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DEPARTMENT OF PUBLIC WORKS - Engineering Division

MEMO

TO: Members of the Municipal Services Committee

FROM: Ross Buetow, Deputy Director of Public Works / City Engineer

SUBJECT: 2020 Aerial Imagery/LiDAR Contract Award

DATE: January 7, 2020

In 2017, the Common Council approved a ten-year agreement between the City and Ayres Associates, Inc. for orthophotography, lidar and digital mapping services, with specific scopes of services and their related contracts to be approved on a project-by-project basis. To date, Ayres Associates has provided high quality technical services and the City has been very satisfied with our professional relationship.

For our 2020 project, we are requesting approval for all necessary fieldwork (i.e. flights, ground control and aerial imagery) to obtain updated 3-inch pixel resolution orthoimagery and complete LiDAR (*Light Detection and Ranging*) data coverage for all of Appleton (see attached Exhibit 1). In addition to the fieldwork described above, the project scope also includes the creation of 1-foot contour maps prepared to USGS map accuracy standards for the entire city. The LiDAR process will essentially provide a complete three-dimensional point cloud representation of the City's ground surface, which can be used by City Engineering and GIS staff for numerous subsequent stormwater and mapping applications.

We hereby request to award the 2020 Aerial Imagery/LiDAR Contract to Ayres Associates in an amount not to exceed \$62,600 based on the attached scope of services. The approved 2020 budget allocation for this project is \$60,000.

Thank you for your consideration.

June 6, 2019



Ross M Buetow, P.E.
Deputy Director of Public Works/City Engineer
City of Appleton
100 North Appleton Street
Appleton, WI, 54911

Dear Mr. Buetow:

Thank you for the opportunity to submit a proposal for orthoimagery and lidar services for the City of Appleton in 2020. This letter describes the project approach and fees for 3-inch resolution orthoimagery and two lidar options that you requested for the City. The Wisconsin-based consulting team of Ayres Associates/Quantum Spatial team will provide the following services.

Proposed Project Services – Orthoimagery

Ayres Associates understands that one goal of the project is to acquire 3-inch resolution, 4-band (RGB-NIR) digital orthoimagery for the City's project area. Please carefully examine and confirm the boundary on Exhibit 1 as it is the basis for the prepared estimate.

Scope of Work

Ayres Associates is offering the City digital orthoimagery services at 3-inch resolution across approximately 43 square miles. The orthoimagery will be developed from aerial photography acquired using a calibrated, digital photogrammetric camera, in the spring of 2020 during the leaf-off state. The aerial photography will support 1" = 50' scale planimetric mapping if the City is interested in future mapping of infrastructure.

The delivered orthoimagery will consist of GeoTIFF tiles based on PLSS quarter sections (or other tile format agreed upon). Additionally, we will provide MrSID compressed tiles and a project-wide mosaic. The 3-inch pixel resolution digital orthoimagery for the 3-inch Project Area which will meet ASPRS horizontal accuracy standards of 0.7 feet RMSE.

Orthoimagery DEM

Ayres Associates will use a digital elevation model (DEM) created from existing or new lidar for image orthorectification. Our technicians will review the existing data and will create a new DEM capable of supporting the horizontal accuracy of the orthoimagery.

Ground Control

Ayres Associates will use airborne global navigation satellite systems (GNSS) and an inertial measurement unit (IMU) that accompanies the digital sensor to reduce the required amount of ground control. To meet the specifications of the project, we estimate a total of 15 control points will be needed. Ayres Associates will provide the ground control survey services for this project.

Project Deliverables

Deliverable products included in the estimate are as follows:

- Digital ortho tiles in GeoTIFF (with world file) and MrSID format
- Project-wide mosaic in MrSID format
- Ortho tile index, .shp format
- Ground control locations, .txt format

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- Project Plan, PDF format
- Flight Plan, .shp format
- Aerial Photography Report, PDF format
- AT Report, PDF format
- FGDC compliant metadata, .xml format

Proposed Fees – Orthoimagery Services:

We will perform the digital orthoimagery services for the following lump-sum fees:

Orthoimagery:

3-inch pixel, 4-band orthoimagery: \$30,100.00

Proposed Project Services – Lidar

We understand the City of Appleton would like to conduct a new lidar project to produce high density point clouds and resulting topographic datasets. The proposed lidar options will produce a bare earth point cloud to support 1-foot contour generation. The lidar project is being considered for a 2020 spring leaf-off flight. Two options of varying point density are being proposed to the City.

