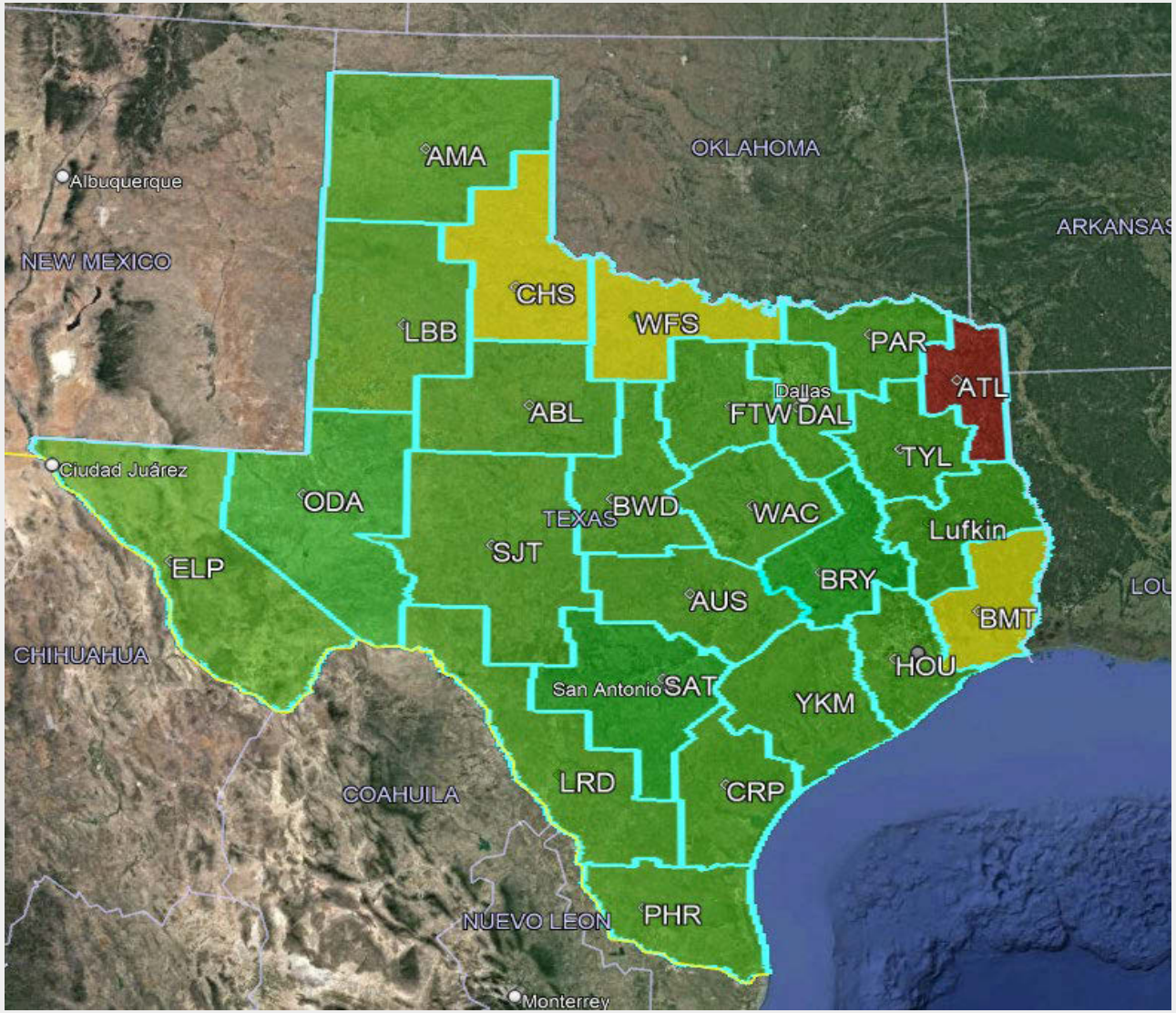
TxDOT Drones

Now that we have them, when do we use them?

TxDOT Unmanned Aircraft Systems Program

- Training TxDOT team members to deploy UAS in support of department business
  - 96 Certified UAS Pilots
  - 11 additional started training Today
  - 24 of 25 districts have (or are scheduled to have) a trained pilot within their boundaries
  - 60 training slots available per FY
  - ~180 Pilots by end of FY25 + 60 each FY

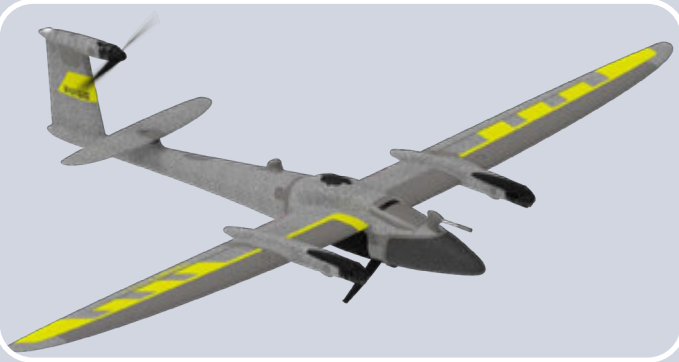
- Inspection and supplementation of:
  - Infrastructure inspection
  - Land Survey
  - Emergency response
  - Project progress management
  - Corridor management support
  - Digital Delivery / reality modeling / digital twin



