Airborne Topographic Lidar Report

Wisconsin WROC – 3DEP
Rock County Lidar 2020

Prime Contractor: Ayres

Airborne Lidar Acquisition:
Quantum Spatial, an Nv5 Company

Ingenuity, Integrity, and Intelligence.

www.AyresAssociates.com

AYRES NV5 GEOSPATIAL powered by QUANTUM SPATIAL

Table of Contents

List of Figures

List of Tables

1. Summary / Scope

1.1 Summary

This report contains a summary of the WROC 2020 Rock County lidar acquisition task order, issued by Ayres Associates Inc. under Task Order 54 that was executed on January 21, 2020. The task order yielded a project area covering approximately 771 square miles over Rock County in Wisconsin. The intent of this document is only to provide specific validation information for the data acquisition/collection, processing, and production of deliverables completed as specified in the task order.

1.2 Scope

Aerial topographic lidar was acquired using state-of-the-art technology along with the necessary surveyed ground control points (GCPs) and airborne GPS and inertial navigation systems. The aerial data collection was designed with the following specifications listed in Table 1 below.

Table 1. Originally Planned Lidar Specifications

AVERAGE POINT DENSITY	FLIGHT ALTITUDE (AGL)	FIELD OF VIEW	MINIMUM SIDE OVERLAP
2 pts / m^2	2300 m	58.5°	30%

1.3 Coverage

The project boundary covers approximately 771 square miles over Wisconsin. Project extents are shown in Figure 1.

1.4 Duration

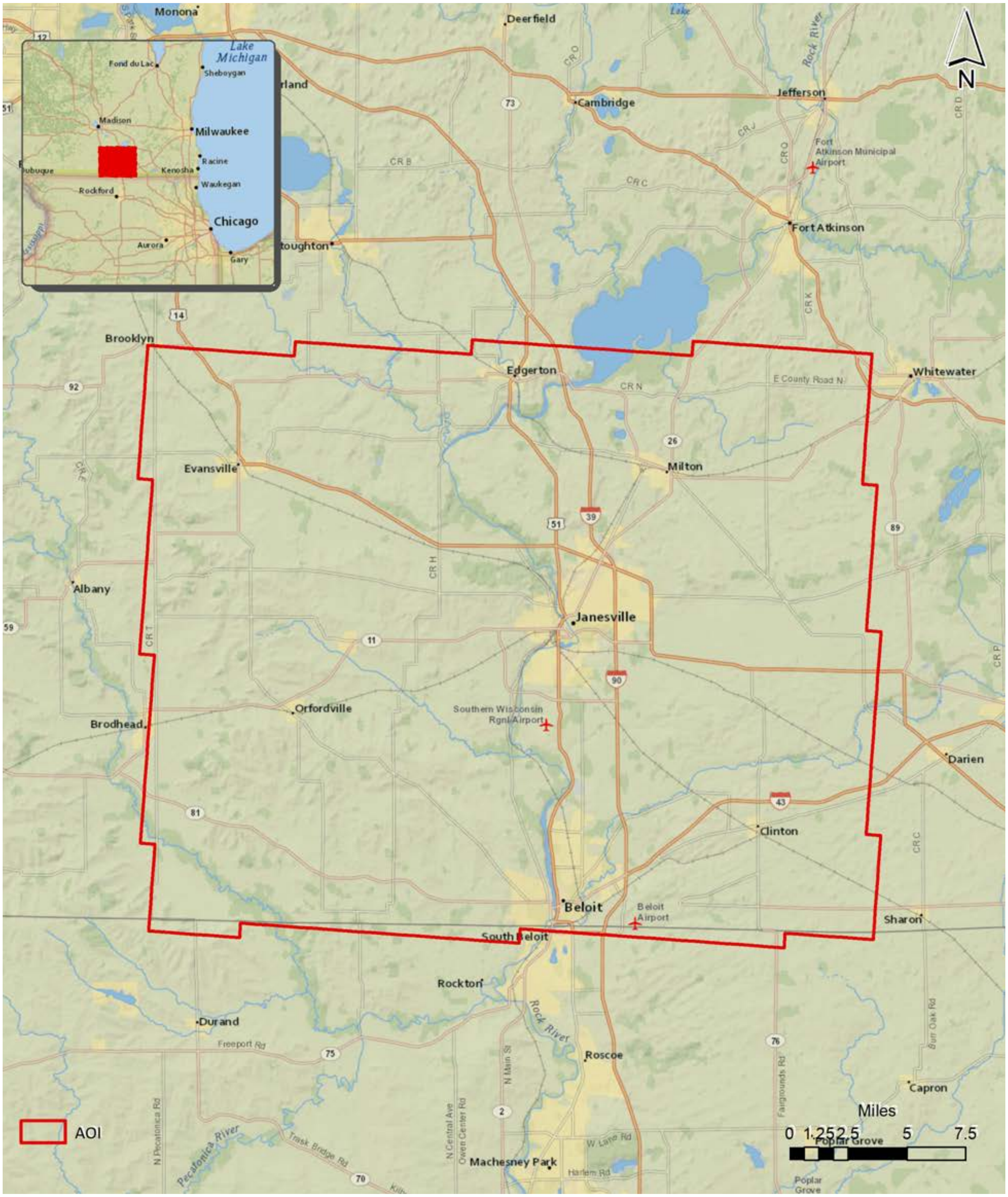
Lidar data was acquired from April 16, 2020, to April 26, 2020, in five lifts. See "Section: 2.4. Time Period" for more details.

