

BIRDS AREN'T REAL - TXDOT'S UAS PROGRAM AND THE BIRTH OF A DIGITAL TWIN

How TxDOT developed a UAS program, how remote sensing data will help create digital twins, and how contractors can use drones for TxDOT projects.

Presenters



Travis Scruggs
GIS Analyst/UAS Pilot

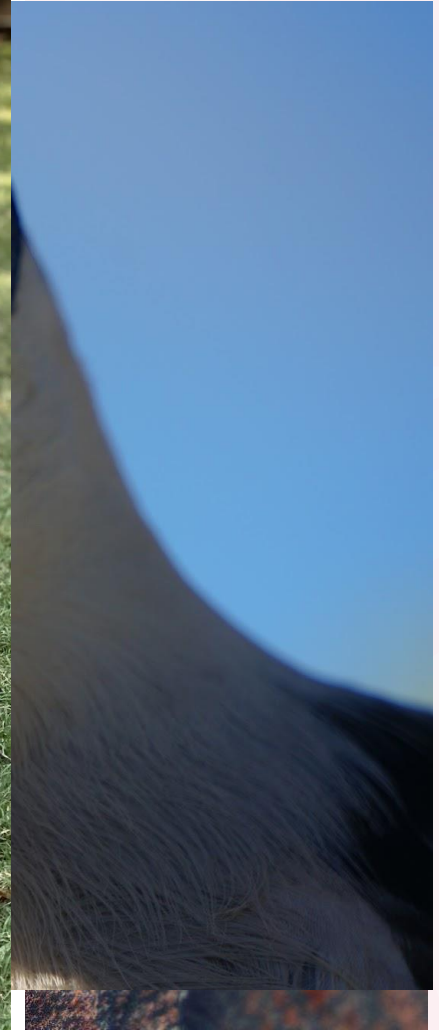
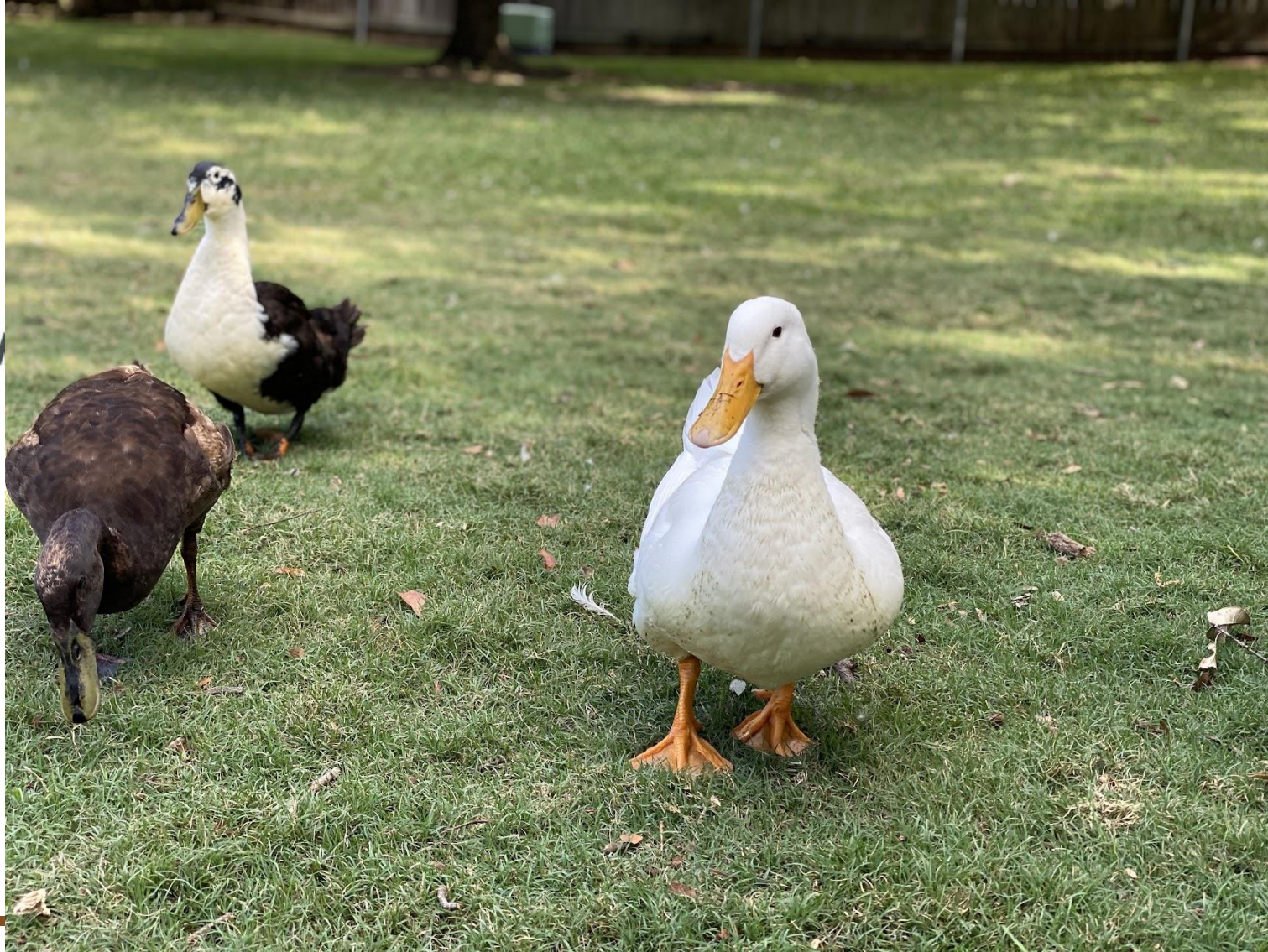
TxDOT – Transportation,
Planning, and
Programming Division