Scope of Work

The Ayres/Quantum Spatial team understands that the proposed lidar project calls for the development of topographic mapping across 43 square miles in Appleton. The lidar data collection will be done using a low altitude aircraft equipped with a lidar sensor and with airborne GNSS/IMU system for accurate georeferencing. The lidar point cloud will be captured during the spring leaf-off state, and when clouds or haze are not present between the aircraft and the ground.

The lidar will be collected at 30 points per square meter nominal pulse density to support a high definition point cloud, surface model, and 1-foot interval contours. The lidar will achieve Quality Level 0 (QLO) vertical accuracy as defined by USGS Lidar Base Specifications, which equates to 5 cm RMSEz on level or uniformly sloped non-vegetated ground. For your consideration, we are also including a lower density option, which is based on lidar collection at 8 PPSM to achieve Quality Level 1 vertical accuracy, which equates to 10 cm RMSEz.

The raw lidar point cloud will be calibrated and then classified according to the classification scheme listed below. All collected Lidar points will be retained in the point cloud according to these classifications. High vegetation and building classifications will be done using automated routines.

Lidar Base Classification Scheme:

- 1: Processed, but unclassified
- 2: Bare earth
- 5: High vegetation (10' and greater above the ground)
- 6: Buildings
- 7: Low noise
- 9: Water
- 17: Bridge deck
- 18: High noise
- 20: Ignored ground (breakline proximity)

Breaklines will be collected to constrain the hydro features, a process called hydro-flattening. Streams 20 feet wide and greater will be collected, along with ponded water two acres and larger. A bare earth digital elevation model for the entire project area will be generated from the processed lidar data and the breaklines. One foot contours will be prepared from the bare earth classified points and the hydro-flattening breaklines. The bare earth DEM will be produced at 2 foot pixel size for 8 PPSM and 1 foot pixel size for 30 PPSM.

Lidar Ground Control

We will use the airborne GNSS/IMU data collected at the time of flight to reduce the required amount of ground control. During the flight, we will use WISCORS base stations to collect GNSS data during the mission, along with surveyed ground control that will be used to calibrate the raw lidar data. Ayres Associates will collect a number of vertical checkpoints across the City for verification of the calibration.

Lidar Project Deliverables

Deliverable products included in the proposal are as follows:

- Classified point cloud, LAS v1.4 format
- Hydro breaklines (20' flowing and 2 acre ponded), ESRI shapefile format
- Bare Earth DEM, 32-bit floating point grid
- 1-foot contours, four types, ESRI shapefile format
- Ground control report, PDF format
- Tile Schematic, ESRI shapefile format

Additional deliverable options:

- Intensity Imagery, GeoTIFF format
- First return Digital Surface Model (DSM), 1 foot pixel, 32-bit floating point grid

Proposed Fees – Lidar Services:

Ayres Associates proposes two options for lidar acquisition and processing for the City of Appleton.

Option 1: 8 PPSM lidar collection, processing, and delivery for a total fee of: \$32,500.00

Option 2: 30 PPSM lidar collection, processing, and delivery for a total fee of: \$39,500.00

Additional deliverable options:

- Intensity Imagery: \$2,000.00
- First return DSM: \$2,000.00

Proposed Fees – Orthoimagery and Lidar Services:

We will provide the orthoimagery and lidar services described in this proposal for the following lump sum fees:

3-inch, 4-band orthoimagery:	\$30,100.00
Option 1: 8 PPSM lidar collection:	\$32,500.00
Additional deliverables:	TBD
Total project fees:	\$62,600.00

3-inch, 4-band orthoimagery:	\$30,100.00
Option 2: 30 PPSM lidar collection:	\$39,500.00
Additional deliverables:	TBD
Total project fees:	\$69,600.00

I hope that we have provided the information you require to consider options for your 2020 projects. In the event that you require additional information or clarification of any issue, please feel free to contact me at 608.443.1207.

Sincerely,

A handwritten signature in blue ink, appearing to read "Zachary Nienow".

Ayres Associates Inc
Zachary J. Nienow, GISP
Project Manager
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nienowz@AyresAssociates.com

Exhibit 1

Orthoimagery and lidar project area, approximately 43 square miles:

