aero-graphics

TECHNICAL PROJECT REPORT

TETON COUNTY AERIAL SURVEY

TETON COUNTY, IDAHO

September 2019

Submitted to:

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Teton County Aerial Survey
Teton County, ID

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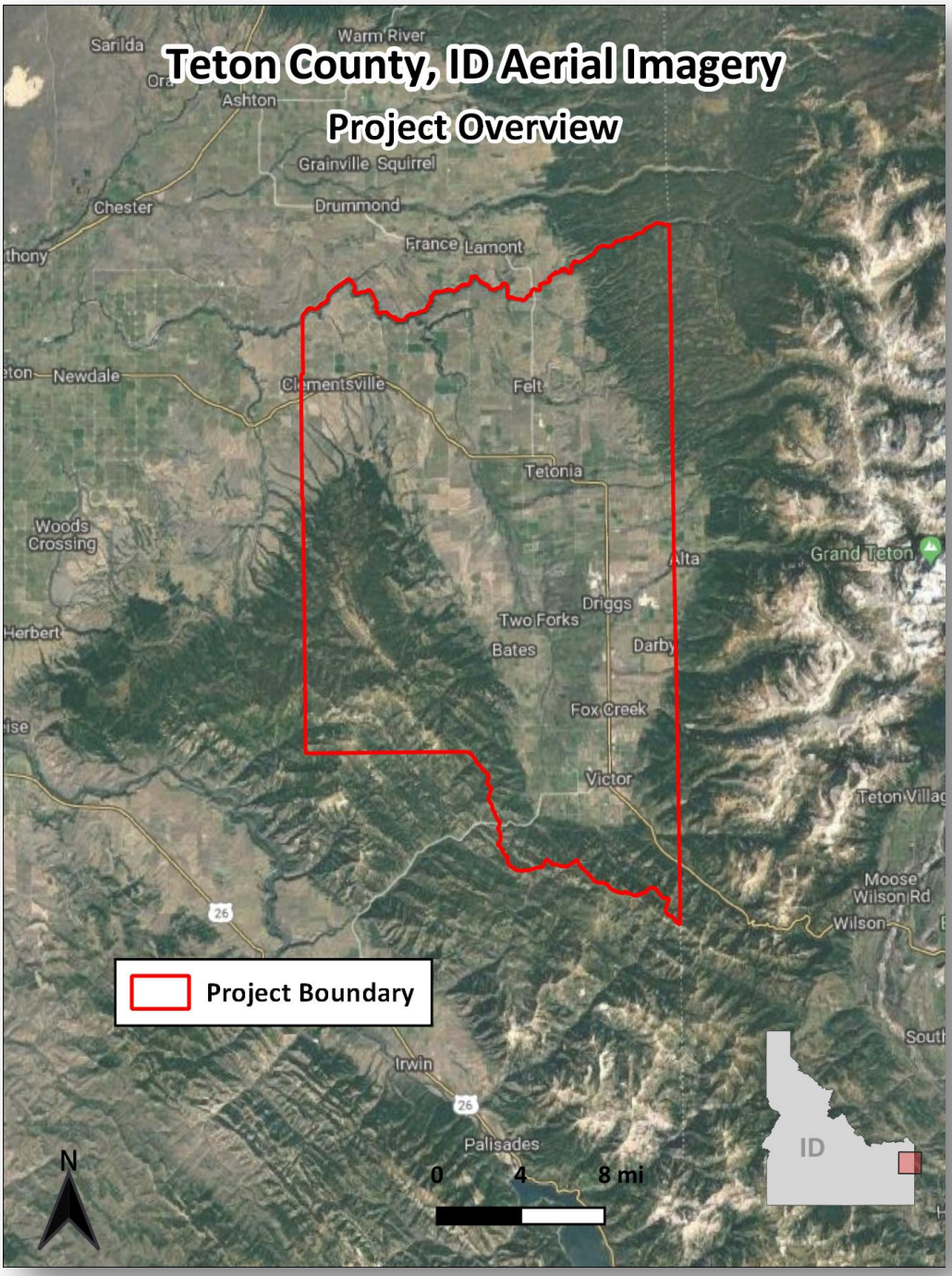
1. Overview

During September of 2019 Aero-Graphics acquired high resolution digital stereo imagery over the Teton County, ID. The project area covers approximately 451 square miles. This project will be used to update an existing dataset.