Sergio Roman
UAS Coordinator/UAS
Pilot

TxDOT – Aviation Division

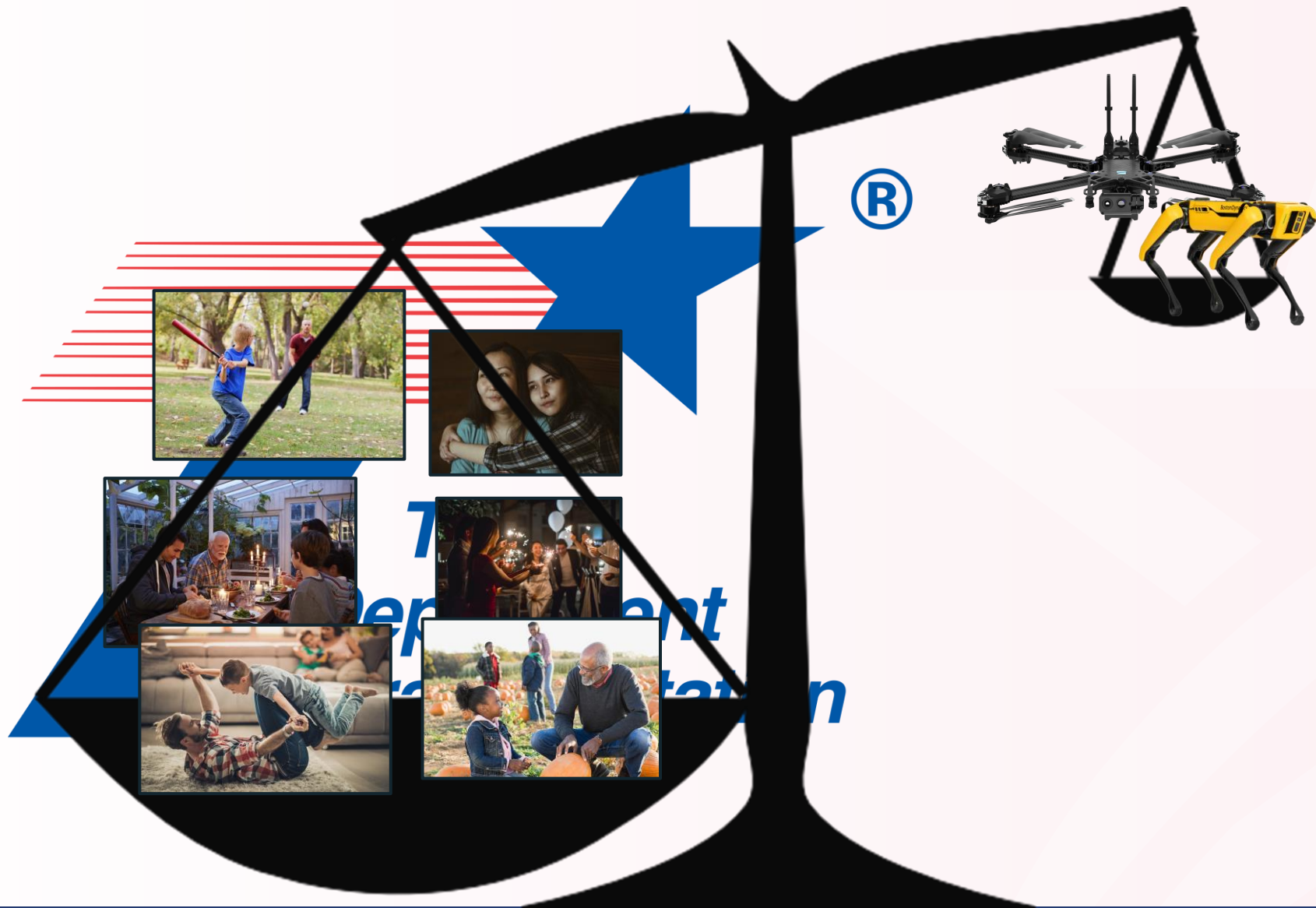
Birds aren't real?!



DRONES ARE REPLACEABLE. YOU ARE NOT.



How Drones are increasing safety and redefining what we have considered ‘acceptable risk’



What we mean when we say “drone”

- An UAS (aka Drone) is an aircraft operated without the possibility of direct human intervention from within or on the aircraft



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- Typically used for data collection, infrastructure inspection, mapping and modeling, etc



What we mean when we say “drone”

- An UAS (aka Drone) is an aircraft operated without the possibility of direct human intervention from within or on the aircraft
- Typically used for data collection, infrastructure inspection, mapping and modeling, etc
- Capable of carrying LiDAR, high-resolution Imagers, and other data collection sensors



HELP
#EndTheStreakTX
End the streak of daily deaths on Texas roadways.

Why TxDOT, Why Drones?



Why TxDOT, Why Drones?



Why TxDOT, Why Drones?



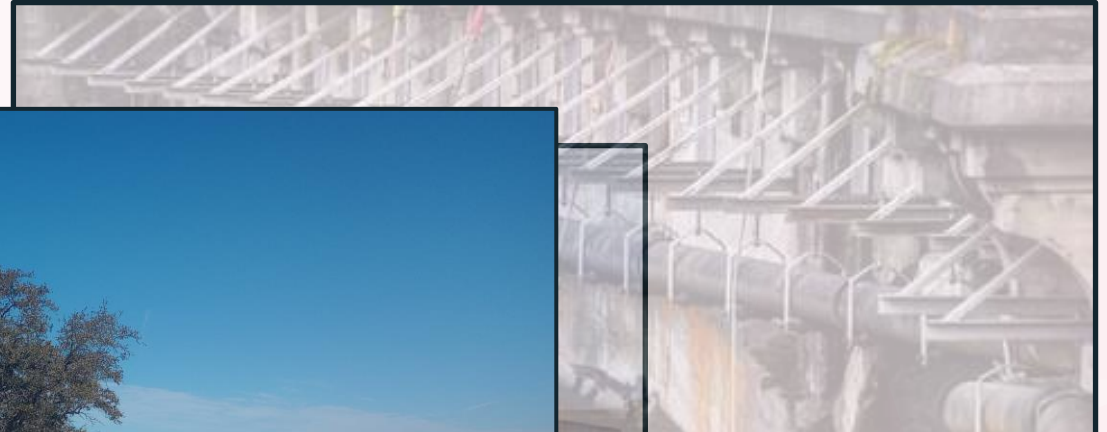
Why TxDOT, Why Drones?



