Amendment 7
to
Agency Specific Price Agreement 7525

1. This is Amendment 7 (this “Amendment”) entered into between the State of Oregon acting by and through its Department of Administrative Services (“DAS”), Procurement Services on behalf of the Oregon Department of Geology and Mineral Industries (“DOGAMI”) and Quantum Spatial, Inc., a Wisconsin corporation registered in Oregon (formerly known as Watershed Sciences, Inc.) (“Contractor”). This Amendment amends the Agency-Specific Price Agreement between DAS and Contractor dated March 19, 2008 (as amended, the “Agreement”). (The Agreement number changed from 8865 to 7525 when Quantum Spatial, Inc. became the Contractor.) This Amendment is effective on the date it has been signed by the parties and approved in accordance with applicable law.

2. Prior amendments. The parties previously amended the Agreement six times, and it has been assigned to another vendor.

* Amendment 1 extended the termination date from March 18, 2010 until March 18, 2011.
* Amendment 2 extended the termination date from March 18, 2011 until March 18, 2012.
* Amendment 3 extended the termination date from March 18, 2012 until March 18, 2013.
* Amendment 4 extended the termination date to June 30, 2014, and added services.
* Amendment 5 extended the termination date to June 30, 2017, and replaced two exhibits.
* Amendment 6 made changes to the technical specifications.
* Assignment and Assumption Agreement substituted Quantum Spatial, Inc. for Watershed Sciences, Inc.

3. Purposes of Amendment 7. The purposes of this Amendment are (1) extend the term of the Agreement, (2) entirely replace Exhibit A, including updating the pricing in Table 1 of Section 2.6, and (3) remove references to a repealed DAS rule.

4. The Agreement is hereby amended as follows:

4.1 The term of the Agreement is extended until June 30, 2020.

4.2 Exhibit A to the Agreement (“Description and Specification of the Services”) is entirely deleted and replaced with Exhibit A to this Amendment.

4.3 Exhibit B to the Agreement (“Purchase Order, Invoicing, and payment Terms”) is entirely deleted. [Portions of] Exhibit B have been incorporated into Exhibit A.

4.4 In 2012, DAS repealed its “anticipated amendment” rule (formerly OAR 125-246-0560). To conform to the repeal of that rule, Agreement Sections 24(i) and (ii) concerning anticipated and unanticipated amendments are hereby entirely deleted, and replaced by “Reserved.”
5. As modified by this Amendment, the Agreement (including without limitation the insurance terms in Exhibit C) remains in full force. Contractor certifies that the representations, warranties and certifications in the Agreement are true and correct as of the effective date of this Amendment.

6. Contractor certification. By signature on this Amendment for Contractor, the undersigned hereby certifies under penalty of perjury that he or she is authorized to act on behalf of Contractor and that Contractor is, to the best of the undersigned’s knowledge, not in violation of any Oregon Tax Laws. For purposes of this certification, “Oregon Tax Laws” means a state tax imposed by ORS 320.005 to 320.150 (Amusement Device Taxes), 403.200 to 403.250 (Tax For Emergency Communications), 118 (Inheritance Tax), 314 (Income Tax), 316 (Personal Income Tax), 317 (Corporation Excise Tax), 318 (Corporation Income Tax), 321 (Timber and Forest Land Taxation) and 323 (Cigarettes And Tobacco Products) and the elderly rental assistance program under ORS 310.630 to 310.706 and any local taxes administered by the Department of Revenue under ORS 305.620.

Contractor: Quantum Spatial, Inc., a Wisconsin corporation registered in Oregon

By: ________________________________

Signature: __________________________

Print name: Robert Vander Meer

Title: Vice President

Date: April 21, 2017

DOGAMI: Oregon Department of Geology and Mineral Industries

By: ________________________________

Name: __________________________

Title: CFO

Date: 04/24/17

DAS: Oregon Department of Administrative Services, State Procurement Office

Approved by: ________________________________

Name: __________________________

Title: __________________________

Date: 4/24/17

Approved for legal sufficiency under ORS 291.047 and OAR 137-045-0015 by Oregon Department of Justice Assistant Attorney General by email dated 4-12-2017.

632020-GF0297-17

Amendment 7 to Lidar Agreement 7525
Page 2 of 25
Exhibit A

to

Amendment 7

Description and Specification of the Services


1.1 Lidar Data

Contractor shall provide the lidar ("light radar," or airborne laser swath mapping) data services (the "Services") that meet or exceed the specifications in this Exhibit A. The Services will be provided for lidar data collection projects, which may be ordered by written or electronic Purchase Orders (POs) issued by DOGAMI.