Exhibit 1: *Teton County project boundaries*



2. Acquisition

2.1 Airborne Acquisition – Equipment and Methodology

Image acquisition was performed using the industry-leading Vexcel UltraCam Eagle (UCE) Mark 3 digital camera system. The imagery was acquired at an average altitude of 9,514 ft above ground level (AGL), collecting 754 individual images over 14 flightlines at a 0.49' (15 cm) ground sampling distance (GSD).

Exhibit 2: *Summary of flight parameters*

Altitude (ft AGL)	Overlap (%)	Sidelap (%)	# Flightlines	# Images
9,514	60	30	14	754

The UCE Mark 3 collected 4-band imagery at a 16-bit radiometric resolution. The imagery was processed and output to 8-bit per band radiometric resolution to create the final images. Aero-Graphic's UCE utilized a 100 mm length focal lens which allowed for flying at higher altitudes without an increase in GSD. The UCE is equipped with precision GPS/IMU to accurately position the raw imagery for orthorectification. In addition, it is equipped with Forward Motion Compensation and mounted in a GSM-4000 gyro-stabilized mount that works together with the IMU to automatically correct up to 5° roll, 8.4° pitch, and 6.2° yaw before each exposure is fired. The imagery was then reviewed for completeness before mobilizing the imagery back to the office.

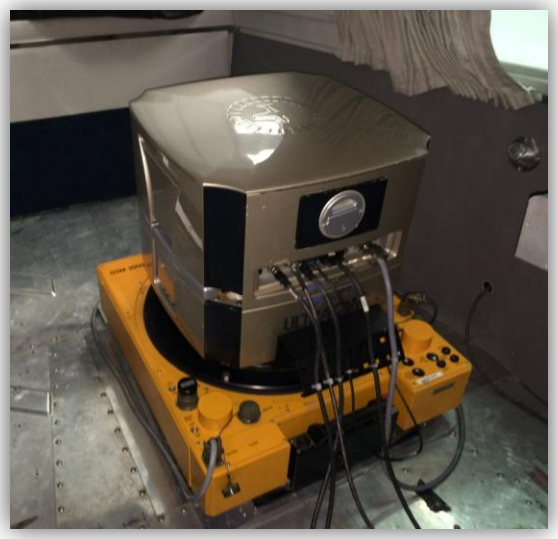
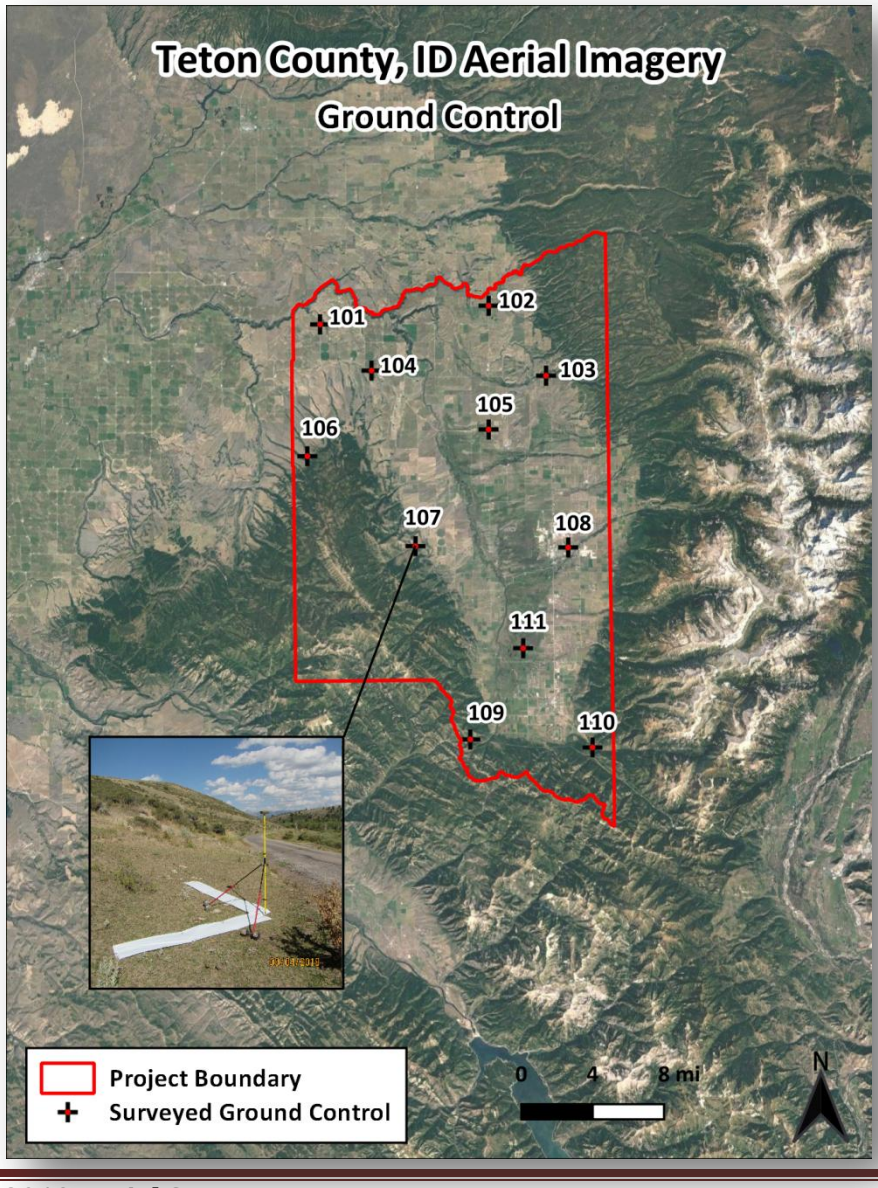


