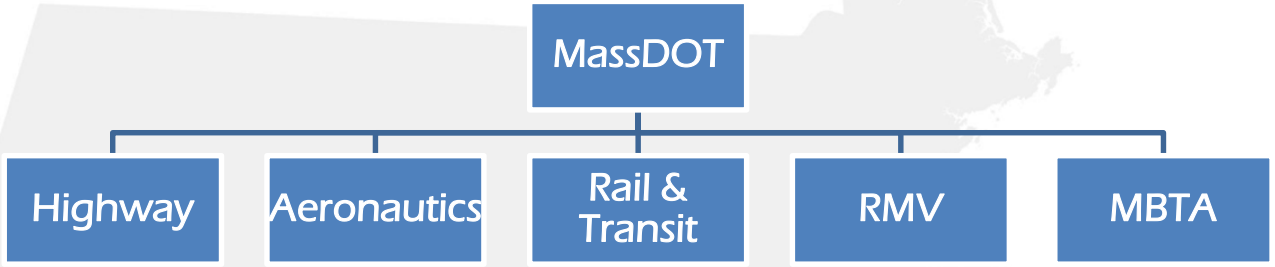
Interstate-95 Corridor Coalition UAS Workgroup

Samuel Nelson, Project Manager
MassDOT

Massachusetts Department of Transportation (MassDOT)



- November 1, 2009. The Commonwealth integrated its transportation agencies and authorities into a new streamlined Massachusetts Department of Transportation (MassDOT)
- MassDOT is an organization with over 10,000 employees working to simplify and streamline the transportation system while making it more accountable and accessible
- MassDOT Aeronautics is conducting a Unmanned Aerial Vehicle (UAV) pilot program for the use of UAVs in transportation use cases, Interim Drone Policy Presented on 10/16/2017 by Administrator Dr. J. DeCarlo to MassDOT Board of Directors.

Overview

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- Drones are widely available and are an opportunity for MassDOT and the MBTA as potentially cost effective and useful tools to support our missions and core activities, including:
  - Asset management and infrastructure inspections;
  - Drones will NOT be used for surveillance or intentional collection of Personally Identifiable Information
- A policy will insure that internal usage will meet:
  - Legal, standardized methods to access drones, and
  - Support and oversight to operate drones safely and effectively
- Staff Requests that both Boards vote to adopt the interim drone policy. A draft/suggested policy has been provided

Statement of Purpose

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- Facilitate the adoption of drones across MassDOT in a manner that is:
  - Safe
  - Cost effective
  - Secure
- Incentivize applied research to enable UAS operations and develop counter-UAS solutions

APPROACH

Agenda

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Developing a Comprehensive Drone Program

Review of Use Cases and UAS Operations

Growing Capability to Support Multi-Modal Needs Across Commonwealth

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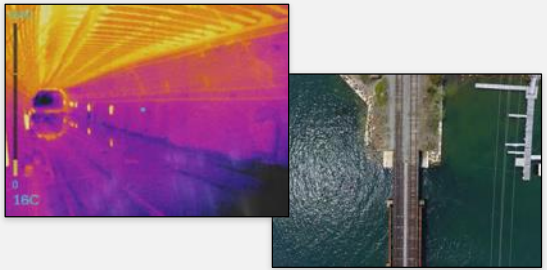
AERONAUTICS

- Runway/taxiway/apron pavement inspection
- General airport inspections
- Obstacle/obstruction analysis to ensure clear approach and departure flight paths

RAIL & TRANSIT/MBTA

- Rail inspection
- Rail obstructions
- 3rd rail inspection
- Tunnel inspection (testing)



HIGHWAY

- Pavement inspection
- Bridge inspection
- Environmental inspection (stormwater management)
- Construction site monitoring
- Incident response
- Asset management

- Addressing multi-modal needs across MassDOT and the MBTA, and becoming a shared service for Commonwealth agencies

Deploying UAS Resources for Emergency Response Documentation

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AIRCRAFT ACCIDENTS

- MassDOT Aeronautics state lead accident investigator

PIPELINE FIRES

- Documented damage due to gas fires
- Performed operations in conjunction with NTSB