Why TxDOT, Why Drones?



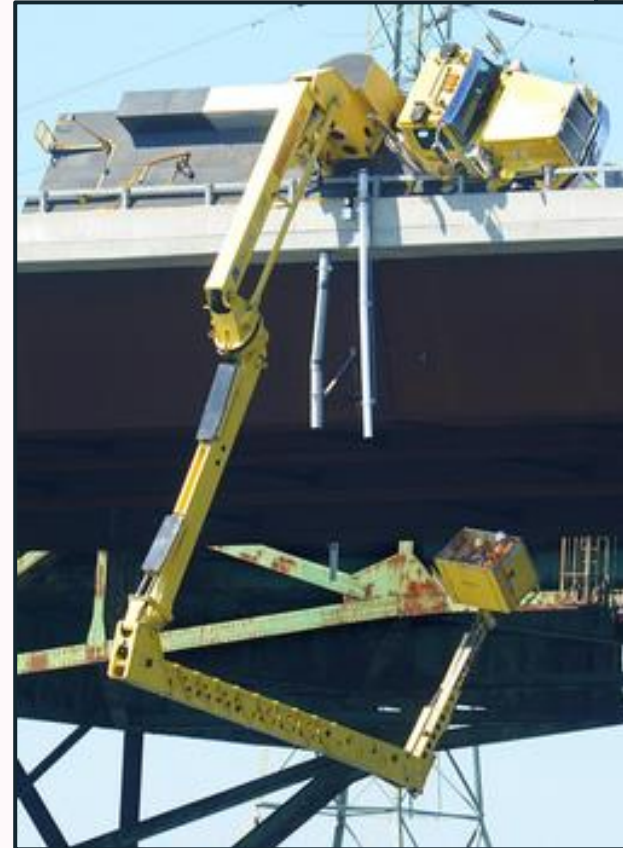
Why TxDOT, Why Drones?



Use cases and Safety facts

Bridge

- OSHA: bridge inspectors have a higher rate of fatal and nonfatal injuries than other workers in the construction industry.
- Bureau of Labor Statistics: 120 fatal injuries per year on bridge and road work
- 2019 FHWA study: Drones reduce risk of injuries and accidents by up to **90 %**



Bridge



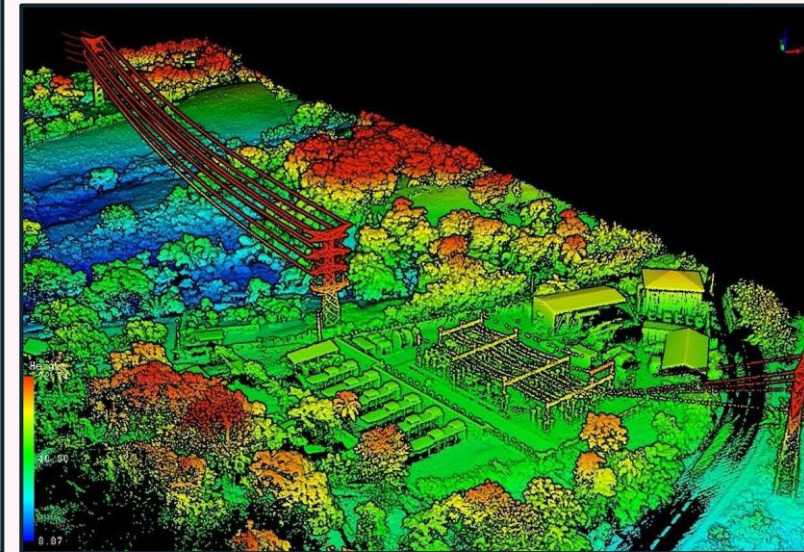
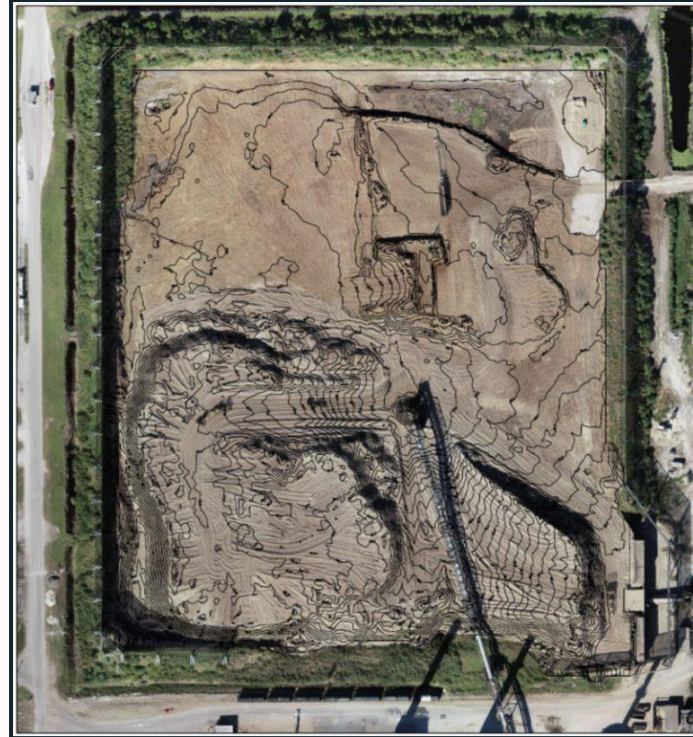
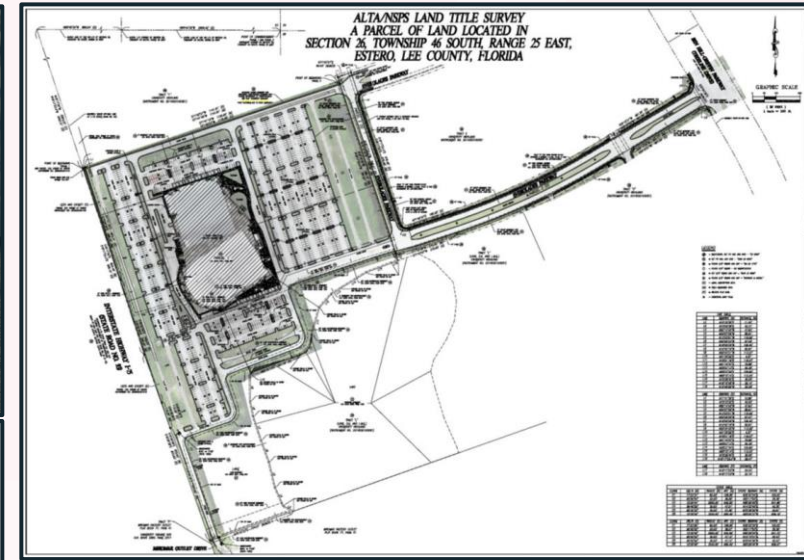
Survey