What TxDOT is Purchasing

Small Multi-Rotor

35 units to start.
70 total



VTOL Fixed Wing

3 units to start.
5 total

Medium Lift Multi-Rotor

6 units to start.
9 total

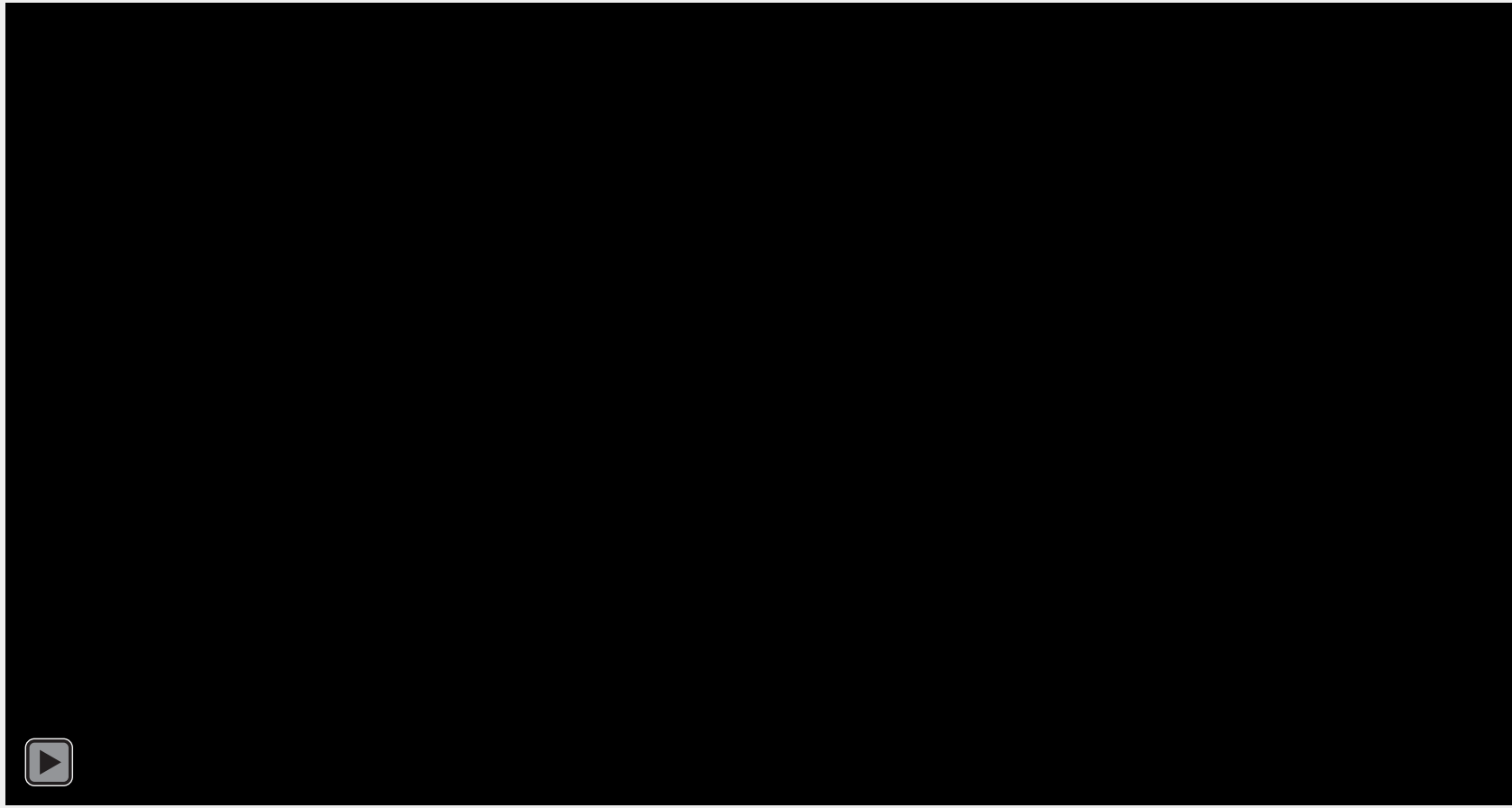
What can they do?

Small Multi-Rotor

- Visual inspections
- Small to medium mapping and modeling mission
- Emergency / disaster response
- Up to 40 minutes of flight per battery
- 41 MP visual inspection camera
- High resolution Radiometric Thermal sensor
- 360 obstacle avoidance—even at night
- Highly automated
- 2D/3D mapping and modeling

VTOL Fixed Wing

- Large Scale Mapping and survey
  - Up to 90 minutes of flight per battery
- LiDAR
  - 240,000 distance measurements per second
  - < 3cm accuracy at 120m
  - Night mapping and survey
- Photogrammetry
  - Mirrorless RGB (60MP)
  - Oblique 3D camera
- Other sensors available
  - Multispectral
  - Thermal/infrared
  - etc