1.5 Issues

There were no major issues to report for this project.

WROC 2020 ROCK COUNTY – DELIVERABLES PROJECTED COORDINATE SYSTEM: WISCRS ROCK COUNTY HORIZONTAL DATUM: NAD83 (2011) VERTICAL DATUM: NAVD88 (GEOID 12B) UNITS: U.S. SURVEY FEET
• One copy of lidar tiled point cloud data in LAS format on external hard drive
• All flight mission parameters appropriate for inclusion in FGDC/USGS compliant metadata

Figure 1. Rock County Project Boundary



2. Planning / Equipment

2.1 Flight Planning

Flight planning was based on the unique project requirements and characteristics of the project site. The basis of planning included: required accuracies, type of development, amount/type of vegetation within project area, required data posting, and potential altitude restrictions for flights in project vicinity.

Detailed project flight planning calculations were performed for the project using Leica MissionPro, RiPARAMETER, and TrackAir SnapPLAN planning software. The entire target area was comprised of 26 planned flight lines (Figure 2).

2.2 Lidar Sensor

Quantum Spatial used a Riegl VQ1560i lidar sensor (Figure 3), serial number 4040, for lidar collection.

The Riegl 1560i system has a laser pulse repetition rate of up to 2 MHz, resulting in more than 1.3 million measurements per second. The system uses a Multi-Pulse in the Air option (MPIA). The sensor is also equipped with the ability to measure up to an unlimited number of targets per pulse from the laser.

A brief summary of the aerial acquisition parameters for the project are shown in the Lidar System Specifications in Table 2.