- Bureau of Labor Statistics: 10 fatal injuries per year on bridge and road work
- Journal of Occupational and Environmental Safety: UAS can reduce the risk of accidents and injuries for land surveyors by up to 75%.



Survey

- Fly Drone to collect data and generate point clouds from
 - RGB imagers
 - LiDAR
- Thousands of points with an X,Y,Z and R,G,B value
- Feature extraction, measurements, volumetrics, etc

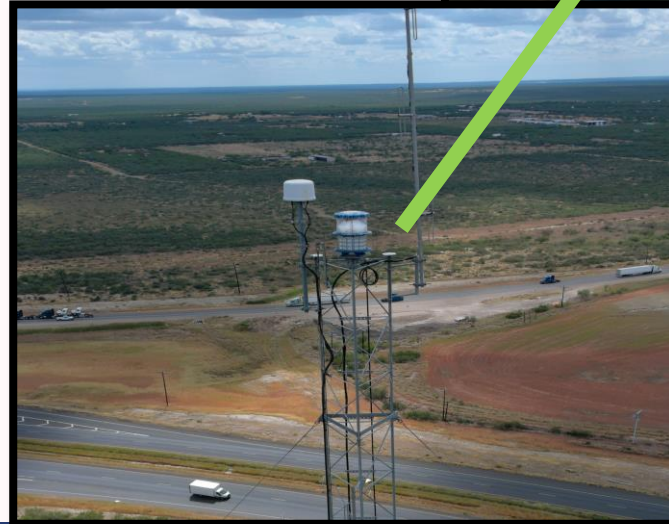
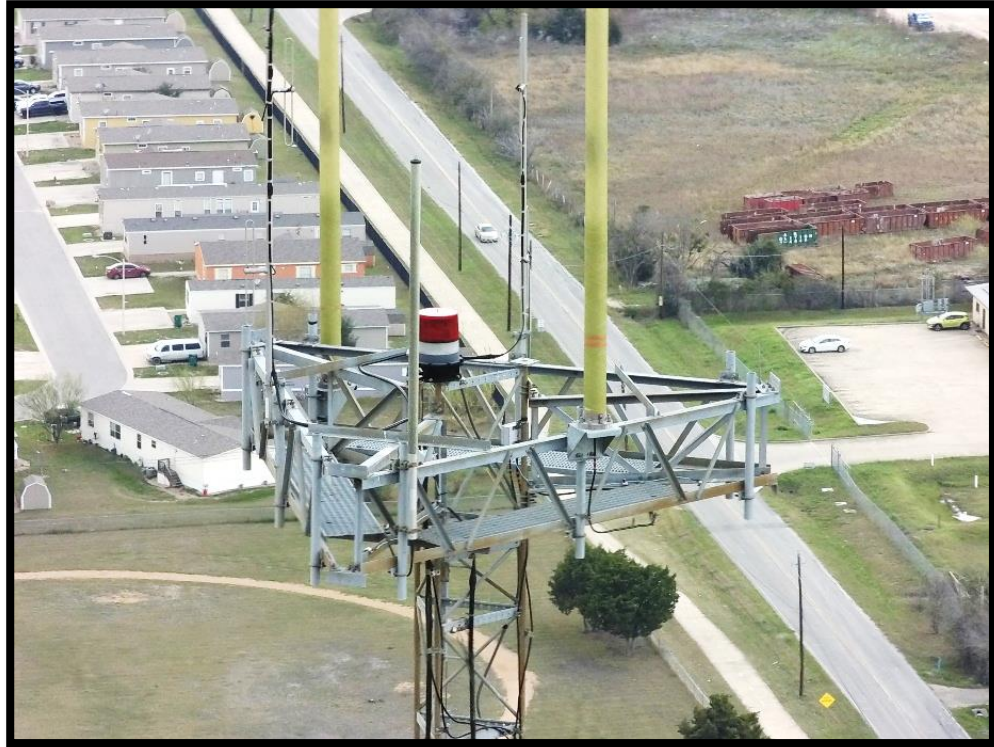


Natural Disasters

- Emergency response
- Real time condition updates
- Hazmat runoff detection
- Debris calculations



