**Scope of Work on Master Agreement # AV2408**

**Acquisition of Aerial Lidar Elevation Data**

**Great Salt Lake, Bear Lake, Cache Valley, and Washington County Areas**

The State of Utah, Department of Technology Services, Division of Integrated Technology, Automated Geographic Reference Center (AGRC) and partners are contracting with Quantum Spatial, Inc. to acquire, process, and deliver aerial Lidar data and derivative products that meet the specifications described in this Scope of Work, and contracted under Master Agreement #AV2408.

This Scope of Work (SOW) identifies the specific acquisition requirements, production specifications and standards, deliverables, and schedule for Lidar data collection and deliverable data products that adhere to the U.S. Geological Survey (USGS) Quality Level 1 (QL1) and Quality Level 2 (QL2) Lidar specifications for the entire area defined in this agreement. The Lidar data will be acquired in the Fall of 2016 with leaf-off conditions and no snow on the ground. Pricing will be based on the cost submitted in the bid response to RFP Solicitation #WS16020-Stage 2 by Quantum Spatial, Inc.

**1. Lidar Data Products**  
  
The lidar data product must adhere to USGS National Geospatial Program (NGP) *Lidar Base Specification Version 1.2* (2014) available at <http://pubs.usgs.gov/tm/11b4/>. These lidar specifications are required minimum baseline specifications and project deliverables shall meet or exceed USGS QL1 or QL2, as specified per project area. For any item which is not specifically addressed, the referenced *Lidar Base Specification Version 1.2* will be the required specification authority.

**2. Project Areas, Performance Period, and Acquisition Modifications**

The State of Utah 2016 Lidar Acquisition Project (“Project”) covers portions of Utah and Idaho shown in Figure 1, and are delineated in Attachment 1: (Utah\_Acquisition\_Area.shp).

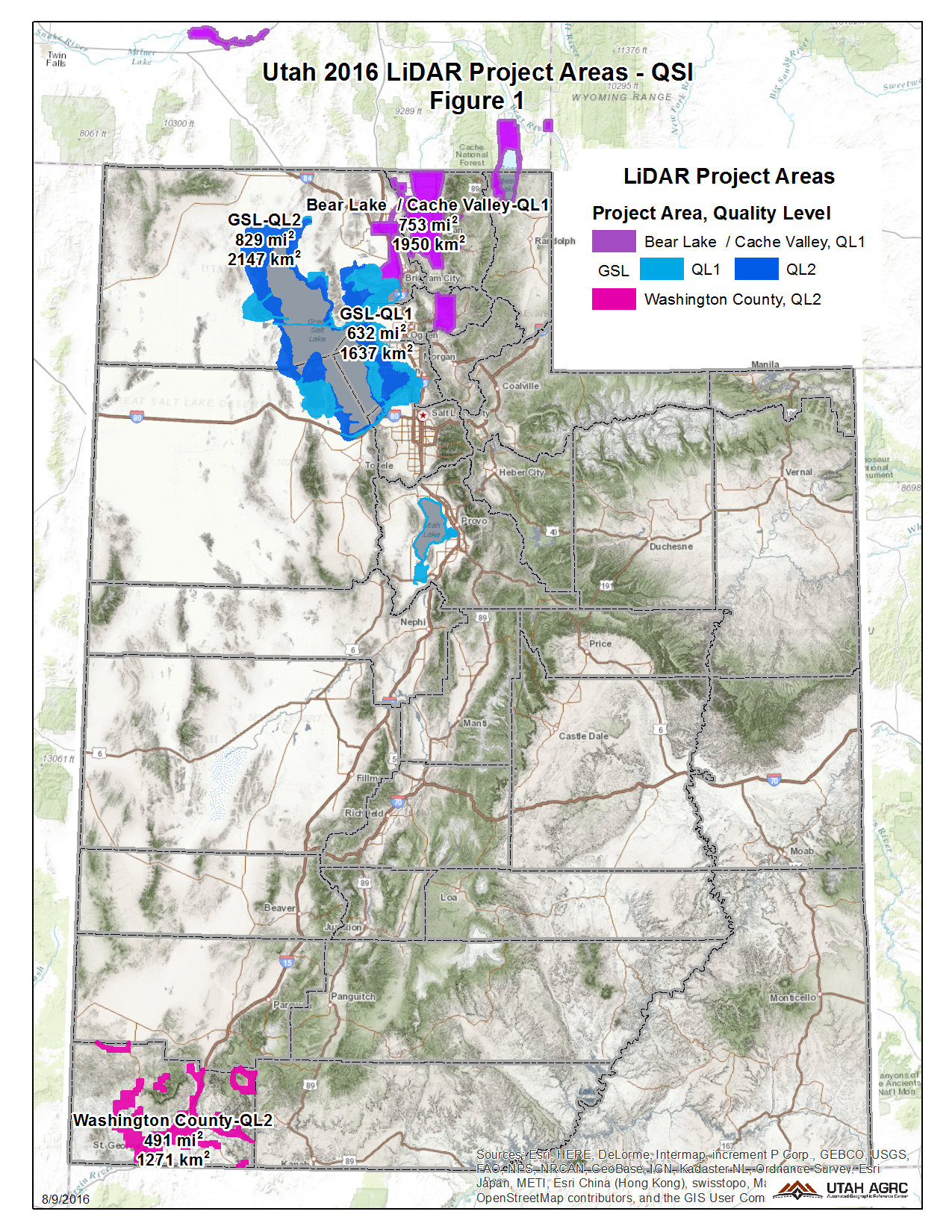
**2.1. Project Areas**  
  
The Project acquisition areas total approximately 7,005 km2 in northwest Utah, southwest Utah, and southern Idaho as shown in Figure 1. Further explanation of the project areas is explained in Section 2.1.1. to 2.1.3. For the contracted acquisition areas, the delivered data products must cover at least the spatial extent (footprint) of the acquisition areas delineated in Attachment 1. Any acquisition footprints that extend beyond Attachment 1 are acceptable, and if data is acquired outside these footprints, at least the raw point cloud data shall be provided.

**2.1.1. Great Salt Lake**

The Great Salt Lake area consists of approximately 3,784 km2. Lidar acquisition in this area require a combination of QL1 and QL2 specifications. QL2 specifications are desired for the shoreline of the Great Salt Lake, with the exception of areas specified as QL1. Due to the general lack of vegetation within this project area, lidar acquisition can occur anytime during the acquisition phase of the project, given the Great Salt Lake and Utah Lake are close to the lowest levels of the year.

**2.1.2. Bear Lake, Bear River and Cache Valley**The Bear Lake, Bear River and Cache Valley areas consist of approximately 1,950 km2. Lidar acquisition in these areas requires QL1 specifications, preferred with leaf-off conditions (required in Cache Valley); however, leaf-on conditions may be negotiated assuring that lidar penetration to the ground must be adequate to produce a bare-earth surface digital elevation model (DEM) that meets or exceeds requirements for vertical accuracy and that Bear Lake and Bear River are close to the lowest levels of the year.

**2.1.3. Washington County**The Washington County area consists of approximately 1,271 km2. Lidar acquisition in this area require QL2 specifications with leaf-off conditions.

  
**Figure 1: Acquisition Areas**

## 2.2. Performance Period

For the areas described in Section 2.1. the acquisition shall be in the Fall of 2016, maximizing leaf-off conditions, low water levels, and no snow on the ground (such as, may be encountered during October and/or November and later.

## 2.3. Acquisition Modifications

Any additions or modifications to the lidar project areas (including areas located outside of Utah), by either the State or the other cooperators, will adhere to the data deliverables, standards, specifications criteria, and inspection process described in this SOW. Any changes after initial contracts are negotiated will be made through the agreed upon contract amendment process.

## 2.4. Extreme Low Water Conditions

The water levels of the Great Salt Lake and Utah Lake are the lowest they have been in decades. It is important that the Lidar acquisition covers the shorelines of the lakes where the water terminates on the shoreline. The project area footprint provided should be sufficient to capture the water and land interface. However, should Quantum Spatial at anytime during the acquisition, find that flight lines do not adequately cover the water and land interface, will negotiate any additional costs with AGRC to expand the footprint to cover these areas.

# 3. Delivery and Quality Assessment and Acceptance Schedule

The Lidar data acquisition schedule will be agreed to by the State and Quantum Spatial, Inc. based on actual weather and on-the-ground conditions after the contract has been approved. This schedule may include a small initial pilot delivery, selected from within the project areas, to ensure that data meets the specifications and conditions of the contract.

A formal data product delivery schedule will be agreed to by AGRC and Quantum Spatial, Inc. after the contract has been approved and may be modified by changes in the acquisition schedule. Lidar acquisition should be timed to ensure the ground is free of snow, ice and standing water, rivers are free of ice and are at a stage of low flow, and lakes and reservoirs are close to the lowest levels of the year. Leaf-off vegetation conditions are preferred for most areas, required for the Cache Valley area, and lidar penetration to the ground must be adequate to produce a bare-earth surface DEM that meets or exceeds requirements for vertical accuracy.

The anticipated schedule of delivery and quality assurance is as follows:

* Flight of contracted area for data product.
  + Length of acquisition time to be determined by Quantum Spatial, Inc. in collaboration with AGRC.
* Process and deliver all data products to AGRC for initial inspection and review.
  + AGRC has 30 days to review and submit correction requests.
* Quantum Spatial, Inc. addresses initial review comments and redelivers areas to AGRC for final inspection.
  + Quantum Spatial, Inc. has 20 days to redeliver with corrections.
* AGRC final inspection and review.
  + AGRC has 20 days to review and submit correction requests.
* Quantum Spatial, Inc. addresses final review comments and delivers final and complete data products to AGRC.
  + Quantum Spatial, Inc. has 20 days to redeliver final data product.

If it is not possible to rework the data to correct error(s), a reflight of that area may be required.

## 3.1. Inspection Schedule

An inspection schedule for quality assurance of all products will be developed between Quantum Spatial, Inc. and AGRC. Quantum Spatial, Inc. shall document its internal quality assurance work as described in Section 6. A review committee designated by AGRC will quality check the lidar products. The USGS National Geospatial Technical Operations Center (NGTOC) will also be used to ensure that the delivered data products meet the requirements of the USGS NGP *Lidar Base Specification Version 1.2* (2014) and The National Map: 3D Elevation Program (3DEP) set forth in this SOW. Deliverables will not be accepted without acceptance by the USGS NGTOC. The inspection period for each initial data product delivery will be up to 30-calendar days; these inspection periods may be concurrent. Review of any redelivery of data with corrections will be completed within 20-calendar days of receipt. If collection conditions necessitate the need for a later acquisition, AGRC, and Quantum Spatial, Inc. can modify this date through a contract amendment. Deliveries will be made to AGRC.

# 4. Access to Lands and Airspace

Quantum Spatial, Inc. is responsible for applying for and obtaining all required permits, clearances, permissions, etc. for access, over-flight, or intrusion to restricted or otherwise limited ground access and/or airspace, which may be included within the requirement of this project. AGRC can assist with expediting these processes where possible.

# 5. Data Product Deliverables

See the USGS NGP *Lidar Base Specifications Version 1.2* (2014) (<http://pubs.usgs.gov/tm/11b4/>) “Data Processing and Handling” section and Section 15 “Cited Specifications and Standards” for requirements on the processing and handling of the lidar data.

## 5.1. Metadata

Descriptive information about the project to include textual reports, graphics, supporting shapefiles, and Federal Geographic Data Committee (FGDC) compliant metadata files are required. See National Spatial Data Infrastructure (NSDI) Content Standards for Digital Geospatial Metadata (FGDC, 1998) and Lidar Base Specifications Version 1.2 (USGS, 2014) “Metadata” section for metadata requirements for this project.

A current Product Characterization Report of the instrument used shall be included in the Project History Report/Folder (Section 6) as a deliverable.

**5.2 Raw Point Cloud**  
  
Raw point cloud deliverables shall include or conform to the following procedures and specifications:

* No classifications are required; however, Overage (overlap) and Withheld Flags will be properly set.
* All collected points, fully calibrated, georeferenced, and adjusted to ground, organized and delivered in their original swaths, one file per swath, one swath per file.
* If production processing required segmentation of the swath files, the requirements listed in the section “Swath Size and Segmentation,” shall be met.
* Fully compliant LAS Specification version 1.4, Point Data Record Format 6, 7, 8, 9, or 10.
* If collected, waveform data in external auxiliary files with the extension .wdp. See the LAS Specification version 1.4 (American Society for Photogrammetry and Remote Sensing, 2011) for additional information.
* Correct and properly formatted georeference information as Open Geospatial Consortium (OGC) well known text (WKT) in all LAS file headers.
* GPS times recorded as Adjusted GPS Time at a precision sufficient to allow unique timestamps for each pulse.
* Intensity values, normalized to 16-bit. See the LAS Specification version 1.4 (American Society for Photogrammetry and Remote Sensing, 2011) for additional information.
* A report of the assessed relative vertical accuracy of the point cloud (smooth surface repeatability and overlap consistency). Relative vertical accuracy requirements are listed in table 2. Raw swath point cloud data shall meet the required accuracy levels before point cloud classification and derivative product generation.
* A report of the assessed absolute vertical accuracy (NVA only) of the unclassified lidar point data in accordance with the guidelines set forth in the Positional Accuracy Standards for Digital Geospatial Data (American Society for Photogrammetry and Remote Sensing, 2014). Absolute vertical accuracy requirements using the ASPRS methodology for the raw point cloud are listed in table 4. Raw swath point cloud data shall meet the required accuracy levels before point cloud classification and derivative product generation.

**5.3 Classified Point Cloud**  
  
Classified point cloud deliverables shall include or conform to the following procedures and specifications:

* All project swaths, returns, and collected points, fully calibrated, adjusted to ground, and classified, by tiles. Project swaths exclude calibration swaths, cross-ties, and other swaths not used and not intended to be used, in product generation.
* Fully compliant LAS Specification version 1.4 Point Data Record Format 6, 7, 8, 9, or 10.
* If collected, waveform data in external auxiliary files with the extension .wdp. See the LAS Specification version 1.4 (American Society for Photogrammetry and Remote Sensing, 2011) for additional information.
* Correct and properly formatted georeferenced information as OGC WKT included in all LAS file headers.
* GPS times recorded as Adjusted GPS Time at a precision sufficient to allow unique timestamps for each pulse.
* Intensity values, normalized to 16-bit. See the LAS Specification version 1.4 (American Society for Photogrammetry and Remote Sensing, 2011) for additional information.
* Tiled delivery, without overlap, using the project tiling scheme.
* Classification, as defined below.

|  |  |
| --- | --- |
| **Code/Class** | **Description** |
| 1 | Processed, but unclassified |
| 2 | Bare earth |
| 7 | Low noise |
| 9 | Water |
| 10 | Ignored ground (near a breakline) |
| 17 | Bridge decks |
| 18 | High noise |

**5.4 Bare-Earth Surface (Raster DTM), Hydro-Flattening, Breaklines and Centerlines**  
  
Bare-earth deliverables include the following:

* Bare-earth DEM with hydro-flattening (see section 5.4.1 Hydro-Flattening).
* Cell size no greater than 0.5 meters and no less than the design Nominal Pulse Spacing (NPS) for QL1 collections.
* Cell size no greater than 1 meters and no less than the design Nominal Pulse Spacing (NPS) for QL2 collections.
* Delivery in an industry-standard, GIS-compatible, 32-bit floating point raster format (ESRI Grid preferred).
* Georeference information shall be included in each raster file.
* Tiled delivery, without overlap, using Project Tiling Scheme (section 7).
* DEM tiles will show no edge artifacts or mismatch. A quilted appearance in the overall project DEM surface, whether caused by differences in processing quality or character between tiles, swaths, lifts, or other non-natural divisions, will be cause for rejection of the entire deliverable.
* Void areas shall be coded using a unique ‘NODATA’ value. This value shall be identified in the appropriate location within the raster file header or external support files (for example, *.aux*).
* A report on the assessed absolute vertical accuracy (NVA and VVA) of the bare-earth surface in accordance with the guidelines set forth in the “Positional Accuracy Standards for Digital Geospatial Data” (American Society for Photogrammetry and Remote Sensing, 2014).
* The following thresholds represent the minimum vertical accuracy requirements using the NDEP/ASPRS methodology:
  + - NVA ≤ 19.6 cm, 95% Confidence Level (≤10 cm RMSEz)
    - VVA ≤ 29.4 cm, 95% Confidence Level (≤10 cm RMSEz)
    - All Quality Assurance/Quality Control (QA/QC) analysis materials and results are to be delivered to the State.
* Depressions (sinks), natural or man-made, are not to be filled (as in hydro-conditioning and hydro-enforcement).
* Permanent islands 1 acre or larger shall be delineated within all water bodies.

**5.4.1. Hydro-Flattening**

* Hydro-flattening shall be applied to all water within the main channels of rivers and streams, along with all water bodies or impoundments, natural or man-made, that are larger than 2 acres in area (approximately equal to a round pond 350 feet in diameter), and to all streams that are nominally wider than 100 feet, and to all non-tidal boundary waters bordering the project area regardless of size are to be hydro-flattened within the delivered DEMs. Refer to *Lidar Base Specifications Version 1.2* (USGS, 2014) “Hydro-Flattening” sectionfor further explanation.
* Hydro-flattening shall be applied to the specific stream reaches within the project areas identified below:
  + Bear River (GSL and Bear Lake)
  + Weber River (GSL)
  + Jordan River (GSL)
  + American Fork Creek (GSL)
  + Hobble/Spring Creek (GSL)
  + Provo River (GSL)
  + Spanish Fork River (GSL)
* Hydro-flattened water bodies (lake and ponds) are leveled at a single elevation and streams and rivers are conditioned for continuous downhill flow.
* Hydro-flattened/Bare-earth surface must cover the entire water body and leave no holes in the center. This can be done with interpolation and does not require lidar collection over the entire water body.
* All hydro-flattened areas should have pleasing aesthetic appearance.
* The methodology used for hydro-flattening is at the discretion of Quantum Spatial, Inc.. Refer to the “Digital Elevation Model Hydro-Flattening” section and “Appendix 2. Hydro-Flattening Reference” in the Lidar Base Specifications Version 1.2 for detailed discussions concerning hydro-flattening.
* The bare-earth DEM data should keep intact all road culverts and similar features, regardless of size, defined as having earth between the road surface and the top of the structure.
* Bridges are required to be removed from the bare-earth DEM. Streams and rivers should be continuous at bridge locations.

## 5.4.2. Breaklines

All breaklines used for hydro-flattening are to be delivered in a shapefile and/or geodatabase format as PolylineZ or PolygonZ feature classes. See *Lidar Base Specifications Version 1.2* (USGS, 2014) “Breaklines” section for breakline requirements.

## 5.4.3. Stream Centerlines

Stream centerlines representing water surface elevations at 0.5 m intervals are to be delivered in a shapefile and/or geodatabase format as PolylineZ feature classes.

**5.5 First Return Surface (Raster DSM)**

First-return deliverables include the following:

* First return DEM (for example, highest hit).
* Cell size no greater than 0.5 meters and no less than the design Nominal Pulse Spacing (NPS) for QL1 collections.
* Cell size no greater than 1 meters and no less than the design Nominal Pulse Spacing (NPS) for QL2 collections.
* Delivery in an industry-standard, GIS-compatible, 32-bit floating point raster format (ESRI Grid preferred).
* Georeference information shall be included in each raster file.
* Tiled delivery, without overlap, using Project Tiling Scheme (Section 7).
* DEM tiles will show no edge artifacts or mismatch. A quilted appearance in the overall project DEM surface, whether caused by differences in processing quality or character between tiles, swaths, lifts, or other non-natural divisions, will be cause for rejection of the entire deliverable.

Void areas shall be coded using a unique ‘NODATA’ value. This value shall be identified in the appropriate location within the raster file header or external support files (for example, *.aux*).

**5.6 Intensity Images**

* 0.5 m resolution intensity images in 8-bit grayscale GeoTIFF format for QL1 collections.
* 1 m resolution intensity images in 8-bit grayscale GeoTIFF format for QL2 collections.

# 6. Contractor’s Project History Report/Folder

Quantum Spatial, Inc. will compile and provide a project history report/folder upon conclusion of the lidar acquisition. This folder will be used by AGRC in the inspection process for the lidar. The report/folder, will contain, at a minimum, the following:

* Methods
  + A record of field work procedures.
  + Data derivation and adjustments.
  + Processing report detailing calibration, classification, and product generation procedures including methodology used for breakline collection and hydro-flattening.
  + Any problems encountered and solutions used in resolving such problems.
* Correspondence and records
  + The Statement of Work (SOW) between AGRC and Quantum Spatial, Inc..
  + All production guidance received from AGRC to include all written guidance from telephone conferences, emails, or contractual modifications, or any other source.
  + Lidar acquisition methods; results; Quantum Spatial, Inc. accuracy assessments, including internal reproducibility and absolute accuracy; file formats; file-naming schemes; and tiling schemes.
* Flight information
  + Aircraft trajectory log
    - SBET files (smooth, best, estimated trajectory) detailing aircraft position (easting, northing, elevation), angle, rotation (heading, pitch, and roll), and GPS time, recorded at regular intervals of ≤ 1 second. May include additional attributes (ASCII text or shapefile and .dbf format).
  + Statistical report summarizing the results of the airborne GPS adjustment and the overall accuracy of the adjusted IMU data.
  + Collection report detailing mission planning and flight logs.
* Control
  + Survey Report detailing the collection of control and reference points used for calibration and QA/QC.
  + The documentation for the identity, published position, and measured position of all existing National Geodetic Survey (NGS) marks used for reference stations.
* Quality Assurance/Quality Control (QA/QC)
  + QA/QC Reports (detailing the analysis, accuracy assessment and validation of:
    - * The point data (absolute, within swath, and between swath)
      * The bare-earth surface (absolute)
      * Other optional deliverables as appropriate
  + Quality control procedures and results.
  + All internal quality control checklists.
  + Internal quality control error calls and the corrective actions taken to correct the error(s).
  + All Quantum Spatial, Inc. QA validation reports/error reports and accuracy reports, generated from internal software QA programs demonstrating that the data meets requirements as stated in the SOW.

# 7. Tiling Scheme

A single non-overlapped tiling scheme for both data products will be established and agreed upon by AGRC and Quantum Spatial, Inc. before each collection. This scheme will be used for ALL tiled deliverables.

Tiling for the Lidar deliverables will be based on the U.S. National Grid and should be named according to the U.S. National Grid System based on the SW corner (ex. 12TVK060160). Tiles will be 2,000 meter x 2,000 meter tiles with the exception of tiles around the periphery of the project area that are better suited for 1,000 meter x 1,000 meter tiles. 1,000 meter x 1,000 meter tiles will be used for the .las point cloud files.

* Tile size is required to be an integer multiple of 0.5 meters for raster deliverables.
* Tiles are required to be sized using the same units as the coordinate system of the data.
* Tiles are required to be indexed in X and Y to an integer multiple of the tile’s X-Y dimensions.
* All tiled deliverables will conform to the project tiling scheme, without added overlap.
* Tiled deliverables will edge-match seamlessly and without gaps.

## 7.1. Void Areas

The extent of lidar coverage over the project area shall be sufficient to ensure void areas do not exist within the project area.  Void areas within delivered tiles and within the project area are not acceptable.

# 8. Delivery Medium and Format

Deliverables shall be delivered on USB3 compatible portable hard drives using an uncompressed and unencrypted NTFS file system. Delivery tiles shall be accompanied by an index shapefile, of the tiles delivered, suitable for loading into ArcMap.

All data and products associated with contract deliverables will meet or exceed relevant National Standard for Spatial Data Accuracy (NSSDA) standards. See *NSDI Geospatial Positioning Accuracy Standards, Part 3: National Standard for Spatial Data Accuracy* (FGDC, 1998).

At the completion of the project, after all deliverables have been accepted by AGRC, Quantum Spatial, Inc. will deliver hard drives containing all the finalized deliverables for the project, and become the property of the State of Utah.

# 9. Data Acquisition Requirements and Collection Conditions

Refer to *Lidar Base Specification Version 1.2* (2014) for the following specifications:

* Acquisition requirements
* Collection conditions

## 9.1. Additional Data Acquisition Requirements

* Instrument calibrated for every mission.
* Flight plans are parallel flight lines with a cross-tie at/and or near the end of each project flightlines.
* Flight plan considers requirements for point density, terrain, PDOP (positional dilution of position), and Geomagnetic *Kp* Index (see <http://www-app3.gfz-potsdam.de/kp_index/description.html>).
* The intensity values (signal strength) of each return pulse will be recorded in the LAS, in their files native radiometric resolution.
* In order to prevent clustering effects and ensure uniform densities throughout the data set, a regular 1 x 1 meter grid will be laid over the data. At least 90% of the cells in the grid shall contain the requisite number of points per square meter (ppsm).

# 10. Standards, Specifications, and Requirements

Refer to *Lidar Base Specification Version 1.2* (2014) for the following specifications:

* Quality Level 1 and Quality Level 2 Specifications
* Vertical Accuracy Requirements
* Positional Accuracy Validation
* Relative Accuracy Requirements
* Completeness of coverage

### **10.1. Projection and Mapping Units**

* Projection (Coordinate System):  Universal Transverse Mercator (UTM) Zone 12, NAD 83, Meters; NAVD88, Meters.
* Mapping Units: Meters (UTM).
* Vertical Reference: Orthometric Heights, Meters.

### **10.2. Datums**

All data collected must be tied to the datums listed below:

* Horizontal Datum:
  + North American Datum of 1983 / High Accuracy Resolution Network adjustment (NAD 83 [2011] / HARN) required.
* Vertical Datum:
  + North American Vertical Datum 1988 (NAVD88), using latest geoid model available from the NGS (for example, GEOID12B). All vertical units will be measured in meters.
* Geoid Model:
  + The most recent NGS approved geoid model is required to perform conversions from ellipsoidal heights to orthometric heights.

### **10.3. Usability**

* Files shall have consistent internal formats.
* Quantum Spatial, Inc. shall propose all details of file names and file formats that are not specified here. Proposed names and formats must be approved by AGRC.
* Files may be gzip or zip compressed. Use of compression shall be lossless and uniform across a given data layer.
* GIS data (ESRI grids, shapefiles) shall have complete and correct associated projection, metadata, and sidecar files.
* All files must be readable and free of malicious code.

### **10.4. GPS Procedures**

#### 10.4.1. GPS Measurements

All GPS measurements shall be made with dual frequency Global Navigation Satellite System (GNSS) receivers with GLONASS. All GPS measurements shall be made during periods with PDOP ≤ 3.0 and with at least six satellites in common view of both a stationary reference receiver and the roving receiver.

#### 10.4.2. Stationary Reference Receivers

Stationary reference receivers shall be located at existing NGS marks or at new marks. In the case of an existing mark, its location shall be verified by processing one GPS session of at least two hours duration and comparing the computed position with the position published by NGS. Each new mark shall be located by tying to one or more NGS Continuously Operating Reference Stations (CORS) by static GPS methods. If the distance to the nearest CORS is less than 80 km, use at least two independent GPS sessions, each at least two hours long. If the distance to the nearest CORS is greater than 80 km, use at least two sessions each at least four hours long.

#### 10.4.3. GPS Reference Receivers

At least two GPS reference receivers shall be in operation during all lidar missions, sampling positions at ≥1 Hz. The roving GPS receiver in the aircraft shall sample positions at ≥ 2 Hz. Differential GPS baseline lengths shall be no longer than 30 km. Check Points, Ground Control Points (GCPs), or ground survey points used for both survey calibration and assessment of absolute vertical accuracy, shall be established using GPS and (or) other techniques that are expected to result in accuracies of 1.5 cm (RMSEz) or better. Strongly clustered GCPs are useful, perhaps even desirable, for calibration. Vertical accuracy shall be assessed by calculating and averaging the distances between a subset of at least 30 GCPs that are not clustered and a surface interpolated from lidar first returns. At least 20% of flight line swaths should contain points in this subset and the maximum distance between these GCPs should be no less than one-half the maximum distance across the survey area.

#### 10.4.4.  Project History Report/Folder

Quantum Spatial, Inc. Project History Report/Folder (Section 6) shall document the identity, published position, and measured position of all existing NGS marks used for reference stations. The locations of new marks shall be described, along with their measured positions and the identity and published positions of CORS to which their locations were tied. The report shall describe the technique(s) used to establish GCPs and document the positions and residuals of all GCPs used to evaluate survey accuracy.

### **10.5. Ground Control**

Two types of vertical accuracy GCP (or ground surveyed points) will be collected by Quantum Spatial, Inc. for this project:  Control Points and Check Points. Refer to NSSDA guidelines, Lidar Base Specifications Version 1.2 (USGS, 2014) “Collection” section, and ASPRS Guidelines, Vertical Accuracy Reporting for Lidar Data (ASPRS, 2004) “2.3 Selecting and Collecting Check Points” section for Check Point placement in land cover classes and guidelines on Check Points.

* The above two types of ground control will be clearly labeled and delivered as separate shapefiles to the State.

### **10.6. Supplemental Ground Control**

Differentially corrected or real time GPS network (RTK) GPS ground control used to supplement the airborne GPS positional adjustment shall be stored on portable media, in a non-proprietary format mutually agreeable to AGRC and Quantum Spatial, Inc.. Ground control is the responsibility of Quantum Spatial, Inc..

#### 10.6.1. Utah Reference Network

AGRC maintains The Utah Reference Network (<http://gis.utah.gov/#gps>) of over 90 GPS VRS RTK stations and will facilitate use of this network upon request of Quantum Spatial, Inc..

# 11. Data Release, Data Use and Distribution Rights

## 11.1. Data Release

Qunatum Spatial, Inc. will not release data produced in each project plan, to any other party or entity without approval by AGRC, prior to the processing, loading, incorporation, and AGRC’s final acceptance of data products.

## 11.2. Data Use and Distribution Rights

After final acceptance has been made, all deliverable data and documentation will be free from restrictions regarding use and distribution (the State of Utah and partners require unrestricted rights to all delivered data and reports that are placed in the public domain). Data and documentation provided under this project plan shall be in the public domain and freely distributable by Federal, State, and local government agencies.

# 12. Contact List

|  |  |  |  |
| --- | --- | --- | --- |
| **Agency** | **Contact Person** | **Phone Number** | **Email** |

ADMINISTRATIVE

|  |  |  |  |
| --- | --- | --- | --- |
| Utah AGRC | Bert Granberg  *Director* | 801-538-3163 | bgranberg@utah.gov |

TECHNICAL

|  |  |  |  |
| --- | --- | --- | --- |
| Utah AGRC | Rick Kelson  *Project Manager* | 801-538-3237 | rkelson@utah.gov |

# 13. Project Communication

## 13.1. Production Status Reports

Quantum Spatial, Inc. shall provide weekly status reports for all work on projects to AGRC’s Project Manager. Reports will include detailed information regarding the work accomplished for each production phase. An online website may be used to provide status information.

## 13.2. Acquisition Reports

Quantum Spatial, Inc. shall provide regular progress updates to AGRC’s Project Manager throughout the data acquisition process.

* Update frequency shall be based upon the collection period, but no less than once a week.
* Reports shall include shapefiles representing the geographic extent of the acquired data.
* Updates shall commence at acquisition onset and shall continue until acquisition is complete.

## 13.3. Initial Project Meeting

An initial project meeting between AGRC and Quantum Spatial, Inc. will be scheduled after each project request. This meeting will ensure that both AGRC and Quantum Spatial, Inc. 1) understand the requirements necessary to produce the deliverables, 2) review source data, and 3) make any final adjustments to technical guidance.

## 13.4. Teleconference

Quantum Spatial, Inc. will teleconference regularly (weekly or as needed) with the State to discuss status, production, and technical issues during a project.

# 14. Delivery Date and Timely Completion

## 14.1. Delivery Date

AGRC and Quantum Spatial, Inc. will agree in writing to a delivery schedule for Lidar products. Deliver for all final Lidar products, including any redeliveries because of quality assurance rejection, is no later than May 31, 2017. Quantum Spatial, Inc. shall not exceed this date without agreement to a new date from AGRC. Any request for modifications of the final delivery date must be received 30 days prior to the expiration of the original date. Request will only be considered for reasons outside Quantum Spatial, Inc, control, such as unforeseen weather changes.

## 14.2. Timely Completion

The payment schedule shall include penalties for late delivery of products. The payment schedule will be based on 40% of the total project cost after completion of the lidar acquisition flights. After the completion of processing and corrections based on the quality assurance review by AGRC, and delivery of the final product(s) to AGRC, payment will be made as follows. If delivered on time as specified in the contract, another 30% of the total project cost will be paid. There will be a 30% holdback that will be paid after that final delivery of all data and required reports and metadata deliveries are confirmed by AGRC. If the final product(s) is not delivered on the schedule specified, there will be a 3% (of the total bid) penalty for each week the product delivery is delayed.

**15. List of Cited Specifications and Standards**

Specifications for the acquisition of Lidar and deliverables not explicitly outlined above must adhere to the required specifications in the following documents:

|  |  |  |  |
| --- | --- | --- | --- |
| **Proponent Agency/ Organization** | **Name** | **Published Date** | **Website** |
| American Society for Photogrammetry and Remote Sensing (ASPRS) | LAS Specification Version 1.4 | July 2011 | <http://www.asprs.org/a/society/committees/standards/LAS_1_4_r13.pdf> |
| U.S. Geological Survey, National Geospatial Program (USGS NGP) | Lidar Base Specifications Version 1.2 | 2014 | <http://pubs.usgs.gov/tm/11b4/> |
| Federal Geographic Data Committee (FGDC) | National Spatial Data Infrastructure (NSDI) Geospatial Positioning Accuracy Standards, Part 3: National Standard for Spatial Data Accuracy | 1998 | [http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/ part3/chapter3](http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/) |
| National Digital Elevation Program (NDEP) | NDEP Guidelines for Digital Elevation Data | May 2004 | <http://www.ndep.gov/NDEP_Elevation_Guidelines_Ver1_10May2004.pdf> |
| FGDC | NSDI Content Standard for Digital Geospatial Metadata | 1998 | [http://www.fgdc.gov/standards/projects/FGDC-standards-projects/metadata/ base-metadata/v2\_0698.pdf](http://www.fgdc.gov/standards/projects/FGDC-standards-projects/metadata/) |
| Federal Emergency Management Agency (FEMA) | Guidance for Flood Risk Analysis and Mapping: Elevation Guidance | Nov. 2015 | <http://www.fema.gov/media-library-data/1449865619080-7895ba81cd9b94c6d9ac125bb1958e0c/Elevation_Guidance_Nov_2015.pdf> |
| FGDC | United States National Grid | December 2001 | http://www.fgdc.gov/standards/projects/FGDC-standards-projects/usng/fgdc\_std\_011\_2001\_usng.pdf |

**16. Pricing**

**16.1. Washington County**

Pricing is based on the cost of **$135,405 for the 1,271 km2 project area**, submitted in the Utah Lidar Proposal 2016 Price Matrix in the bid response to solicitation #WS16020-Stage 2 (see attached).

**16.2. Great Salt Lake**

Pricing is based on the cost of $364,828 for the 3,538 km2 project area, submitted in the Utah Lidar Proposal 2016 Price Matrix in the bid response to solicitation #WS16020-Stage 2 (see attached). With the adjustments to the project area the final cost is **$393,856.44 for the 3,784.3 km2 project area.**

**16.3. Bear Lake and Cache Valley**

Pricing is based on the cost of $276,593 for the 1,920 km2 project area, submitted in the Utah Lidar Proposal 2016 Price Matrix in the bid response to solicitation #WS16020-Stage 2 (see attached). With the adjustments to the project area the final cost is **$280,980.88 for the 1,950 km2 project area.**

**16.4. Hydroflattening and Hole Filling**

Pricing is based on the cost of **$13,094**, submitted in the Utah Lidar Proposal 2016 Price Matrixrevised 8-9-16 (see attached).

**17. Contract Payments**

1. For purchases and service pursuant to this contract, invoices shall be sent electronically to Bert Granberg at the Utah Department of Technology Services:

bgranberg@utah.gov

1. Invoices approved for payment shall be sent electronically to:

[dtsreceiving@utah.gov](mailto:dtsreceiving@utah.gov)

Payments will be processed in accordance with the State of Utah Cooperative Contract Standard Terms and Conditions for Services, as included in Master Agreement # AV2408.

IN WITNESS WHEREOF, the parties sign Scope of Work on Master Agreement # AV2408

**CONTRACTOR**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Contractor’s Signature

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Type or Print Name and Title

**AGRC**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Agency’s Signature

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