EXERCISES

- Demonstrated operational integration of UAS and de-confliction with crewed/manned aircraft

- Working with MEMA and FEMA to support emergency response and to bring capabilities across state lines (UAS and crewed aircraft)

MassDOT UAS Fleet

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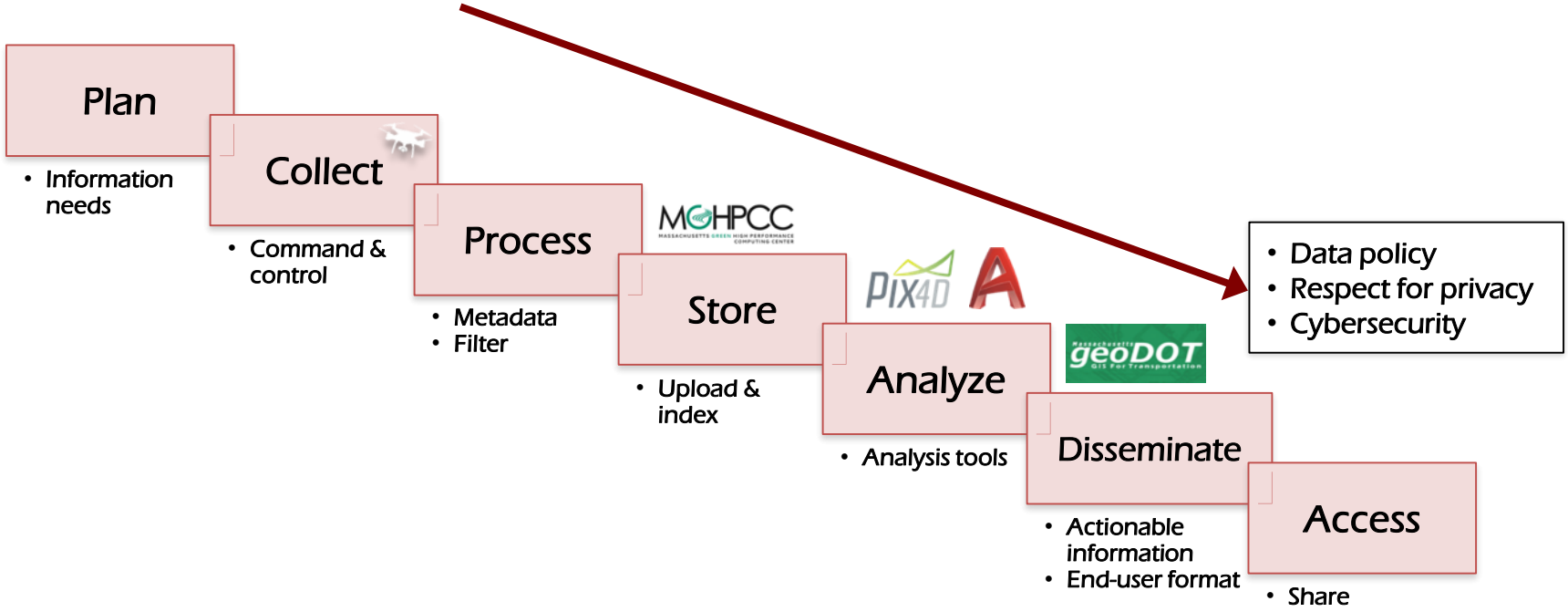
- Fleet selected through evaluation of UAS use cases and analysis of alternatives
- Expanding fleet with new purchases of DJI Mavics, LIDAR, Multispectral sensors, robust computing systems and other specialized systems such as a Fixed sUAS tether.