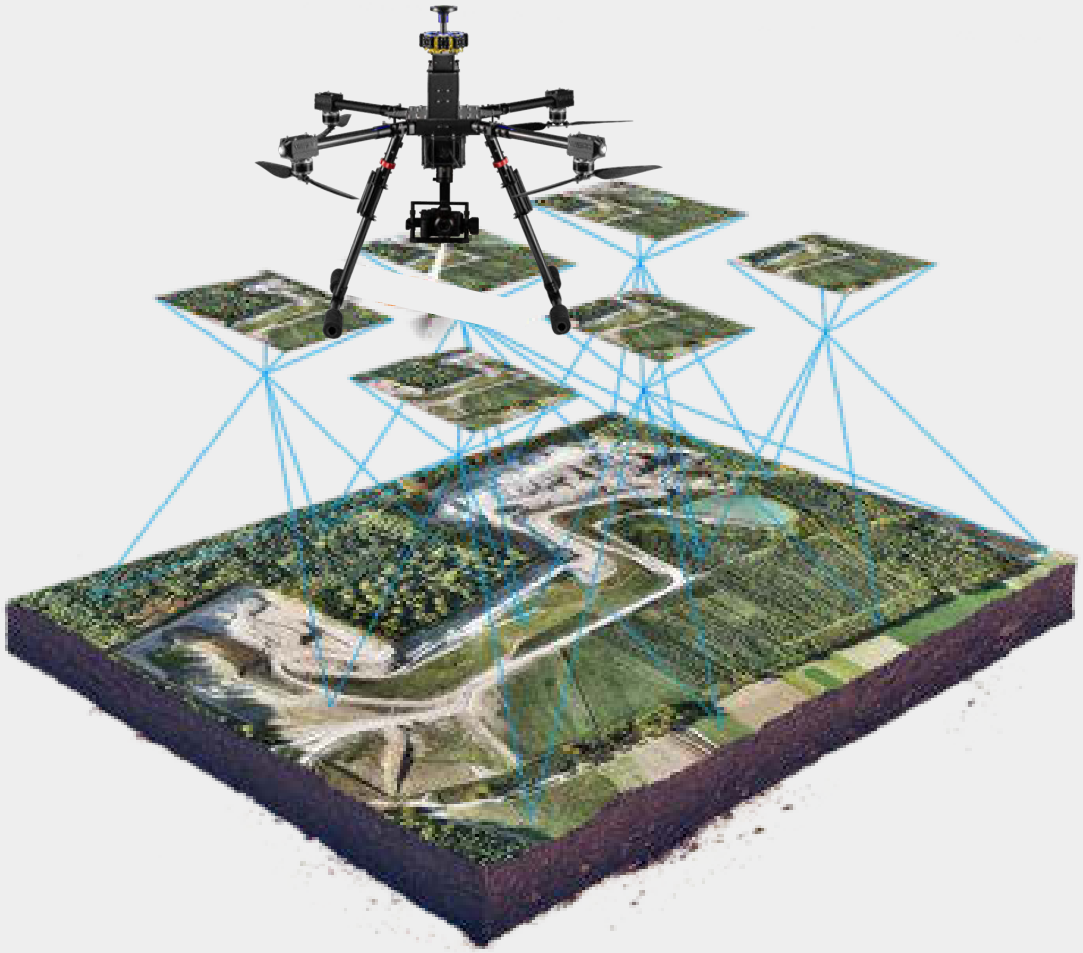
Medium Lift Multi-Rotor

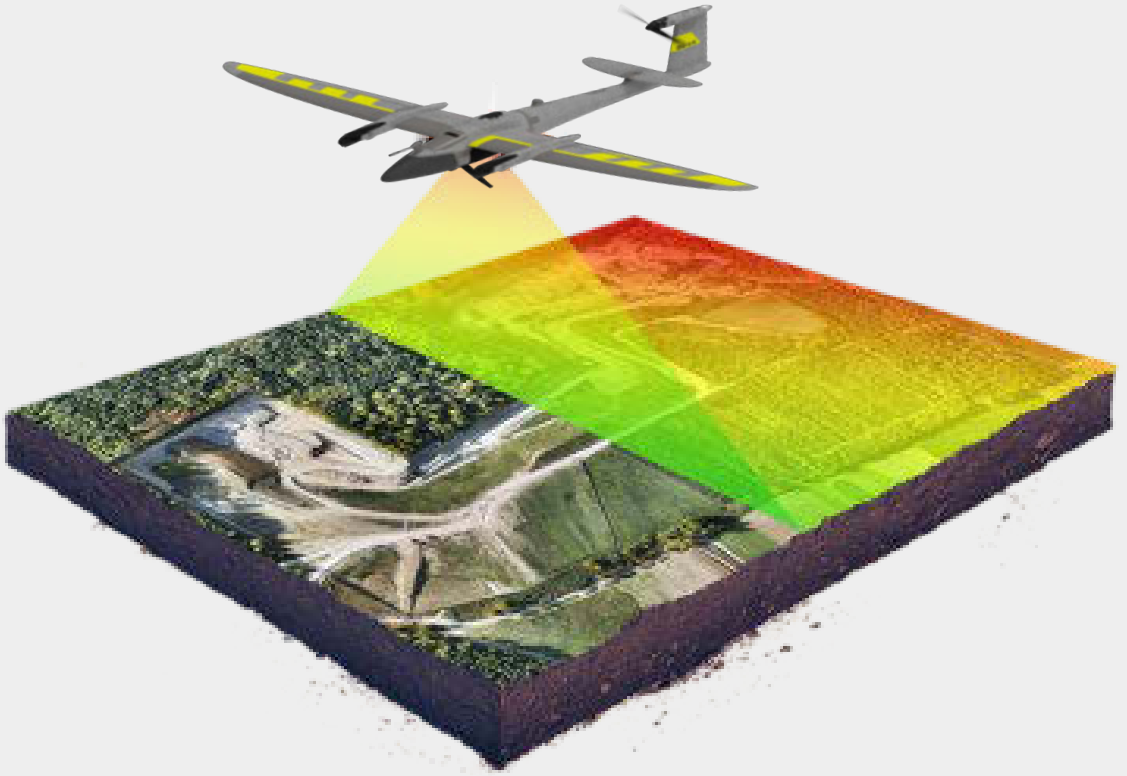
- Small to Medium mapping sites
  - Up to 25 minutes of flight per battery
- LiDAR
  - 240,000 distance measurements per second
  - < 1.5cm accuracy at 120m
  - Night mapping and survey
- Photogrammetry
  - Mirrorless RGB (60MP)
  - Oblique 3D camera
- 360 obstacle avoidance
- 2D / 3D modeling

