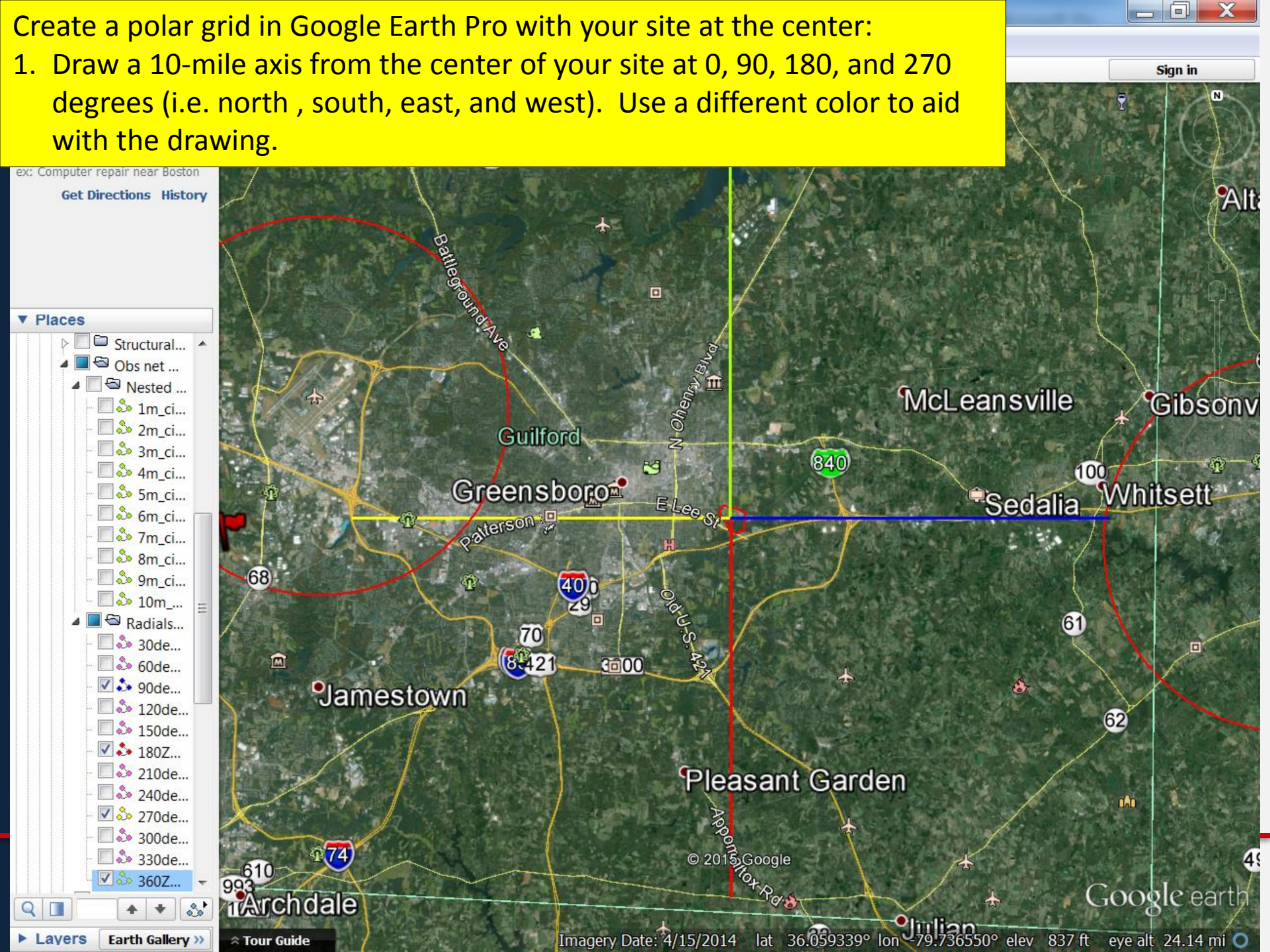
In addition, make a polar grid on a magnetic whiteboard and use magnets to represent aircraft at different positions

Create a polar grid in Google Earth Pro with your site at the center:



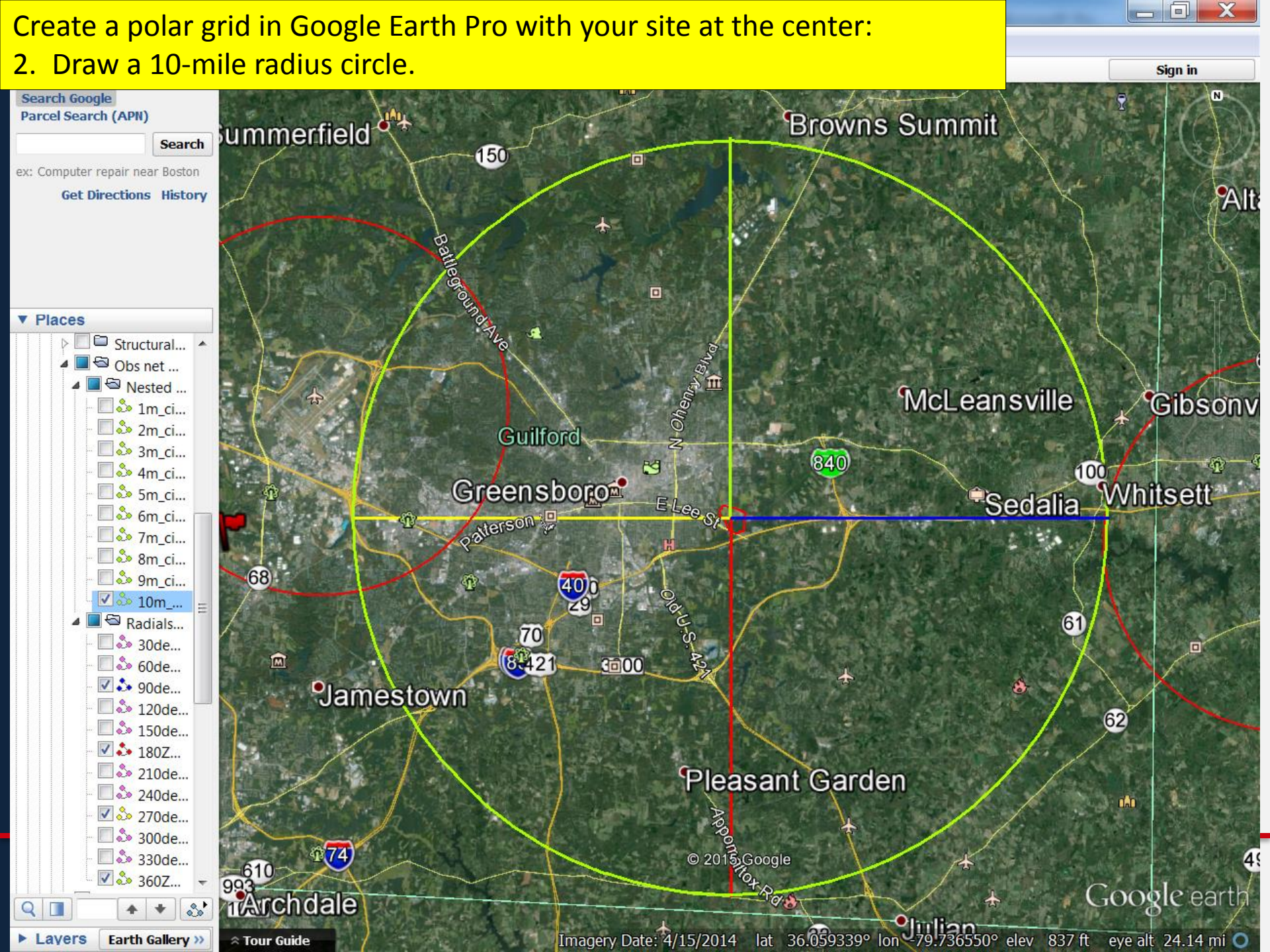
Create a polar grid in Google Earth Pro with your site at the center:

1. Draw a 10-mile axis from the center of your site at 0, 90, 180, and 270 degrees (i.e. north , south, east, and west). Use a different color to aid with the drawing.



