UAS Photogrammetry
Stormwater Management Existing Conditions Survey
Background of the project.

- **Existing facility retrofit**
  - Subdivision built in the 1980’s
  - Existing quantity stormwater management via detention basin
  - Drainage area approximately 38 acres with 12.5 acres impervious
  - Seeking to retrofit the existing basin to manage Water Quality Volume, Channel Protection Volume, and Overbank Flood Protection Volume.
  - “As-built” provided with RFP.
Project Scope

- Perform topographic survey and verify as-built
- Create base mapping with 1’ contours
- Existing condition orthoimage
- Locate all Sanitary and Storm Sewer X,Y,Z
- Deliverable:
  - MicroStation V8i drawing
  - Digital Terrain Model
Existing Conditions Survey

- Provided the “As-Built”
  - Upon Review it is a construction plan not and as-built plan.
- Changed from as-built verification to existing conditions survey.
- Provide a datum as none are shown on the plan.
  - NAD 83/2011 Horizontal
  - NAVD 88 Vertical
Flight Planning

1. Can you fly the site.
2. What accuracy are we looking for.
   a. What sensor should be used?
   b. What altitude and speed?
   c. Ground Control - How much and how accurate?
3. What equipment? Drone and Sensor
4. What battery power is needed?
Establishing Ground Control
Perform Existing Conditions Survey

- Locate all sewer and storm drain structures
- Locate inverts
- Survey obscured areas
- Measure and sketch headwalls and riser structures
- PERFORM FLIGHTS
- Download and review imagery on site
Office processing

- Download imagery
- Select panel points
- Select check shots
- Select Parameters
- Process and go home
Ground Control and Check Points

- Review each point to verify that they are reasonable.
- Review Root Mean Square Error (RMS)
- The \( \text{Mean X, Y, or Z error} \) helps to recognize systematic errors due to bad GCP acquisition.
- The \( \text{Sigma error} \) gives confidence intervals around the \( \text{Mean error} \): 95.4% of the points of the project will have an error of \( \leq \pm 2\sigma \)
- The \( \text{RMS error} \) will take into account the systematic error. If \( \text{Mean error}=0 \), the \( \text{RMS error} \) will be equal to the \( \text{Sigma Z error} \). The comparison of the \( \text{RMS error} \) and \( \text{Sigma error} \) indicates a systematic error.
- Of the 3 indicators, the RMS Error is the most representative of the error in the project since it takes into account both the mean error and the variance.
Cross Sectional Check
Contour Comparison (Field vs. Photogrammetry)

East Slope of Pond

West Slope of Pond
LiDAR and Photogrammetry

Accuracy Standards - ASPRS Digital Data Delivery

- Vertical Data
  - “This data set was tested to meet ASPRS Positional Accuracy Standards for Digital Geospatial Data (2014) for a ___ (cm) RMSE z Vertical Accuracy Class. Actual Non-vegetated Vertical Accuracy was found to be RMSE z = ___ cm, equating to ____ at 95% confidence level. Actual Vegetated Vertical Accuracy was not tested.”
  - “This data set was produced to meet ASPRS Positional Accuracy Standards for Digital Geospatial Data (2014) for a ___ cm RMSE z Vertical Accuracy Class equating to NVA =+/- ___ cm at 95% confidence level and VVA =+/- ___ cm at the 95% percentile.

- Horizontal Data
  - “This data set was tested to meet ASPRS Positional Accuracy Standards for Digital Geospatial Data (2014) for a ___ (cm) RMSE x / RMSE y Horizontal Accuracy Class. Actual positional accuracy was found to be RMSE x = ___ (cm) and RMSE y = ___ cm which equates to +/- ___ at 95% confidence level.”
  - “This data set was produced to meet ASPRS Positional Accuracy Standards for Digital Geospatial Data (2014) for a ___ (cm) RMSE x / RMSE y Horizontal Accuracy Class which equates to +/- ___ cm at a 95% confidence level.”

Note: DATA was produced based on flight testing. Tested would have required 20 check points.
Advantages of UAS on this project

- Reality Capture
- Less invasive (adjoining property mapping)
- Accurate and current background imagery
- Less time in the field
DISCUSSION