Advantages and Drawbacks of each type of airframe

UAS Platform	Advantages		Drawbacks
Multi-Copter Rotary  	-Accessibility -Easy to use, control, maneuver -VTOL and hovering capabilities -Higher payload capacity	-Good camera control -Operation in confined areas -More compact in size -Lower price	-Short endurance flight -Small payload capabilities -Lower flight speed -Less safe if critical failure (just falls out of the sky)
VTOL Fixed-Wing 	-Long-endurance flight -Heavier payload capabilities -Higher flight speed	-Stable in high winds -Safer recovery for failure (glide)	-More space for required launch and recovery operations - Less maneuverable -Less margin for error flying at mission speeds

Photogrammetry and LiDAR



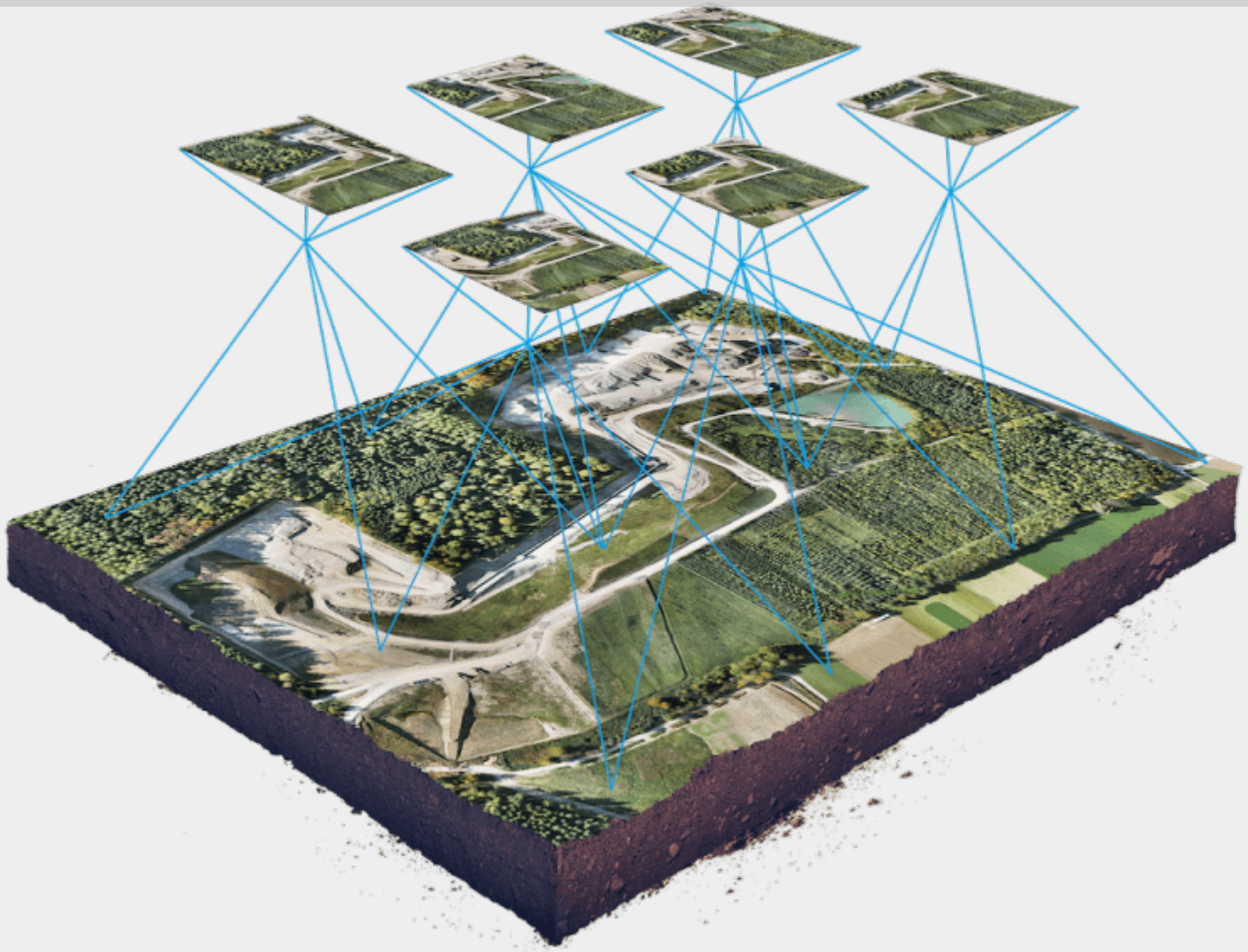


LiDAR (Light Detection and Ranging)