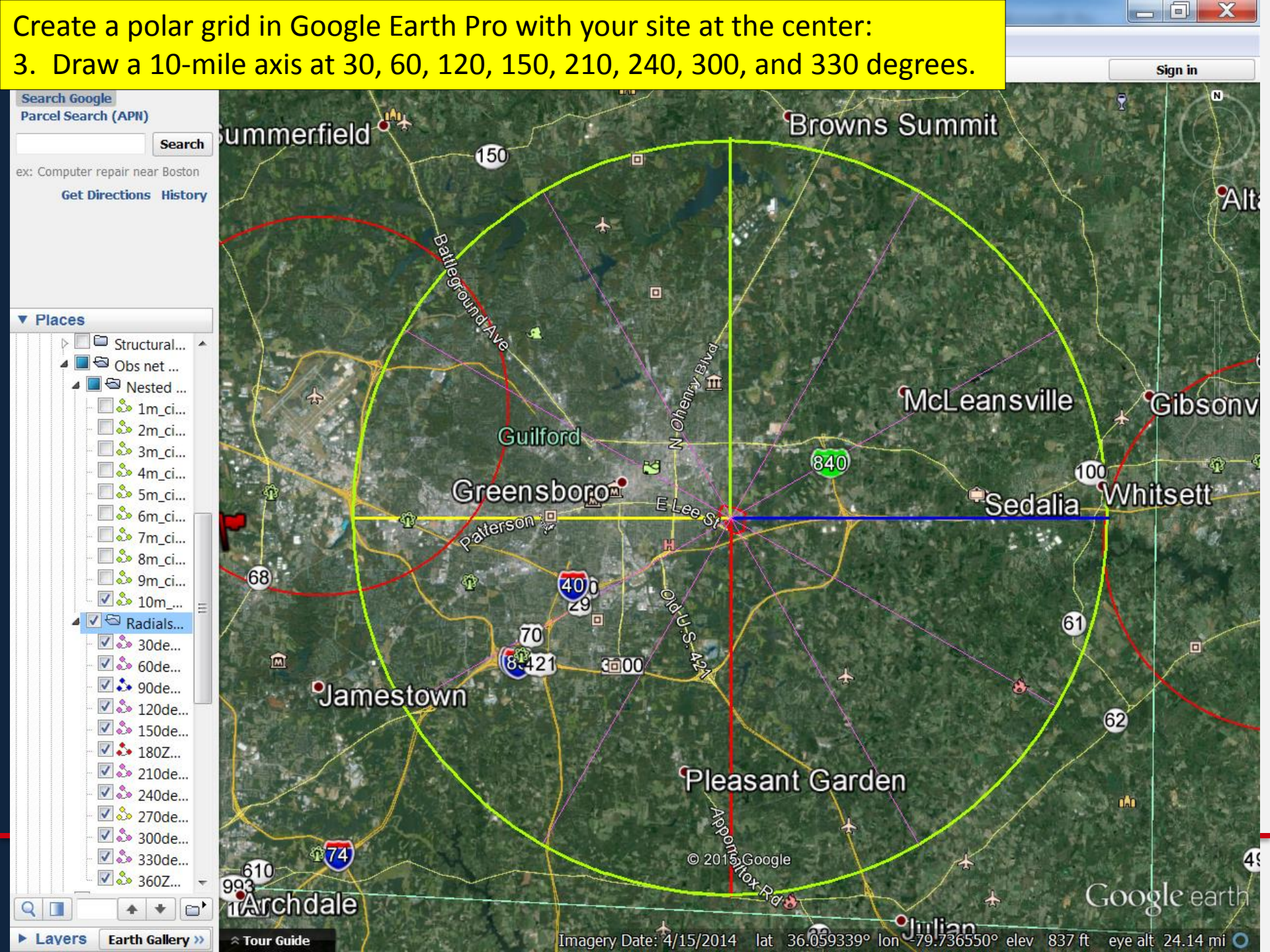
Create a polar grid in Google Earth Pro with your site at the center:

2. Draw a 10-mile radius circle.



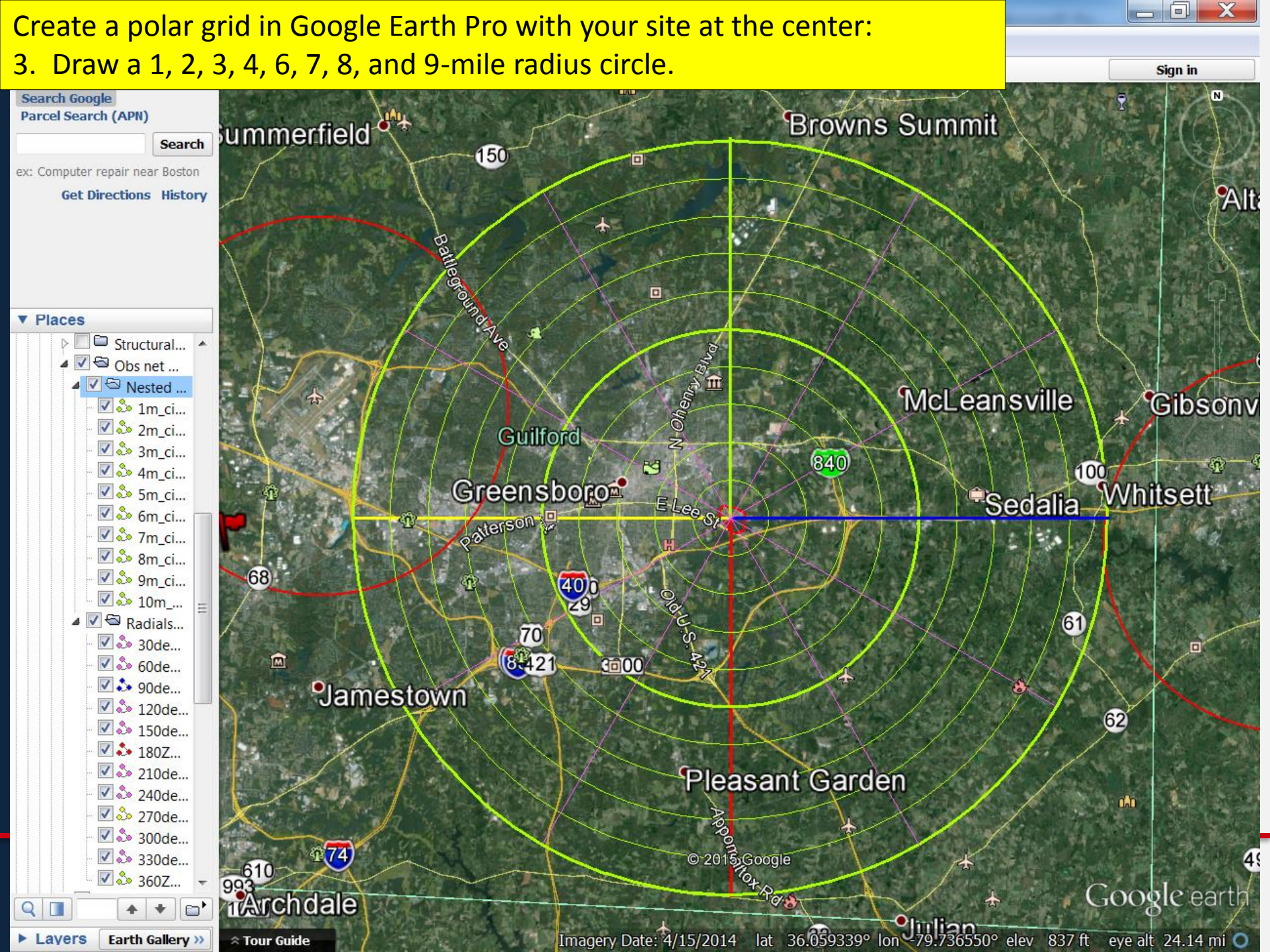
Create a polar grid in Google Earth Pro with your site at the center:

3. Draw a 10-mile axis at 30, 60, 120, 150, 210, 240, 300, and 330 degrees.



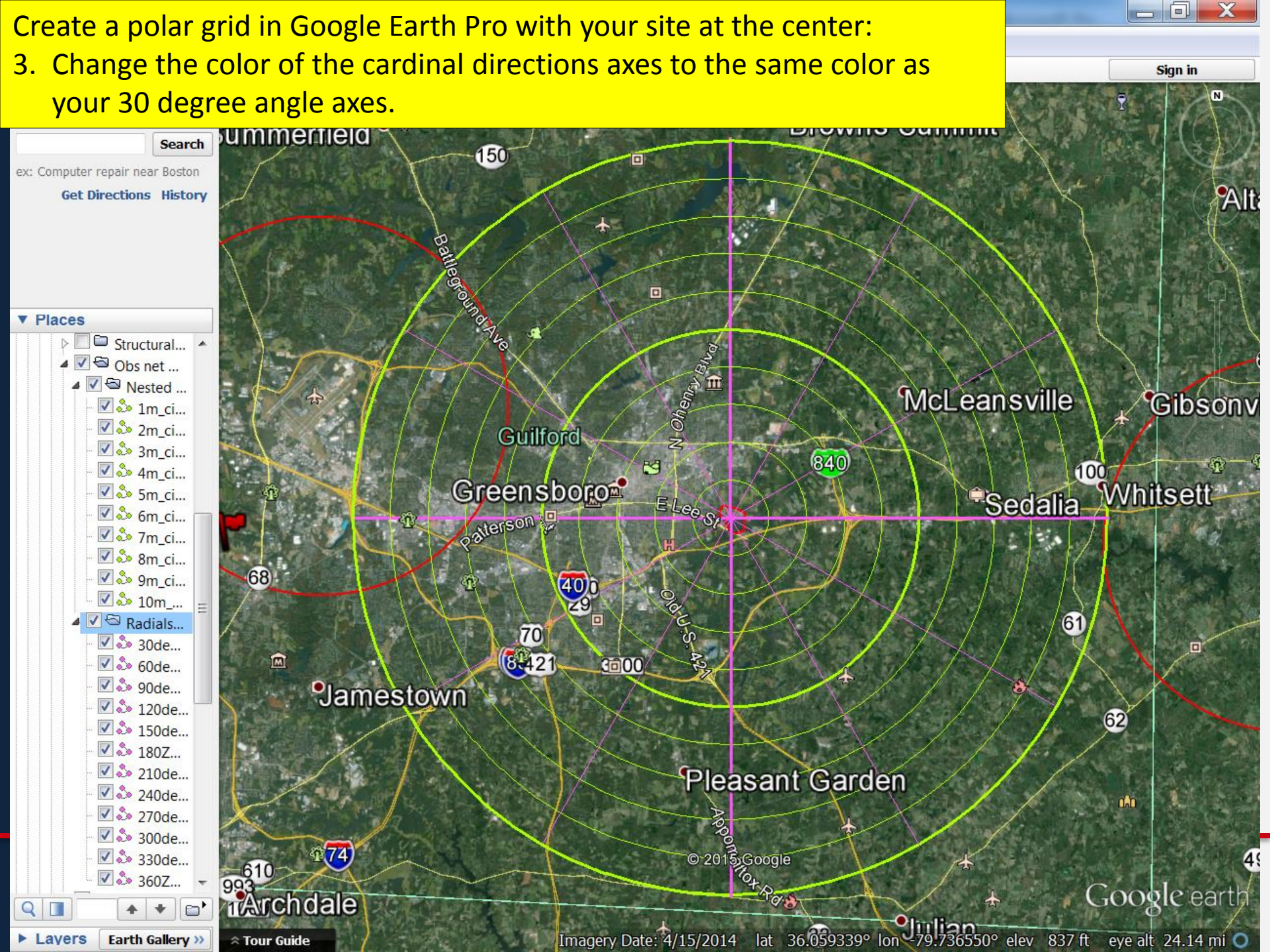
Create a polar grid in Google Earth Pro with your site at the center:

3. Draw a 1, 2, 3, 4, 6, 7, 8, and 9-mile radius circle.



Create a polar grid in Google Earth Pro with your site at the center:

3. Change the color of the cardinal directions axes to the same color as your 30 degree angle axes.



Steps to implementing UAS technology into your enterprise

8. Practice determining the flight path of an approaching aircraft

   b. The observer will call out the location of an airplane at least twice to determine its bearing using the following protocol:

      1). **Elevation:** **Low (<1,500 ft)**, Medium (1,500 – 5,000), and High (5,000 and up)

      Note: The **1,500 ft** value was chosen to maintain a 1,000 ft separation, which is the vertical separation that planes use, between your UA's max height and the approaching aircraft. The main point of categorizing elevations is to **prioritize the tracking into those of critical importance**, moderate importance, and negligible importance.

      Note: The observer might be able to determine the plane's vertical path (ascending, descending, or cruising) on the second or third call.

