Challenges of Developing a sUAS (Drone) Program to Support Engineering Design Within the Power Generation and Distribution Industry

FLORIDA MUNICIPAL ELECTRIC ASSOCIATION

OUTLINE

- Introduction
- Commonwealth background
  - Why a drone program?
- Challenges of a drone program
  - Services?
  - Rules/Regulations
  - Safety
  - Airspace
  - Clients
  - Flight Plans and Weather
  - sUAS Types
  - Technology
  - Successful Programs
- Engineering Design
  - 3D Mapping
  - Record document photos
  - Steel tower inspection
  - Volume estimation and tracking
- Questions?

INTRODUCTION

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COMMONWEALTH LOCATIONS

SAFETY FIRST

WHY A DRONE PROGRAM?

- Watervliet Project
  - Subcontractor Cost - $24,000 for 12 flights
    - $1,200/flight UAS Services
    - $800/flight Data Processing

- In house example:
  - 2 person Crew. PIC and VO
    - Person 1 billing rate $100/hr @ 8 hours
    - Person 2 billing rate $75/hr @ 8 hours
    - 1 day Car Rental/Mobilization Fee = $100/day
  - Person 1 office processing @ 4 hours
  - Total: $1,900/flight x 12 = $22,800

WATERVLIET

Progress Monitoring - Large-area Composites

Construction of solar facility. Both photos are a composite of approximately 520 images taken from 300' AGL.

DRONE PROGRAM BACKGROUND

- Initial Discussions – Early 2017
- Certification (Joel) – April 2017
- System Research – Mid 2017
- Drone Conference – October 2017
- Training (Joel) – November 2017
- UAS Purchase/Registration – November 2017
- Initial Field Testing – November 2017
- Internal Program Development – Early 2018 (continuing)
  - Policies, Procedures, Checklists, Logs
  - Marketing Research, Business Plan
  - Post-processing Software & Vendors
- Certification (Doug) – February 2018
- Field Testing – Spring 2018 (continuing)
- Presentation and Field Demonstration (Doug) - Cobb EMC, Georgia, July 2018
- Presentation and Field Demonstration (Norm) – Georgia, August 2018
- Training (Joel, Doug) – August 2018
- Presentation and Field Demonstration (Doug, Joel) –IRWA, Michigan, September 2018
- Anticipated Deployment – Fall 2018

SERVICES?

- Military Operations
- Product Shipping/Delivery
- Photography/Cinematography
- Disaster Management
- Search & Rescue
- Mapping
- Structural Inspections
- Precision Agriculture
- Construction Monitoring
- Vegetation Monitoring

WHY ARE DRONES BEING USED?

- Relatively easy to operate.
- Relatively non-invasive.
- Easily deployable.
- Efficient and effective data collection.
- Can fly at lower altitudes than manned aircraft so imagery is more detailed.
- Cheaper than a manned aircraft on small to medium sized projects and for routine monitoring.
- Less dangerous in rugged terrain than ground surveying.
- Easier to access difficult to reach areas than going on foot.
- Faster time in and out of danger zones.
- Reduces risk to personnel during tower inspections and at climb sites.

RULES & REGULATIONS

To fly under the FAA's sUAS Rule (14 CFR part 107.61), you must:

- Have a Remote Pilot certificate from the FAA.
  - Must be at least 16 years old;
  - Must be able to read, write, and speak English;
  - Be unaware of any mental or physical conditions that would prevent a safe operation of the drone.
  - Must pass the Unmanned Aircraft General – Small (UAG) knowledge test.
- Follow all part 107 rules

https://www.faa.gov/newsroom/small-unmanned-aircraft-systems-uas-regulations-part-107

https://www.ecfr.gov/current/title-14/chapter-I/subchapter-F/part-107

REMOTE PILOT CERTIFICATION

A remote pilot in command (PIC) is required for each UAS flight and the PIC must be certified by the FAA.

Certification Testing:

- Applicable regulations, limitations, and flight operation;
- Airspace classification, operating requirements, and flight restrictions;
- Aviation weather sources and effects of weather on performance;
- Loading and Performance (load factors);
- Emergency procedures;
- Crew resource management;
- Radio communication procedures;
- Determining the performance of sUAS
- Physiological effects of drugs and alcohol;
- Aeronautical decision-making and judgment;
- Airport operations;
- Maintenance and preflight inspection procedures.
- Operation at night

Clip of FAA Visual Flight Rules (VFR) Aeronautical Chart for Detroit showing the Jackson area.