- Active sensor which emits LASER pulses to measure distances.
  - Direct measurements from subject to sensor
  - Does not rely on ‘reconstruction’ of data (like photogrammetry)
- Does not rely on ambient or supplemental light sources
  - Can be used day or night
    - Night ops = lower traffic density
  - Penetration of dense vegetation and tree canopy
- Deliverables:
  - 3D Point cloud (may be colorized)
  - Contours
  - Elevation models
  - Bare earth models

Photogrammetry

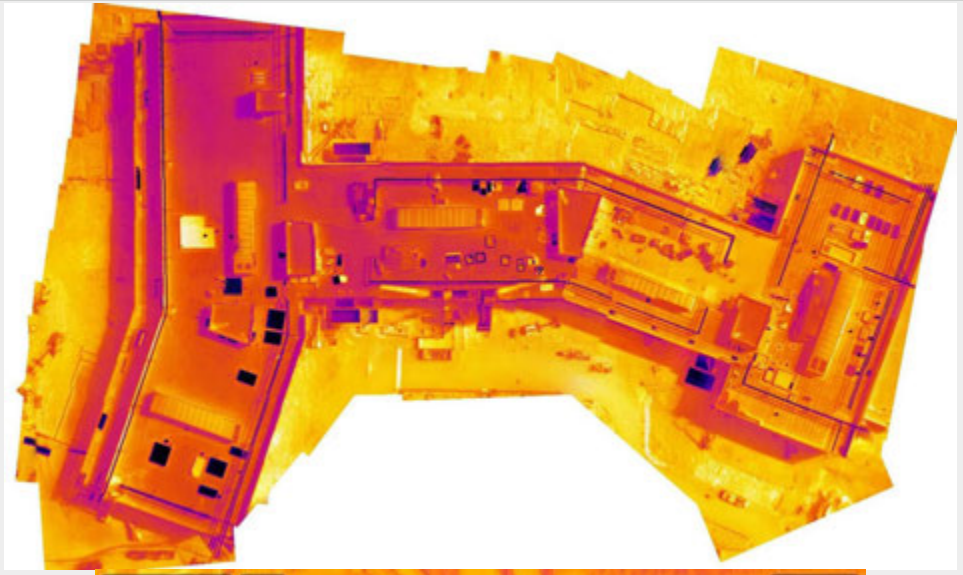
- Passive sensor which receives photons of light into camera sensor.
  - Photos with overlap are used to Triangulate and reconstruct the captured data
- Strict reliance on ambient or supplemental light sources
- Deliverables:
  - Orthophotos (high-res maps)
  - 3D textured Mesh
  - Colorized Point cloud (from reconstruction)
  - Contours
  - Surface models (not bare earth)



Radiometric Thermal

- Detects and measures the infrared energy of objects.
  - The camera converts that infrared data into an electronic image that shows the apparent surface temperature of the object being measured.

- Deliverables:
  - Thermal Maps
    - Structures
    - Project sites
  - Visual thermal inspections
    - Delamination
    - Water intrusion
    - Materials failures
  - Disaster response / search and Rescue