High Mast Inspection and Inventory



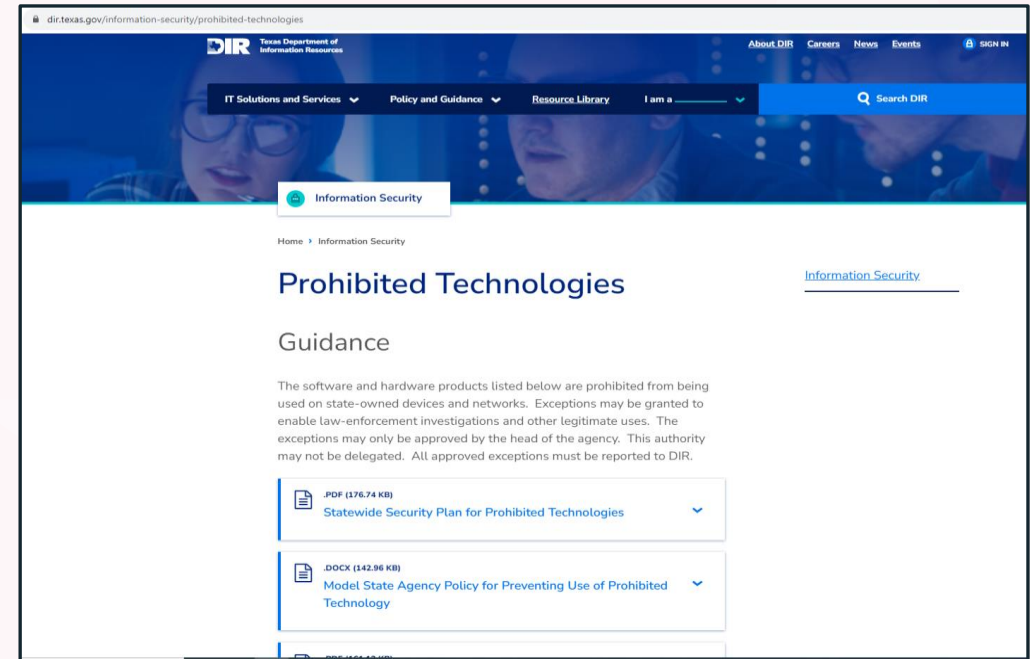


Contractors and Consultants: How to use UAS on TxDOT Projects

- 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*

Prohibited Technologies

- Mandates that state entities and agencies abide by the Prohibited Technologies policy.
- DJI specifically listed as a prohibited manufacturer.
- DJI cannot be used to conduct state business.
- Exemptions on a case-by-case basis for emergency situations (think declared state of emergency)



The official TxDOT list is available at [Prohibited Technologies List \(txdot.gov\)](https://www.txdot.gov/prohibited-technologies-list)

Software / Applications

- Alipay
- CamScanner
- Kaspersky Security & VPN
- SHAREit
- TikTok
- WeChat
- WeChat Play
- WPS Office

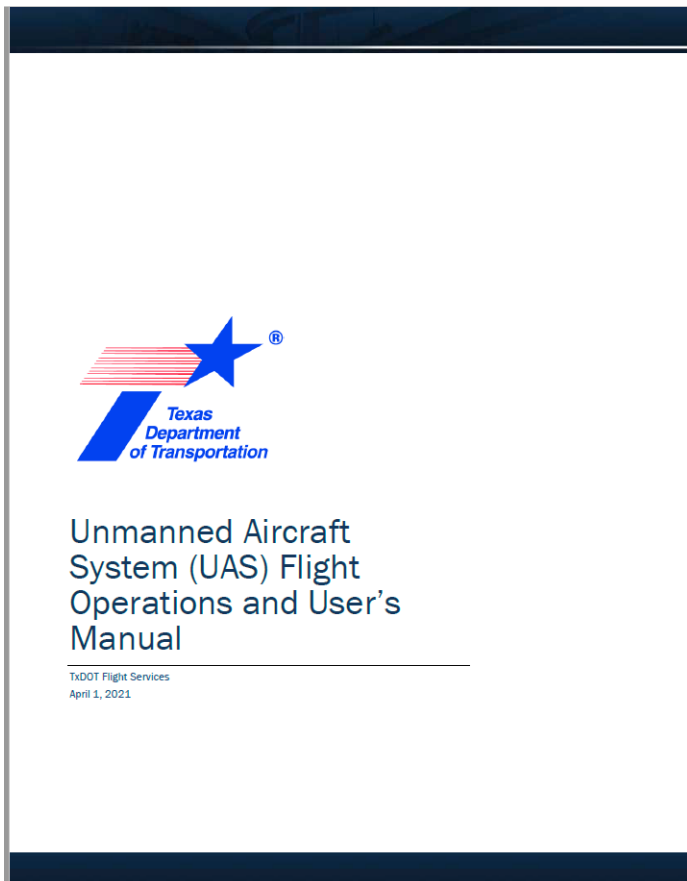
Developers

- Alipay (Hangzhou)
- ByteDance LTD
- INTSIG Information Co., Ltd
- Kaspersky Lab Switzerland GmbH
- Kingsoft Office Software Corporation
- SHAREit Technologies Co. Ltd
- Tencent Holdings
- TikTok Ltd.
- WeChat

Hardware / Equipment Manufacturers

- Dahua Technology Company
- Huawei Technologies Company
- Hangzhou Hikvision Digital Technology Company
- Hytera Communications Corporation
- SZ DJI Technology Company
- ZTE Corporation

What does the Flight Operations and User's Manual Cover?



- Section i – TxDOT UAS Program
- Section ii – UAS at TxDOT
- Section iii – Regulatory Environment
- Section iv – FAA Remote Pilot Certificate
- Section v – Indemnification
- Section vi – Emergency Operations
- Section vii – Important Information Links

TxDOT UAS Program

- Section 1.1. – Organization and Administration
- Section 1.2. – Safety Management System (SMS)
- Section 1.3. – Program Operation

Air Operations

- Section 3.1. – Flight Crew Organization
- Section 3.2. – Flight Crew Duty Day
- Section 3.3. – Flight Crew Health
- Section 3.4. – On-Location Risk Assessment
- Section 3.5. – Flight Procedures
- Section 3.6. – Privacy Issues

Appendix

- Appendix A – Example Flight Plan
- Appendix B – Pre-approval Form
- Appendix C – Example Traffic Control Plan
- Appendix D – In-Flight Emergency Checklist
- Appendix E – Downed Aircraft Emergency Plan Checklist
- Appendix F – Accident Report Form