      2). **Aircraft type:** Airplane (jet or propeller) or helicopter (civilian or military)

      3). **Axes angle:** Given in degrees (e.g. 300 degrees) or as a position on a clock (e.g. 10 o'clock)

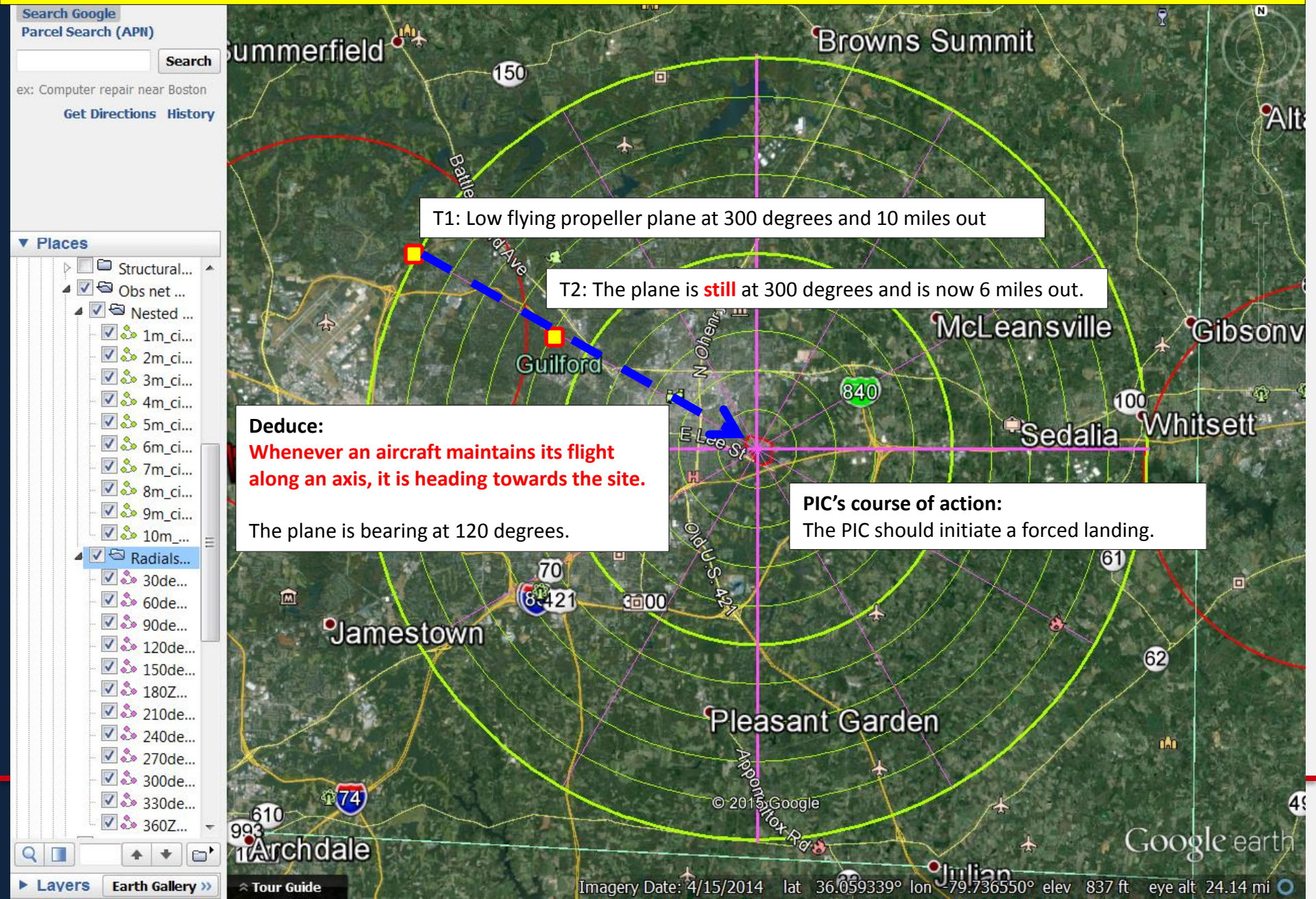
      Note: Regardless of whether you are determining the axes angle using a hiking compass or a SmartPhone compass app, the magnetic declination must be set.

      4). **Distance:** Given in miles (or kilometers if you made your grid in kilometers)

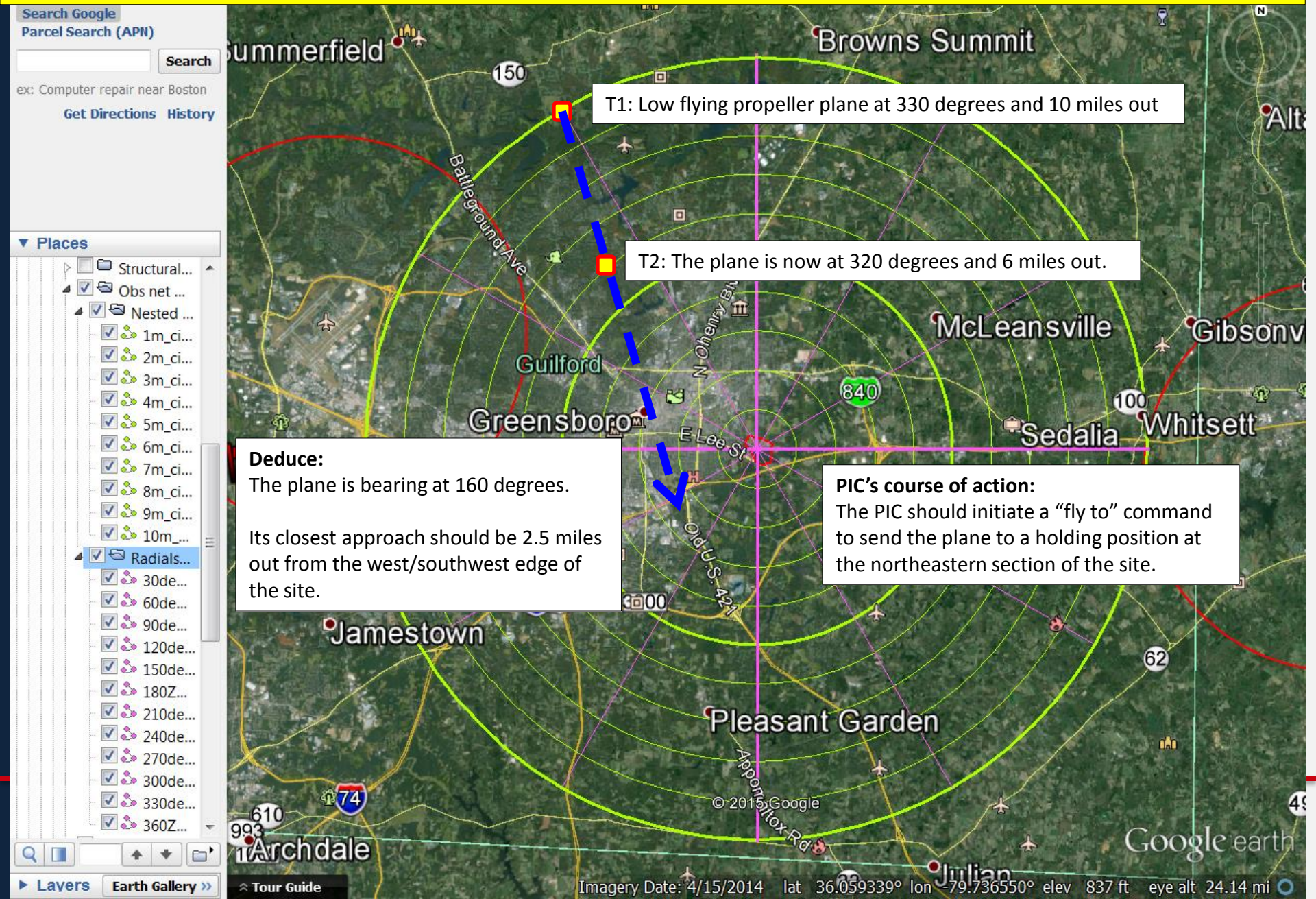
      e.g. Low flying jet airplane at 330 degrees (10 o'clock) and 10 miles out

   c. After the second report, the observer and/or the PIC should be able to determine the plane's bearing and predict its closest approach to the site.