Figure 2. Rock County Planned Flight Lines

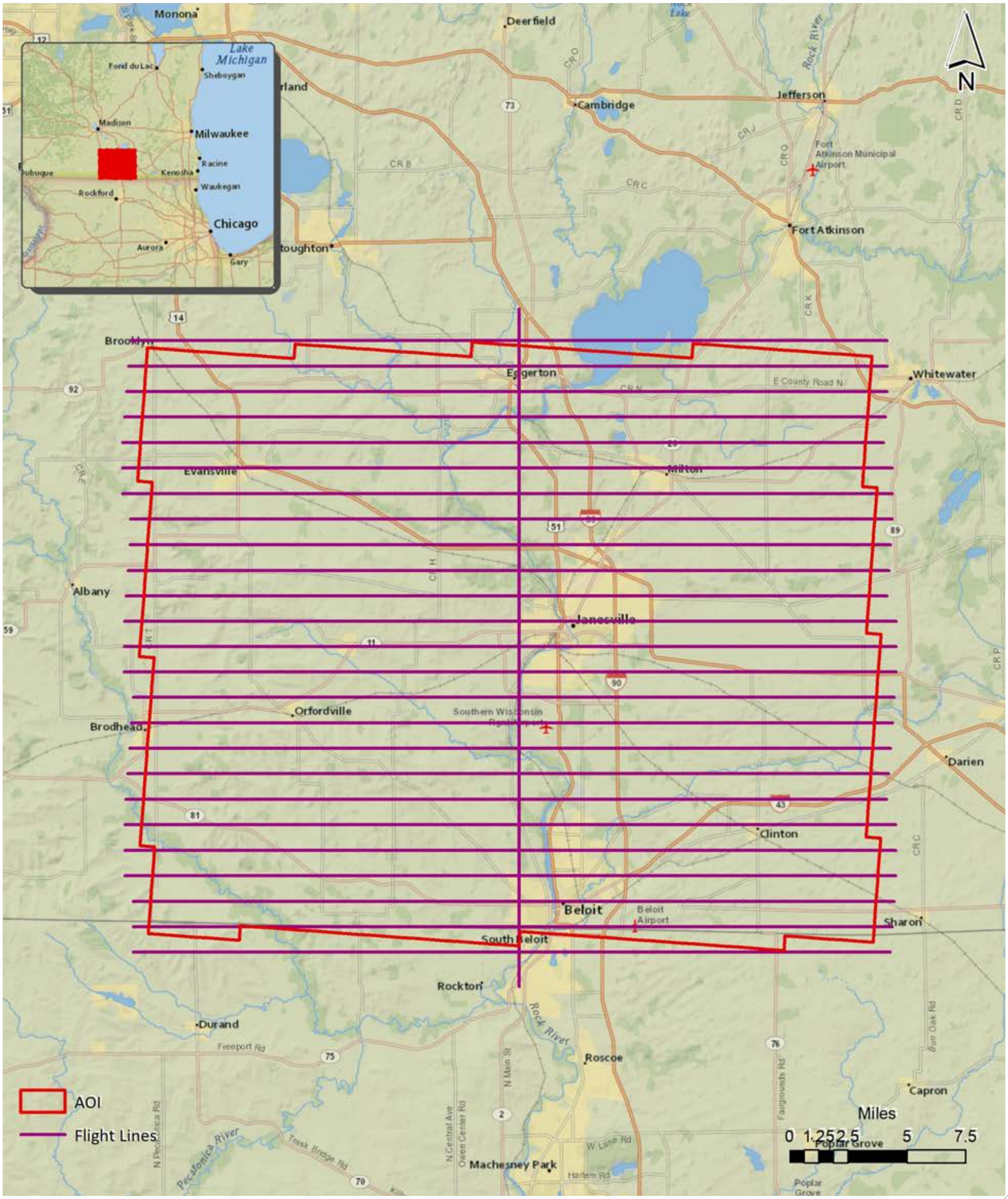


Table 2. Lidar System Specifications

		RIEGL VQ1560i
Terrain and Aircraft Scanner	Flying Height	2300 m
	Recommended Ground Speed	145 kts
Scanner	Field of View	58.5°
	Scan Rate Setting Used	2 x 160 lps
Laser	Laser Pulse Rate Used	2 x 350 kHz
	Multi Pulse in Air Mode	1
Coverage	Full Swath Width	2577 m
	Line Spacing	2375.81 m
Point Spacing and Density	Average Point Spacing	1.81 m
	Average Point Density	2 x 1.21 pts/m²

Figure 3. Riegl VQ1560i Lidar Sensor

2.3 Aircraft

All flights for the project were accomplished through the use of a customized plane. The plane type and tail number are listed below.

Lidar Collection Planes

- Piper Navajo (twin-piston), Tail Number(s): N22GE

This aircraft provided an ideal, stable aerial base for lidar acquisition. This aerial platform has relatively fast cruise speeds, which are beneficial for project mobilization/demobilization while maintaining relatively slow stall speeds, proving ideal for collection of high-density, consistent data posting using a state-of-the-art Riegl VQ1560i lidar system. Some of Quantum Spatial's operating aircraft can be seen in Figure 4 below.