Advantages and Drawbacks of each type of Sensor

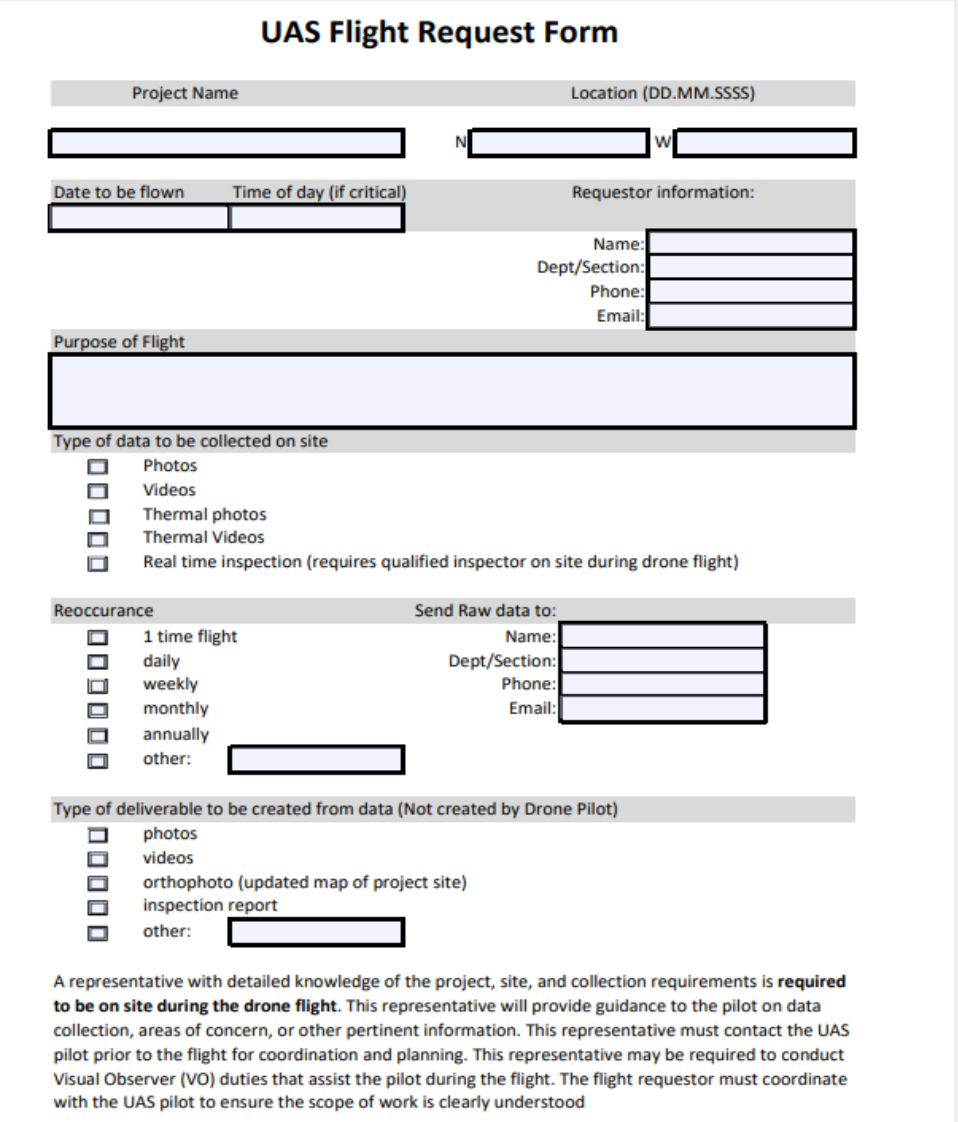
UAS Sensor	Advantages	Drawbacks
RGB 	- Lower Cost -Photogrammetry is rapidly closing the gap on LiDAR deliverables -Limited Multi-Spec NDVI data	-Reliance on ambient light (passive sensor) -Will not have vegetation penetration capabilities of LiDAR -Processing time and computer requirements
LiDAR 	- Can collect data at day or night regardless of existing lighting conditions - Faster processing (compared to photogrammetry) -Direct measurements = better accuracy (generally)	- Much higher cost of sensor -requires larger, more expensive airframe to carry the sensor
Thermal 	- Able to visualize data that LiDAR and RGB sensor cannot -does not rely on existing lighting conditions	-Higher cost of Sensor -Understanding of thermography required to unlock full potential of data

How do we access TxDOT UAS

- **Division and district Pilots**
  - Once delivered, each district (and several divisions) will have at least 1 small UAS
  - Districts / Divisions will have a designated POC
  - Use for as many projects as you require
  - Districts/Divisions will be able to purchase additional approved units to meet demands. AVN facilitates and approves UAS purchases.

- **AVN UAS section**
  - Statewide support
  - TxDOT-UASCoord@txdot.gov

- **Larger Drones** (fixed wing & medium lift multi-copter) staged around the state
  - FTW
  - HOU
  - AUS
  - ELP
  - etc



UAS Flight Request Form

Project Name | Location (DD.MM.SSSS)

N W

Date to be flown | Time of day (if critical) | Requestor information:

Name:
Dept/Section:
Phone:
Email:

Purpose of Flight

Type of data to be collected on site

- ☐ Photos
- ☐ Videos
- ☐ Thermal photos
- ☐ Thermal Videos
- ☐ Real time inspection (requires qualified inspector on site during drone flight)

Reoccurance | Send Raw data to:

- ☐ 1 time flight
- ☐ daily
- ☐ weekly
- ☐ monthly
- ☐ annually
- ☐ other:

Name:
Dept/Section:
Phone:
Email:

Type of deliverable to be created from data (Not created by Drone Pilot)