	 DJI Phantom 4	 DJI Inspire 2	 DJI Matrice 210	 Yuneec H520	 SenseFly ebee	 Delair UX11
# Purchased	5	2	1	1	1	1
Sensors	HD Camera	HD Camera 6K Camera	HD Camera; 30x Optical Zoom; IR (thermal) Camera	HD Camera	S.O.D.A. RGB Sensor[1]	Hi Res, Low/No Distortion
Features	-Robust Comms. Links -Cost effective EO Vehicle	-Dual Operator Mode -Retractable Landing Gear	All-weather; Upward Gimbal; Dual Payload Capable	All-weather; 6 Rotors; 360° View	RTK/PPK Accuracy[2] 20 mile range 2.8ghz	PPK Accuracy[2]; 33 mile/Unlimited range 2.8ghz/4G/LTE
Flight Time	30 min	27 min	25 min	25 min	50 min	59 min

Data Pilot General Process



- Building comprehensive approach to data analytics and security necessary to enable drone benefits and ensure mission success

Agenda

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Developing a Comprehensive Drone Program

Review of Use Cases and UAS Operations

Comprehensive Approach Allows UAS Support to Expand Across Commonwealth

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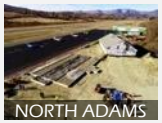
Emergency Response Vigilant Guard Drill



Aeronautics Document Building Move

Highway District 1 Roof Inspection

Highway District 2 Woronocco Bridge

Highway District 2 Agawam Bridge

Highway District 3
(L) MassPike Thermal Imaging
(R) Headquarters Construction

Emergency Response Pipeline Fire

State House Dome

Highway District 6 Comm. Ave. Bridge Replacement

MBTA Subway Drill

Highway District 5 Cohasset Bridge

Highway District 5 I-495 Lobes

Categories of Use Cases and Data Products

USE DATA	DATA PRODUCTS
Public Relations	Imagery & video
Asset management/inspection	Imagery & GIS orthomosaics/3D Models
Construction site monitoring	GIS orthomosaics/3D Models & CAD terrain elevations (DSM/DTM Contours)
Thermography	Infrared imagery & video
Incident/Emergency Response	Imagery, video & live-streaming video – TETHERED OPS

Documented Replacement of Commonwealth Avenue Bridge

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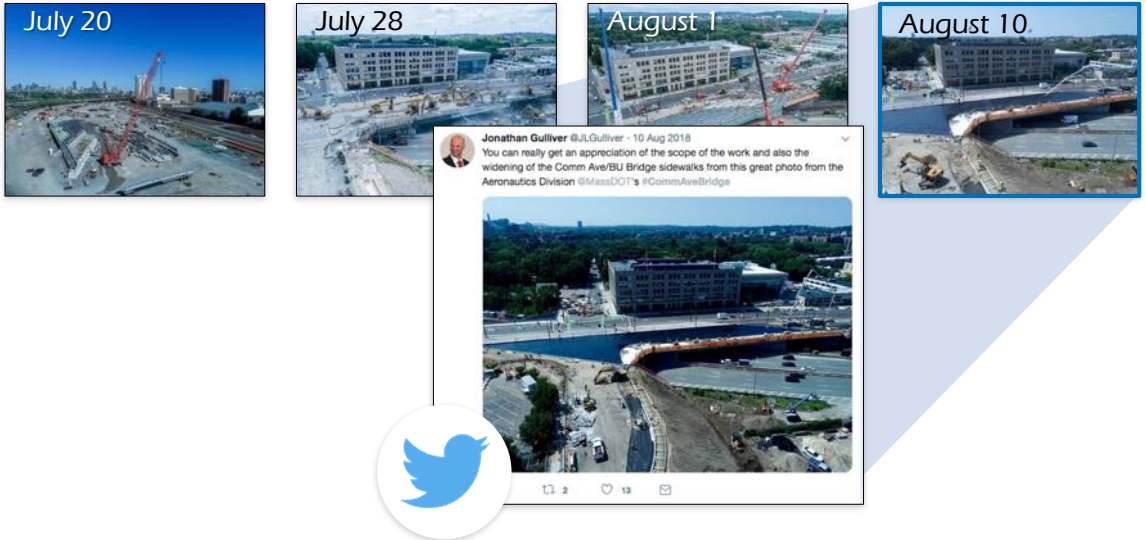
- Documented progress of Commonwealth Ave Replacement Bridge in downtown Boston
  - Flew 11 missions over 3 weeks: July-August 2018



- Demonstrated Drone Team's capability, and provided valuable lessons learned


CAT

State House Dome Inspection

- State House requested Drone Team support to capture discoloration of dome's gold leaf
- Coordinated with FAA to allow flight close to Boston Logan Airport
- Careful flight planning to ensure safe operations around historic and complex structure