Ground Operations

- Section 2.1. – Flight Crew Requirements
 - Section 2.1.1. – Remote Pilot in Command
 - Section 2.1.2. – Visual Observer
 - Section 2.1.3. – Secondary Pilot in Command
 - Section 2.1.4. – Additional Visual Observer
 - Section 2.1.5. – Recurrent Training
- Section 2.2. – Project Risk Assessment
- Section 2.3. – Flight Planning
 - Section 2.3.1. – Flight Planning General Rules
 - Section 2.3.2. – Flight Plan
 - Section 2.3.3. – Traffic Control Plan
- Section 2.4. – Health and Safety Plan
- Section 2.5. – In-Flight Emergency Plan
 - Section 2.5.1. – Total Loss of Aircraft Power
 - Section 2.5.2. – Partial Loss of Aircraft Power
 - Section 2.5.3. – Airspace Encroachment
 - Section 2.5.4. – Loss of Aircraft Control
 - Section 2.5.5. – Erratic Aircraft Behavior
 - Section 2.5.6. – Aircraft Fly-Away
 - Section 2.5.7. – Bird Strikes
 - Section 2.5.8. – Fixed Object Strikes
 - Section 2.5.9. – Interference with Flight Crew
 - Section 2.5.10. – Nearby Emergency Operations
- Section 2.6. – Downed Aircraft Recovery Plan
 - Section 2.6.1. – DARP General Rules
 - Section 2.6.2. – The DARP Procedures
- Section 2.7. – Accident Reporting
 - Section 2.7.1. – TxDOT Reporting Requirements
 - Section 2.7.2. – FAA Notification Requirements
 - Section 2.7.3. – NTSB Notification Requirements

- Section 2.8. – Maintenance
- Section 2.9. – Aircraft Registration Number
- Section 2.10. – Logs and Records
 - Section 2.10.1. – Pilot Log
 - Section 2.10.2. – Aircraft Maintenance Log
 - Section 2.10.3. – Record Retention

Flight Plan

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UAS Flight Plan

Project Information

Project Name US 290 Retaining pond drainage study		Pre-Approval Required? Refer to Section 3.2 Project Risk Assessment. Projects not requiring pre-approval are flown in Class G airspace and have none of the risk factors listed in the Section. <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <small>If pre-approval is required, complete and submit the Pre-Approval Request form in addition to the Flight Plan.</small>	
Location Latitude: 30.44582105 Longitude: 98.23462533		County BURNET	Project Number 2017023
Purpose of Flight The data gathered will be used to assess the drainage around a detention pond located on the north side of Highway 21.			
Maximum flight altitude to be used 100 Feet AGL <small>Above ground level (AGL)</small>	Is an FAA waiver required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Airspace Class <input type="checkbox"/> B <input type="checkbox"/> D <input checked="" type="checkbox"/> Other <small>If other, specify</small> <input type="checkbox"/> C <input type="checkbox"/> E (at ground level) <input type="checkbox"/> G	
Will a NOTAM be used? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Proposed flight date Sep 29, 2018	Backup flight date Sep 30, 2018	

Submitting Organization Information		Performing Organization Information	
Name:	Texas Department of Transportation	Contractor Name:	
Address line 1:	125 East 11th Street	Contractor Address:	
Address line 2:		Contractor City:	
City:	Austin	Contractor State:	
State:	TX	Contractor Zip Code:	
Zip Code:	78701	Contractor Phone Number:	
Phone number:	512 555.5555	Contractor Fax Number:	
Fax number:	512 555.5555	Contractor Contact Name:	
Contact name:	TxDOT employee	Contractor Contact e-mail:	
Contact e-mail:	TxDOT.employee@txdot.gov		

4-1 Flight Operations and User's Manual TxDOT | April 2018

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UAS Flight Plan

General Location Map

Instructions: Provide a map showing the general location of the project. Show nearby towns, roadways, airports, and other cultural features to aid in locating the project.

The nearest improved airport is Burnet Municipal at 9.4 miles. The nearest unimproved airport is Camp Longhorn at 1.8 miles. Camp Longhorn is a remote control aircraft airport.

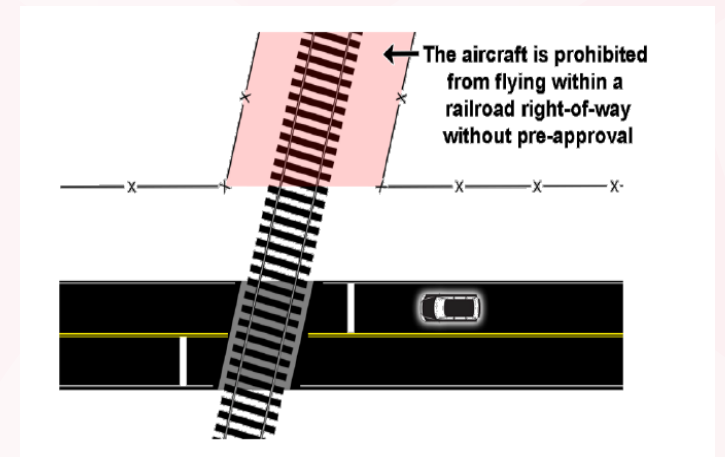
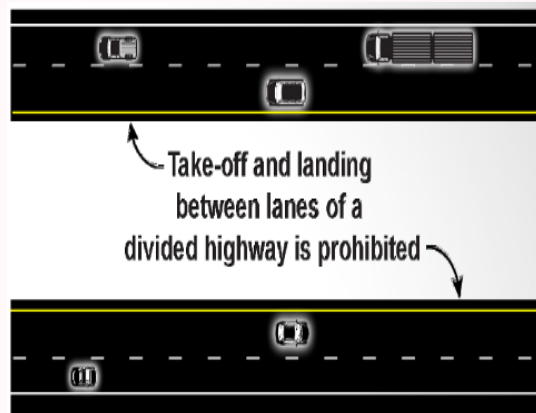
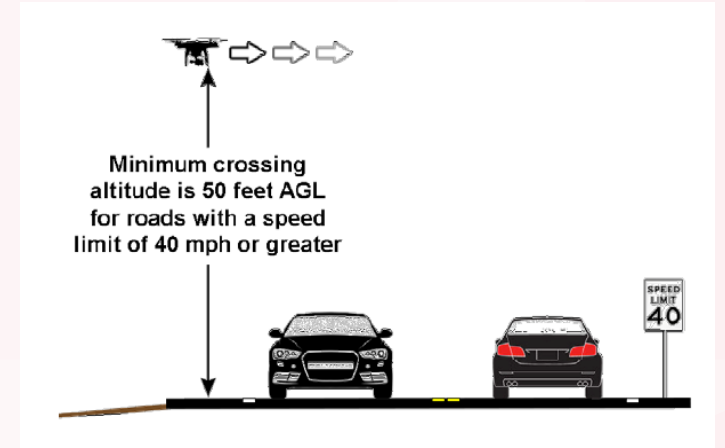
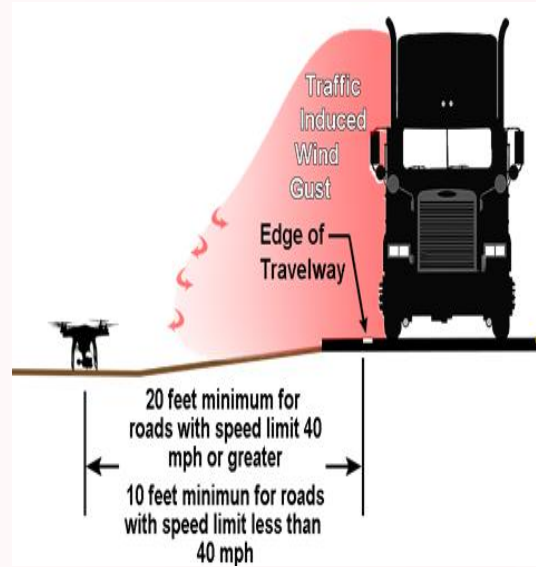
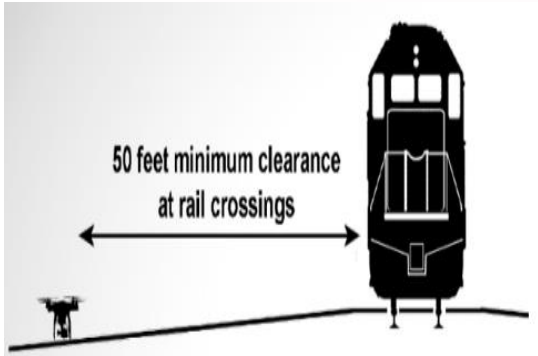
Page 3 of 3