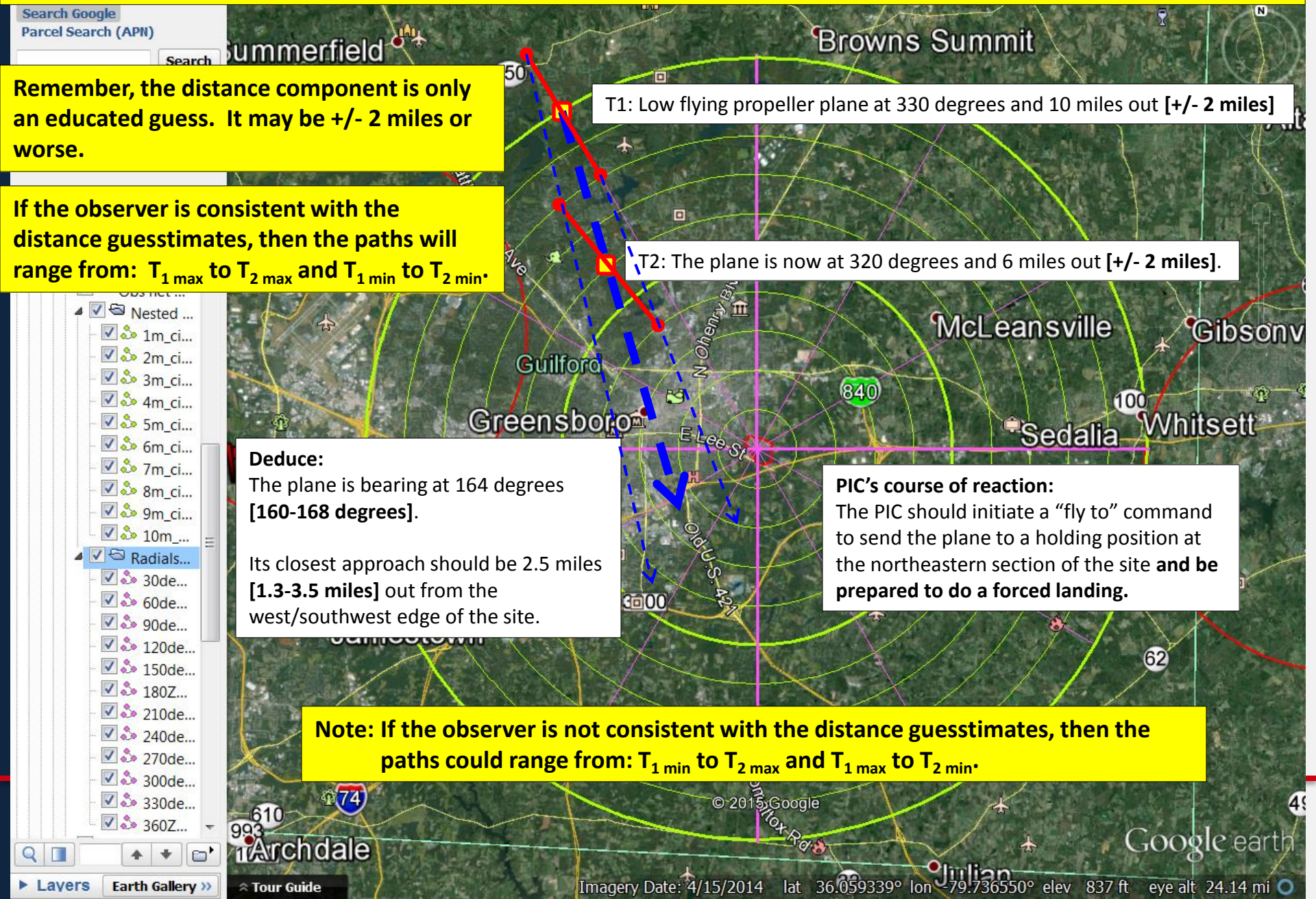
The observer will call out the location of the plane multiple times to determine its bearing using a set protocol (e.g. elevation, aircraft type, axis angle, and distance):



The observer will call out the location of the plane multiple times to determine its bearing using a set protocol (e.g. elevation, aircraft type, axis angle, and distance):



The observer will call out the location of the plane multiple times to determine its bearing using a set protocol (e.g. elevation, aircraft type, axis angle, and distance):



Conclusion

- **Tremendous potential**
- **Costs**
  - Equipment; software; training on the equipment and software

    But, the equipment cost will get cheaper each year and the equipment capabilities will increase each year.
  - Education about aeronautics and regulations (Federal and NC)
  - Administrative costs for applying for Federal 333 exemption or license, Federal COA, and NC permit
- **Safety:**
  - Yourself
  - Bystanders on the ground
  - People onboard passing manned aircraft