Details

- Flew mission day before Thanksgiving
- Great support from State House authority for access and ground crowd control
- "This gives me what I need" to plan repairs – State House authority representative

Elements of Drone Mission

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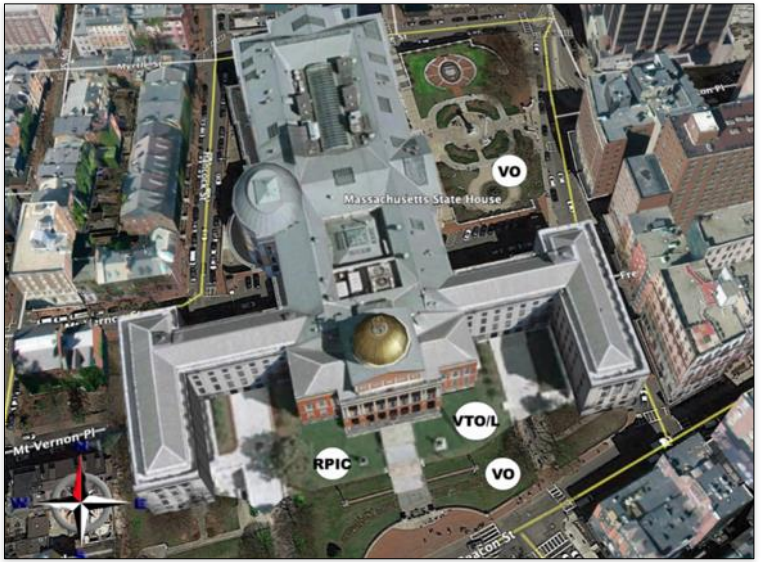
Many elements are required to safely and successfully execute a mission:

- Class B Airspace
- Privacy concerns
- Collision avoidance
- Visual observers
- Stakeholder interaction
- Public safety



Google Earth image showing locations of:

- Remote Pilot-in-Command (RPIC)
- Visual Observers (VO) for safety
- Vertical Take-Off and Landing (VTO/L) location for UAS

State House Dome Video Footage

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Imagery of damage

IR imagery of damage

State House Dome Inspection
Infrared Sensor

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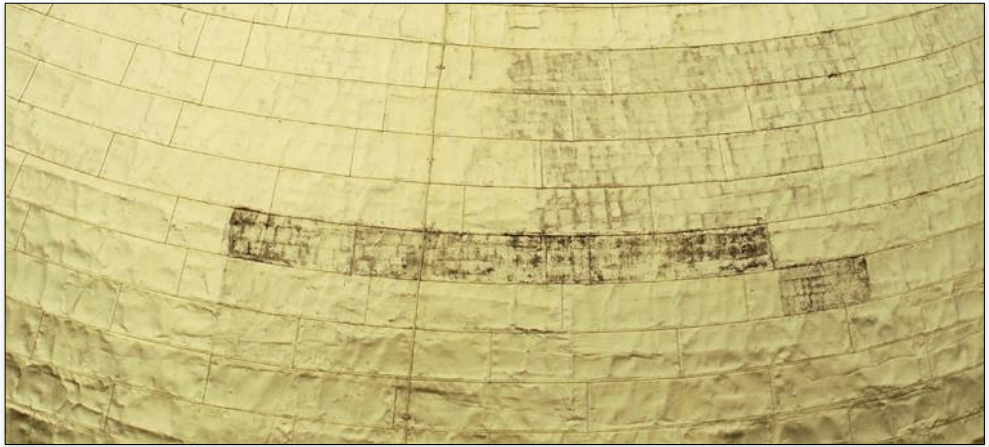
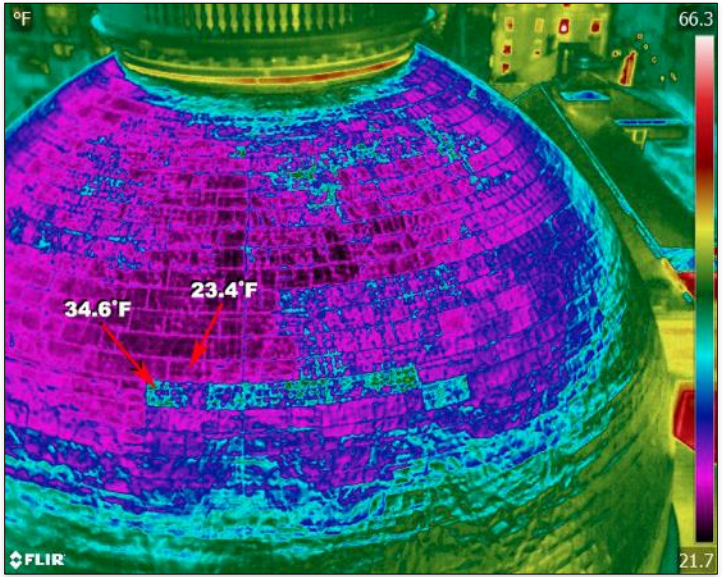
- Demonstrated use of IR (thermal) camera to detect problem area