Figure 4. Some of Quantum Spatial's Planes

2.4 Time Period

Project-specific flights were conducted between April 16, 2020, and April 26, 2020. Five aircraft lifts were completed. The accomplished lifts are listed below.

- 04162020A (SN4040, N22GE)
- 04182020B (SN4040, N22GE)
- 04182020C (SN4040, N22GE)
- 04192020A (SN4040, N22GE)
- 04262020A (SN4040, N22GE)

3. Processing Summary

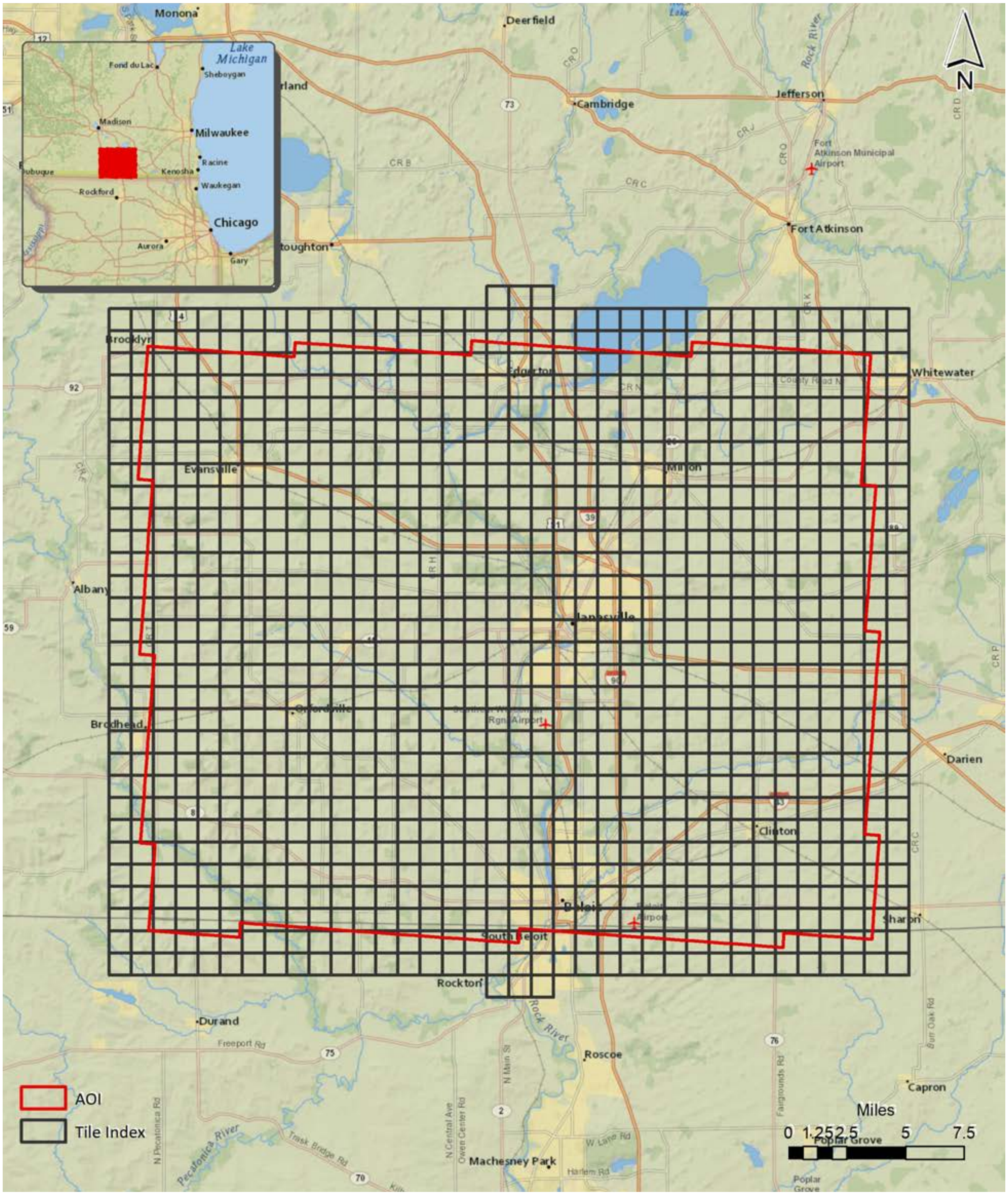
3.1 Lidar Processing

Applanix + POSPac software was used for post-processing of airborne GPS and inertial data (IMU), which is critical to the positioning and orientation of the lidar sensor during all flights. Applanix POSPac combines aircraft raw trajectory data with stationary GPS base station data yielding a “Smoothed Best Estimate Trajectory” (SBET) necessary for additional post processing software to develop the resulting geo-referenced point cloud from the lidar missions.

During the sensor trajectory processing (combining GPS & IMU datasets), certain statistical graphs and tables are generated within the Applanix + POSPac processing environment which are commonly used as indicators of processing stability and accuracy. This data for analysis include: Max horizontal/vertical GPS variance, separation plot, altitude plot, PDOP plot, base station baseline length, processing mode, number of satellite vehicles, and mission trajectory.

Point clouds were created using the RiPROCESS software. The generated point cloud is the mathematical three dimensional composite of all returns from all laser pulses as determined from the aerial mission. The point cloud is imported into GeoCue distributive processing software. Imported data is tiled and then calibrated using TerraMatch and proprietary software. Using TerraScan, the vertical accuracy of the surveyed ground control is tested, and any bias is removed from the data.