UAS Flight Plan

Project Map

Instructions: Provide a map showing the project site. Show the area over which the data will be collected, the limits of the UAS operating area including maneuver and turning areas, and proposed take-off and landing sites.

General Rules



Pre-Approval Request Form

- Within Class B,C,D airspace or Class E at the surface
- Exception from general rules
- If FAA waiver or authorization is required (not LAANC)
- Within a railroad corridor
- If private landowner permission is required
- Within 2 nautical miles of an airport or heliport with a paved runway
- 100 feet of the ROW of an interstate highway or Any highway with 3 or more travel lanes
- Complex UAS operations area
- Traffic control beyond warning signs

Page 1 of 1

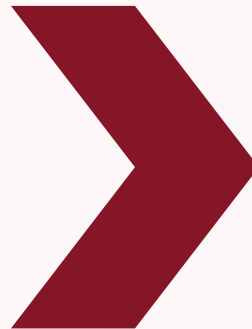
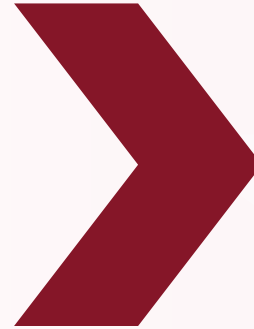
UAS Flight Pre-Approval Form

Project Name <input type="text"/>		Project Number <input type="text"/> <small>The project number is assigned by the TxDOT UAS Coordinator. All correspondence should refer to this project number.</small>	
Location Latitude <input type="text"/> Longitude <input type="text"/> <small>Use latitude/longitude in decimal seconds to four digits of precision in format DD.MM.SS.SSSS</small>		County <input type="text"/>	Proposed flight date <input type="text"/>
Reason Pre-Approval is required: (Fully explain the reason pre-approval is required. Reasons may include airspace approval required for Class B, C, D, or Class E airspace that starts at ground level; Class G airspace with risk factors listed in Section 2.2 Project Risk Assessment; request to deviate from general rules listed in Section 2.3.1, Flight Planning General Rules; the use of an FAA waiver; operation within a railroad corridor; privacy issues; etc. Use additional sheets as needed.) <input type="text"/>			
<input type="checkbox"/> Approved		<input type="checkbox"/> Rejected	
		Date <input type="text"/>	
If rejected, reason for rejection: <input type="text"/>			
TxDOT UAS Coordinator signature: <input type="text"/>			

The TxDOT UAS Program

A good UAS program saves you time, money, and increases safety—If it does not, Its not working.

