ADOT
Engineering Survey Section
Unmanned Aerial Vehicle (UAV) Support
Brown Bag Lunch & Learn
Agenda

• Introductions & Background
• Past Projects
• Equipment
• Rules & Guidelines
• Examples
• Requesting a project
• Project Lifecycle
• Take Aways
• Q & A
How did we begin?

• Last P&M project delivered - March 2017
• Engineering Survey Section transitioned from film based camera to digital - April 2017
• 2 operators FAA Part 107 certified - April 2017
• Greg Byers (Roadway Manager) helped acquire Trimble ZX-5 sUAS - May 2017
• Training completed & began flying - June 2017
So far..

- 245 flights
- 33 hours total flight time
- Average flight ~ 8 minutes
Past Projects...
US-60 Renaissance Fair
SR-89A Sedona Rockfall Mitigation
SR-89A Sedona Digital Terrain Model
Equipment
Equipment

- Trimble ZX-5 Multi-Rotor sUAS
  - 2 LiPo batteries capable of 20 minutes flight time
  - Weight ~ 11 lbs. with camera, gimbal, batteries
  - Speed ~ 6 mph
  - Jeti DC-16 remote controller
- Sony a6000 mirrorless camera
- 16 mm f2.8 aspherical ‘pancake’ lens (photogrammetry workflow)
- 16 – 50mm f3.5 – 5.6 lens (video & photos)
Additional Items

• Yaesu FTA-230 VHF Radio
  – Monitor air radio traffic
• Kestrel 2500 Pocket Weather Meter
  – Wind speed & Direction
  – Temperature
  – Barometric Pressure
Trimble Business Center

- Trimble Business Center (TBC) is primary software
  - Outputs .las file (point cloud)
  - Creates ortho mosaic image (.tif or .jpg)
  - Files can import directly to MicroStation (.dgn .dtm .alg)

- Post-processing is done in-house
- No cloud based processing
- Data remains in-house
- Results are repeatable
CFR Part 107 Small Unmanned Aircraft Systems (sUAS) Summary of Rules
• Cannot fly above 400 feet above ground level (AGL)
• Operator and/or Observer must maintain visual line of sight
• Cannot operate UAV over uncovered persons or moving vehicles
• Non-participants may remain in the area if under the cover of a structure or in a stationary vehicle
• Cannot fly at night
Airspace
Non-Controlled vs Controlled Airspace

- Class G without permission (Non-Controlled)
- Up to 400’ AGL
- May fly in controlled airspace (B, C, D, E) if permission is obtained from control tower through FAA Drone Zone Portal
- Manual authorization can take up to 90 days
- In some cases, permission can be granted instantly via LAANC and smart phone using an app (AirMap, Skyward, etc.)
Low Altitude Authorization and Notification Capability (LAANC)
Low Altitude Authorization and Notification Capability (LAANC)
Low Altitude Authorization and Notification Capability (LAANC)
Other Airspace

- TFR (Temporary Flight Restriction)
- NoTAM (Notice to Airmen)
- MOA (Military Operating Area)
- Restricted Airspace
- Prohibited Airspace
- Wildlife Areas
- National Parks
Expedited Approval for Emergency Situations

Emergency Situations

First responders and others organizations responding to natural disasters or other emergency situations may be eligible for expedited approval through our Special Governmental Interest (SGI) process. Operations that may be considered include:

- Firefighting
- Search and Rescue
- Law Enforcement
- Utility or Other Critical Infrastructure Restoration
- Incident Awareness and Analysis
- Damage Assessments Supporting Disaster Recovery Related Insurance Claims
- Media Coverage Providing Crucial Information to the Public

To apply for a waiver through the SGI process you must be an existing Part 107 Remote Pilot with a current certificate OR you must have an existing Certificate of Waiver or Authorization (COA). To submit a waiver through this process, fill out the Emergency Operation Request Form (EORF) and send to the FAA’s System Operations Support Center (SOC) at 9-ator-hq-sosc@faa.gov. If approved, the FAA will add an amendment to your existing COA or Remote Pilot Certificate that authorizes you to fly under certain conditions for the specified operation. If denied, operators should NOT fly outside the provisions of their existing COA or part 107. Operators have the option to amend their requests.