Successful Use of Drone Data

New Highway District 3 Headquarters

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- Difficult site topography created construction challenges
  - Site surface model created using drone mapping tools; used to evaluate site conditions and test 'fit'

Photomosaics show changes over time

District Application of Drone Data
Construction of Highway District 3 Headquarters

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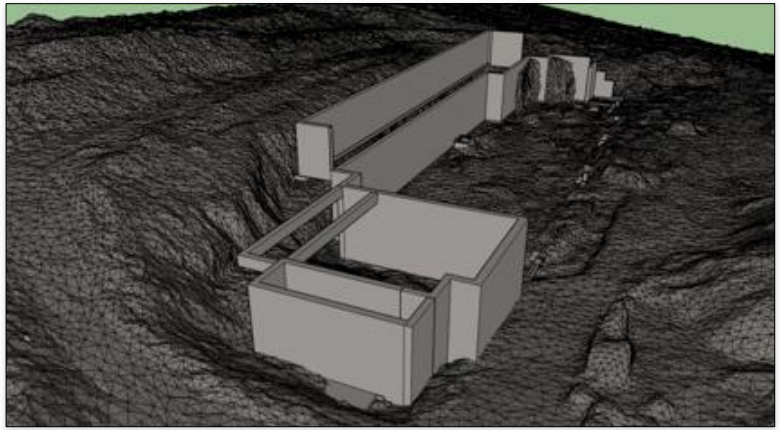
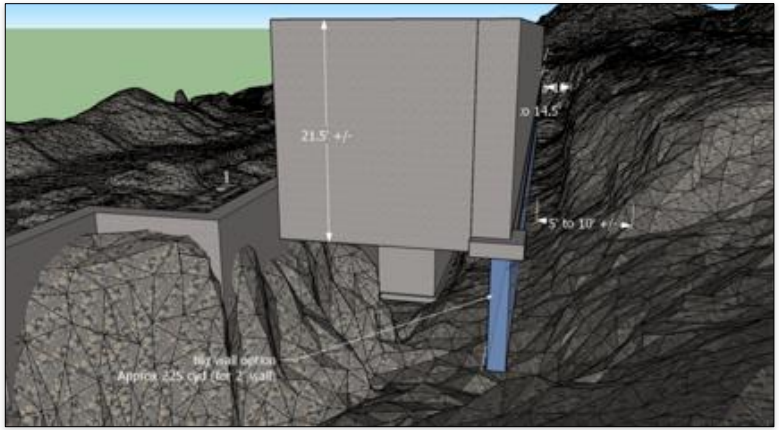
- Combine CAD model of building with terrain model generated from drone data





"The information we received and the processing done by Jason's team allowed us to make construction decisions that would have otherwise cost us significant amounts of time and money."

– Barry Lorion
District Highway Director, District 3

"Use of the drone-derived data revealed $300,000 fill underestimate. Early identification of the gap saved the project money and time."

