MassDOT Highway and MassDOT Aeronautics Drone Program
Integration of Drone Technology and Data Solutions for Wetland Monitoring

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Introduction

MassDOT Highway Environmental Compliance for Construction Section
MassDOT Drone Program

Project Overview

Objective
Traditional Methods
Drone Collection Methods

Data

Finished Products
Benefits
MassDOT Environmental Compliance for Construction

- Provide environmental compliance support during Highway Division construction projects
- Assist with wetland mitigation site management and monitoring
- Maintain compliance with environmental permits
- Advise the district on environmental compliance issues
Leverage UAS for a variety of applications such as inspections, asset management, and incident response.

Span across all DOT modes of transportation including Highway, Rail and Transit, Aeronautics, and the MBTA.

- Increase safety
- Decrease inspection time
- Improve data quality
- Reduce taxpayer costs

Advise, assist, and share UAS policy, procedures, and best practices with other Commonwealth agencies.
### Meeting a Diversity of Operational Needs

**Drone Pilot Program** developed to meet real, user-defined needs across MassDOT and the MBTA

#### HIGHWAYS
- Bridge inspection
- Asset monitoring

[Images: Woronoco Bridge, Commonwealth Bridge, Cohasset Bridge]

#### RAIL & TRANSIT + THE MBTA
- Rail inspection
- Subway/tunnel inspection

[Images: Rain Bridge Inspection, Rail Inspection, Tunnel Inspection]

#### AERONAUTICS
- Airport inspection
- Accident investigation

[Images: North Adams, Fitchburg Airport, Accident Investigation]

#### EMERGENCY MANAGEMENT
- Incident response
- Asset allocation

[Images: Subway Evacuation Drill, Pipeline Explosion, Live-streaming MBTA Training Exercise]
### Drone Pilot Program Fleet

<table>
<thead>
<tr>
<th>Aircraft Model</th>
<th># in Fleet</th>
<th>Sensors</th>
<th>Features</th>
<th>Flight Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>DJI Phantom 4</td>
<td>5</td>
<td>HD camera</td>
<td>Dual operator mode</td>
<td>30 min</td>
</tr>
<tr>
<td>DJI Inspire 2</td>
<td>2</td>
<td>HD camera</td>
<td>All-weather</td>
<td>27 min</td>
</tr>
<tr>
<td>DJI Matrice 210</td>
<td>3</td>
<td>HD camera</td>
<td>Upward gimbal</td>
<td>25 min</td>
</tr>
<tr>
<td>DJI Matrice 600</td>
<td>1</td>
<td>• MicaSense Altum</td>
<td>Heavy lift</td>
<td>16-35 min</td>
</tr>
<tr>
<td>DJI Mavic 2</td>
<td>2</td>
<td>HD camera</td>
<td>Small</td>
<td>27 min</td>
</tr>
<tr>
<td>Yuneec H520</td>
<td>1</td>
<td>HD camera</td>
<td>• All-weather</td>
<td>25 min</td>
</tr>
<tr>
<td>SenseFly ebee</td>
<td>1</td>
<td>S.O.D.A. RGB sensor¹</td>
<td>• Portable</td>
<td>50 min</td>
</tr>
<tr>
<td>Delair UX11</td>
<td>1</td>
<td>HD camera</td>
<td>RTK/ PPK accuracy²</td>
<td>59 min</td>
</tr>
</tbody>
</table>

**Notes:**

- Aircraft fleet and associated sensors selected based on missions needs.
- Continue to build expansive fleet with new aircraft purchases and specialized hardware.

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¹ Sensor Optimized for Drone Ops – RGB broad color array
² Real Time Kinetic/Post-Processed Kinetic
A partnership between the MassDOT Highway Environmental Compliance for Construction Section and the MassDOT Aeronautics Drone Team that supplements traditional inspection of active wetland mitigation areas.

Inspection Data

Provide data to support inspection and performance standards in following areas:

- Illegal dumping
- Invasive/ non-native plant species
- Stream functionality/ soil saturation
- Soil elevations
- Wildlife use/ corridors

Stitched Images

Create a stitched image of each site, allowing Environmental Compliance Group to monitor the progress of wetland mitigation sites.
MassDOT Environmental Compliance for Construction

Traditional inspection methods

Inland wetland systems inspection
- Assessed annually
  - Long-term monitoring

Assessment includes documentation of:
- Vegetative cover – establishing and collecting data from sample plots
- Hydrology – installation of monitoring wells or soil tests with auger
- Plant health including recruitment, mortality, herbivory by wildlife, and area of coverage
- Invasive/ non-native plant species infestations, wildlife use/ corridors, and stream functionality
- Signs of illegal dumping
UAS Data Collection and Dissemination

**Data Collection**
- 16 sites
- 20-30 minutes per site
- Multiple sites per day
- Monitor each site 2-3 times yearly

**Data Processing**
- Processed data using multispectral technology
- Supplied stitched image of each site

**Data Delivery**
- Shared via cloud services
- ArcGIS
- Produced maps showing vegetation health, hydrology, and site elevation
Outline

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- MassDOT Highway Environmental Compliance for Construction Section
- MassDOT Drone Program

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Data
- Finished Products
- Benefits
Finished Products

Multispectral Data
Benefits: Produces advanced imagery utilized for plant health, plant classification, invasive species detection, and elevation models

Orthomosaic Data
Benefits: Detailed, accurate, georectified, interactive, high resolution photographic representation of an area – enabling accurate measurement and volumetrics
Qualitative and Quantitative Benefits

- Increased safety
- Considerable decrease in inspection time - up to 40%
- Improved data quality - Access areas inaccessible by foot
- Improved site documentation
- Historical record - enable change detection

Potential Savings per Inspection: $3-5k
Thank you!