Unmanned Aircraft System (UAS) Guidelines

This document contains guidelines for various types of Unmanned Aircraft System (UAS) surveys which may occur on North Dakota Department of Transportation (NDDOT) construction projects. The guidelines presented below are meant to serve as minimum guidelines. Care should be taken to ensure that they will be adequate for your survey and site conditions.

Coordinate System

When using a software program to process the data, use the appropriate State Plane coordinate system.

Ground Control Points

Ground Control Points (GCPs) will be established using survey grade equipment and survey quality practices. GCPs will help processing software to remove "warps" that can appear along the surface, which can skew the results. GCPs can be thought of like weights holding down a tarp in the breeze.

Checkpoints

Check shots, or checkpoints will be collected using survey grade equipment and survey quality practices. Checkpoints are used as a way to check the surveyed surface for errors. Checkpoints shall be surveyed and added to the data set after processing. They will be used to check the accuracy of the data within the surveyed area. Checkpoints should be spaced evenly around the area of interest and spaced away from GCPs whenever possible.

Survey Requirements

1. General Survey Requirements – Use these guidelines for UAS surveys of stockpiles.
   a. Equipment– UAS platform for survey will utilize a mechanical shutter.
   b. Data Collection
      i. Collect data with a minimum of 75% overlap, forward and side-to-side.
      ii. GCPs and checkpoints should appear in a minimum of three images each to be used.
      iii. Ensure camera settings are set correctly, either manually or via flight software.
      iv. For general mapping and earthwork, collect data in a nadir camera orientation. Any area under overhanging objects or obstacles may require oblique data collection or supplemental ground survey.
   c. Flying Conditions – Ensure flying conditions will allow for accurate data collection.
      i. Verify wind and temperature conditions are within the UAS operating range.
      ii. Fly when ambient lighting conditions are conducive to accurate data collection, generally when there is minimal shadow cast, i.e. midday.
   d. Submittals – Include processing reports, GCP and Checkpoint data, and provide an accuracy report on the GCP's and Checkpoints. Imagery and outputs will be maintained through final acceptance and will be provided to the NDDOT if requested.

2. Stockpile Survey
    a. Ground Control Points (GCPs)
        i. When using a non-RTK (Real Time Kinematics) drone, place a *minimum* of four (4) GCPs evenly spaced around the perimeter of the pile to be measured.
        ii. For RTK-enabled drones, a minimum of 1 GCP is required. The operator must ensure the RTK is active and fixed.
    b. Checkpoints – Collect a minimum of four (4) checkpoints.

3. Borrow Site Survey
    a. Ground Control Points (GCPs) – Place a minimum of four (4) GCPs uniformly spaced around the area to be measured.
        i. Additional GCPs should be placed around the perimeter and throughout the area to be measured to keep the distance between GCPs from exceeding 600 feet, or as the operator determines the site conditions require.
    b. Checkpoints – Include a minimum of four (4) checkpoints.
        i. For larger areas of interest, it is recommended to provide 1 checkpoint per 10 acres of area.

4. Longitudinal Roadway Survey
    a. Ground Control Points (GCPs)
        i. When performing a survey primarily for length/width/area data, place GCPs as follows:
            1. For a non-RTK UAS, place a minimum of one (1) GCP per mile on alternating sides of the alignment.
            2. For an RTK-enabled drone, a minimum of two (2) GCPs will be established, one near the beginning and one near the end of the survey limits. The operator must ensure the RTK is active and fixed.
        ii. When performing surveys where vertical data is critical, space GCPs with a maximum spacing of 1000' along the alignment and alternating sides.
    b. Checkpoints - Establish checkpoints at either end of the project and every 1/2 mile within.