– Jason Benoit
Special Projects Manager, District 3

Expanding Use for Environmental Inspection
Agawam Bridge, West Springfield

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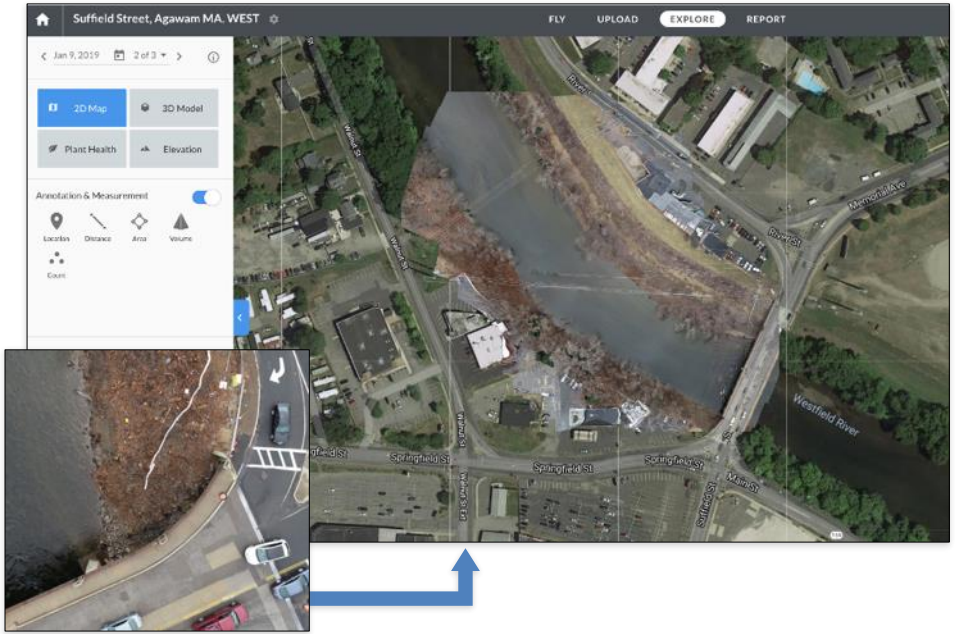
- Working closely with Highway District personnel for environmental inspection



Details

- Use drones for existing conditions survey of bridge embankments in locations that could be impacted by construction and erosion
- Photo documentation for combined storm water and sewer pipe outlet required before construction
- Grade profile of the West Springfield embankment/flood control levee and coffer dam inspections

Woronocco Bridge

District 2, Westfield River, Russell

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- UAS allowed field engineers to monitor structural condition of abandoned bridge, out of service since 1984
- UAS allows access in complex terrain; inspection of unsafe structure

Airplane Accident Investigation

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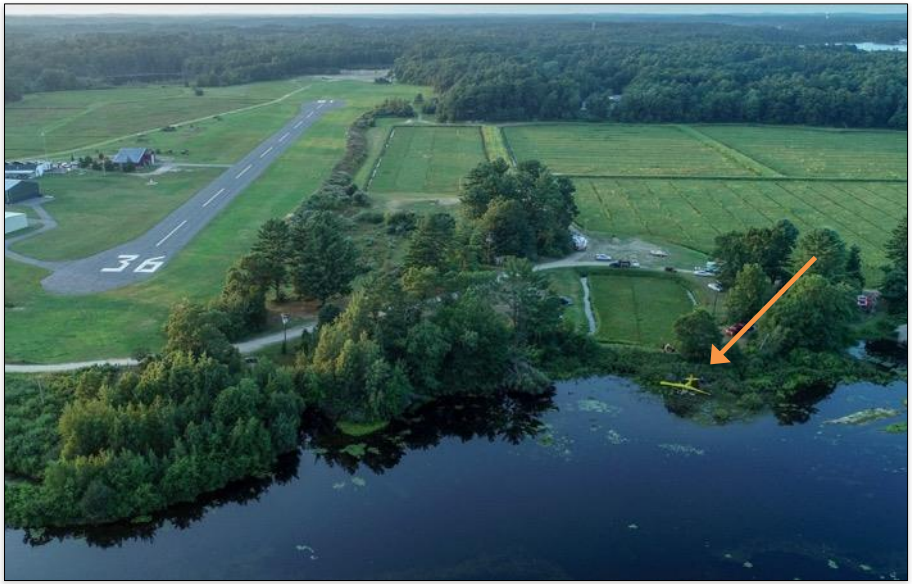
- Supporting NTSB by documenting accidents

Orange Municipal Airport, Orange, MA (9/26/17)
(Photo courtesy of MassDOT Aeronautics)



Cranland Airport, Hanson, MA (8/24/18)
(Photo courtesy of MassDOT Aeronautics)

Deploying Drones for Emergency Response
Lawrence Pipeline Fires & Aircraft Accident

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- Immediate emergency response capabilities deployed for documentation of homes after pipeline fires, and for aircraft accident
  - Coordinated with NTSB (lead agency for investigation) to image damaged structures
  - All necessary waivers and authorizations quickly secured to enable mission

Details

- Team dispatched September 14-16 (days immediately after explosions) to provided real-time coverage and damage assessment of impacted areas
- Successful state and federal coordination
- 3D models created using drone imagery
- Immediate transition to scene of aircraft accident, also coordinating with NTSB

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Emergency Response Preparedness
Vigilant Guard

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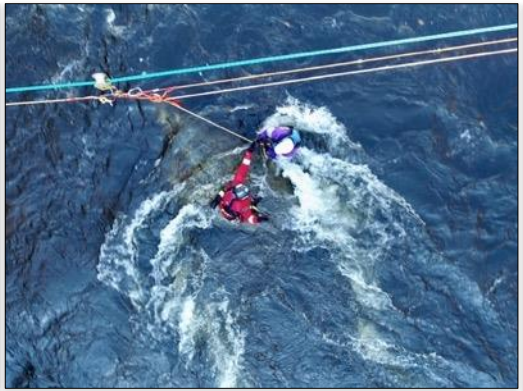
- Developing concepts of operation to support emergency response
  - Vigilant Guard: multi-agency bi-annual exercise to demonstrate collaboration for a variety of emergency response scenarios: dam damage, stadium attack, and coastline flooding
- Participated in multi-vehicle, multi-mode (manned & unmanned) simultaneous operations



Details

- November 2018
- Deconflicted with multiple other UAS and manned aircraft
- Coordinated with ~25 other agencies
- Identified as key contributor in exercise, and to document activity

MBTA Subway Evacuation Drill

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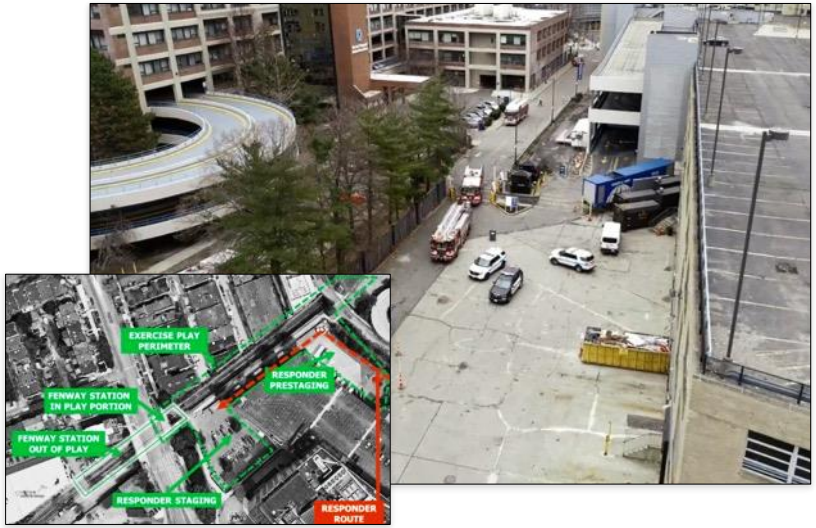

- Support MBTA at Fenway Station for 16 December drill of train derailment
- Provided video for first responders to use to assess evacuation during interagency coordination exercise (MBTA, MBTA Transit Police, Boston EMS, Boston Fire)

Public Relations Documentation

North Adams Airport Building Relocation

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- Documented relocation of existing building for airport manager
- Coordinated with airport manager to allow UAS operations at active airport

Any questions?