1.2 Defined terms used but not defined in this exhibit have the meaning provided in the Agreement.

2. Services to be provided. Contractor’s obligation to perform the Services includes providing all facilities, components, personnel, and equipment required to provide the Services, including without limitation aircraft services.

2.1 Technical specifications.

2.1(a) Lidar instrument.

Contractor’s instruments used for the Services must:

(1) Produce an on-ground laser spot diameter no less than 15 centimeters (cm) and no greater than 40 cm measured at 1/e. 1/e is defined as the diameter at which the beam irradiance (intensity) has fallen to 36.5 percent of its peak value.

(2) Record a minimum of 4 returns per laser pulse, including first and last returns.

(3) Record intensity with 16 bits as specified in the Purchase Order. If the laser power is adjustable, laser power must be recorded by Contractor. And,

(4) Have a laser scan angle that does not exceed 30 degrees overall (+15 to -15 degrees).

2.1(b) Lidar Data Collection Project design.

Each project area must be a contiguous area no smaller than 40 square miles and may range to in excess of 2,000 square miles. Contractor must ensure that project areas of interest (AOIs) are compact, without serrate margins, large internal gaps, and narrow extensions. AOI’s must be at least 1.25 miles wide at their narrowest point and must not have a perimeter to area ratio greater than 2 miles per square mile. In order to maximize efficiency, survey outlines shall be finalized by DOGAMI after consultation with Contractor. The AOI must include all land area within a survey and the area of all water bodies with minimum dimension less than one-half mile. Larger water bodies, except for a 300-foot-wide seaward buffer along a shoreline, must be excluded from the calculation of the survey area, unless otherwise specified in a Purchase Order.
Contractor shall plan surveys with a minimum of 50 percent sidclap of adjacent swaths. Surveys must be designed for 100% double coverage at planned aircraft height above the ground. The aggregate design multi-swath pulse density must be 8.0 pulses per square meter or higher for the area of each swath with a scan angle between 2 and 12 degrees left or right from nadir.

2.1(c) Lidar data collection execution.

Contractor shall fully describe, in a report to DOGAMI, all steps taken to calibrate each aircraft's onboard inertial measurement unit (IMU) and sensor offsets and settings.

Lidar data collection shall be conducted in snow-free conditions, and in some cases, leaf-off and low stream flow conditions will be specified in the PO. Contractor must consult with DOGAMI if potentially adverse collection conditions such as snow, high water, or smoke exist, and may proceed only with written approval.

If data acquisition during specific tide levels, stream or reservoir levels, or dates is required, DOGAMI and Contractor may negotiate a price supplement to compensate Contractor for the additional cost arising from the specific requirements. If specific acquisition conditions are needed, Contractor will provide a written description to DOGAMI of the additional cost required to meet the conditions, and shall explain the basis for the added cost. If DOGAMI wishes to proceed, the costs will be included in the PO, and the written cost description will be attached to the PO.

2.1(d) GPS Procedures.

In the report of survey, Contractor shall fully describe Global Positioning System (GPS) procedures (including GPS instrument specifications) it uses to establish the following:

1. The spatial reference (coordinate) framework and vertical datum that will be used for the purposes of lidar data collection and survey reduction; and,
2. The collection and processing of ground control points (GCPs) for the purposes of undertaking lidar data quality control (QC) used by Contractor.

Contractor shall make all GPS measurements with dual frequency L1-L2 receivers with carrier-phase correction. All GPS measurements must be made during periods with Positional Dilution of Precision (PDOP) less than or equal to 3.0 and with at least 6 satellites in common view of both a stationary reference receiver and the roving receiver.

The horizontal datum for each survey shall be North American Datum (NAD) 83 (2011) (Epoch 2010.00) or the most current horizontal datum at the beginning of the survey, in accordance with published coordinates from the National Oceanic and Atmospheric Administration/National Geodetic Survey (NOASS/NGS) Online Positioning User Service (OPUS). The vertical datum shall be North American Vertical Datum (NAVD) 88 (Geoid 12B) or the most current Geoid.
model at the beginning of the survey, in accordance with the approved and released geoid model by the National Geodetic Survey (NGS).

Contractor's stationary reference receivers must be located at existing NGS marks or at new marks. In the case of an existing mark, its location must 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 must 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 kilometers (km), Contractor must use at least two independent GPS sessions, each at least 2 hours long. If the distance to the nearest CORS is greater than 80 km, Contractor must use at least 2 sessions each at least 4 hours long.

At least two GPS reference receivers must be in operation during all lidar data collection, sampling positions at greater than or equal to 1 hertz (Hz). The roving GPS receiver in the aircraft must sample positions at greater than or equal to 2.0 Hz. Differential GPS baseline lengths shall be no longer than 30 km.