Exhibit 3: *The imagery acquisition platform for the Teton County project was a Cessna T310. Our 310 has been customized for imagery and other airborne sensors with an upgraded power system and avionics. The stability of the Aztec is ideal for imagery collection*

2.2 Ground Survey – Equipment and Methodology

Aero-Graphics utilized statically-collected ground control points set at strategic locations throughout the project area to ensure that the imagery maintained its true geographic integrity. Ground control points are used in conjunction with the Airborne GPS and IMU data to calculate the exterior orientation of each image captured during the flight, producing the AT solution. More detail regarding the processing workflow can be found in **Section 3**. Applanix's industry-leading POSPac MMS GNSS Inertial software (PP-RTX) is used to post-process the aircraft's trajectory data, combining the GPS and IMU data to produce the Smoothed Best Estimate of Trajectory(SBET). This post-processing method allows cm level positioning to be achieved without the use of reference stations. Ground control coordinates can be found in Appendix A.

Exhibit 4: *Static ground control for the Teton County project*



3. Imagery Processing Workflow

a. **Acquisition QA/QC and Image Processing.** Following acquisition the raw images are reviewed for equipment related malfunctions and environmental imperfections such as cloud shadows that would require a reflight. Failed images are flagged and the photo center points are ingested into a spatial database using custom AGI software and project wide acquisition is reviewed. The images are then processed from manufacturer specific formats to a more widely adopted format such as TIFF for further processing.

b. **Aerotriangulation.** Trimble-Inpho's Match-AT software was utilized to perform fully analytical digital aerotriangulation. During this process tie-points are generated for each photo at decreasing scales, pyramids, to identify scale invariant features. Coincident points were found in overlapping images and used to tie each image to its neighbors. Photo identifiable ground control points were then identified and measured manually. These photo IDs, along with tie points, the SBET, and the images were then processed together in a final bundle adjustment to refine the photo center points and provide the best exterior orientation solution which minimizes cumulative error throughout the project.

c. **Aerotriangulation QA/QC.** Once the AT solution was complete, Inpho DTMaster was used to check ground control points in stereo. In conjunction with minimizing ground control error, we ensured that all parallax was cleared as much as possible and that all tie points were on the ground, with no points floating or digging. Our QA/QC procedures aim to find gross errors and correct them before the AT results are passed on to our ortho technicians.

d. **Orthorectification.** An Aero-Graphics generated auto-correlated surface was used for the orthorectification surface and the digital imagery underwent automatic orthorectification in a one-step batch process using Inpho's OrthoMaster software.

e. **Radiometric Balancing.** The orthorectified imagery tiles were then adjusted in Inpho's OrthoVista software to compute subtle radiometric adjustments that compensate for visual effects within individual images. OrthoVista then performed block-wide contrast balancing to achieve a uniform appearance across the project.

f. **Mosaicking and Delivery Prep.** A final review of the imagery was done while preparing the delivery. Compression, reprojection into multiple coordinate systems, and other client specifications were applied as needed. Finally, the orthophotos were combined into one seamless, balanced, and geometrically-perfect ortho mosaic and a tile index was created.

4. Results

3.1 Orthophoto Accuracy

Horizontal accuracy of the orthophoto is dependent upon the quality of the aerotriangulation solution and the resulting ortho surface creation. Each bundle-adjusted AT solution is checked visually with the stereoimagery to ensure the surveyed control point falls directly on the center of the target and within a specified vertical tolerance (one-quarter the equivalent contour interval). If these tolerances are met, horizontal accuracy is always acceptable. In addition, Aero-Graphics utilized the project's survey grade control throughout the block to verify the integrity of the ortho's positional accuracy. Control points yielded a 1.0' RMSE XY.

3.2 Projection, Datum, and Units

Projection:		Idaho State Plane East
Datum:	**Vertical:**	NAVD88
	Horizontal:	NAD83 (2011)
Units:		US Survey Feet

5. Deliverables

Raster Data:	• 4-band orthoimagery at a 0.5' pixel resolution in .TIF and MrSID formats • Overall mosaic in MrSID format with a 0.5' pixel resolution
Vector Data	• Ortho tile index in PDF and shapefile formats
Report of Survey:	• Technical Project Report

6. Highlighted Images

Main St., Victor, ID

N. Leigh Creek Rd

Appendix A – Surveyed Ground Control

Survey Point	Global - NAD83(2011), GEOID 12B			Local - Idaho State Plane East	
	Latitude	Longitude	Elevation	Northing (usft)	Easting (usft)
101	43° 54’ 42.47190”	-111° 22’ 07.07580”	5739.123	819240.639	866464.029
102	43° 55’ 31.65872”	-111° 10’ 44.63041”	6058.051	824760.982	916359.492
103	43° 52’ 05.08687”	-111° 06’ 55.73382”	6257.031	804051.360	933377.021
104	43° 52’ 25.97520”	-111° 18’ 40.86396”	6115.695	805570.788	881701.783
105	43° 49’ 29.91594”	-111° 10’ 50.55359”	6005.388	788127.761	916362.914
106	43° 48’ 17.51979”	-111° 23’ 03.52083”	6909.219	780223.229	862701.049
107	43° 43’ 51.18820”	-111° 15’ 51.16201”	6251.942	753579.208	894700.168
108	43° 43’ 42.16980”	-111° 05’ 35.25029”	6176.394	753205.175	939933.182
109	43° 34’ 24.31315”	-111° 12’ 18.93168”	6559.476	696358.045	910947.300
110	43° 33’ 56.58646”	-111° 04’ 08.04137”	6473.405	693998.377	947120.642
111	43° 38’ 49.16800”	-111° 08’ 41.87623”	6025.144	723365.181	926595.683