METAR for:	KJXN (Jackson Cnty, MI, US)
Text:	KJXN 061456Z 04004KT 10SM -RA SCT008 OVC033 20/19 A3030

Sample Meteorological Aerodrome Report (METAR) for Jackson County-Reynolds Field on 6 September, 2018

REGULATORY

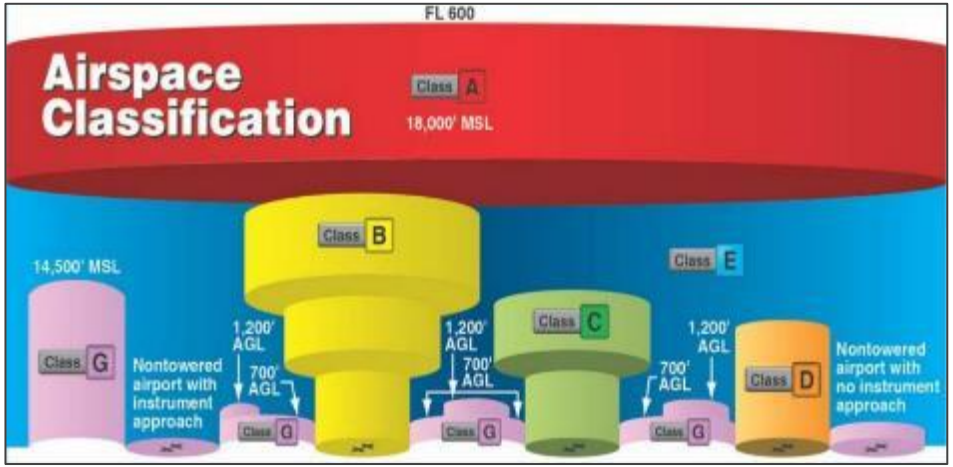
14 CFR Part 107 Rules:

- The aircraft must weigh less than 55 pounds at takeoff.
- The aircraft must remain within visual line-of-sight (VLOS) of the remote pilot in command (PIC) and the person manipulating the flight controls.*
- Daylight-only operations or civil twilight (30 minutes before official sunrise to 30 minutes after official sunset, local time) with appropriate anti-collision lighting.*
- Must yield right-of-way to manned aircraft.*
- Maximum groundspeed cannot exceed 100 mph (87 knots).*
- Maximum altitude of 400 feet above ground level (AGL) or, if higher than 400 feet AGL, remain within 400 feet of a structure.*
- Minimum weather visibility of 3 miles from control station and must remain 500 feet from clouds (no ceiling requirement).*

**Can apply for waivers to operate without abiding by certain rules. However, it can take months to get a waiver and it is project specific.*

REGULATORY

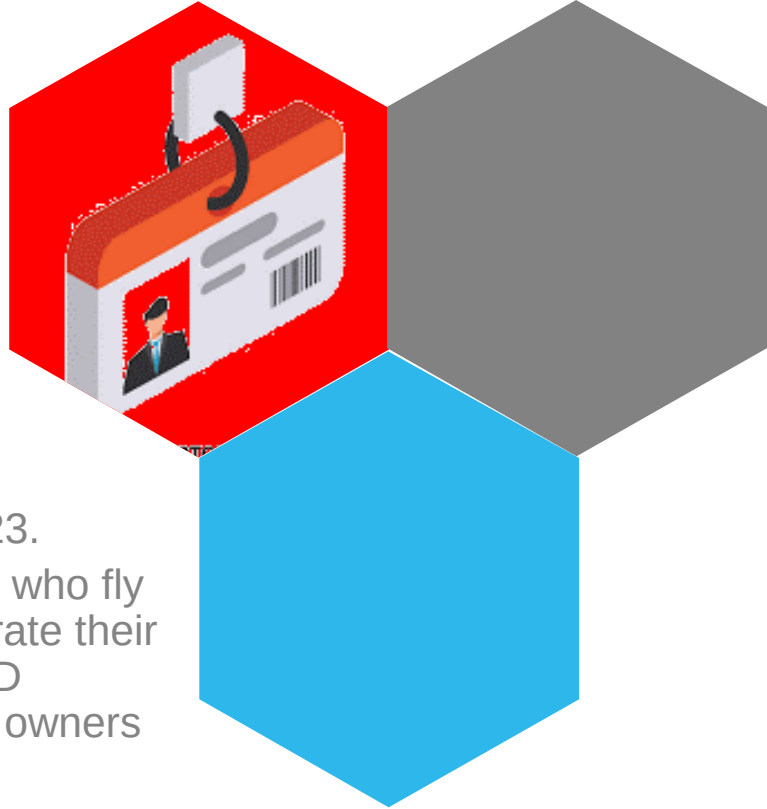
Part 107 Rules (cont.):



