**SCOPE OF WORK**

**Oklahoma NRCS LiDAR Mapping**

**1. Description of Work and Required Services / Deliverables**

The Oklahoma USDA-NRCS requires high-resolution digital elevation data developed from **Li**ght **D**etection **a**nd **R**anging (LiDAR) for approximately ten thousand four hundred seventy-four (10,474) sq. mi. of various watersheds in Oklahoma. See Attachment #1 for locations of flight areas (detailed descriptions of flight areas will be transferred electronically as shapefiles). This data will be used by the USDA-NRCS to generate digital elevation models and contours for use in hydraulic/hydrologic models. The project requires LiDAR that meets the following accuracy standards:

LiDAR data that is tested for and meet vertical and horizontal accuracy as stated in the NDEP guidelines for digital elevation data for NSSDA of 95% confidence interval, for 2’ contours (horizontal accuracy of 4.39 feet RMSE and vertical of 12.5 centimeters RMSE(z)) with a 1.4 meter nominal point spacing.

1. **Period of Performance**

Period of Performance: 365 days after date of award

**3. Intellectual Property**

The USDA-NRCS will make the project deliverables freely available public domain data. It is understood that all processed and unprocessed data become the property of the Government.

1. **Information Supplied by the Government**

An ESRI shapefile defining the shape and size of the area to be surveyed will be supplied by the Government. Any other existing information that may be available from NRCS deemed by the Contractor as necessary for completing the Task Order will be requested from the CO in writing. Such request will include a detailed description of information requested and a statement describing how the information will be used.

#### 5. Description of Tasks

a. After negotiations, and prior to receiving notice to proceed (NTP), before any data collection, the Contractor shall submit a Quality Control (QC) Plan. The Quality Control Plan shall provide for and maintain an effective quality control program that will assure that all services are performed and provided in a manner that meets professional architectural, engineering, and survey quality standards. The Quality Control plan will include the following:

1) A map showing the study area boundaries and flight path at a reasonable scale (approx. 1:150,000) (Prior to NTP)

2) Documentation specifying planned altitude, air speed, scan angle, scan rate, LIDAR pulse rates, and other information deemed appropriate. (Prior to NTP)

3) List of equipment and software to be utilized during project. (Prior to NTP)

4) A chart of areas of high Position Dilution of Precision (PDOP), or a list showing the time of the beginning and end of high PDOP. (Prior to NTP)

5) The proposed ground control plan containing Airborne GPS support. If necessary, the Contractor shall obtain all rights of entry, be responsible for all GPS control information and show all National Spatial Reference System (NSRS) monuments that will be used for the GPS base stations for airborne GPS control during the LIDAR acquisition. (Prior to NTP)

b. The Contractor shall acquire LiDAR elevation data over the required area. The average laser ground sample distance (GSD) 1.4 meters with 20 percent flight line overlap (two-meter resolution). The LiDAR elevation data will be collected when the leaves are off the trees or December 1, 2011 through February 28, 2012. The Contractor shall insure the project is also flown snow-free and not after periods of rain when standing water or saturated ground could inhibit accuracy.

c. The Contractor shall process the LiDAR data and produce a “bare earth” model with overall vertical accuracy on open terrain that meets NDEP guidelines of 37 centimeters (Accuracy(z)) for two-meter resolution. The Contractor shall use automated and manual filtering for bare earth creation, removing 95% or greater of artifacts, outliers, voids, systematic and random errors, noise, anomalies, man-made features and vegetation. The resulting digital terrain data should support production of 2 foot contours.

d. The Contractor shall test and document that all deliverables meet or exceed standards for both vertical and horizontal accuracy as stated in NDEP Guidelines for Digital Elevation Data, Version 1.0 for NSSDA of 95% confidence for 1-ft contours or 2-ft contours (as applicable) and ASPRS Class I Standards.

e. The Contractor shall provide interim deliveries of all products for review by NRCS. Data will be provided on a single Firewire/USB 3.0/2.0 external hard drive to the NRCS technical point of contact at the address provided below. Hard drives will be returned following review and analysis.

f. The Contractor shall generate four copies of all digital data generated and provide them on Firewire/USB 3.0/2.0 external hard drives. Two (one for intermediate storage and one for off-site back-up) will be sent to USDA-NRCS in Stillwater, OK and two will be sent to Steven Nechero at the National Cartography & Geospatial Center, 501 West Felix Street, FWFC Building 23, Fort Worth, Texas. The Firewire/USB drives will become government property upon delivery. All drives will contain the appropriate metadata for the files contained on the drive. Metadata for individual tiles is not required.

g. The Contractor shall certify in writing that all media is free of known computer viruses. The name(s) and release date(s) of the virus-scanning software used to analyze the media, the date the virus scan was performed, and the operator's name shall also be included. The release or version date of the virus-scanning software shall be the current version, which has detected the latest known viruses at the time of delivery of the digital media. This certification will be sent to the Contracting Officer and the government technical point of contact.