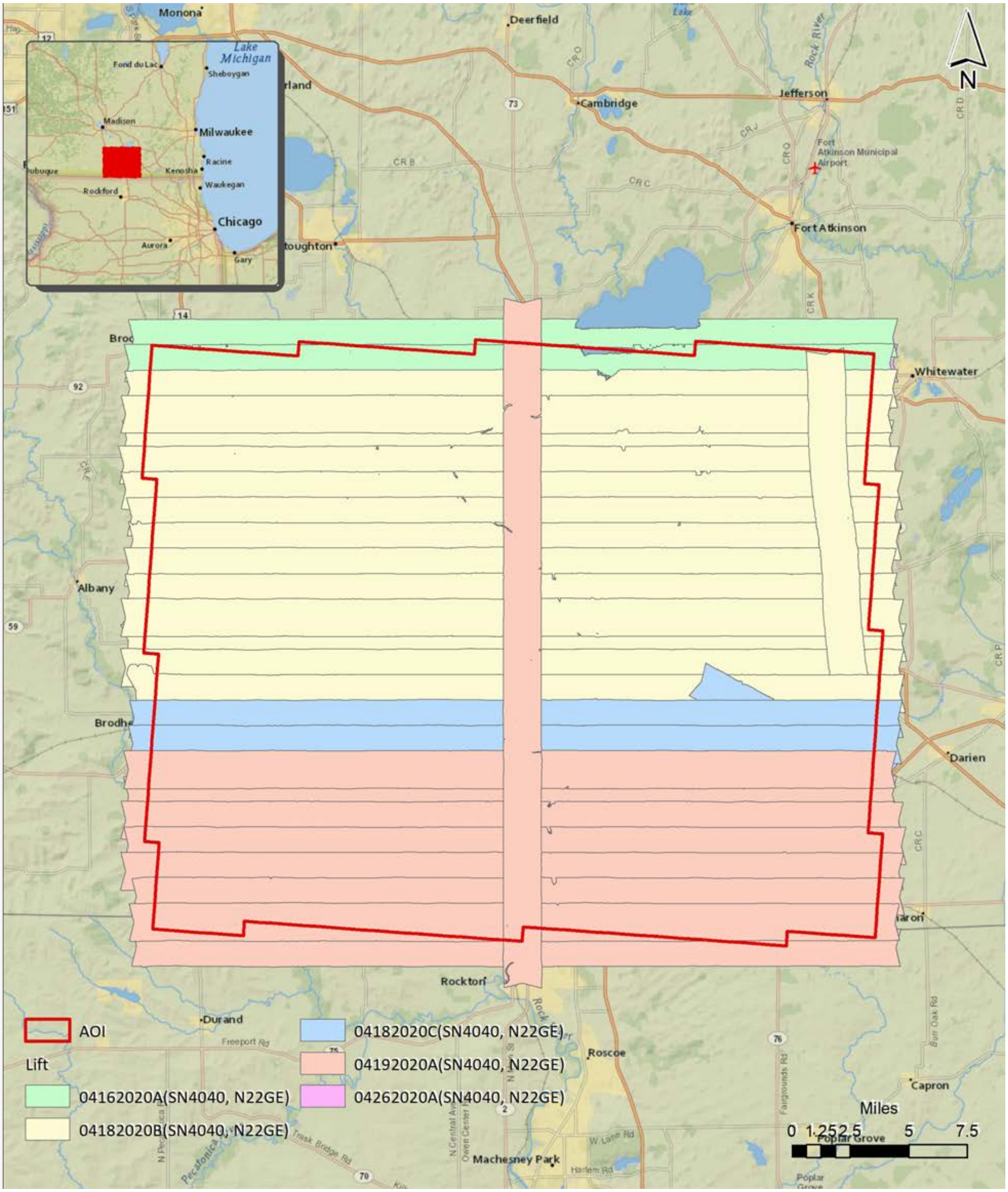
Figure 5. Lidar Tile Layout



4. Project Coverage Verification

Coverage verification was performed by comparing coverage of processed .LAS files captured during project collection to generate project shape files depicting boundaries of specified project areas. Please refer to Figure 6.

Figure 6. Lidar Flight Line Coverage



5. Ground Control and Check Point Collection

Quantum Spatial used 24 ground control (calibration) points collected by Ayres.

5.1 Calibration Control Point Testing

Figure 7 shows the location of each bare earth calibration point for the project area. TerraScan was used to perform a quality assurance check using the lidar bare earth calibration points. The results of the surface calibration are not an independent assessment of the accuracy of these project deliverables, but the statistical results do provide additional feedback as to the overall quality of the elevation surface.

Figure 7. Calibration Control Point Locations

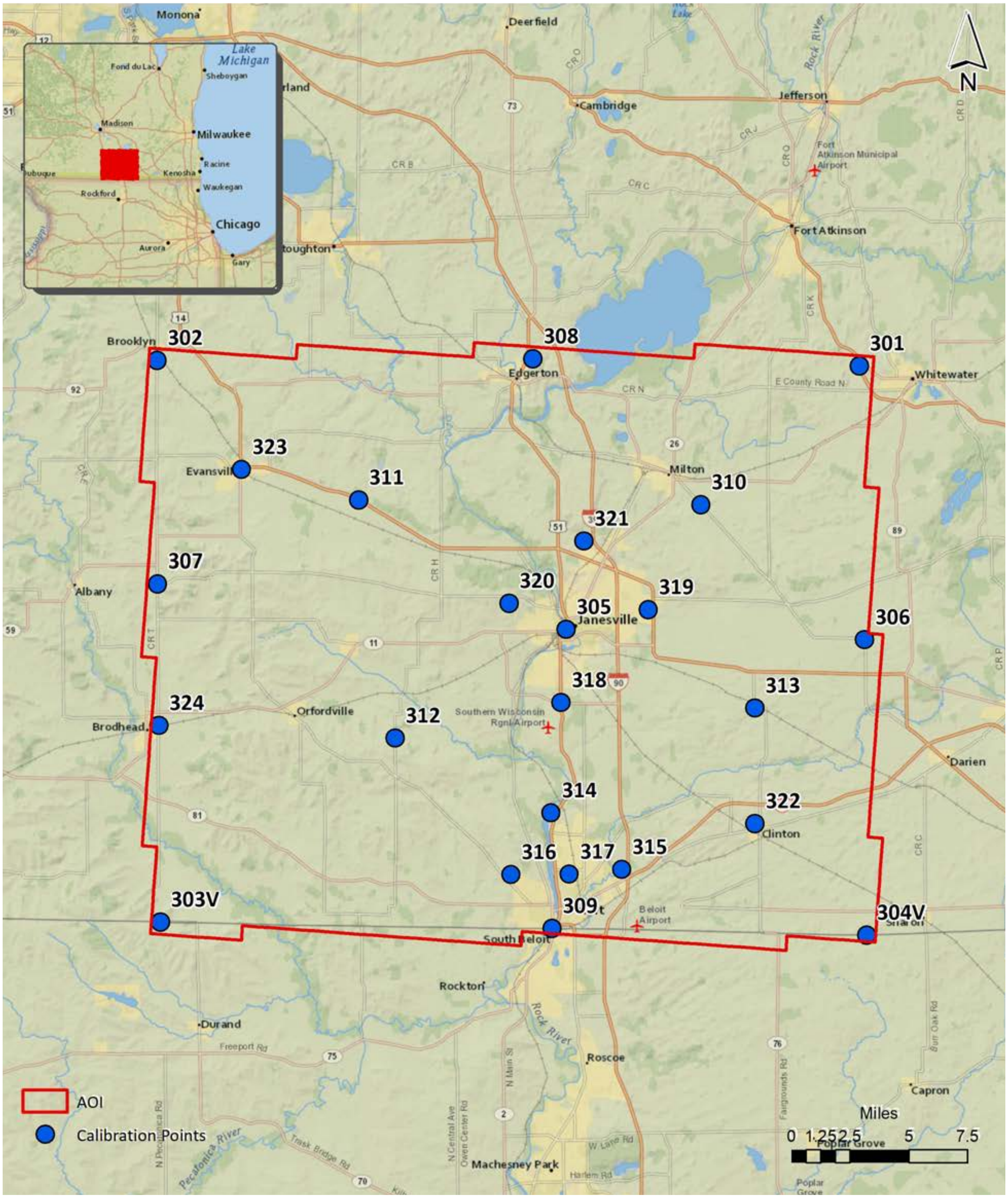


Table 3. Calibration Control Point Report
Units = U.S. survey feet

NUMBER	EASTING	NORTHING	KNOWN Z	LASER Z	DZ
301	558060.361	327532.336	848.468	848.52	0.052
302	400379.243	328732.193	958.603	958.72	0.117
303V	401143.536	202627.129	824.757	824.81	0.053
304V	559767.366	199658.236	966.538	966.51	-0.028
305	492232.058	268444.848	788.594	788.62	0.026
306	559278.459	266130.925	948.728	948.66	-0.068
307	400495.347	278640.991	862.54	862.55	0.01
308	484783.124	329130.182	839.098	839.01	-0.088
309	489123.674	201193.288	740.746	740.5	-0.246
310	522540.681	296324.654	888.556	888.54	-0.016
311	445613.394	297399.008	928.37	928.42	0.05
312	453806.933	243980.041	885.479	885.37	-0.109
313	534608.396	250722.408	953.985	953.87	-0.115
314	488878.958	227122.108	748.745	748.71	-0.035
315	504751.009	214448.885	813.923	813.84	-0.083
316	479838.822	213264.126	865.607	865.67	0.063
317	492963.707	213419.976	798.85	798.82	-0.03
318	491095.924	251956.836	804.376	804.37	-0.006
319	510703.758	272843.228	862.149	862.25	0.101
320	479393.895	274276.187	950.138	950.26	0.122
321	496220.162	288140.609	904.312	904.37	0.058
322	534644.125	224740.031	966.996	967.09	0.094
323	419354.638	304257.407	900.215	900.19	-0.025
324	400722.041	246807.915	796.265	796.49	0.225

Average Dz	0.005
Minimum Dz	-0.246
Maximum Dz	0.225
Average Magnitude	0.076
Root Mean Square	0.096
Std Deviation	0.098