- No careless or reckless operations.
- No carriage of hazardous materials.
- Operations in Class G airspace are allowed without air traffic control (ATC) permission.
- Cannot operate sUAS from a moving aircraft.
- Cannot operate sUAS from a moving vehicle unless the operation is over a sparsely populated area.*
- Operations in Class B, C, D and Class E surface areas are allowed with FAA approval.*
- The aircraft may not operate over any persons not directly participating in the operation, not under a covered structure, and not inside a covered stationary vehicle.

**Can apply for waivers to operate without abiding by certain rules. However, it can take months to get a waiver and it is project specific.*

REMOTE ID



What is it?

- Digital license plate
- FAA-Remote ID is the ability of a drone in flight to provide identification and location information that can be received by other parties.

Enforcement

- Operational requirements are effective as of 9/16/23.
- All drone pilots required to register, including those who fly for fun, for business, or for public safety, must operate their drone in accordance with the final rule on remote ID beginning September 16, 2023, which gives drone owners sufficient time to upgrade their aircraft.

https://www.faa.gov/uas/getting_started/remote_id/drone_pilots

SAFETY

- Field
  - Pre-flight Checklists
  - Post-flight checklists
- Manual
- Public Safety
  - To Public
    - Notifications
    - Warnings
    - Awareness
  - From the Public
    - VO’s second witness

AIRSPACE (WHO OWNS ABOVE THE GROUND?)

Federal Government

- 49 U.S. Code § 40103 - Sovereignty and use of airspace
  - (1)The United States Government has exclusive sovereignty of airspace of the United States.
  - The FAA stands firm that it regulates activities in controlled airspace. Generally, 1000’ Min.
- Have devised a new initiative that splits control of airspace below 400 feet between federal and local governments

Federal Rules vs. State/Local Rule

- Now over 130 localities across 31 states with local rules governing the use of drones.
- Penalties can be stiff - as much as $10,000.
- The FAA maintains that it has the sole authority “to regulate the areas of airspace use, management and efficiency, air traffic control, safety, navigational facilities, and aircraft noise at its source.”
- The FAA does, however, state that local authorities may enact certain rules controlling drone use, including regulations around “land use, zoning, privacy, trespass, and law enforcement operations.”
- They suggest that local authorities are free to regulate the use of drones by police, the use of drones for voyeurism, the use of drones for hunting, and the arming of drones.

CLIENTS

Guidelines, Permissions, and Mission Deconfliction

- No rain, snow, fog for photos
- Property owner notifications
- Know their standards

FLIGHT PLANNING & WEATHER

- Check the weather
- Have a contingency plan
- Remember client standards

sUAS TYPES

Blue sUAS vs “Made in the USA” vs other

- American Security Drone Act
- National Defense Authorization Act (NDAA)
- Defense Innovation unit (DIU)

TECHNOLOGY

- Moving fast
- Multiple cameras for movement within confined spaces

SUCCESSFUL PROGRAMS

- Be able to adapt to change
- Be able to overcome adversity
- Growing as needs provide
- Be open to out of box missions
- Continued marketing internal and external