#### 6. Quality Assurance and Quality Control (QA/QC)

The project completion report described in Section 7.2 shall include a QA/QC narrative. The narrative shall include all aspects of the LiDAR flight, including a description of the fieldwork and detailed office data processing procedures. The description shall include location, navigation and control, operations, all survey logs and data sheets used or acquired under this task order, any difficulties encountered, (including discrepancies with maps, etc.) and documentation of how they were resolved. The Contractor shall provide an interpretation and analysis of the results of the survey, including data quality, coverage of the area, and a summary of the findings. This data will be delivered in the final non-geospatial data deliverables, in the report applicable.

The Quality Control Plan shall be implemented by a project manager assigned within the Contractor’s organization who will be present during the times work is in progress, and will be responsible for assuring that all documents on the project have been coordinated. This individual shall possess extensive, verifiable LIDAR and photogrammetric experience. The Contractor shall perform an independent technical review of all deliverables to insure they meet specified standards. Performance of the independent technical review should not be accomplished by the same personnel that produced the product.

Basic horizontal control, suitable for the base stations supporting airborne GPS, shall be established or recovered from the NGS data base as needed to meet specified accuracy standards. Any control points set by the Contractor shall be of a permanent or semi-permanent nature such as copper weld or rebar rods referenced for recovery by others in the future and for performing quality control checks.

#### 7. Data Processing and Deliverables

All geospatial data deliverables shall be provided in UTM, Zone 14 and15, horizontal datum of NAD83, vertical datum NAVD88 coordinates (GOED model 2009). Horizontal and vertical units should be floating point decimal meters. When necessary for reasonable file sizes, USGS quarter-quarter quad tiles and naming conventions (including a, b, c, d quadrant designations starting in the upper right corner or the quarter quad and moving counterclockwise) should be used to partition the data, with no gaps or voids. Quarter-quarter quad files shall have a seamless continuity among files.

1. Geospatial data deliverables include:

a. Bare-earth 2-meter pixel size (as appropriate) Digital Terrain Model (DTM) in ESRI grid format with defined projection/coordinates in quarter-quarter quad tiles and mosaics

b. First return 2-meter pixel size (as appropriate) Digital Surface Model (DSM) in ESRI grid format with defined projection/coordinates in quarter-quarter quad tiles and mosaics

c. ASPRS .LAS format (Ver. 1.2) files with LiDAR points classified as bare-earth and canopy (first return). The .LAS file must also have intensity values for the LiDAR data, flight information and flight acquisition date, return value and flight lines (tiles only)

Classification Scheme (minimum):

 Code 1 – Processed, but unclassified

 Code 2 – Bare-earth ground

 Code 7 – Noise (low or high, manually identified, if needed)

 Code 9 – Water

 Code 10 – Ignored Ground (Breakline Proximity)

*Note: Class (code) 7, Noise, is included as a convenience for the data producer. It is not required that all “noise” be assigned to Class 7.*

*Note: Class (code) 10, Ignored Ground, is for points previously classified as bare-earth but whose proximity to a subsequently added breakline requires that it be excluded during Digital Elevation Model (DEM) generation.*

d. Index map of project area as an ESRI polygon quarter quad shapefile with file names and acquisition dates

e. FGDC compliant geospatial metadata for each file in .xml format that includes:

* Date of acquisitions
* System type and system collection parameters (flying height, Scan FOV full angle, pulse rate, scanner frequency, side-lap percentage, point density etc.)
* Nominal point density
* Calibration procedures
* Base station control information

f. ESRI Geodatabase of classified mass points with same classification as LAS deliverable.

2. Non-geospatial data deliverable includes a project completion report containing:

a. A LiDAR system data report including discussions of data processing methods used, final LiDAR pulse and scan rates, scan angle, capability for multiple returns from single pulses, accuracy and precision of the LiDAR data acquired, accuracy of the topographic surface products, quality control report details and companion imagery (if any).

b. A flight report documenting mission date, time, flight altitude, airspeed, and other information deemed pertinent. The report must include information about GPS-derived flight tracks, provide a detailed description of final flight line parameters and GPS controls (i.e. benchmarks), and include ground truth and complementary data. A chart of areas of high PDOP, with curtains (point obstructions) created for each of the receiver sites is required. A site obstruction diagram shall be provided for each receiver site.

c. A ground control report that includes, at a minimum, all pertinent base station information and mission notes, including information on GPS station monument names and stability.

d. Data processing procedures of posting, and all orthometric values of x, y, and z coordinates for LiDAR returns.

e. A system calibration report.