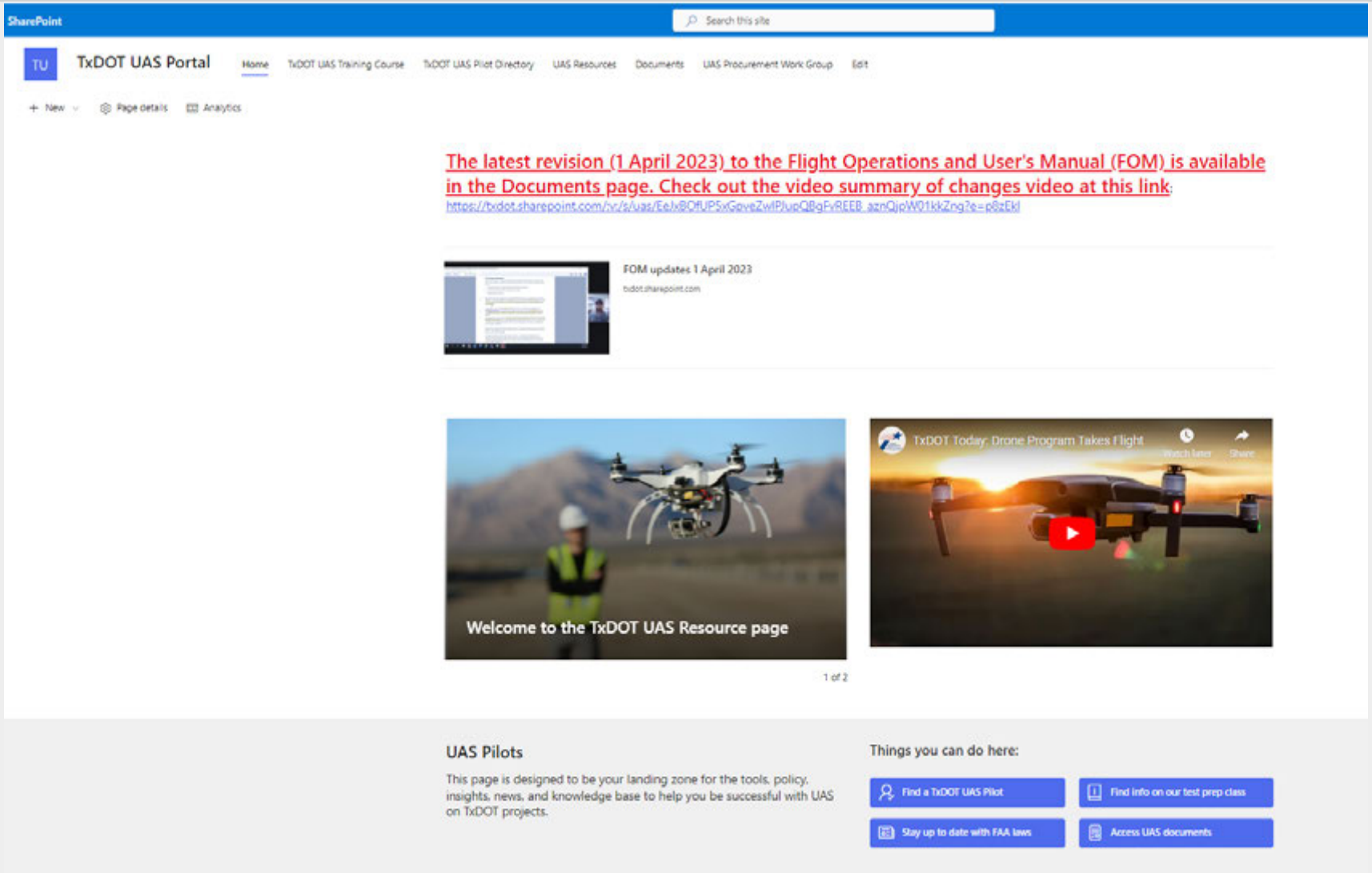
- ☐ photos
- ☐ videos
- ☐ orthophoto (updated map of project site)
- ☐ inspection report
- ☐ other:

A representative with detailed knowledge of the project, site, and collection requirements is **required to be on site during the drone flight**. This representative will provide guidance to the pilot on data collection, areas of concern, or other pertinent information. This representative must contact the UAS pilot prior to the flight for coordination and planning. This representative may be required to conduct Visual Observer (VO) duties that assist the pilot during the flight. The flight requestor must coordinate with the UAS pilot to ensure the scope of work is clearly understood