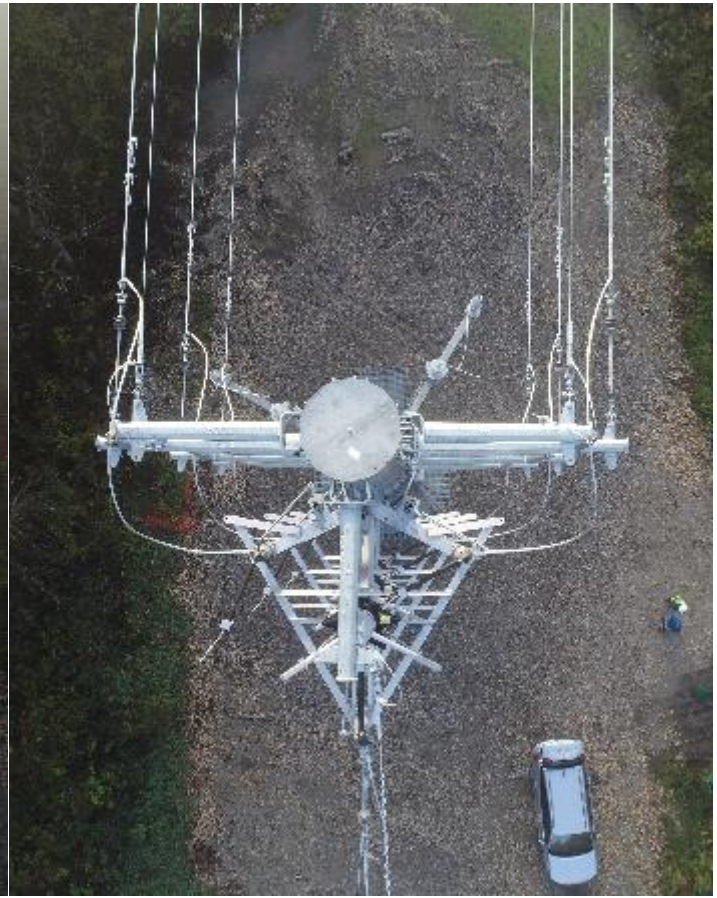
ENGINEERING DESIGN

- 3D Mapping
  - Rooftop
- Record Document Photos
- Steel Tower Inspection
- Coal Pile Volume Estimation
- Vegetation Identification/Management
- Infrared inspections

3D MAPPING

3D MAPPING

RECORD DOCUMENT PHOTOS



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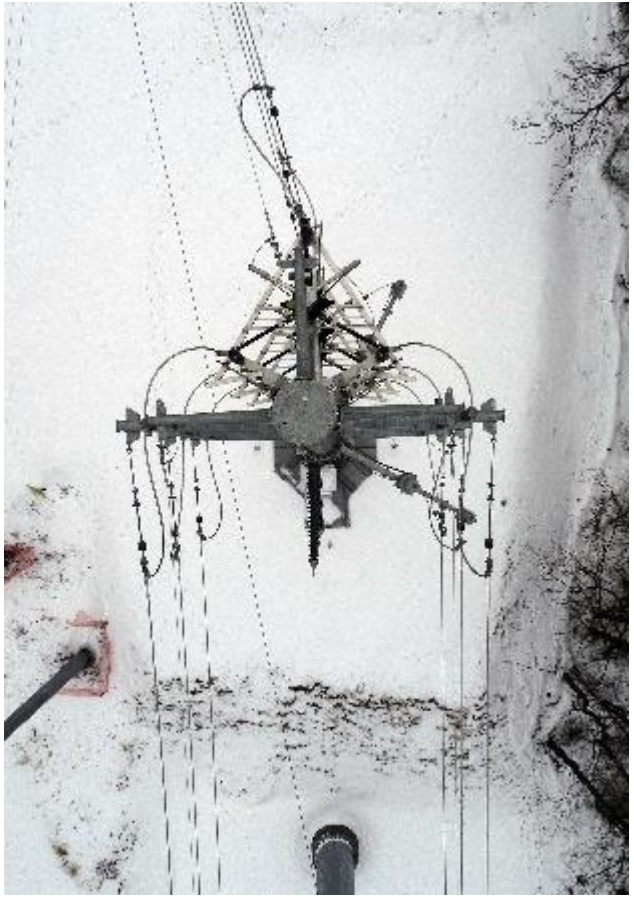

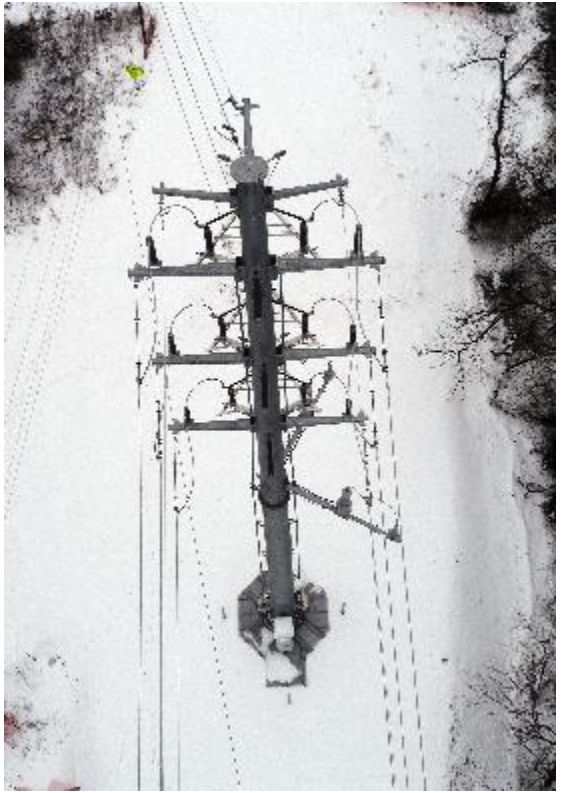

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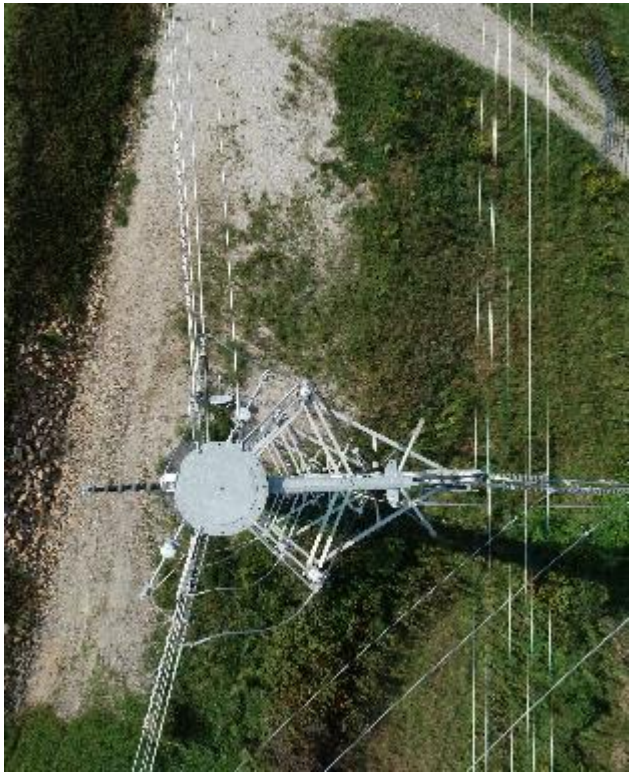