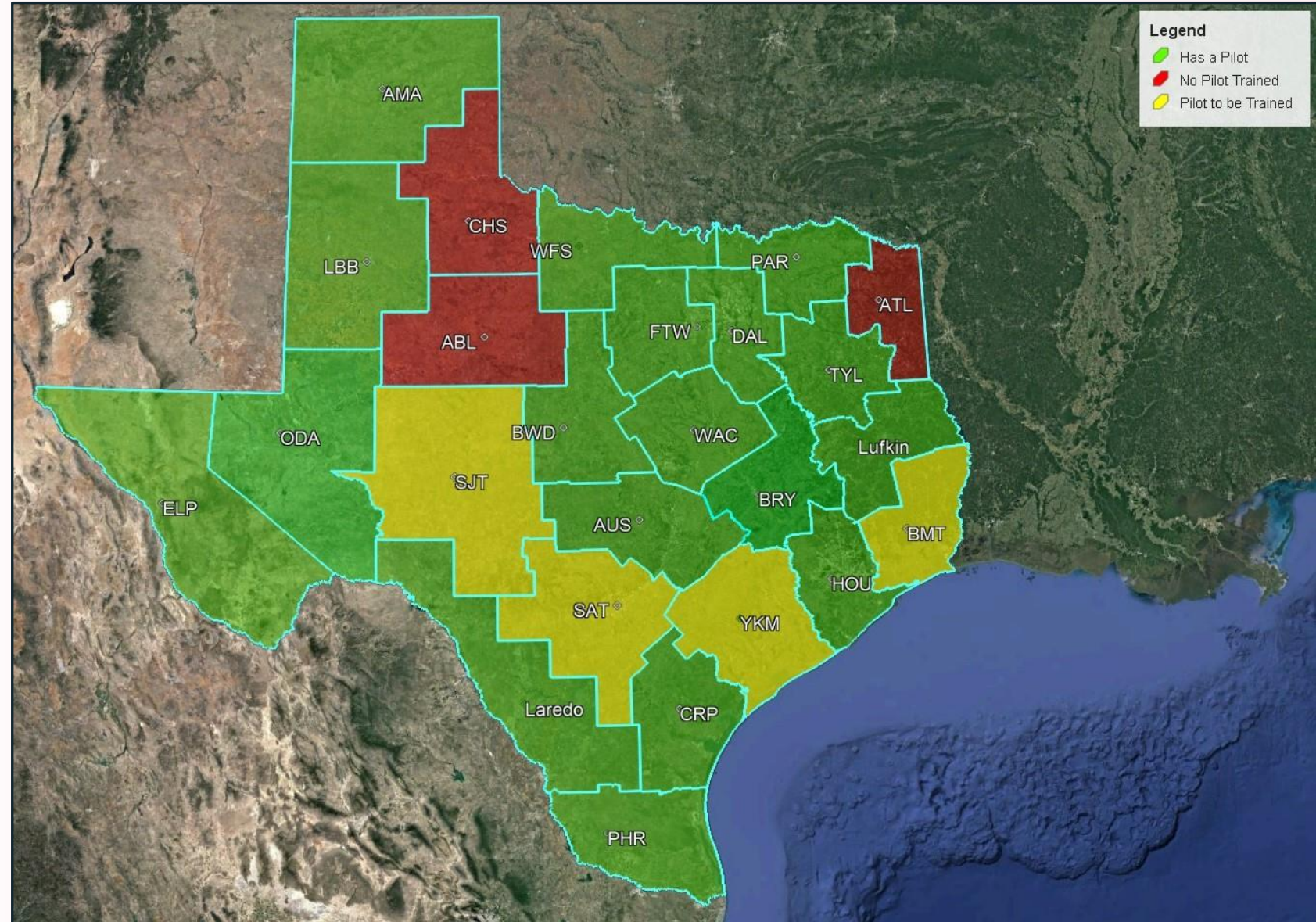
- Use UAS as a tool to collect quantitative and qualitative data.
- Train and equip the department to deploy UAS at scale
- Ensure all UAS operations abide by state / federal rules, regulations, and policy
- Create a standardized program across the state
- Enable txdot personnel to oversee UAS operations by external parties
- Redefine ‘acceptable risk,’ mitigate or eliminate accidents and injuries



- Comprehensive training program from FAA certification preparation through advanced flying tactics and techniques
- Hardware and Software Procurement
- Specialty training
 - Mapping and modeling
 - Confined space / close quarters
 - Cinematic flight movements
 - Inspections
 - etc
- TxDOT UAS Flight Operations and User’s Manual
- TxDOT UAS community of Practice
- Pilot Culture

State of the TxDOT UAS Program as of October 2023

- 68 UAS Pilots
- 32 additional queued for training
- 21 additional training slots remaining for FY24
- 22 of 25 districts have (or are scheduled to have) a trained pilot within their boundaries
- 19 Divisions have Pilots
- 60 training slots available per FY
- ~180 Pilots by end of FY25 + 60 each FY



The Big Picture



Specialty UAS for relevant missions



Increase safety



District pilots:

- Determine when to use UAS
- Determine which UAS to use
- Ensure adherence to TxDOT UAS policies
- Oversight of outsourced UAS services



Increase efficiency



Every district has UAS on hand for daily operations

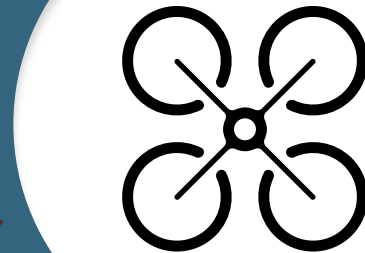


Reduce costs



How?

Why?



UAS SharePoint

SharePoint All changes have been saved Search this site

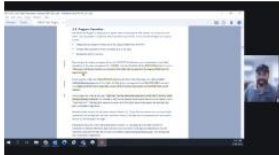
TU TxDOT UAS Portal Home TxDOT UAS Training Course TxDOT UAS Pilot Directory UAS Resources Documents UAS Procurement Work Group Edit

Following Site access


+ New Page details Analytics Published 7/25/2023 Share Edit

The latest revision (1 April 2023) to the Flight Operations and User's Manual (FOM) is available in the Documents page. Check out the video summary of changes video at this link:
https://txdot.sharepoint.com/:v:/s/uas/EeJxBOfUP5xGpveZwIPJupQBgFvREEB_aznQjpW01kkZng?e=p8zEkl


FOM updates 1 April 2023
txdot.sharepoint.com



Welcome to the TxDOT UAS Resource page



TxDOT Today: Drone Program Takes Flight
Watch later Share



Watch on YouTube



[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



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.



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Digital Twin



Engineering



Construction



Photogrammetry



Public

Digital twins are motivated by outcomes, tailored to use cases, powered by integration, built on data, guided by domain knowledge, and implemented in IT/OT systems.

Collection and Processing for UAS Data

- Data collection
- Bentley iTwin Capture Modeler
- ArcPro

Collecting UAS Data



Data



Source: Stephanie Marquez

FM 1977 widening



CAD  **GIS**



Journey to Enterprise Data Integration

GOALS

1. Assess the state of geospatial data systems at the agency
2. Provide Recommendations on how to advance shared goals
3. Create strategy to fulfil identified needs



Summary

- Understand the needs
 - Define the structure
 - Collect and process the data
 - Display in context
-
- Birdwatching goes both ways...



Special Thanks

- Stephanie Marquez
- Sergio Roman
- Matt Washburn
- Design Division
- Chris Bardash
- Jenn Lash

Safety: Mission

ZERO



Safety Never Stops!



TEXAS DEPARTMENT OF TRANSPORTATION