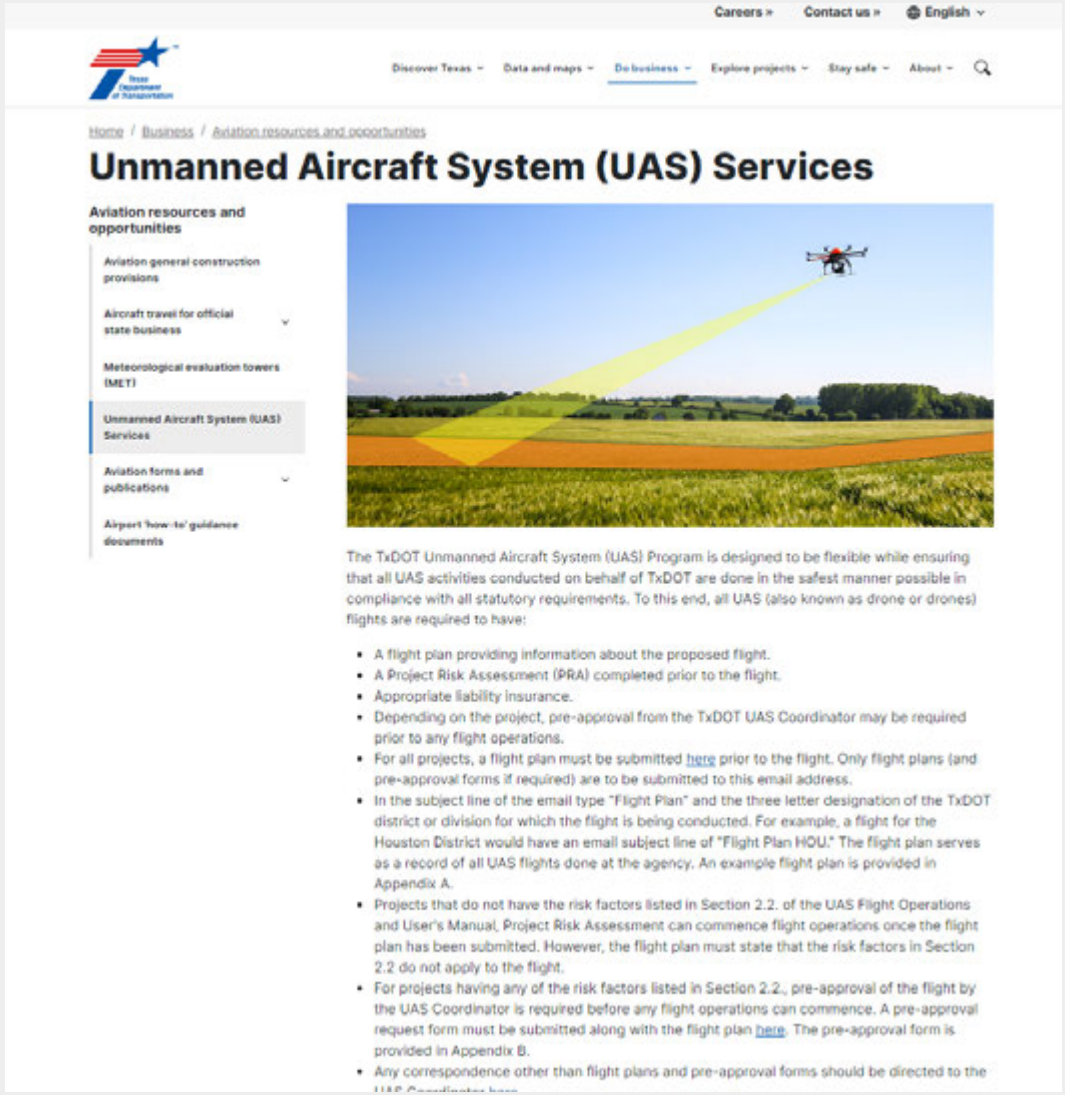
Threats

- Data storage and Data Governance
  - “In the 2 years that we started using drones at scale, we required more storage than we have since the State DOT’s inception.”
  - 25 districts, 25 divisions—all collection data with just as many drones, several times a week, if not several times a day.

TxDOT UAS Portal (https://txdot.sharepoint.com/sites/uas)



txdot.gov/business/aviation/uas-services



Careers » Contact us » English

Discover Texas | Data and maps | Do business | Explore projects | Stay safe | About

Home / Business / Aviation resources and opportunities

Unmanned Aircraft System (UAS) Services

Aviation resources and opportunities

- Aviation general construction provisions
- Aircraft travel for official state business
- Meteorological evaluation towers (MET)
- Unmanned Aircraft System (UAS) Services
- Aviation forms and publications
- Airport 'how-to' guidance documents

The TxDOT Unmanned Aircraft System (UAS) Program is designed to be flexible while ensuring that all UAS activities conducted on behalf of TxDOT are done in the safest manner possible in compliance with all statutory requirements. To this end, all UAS (also known as drone or drones) flights are required to have:

- A flight plan providing information about the proposed flight.
- A Project Risk Assessment (PRA) completed prior to the flight.
- Appropriate liability insurance.
- Depending on the project, pre-approval from the TxDOT UAS Coordinator may be required prior to any flight operations.
- For all projects, a flight plan must be submitted here prior to the flight. Only flight plans (and pre-approval forms if required) are to be submitted to this email address.
- In the subject line of the email type "Flight Plan" and the three letter designation of the TxDOT district or division for which the flight is being conducted. For example, a flight for the Houston District would have an email subject line of "Flight Plan HOU." The flight plan serves as a record of all UAS flights done at the agency. An example flight plan is provided in Appendix A.
- Projects that do not have the risk factors listed in Section 2.2. of the UAS Flight Operations and User's Manual, Project Risk Assessment can commence flight operations once the flight plan has been submitted. However, the flight plan must state that the risk factors in Section 2.2 do not apply to the flight.
- For projects having any of the risk factors listed in Section 2.2., pre-approval of the flight by the UAS Coordinator is required before any flight operations can commence. A pre-approval request form must be submitted along with the flight plan here. The pre-approval form is provided in Appendix B.
- Any correspondence other than flight plans and pre-approval forms should be directed to the

Contractors and Consultants: How to use UAS on TxDOT Projects

- Welcoming and enabling our consultants and contractors to utilize UAS on TxDOT Projects
- Adhere to Federal Aviation Administration's requirements in 14 CFR 107 (or applicable regulation if UAS is greater than 55lbs)
- Adhere to the data collection and deliverables standards set fourth in your specific disciplines and/or contracts
  - TxDOT Surveyor's toolkit
  - ASPRS
  - FHWA NBIS
  - ASCE
- Adhere to the TxDOT UAS Flight Operations and User's Manual
- *Prohibited Technologies Policy*

Sergio Roman

Aviation Division

Flight Services

Sergio.roman@txdot.gov

512-239-9284

William Graffis

Aviation Division

Flight Services

William.Graffis@txdot.gov

512-979-5685

Safety: Mission

ZERO

Safety Never Stops!