STEEL TOWER INSPECTION

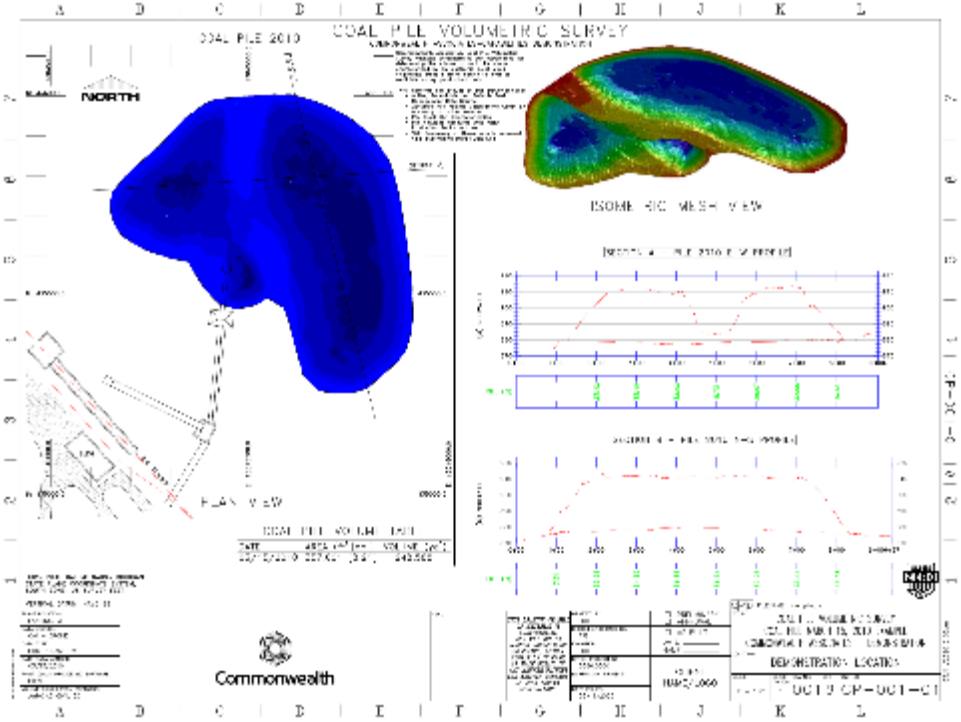
INSPECTIONS

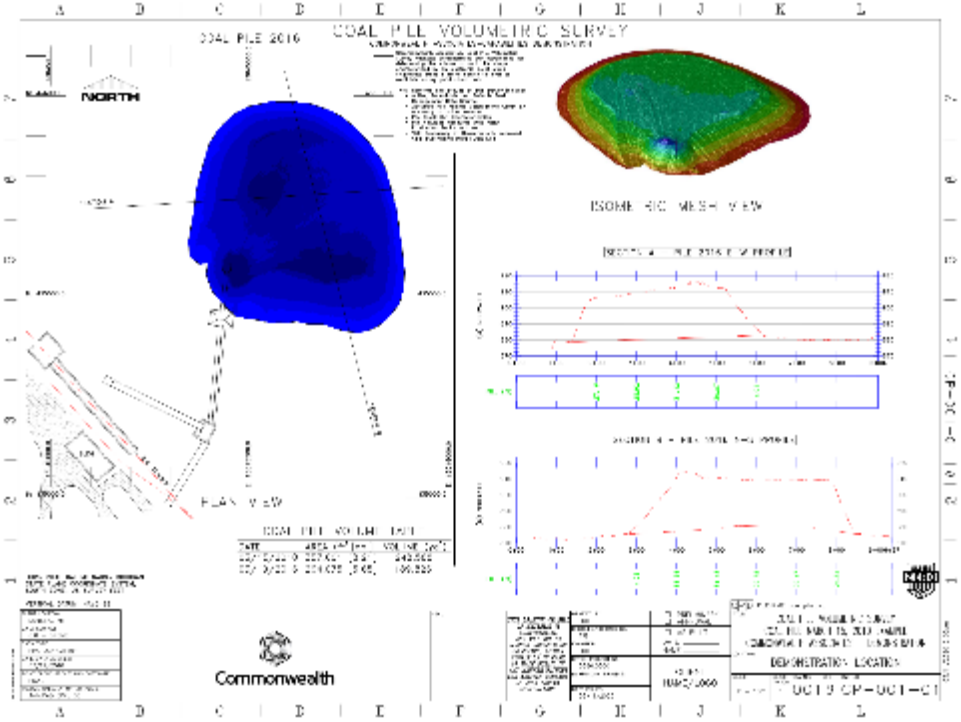
Asset Inspection - Detailed Oblique

INSPECTIONS

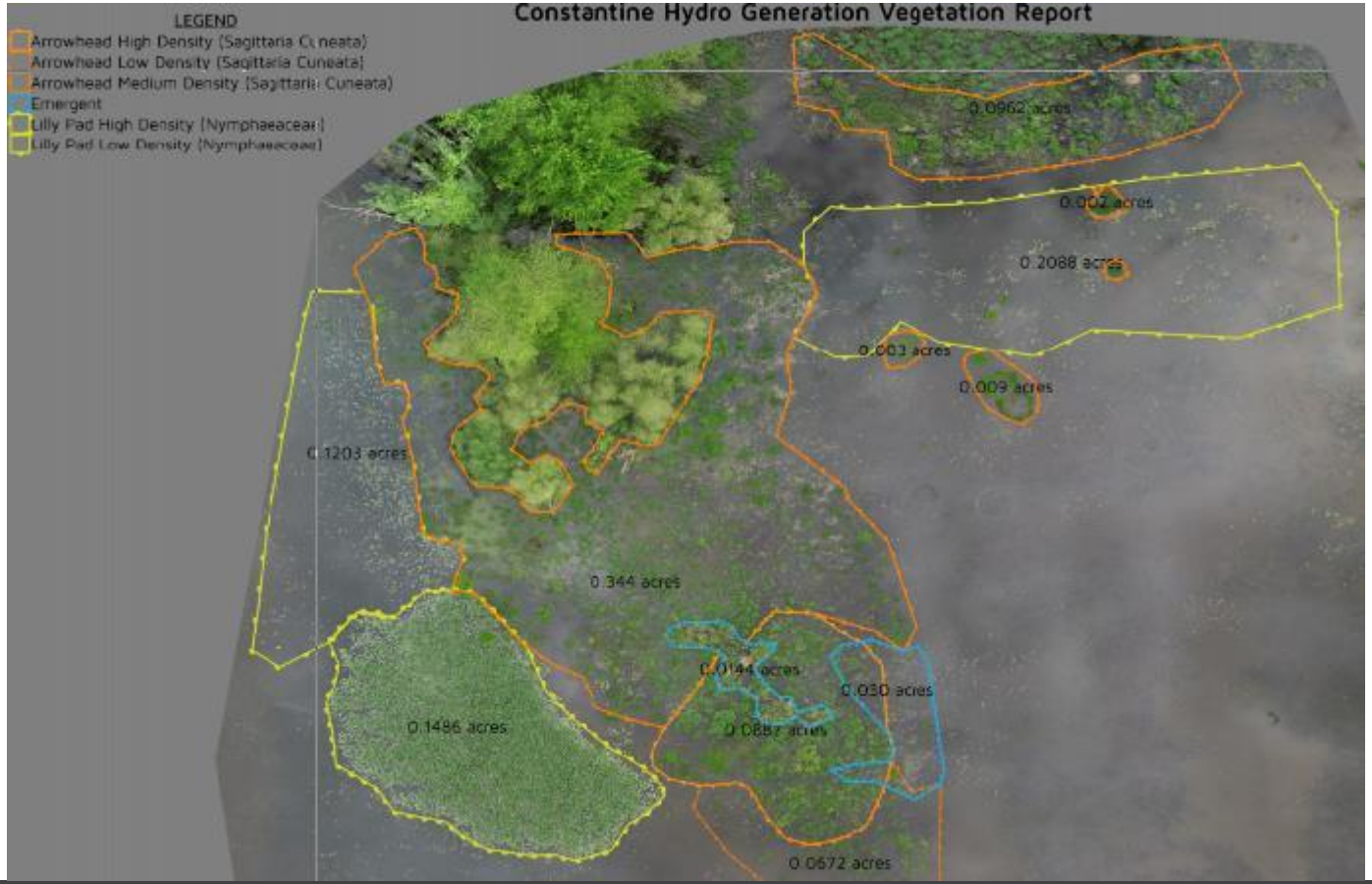
Asset Inspection - Detailed Perpendicular

COAL PILE VOLUMES





VEGETATION IDENTIFICATION/MANAGEMENT



VEGETATION IDENTIFICATION/MANAGEMENT

Vegetation Management – Overhead

(excessive undergrowth in ROW)

Vegetation Management - Overhead

(potential danger trees)

CAPABILITIES

Processing & Post Processing

Processing is where we take the collection of captured photos and send it through a program to produce an orthomosaic, 3D Point Cloud, Digital Surface Model (DSM), Digital Elevation Model (DEM), texture model, 3D meshes, etc.

Post-processing is where we take the processed data and analyze, manipulate, and further process it to produce a final product.

- Image Rectification - geographical alignment of images
- Digitizing – creating and editing features
- Feature Rendering – assigning visual characteristics to vector features.
- Terrain Analysis
  - View shed, cross-sectional, line of sight views and calculations
  - Cut and fill calculations, contour creation
- Data Processing
  - Reprojecting layers into another system
  - Managing attributes, extracting features that share common characteristics.
- Map, Chart, Graph creation

CAPABILITIES

Photogrammetry

Parallax

- Stereo-pair Cross-eye

CAPABILITIES

Photogrammetry

Typical Deliverables

- Line maps
  - Planimetric maps
  - Topographic maps
- Photo maps
  - Rectified photos
  - Orthophotos
  - Photo mosaics
- Point cloud


QUESTIONS?

THANK YOU!

Commonwealth