#### 8. Deliveries or Performance

The Contractor shall include interim deliverables with dates within the proposal before the final deliverable is made.

##### 9. Key Personnel

NRCS Contracting Officer:

Martha Worlein

100 USDA, Suite 206

Stillwater, OK 74074

405-742-1224

Martha.worlein@ok.usda.gov

NRCS Project Coordinator:

Chris Stoner, PE

Martha Worlein

100 USDA, Suite 206

Stillwater, OK 74074

405-742-1260

Chris.stoner@ok.usda.gov

NRCS Technical Contact:

Gary Utley

USDA-NRCS

100 USDA Ste. 206
Stillwater, Oklahoma 74074
Tel: 405.742.1229
Fax: 405.742.1201
Gary.Utley@ok.usda.gov

All deliverables shall be made to Gary Utley

##### 10. Acceptance

The Contracting Officer will notify the Contractor within 30 business days of receipt of the deliverables whether the items are in full compliance with the specifications. The contractor and NRCS will have monthly progress review calls to discuss project status. The Contracting Officer may be included in these calls. The contractor shall provide a written minutes and summary of each progress review call within 10 working days following the call. The contractor may request that NRCS provide reviews of draft contractor work products prior to final deliverable submissions.

**11. Reference documents**

* The National Standard for Spatial Data Accuracy (NSSDA) is a Federal Geographic Data Committee (FGDC) standard that will be used by the government for use in determining geospatial accuracy.

<http://www.fgdc.gov/standards/documents/standards/accuracy/chapter3.pdf>

The National Digital Elevation Program (NDEP) has created a set of recommended guidelines for digital data that provides information on digital elevation types, product descriptions, metadata profiles, definitions, and map accuracy standards.

<http://www.ndep.gov/TechSubComm.html>

* Terminology & Abbreviations
	+ ESRI Environmental Systems Research Institute
	+ NGS National Geodetic Survey
	+ ASPRS American Society for Photogrammetry and Remote Sensing
	+ FGDC Federal Geographic Data Committee
	+ UTM Universal Transverse Mercator
	+ GSD Ground Sample Distance
	+ NDEP National Digital Elevation Program

**12. Mutually Agreed Upon Assumptions**

The following assumptions are mutually agreed:

 (1) Full contact information (name, address, phone number) of all property owners where right-of-entry permission is required will be provided to URS by NRCS within 20 working days after the contractor informs NRCS/contracting officer of the areas needing right-of-entry.

 (2) Access to any location necessary for the performance of the above field work will not be delayed through denial of access by private property owners. NRCS cannot guarantee access. Alternate locations will be identified by the contractor if access to the initial location is denied. The contractor shall notify NRCS if denial of access will adversely impact obtaining necessary ground control.

 (3) If insufficient NGS control monuments exist, the contractor will be responsible for setting the needed control to meet the specified accuracy.

 (4) As long as the contractor is meeting due diligence in obtaining :LiDAR, the contractor shall inform NRCS/contracting officer of unfavorable weather and ground conditions which may impact the contractor’s delivery schedule to discuss and propose revised timelines.

 (5) A portion of the LiDAR may be captured during the day, evening, or overnight depending on weather and ground conditions.

**13. Proposal Instructions**

Written proposals are requested for two-meter resolution. (See attached maps for the proposed LiDAR flight areas).

The following table summarizes the proposal process:

1.4 Meter Nominal Point Spacing with vertical accuracy of 12.5 centimeters RMSE(z):

|  |  |
| --- | --- |
| # OF TARGET AREAS | 1 |
| SQUARE MILES | 10,474 |
| LIDAR ACQUISITION | $ |

All proposals will include:

* Name of LiDAR Contractor
* Standard equipment used by Contractor
* Description of proposed ground control surveys
* Description of proposed quality control procedures
* Resume and detailed information on the individual assigned to quality control of LiDAR to assure individual possesses extensive, verifiable LiDAR and photogrammetric experience.
* Cost proposal will include a detailed break-down of the types of personnel, an estimate of man-hours required to complete the tasks, a summary of labor costs and other direct costs (including travel).

Note: Digital shapefiles of target areas will be transferred electronically to Contractor.

**Attachment #1**

**Location of Flight Areas**