* This process is called the Special Government Interest (SGI) amendment process and is outlined in FAA Order JO 7200.23A.
# Request Form

## FAA Request Form for Expedited SGI Waiver or Authorization for UAS Operation

### Basic Qualifications
- The requesting operator must possess a Certificate of Waiver or Authorization (COA) or Part 107 Pilot License.
- The UAS operation must support an emergency response or other effort being conducted to address exigent circumstances and that will benefit the public good.
- The requested FAA approval cannot be secured via normal processes in time to meet urgent operational needs.

### Operator Information

**Mandatory entry**

- Operator Organization (e.g., agency or company)
- Operator Address
- Operator Point of Contact (including name, office, mobile phone number, and email)
- Pilot and Observers (including names, mobile phone numbers, and emails)
- Type of UAS

### Documentation
If the requested UAS operation will be flown under a pre-existing COA, please attach it here and provide the COA number below.

If the request UAS operation will be flown under Part 107, please provide the Part 107 Pilot License number below.

### Requested Flight Details

- **Enter the date(s) of the proposed UAS operation**: e.g., 03/18/2018, 03/19/2018 (01/21/2018). Mandatory entry.
- **Enter the times of the proposed UAS operation**: (be sure to confirm time zone, e.g., 1200-0400 PST) Mandatory entry.
- **Enter the location of the proposed UAS operation**: (be sure to confirm time zone, e.g., 1200-0400 PST) Mandatory entry.
- **Enter the distance and direction from the nearest airport and FAA identification of the same**: (e.g., 4 NM W 45°)
- **Identify the classes of airspace in which the flight will be conducted**: (e.g., Class G/G0/G/A/BN)

### Nature and Description of Event

**Enter the type of urgent UAS operation to be flown**

- Firefighting
- Law Enforcement
- Search and Rescue
- Local/Regional/Natural Disaster
- Other (Specify below)

### Additional Pilot Qualifications

- Sport/Recreational/Private pilot certificate
- Commercial/Airline pilot certificate
- Flight Instructor certificate

### Contacting the SOSC

The SOSC office and email are staffed/monitored 0000-2400 Eastern Time. For all emergencies, please follow up any email with a phone call to 302-379-8000, which is answered 24/7.
Other Guidelines

- UAS Guidance Memo from State Engineer’s Office
  ‘ADOT employees operating agency owned UAS for the purposes of conducting Department business will do so in a manner that complies with all FAA regulations...employees are prohibited from using privately owned UAS for conducting Department business or on Department time.’
Picacho Pit Pre-Mine
SR-88 Apache Trail Road Erosion
Adjustment Report

Ground control points

Ground control point errors

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<td>RMSEz * 1.9600</td>
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A measure of how well ground control panels were ‘read’ compared to survey.
Final Block Adjustment

Block adjustment results

Accuracy

| Sigma naught [micron] | 4.9569 |

Mean standard deviation of translations

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Mean standard deviation of rotations

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<th>Phi [deg/1000]</th>
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Mean standard deviation of terrain points

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A measure of how well the point cloud fits the survey network created by control panels.
Drone Request Form available on-line:
Type ‘drone’ in Essential Docs tab
## Types of Projects

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<tr>
<td>Digital Terrain Model (DTM)</td>
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<td>Contour Interval =</td>
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<tr>
<td>Traffic Monitoring</td>
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<tr>
<td>Right of Way (Parcel Imagery)</td>
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<tr>
<td>Pre-construction Survey</td>
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<tr>
<td>Construction Progress Monitoring</td>
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<tr>
<td>Material Volume Verification/Stockpile Volume Calculations</td>
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<tr>
<td>Infrastructure/Quality Inspection</td>
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<td>Asset Management/Inventory</td>
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<tr>
<td>Environmental Impact Assessment</td>
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<td>Other (please specify)</td>
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Project Lifecycle

• Request received
• Determine if project can be flown (airspace, FAA restrictions, etc.)
• Plan flight and control panel layout
• Estimate hours needed to complete and submit cost estimate
Project Lifecycle (cont.)

• Establish and survey aerial control panels
• Fly project
• Download and post-process
• Create and submit electronic deliverables via Sharefile
Take Aways

• Many projects lend themselves to UAV’s
  – DTM’s (volumes, topography)
  – Construction Progress
  – Traffic Monitoring
  – 5s (inventory, asset management, etc.)

• Sensor (camera) is the most important element of the entire system
For more information contact:

• Abel Federico
  • 602-712-8411 (office)
  • 602-521-0619 (cell)
  • afederico@azdot.gov

• Martin Leveque
  • 602-712-7287
  • mleveque@azdot.gov
Questions?