GCPs, used for both survey calibration and assessment of absolute vertical accuracy, must be established using GPS or other techniques that result in vertical and horizontal accuracies of 1.5 cm root-mean-square-error (RMSE) or better. Dependent upon terrain and accessibility GCPs must be strongly clustered, and GCP clusters must be uniformly distributed throughout the AOI. Vertical accuracy must be assessed by Contractor by calculating and averaging the distances between GCPs that are not clustered and a surface interpolated from lidar first returns. A minimum of 50 points for every 15.6 square miles of project area, shall be used for the accuracy assessment, with a minimum of 200 for smaller projects. At least 20 % of flight line swaths must contain points in this subset and the maximum distance between these GCPs must be no less than one-half the maximum distance across the AOI.

In the report of survey, Contractor must document the identity, published position, and measured position of all existing NGS marks used for reference stations. The locations of new marks must be described, along with their measured positions and the identity and published positions of CORS to which their locations were tied. The report of survey must describe the technique(s) used to establish GCPs and document the positions and residuals of all GCPs used to evaluate survey accuracy.

2.2 Project Deliverables. All data delivered to DOGAMI under this Agreement shall be in the public domain. Contractor may resell the LIDAR data provided under this Agreement only with advanced written consent by DOGAMI, and only after the data has been made available to the public.

2.2(a) Spatial Reference Framework.

Contractor shall deliver all data to DOGAMI in the Oregon Coordinate Reference System Standard, Oregon Lambert (NAD 83), international feet. Specific details on the Oregon Lambert projection are available at the following web link:


Amendment 7 to Lidar Agreement 8865
Page 5 of 25
DOGAMI may specify the use of Universal Transverse Mercator (UTM) NAD83 (2011), epoch 2011, or the most current horizontal datum. Other projections and horizontal datums may also be requested. The spatial reference framework specification will be included in a purchase order.

The vertical datum must be NAVD88 (Z units must be identical to XY units (i.e.: international feet or meters), and the Geoid must be the most current.

Contractor shall deliver data in tiles that are rectangular in geographic coordinates, corresponding to standard USGS 7.5-minute quadrangles and divisions thereof, and are named according to the following schemes:

- qAAOOORC (quadrangle, 7.5 minute by 7.5 minute region)
- qAAOOORCQ (quarter-quadrangle, 3.75 minute by 3.75 minute region)
- qAAOOORCQNN (1/100th quadrangle, 0.75 minute by 0.75 minute region)

where AA is the integer north latitude of the SE corner of the 1° by 1° region that contains the quadrangle, OOO is the integer west longitude of the SE corner of the 1° by 1° region, R is the row, labeled from a to h, south to north, and C is the column, labeled from 1 to 8, east to west. That is, in Diagram A below, for the 1° by 1° region with a southeast corner at 45N, longitude 118W, the highlighted quadrangle is q45118d2.

Q is the quadrangle quadrant, which is numbered west-to-east, north-to-south, as is shown in Diagram B below. That is, the highlighted quarter-quadrangle tile in diagram B is q45118d22.

QNN identifies the 1/100th quadrangle, which is labeled by numbering the 25 divisions of each quarter-quadrangle west-to-east, north-to-south, as shown in Diagram C below. That is, the highlighted tile in Diagram C is q45118d2209.

Diagrams A, B, and C
Contractor shall provide to DOGAMI a report of survey, aircraft trajectories, LAS 1.2 or 2.0 format all-return point files, ground (bare-earth) digital elevation model (DEM), full-feature (highest-hit) DEM, intensity image, and formal metadata.

2.2(b) **Survey Report.** Contractor’s survey report must be a digital text report that describes lidar data collection methods and results. At a minimum, it must include:

- Project overview, including project name, location map, table - including date ordered, acquisition window, delivery date, project AOI, project Total Area Flown (TAF), specified units coordinate system and datum, list of options requested.
- Description of lidar acquisition, including map of flight lines indicating dates of collection, table of acquisition parameters including information about the aircraft, sensor, acquisition settings, flight elevation.
- Report of ground survey, including reference map and table showing monuments used, and a detailed description of GPS procedures used in establishing the reference network and control points for the project. A map showing the locations of all GCPs collected shall be included and location data for all control points shall be included in spreadsheet format as a digital appendix to the report.
- Calibration report for the system(s) used in the data acquisition.
- Specific information indicating what projection, datum, epoch of adjustment, and geoid was used for the survey.
- Contractor’s assessment of accuracy, including relative (swath to swath) accuracy, absolute (with respect to GCPs) accuracy, presented both as summary statistics and in histogram form. Vertical accuracy shall be reported to meet the guidelines of the National Standard for Spatial Data Accuracy (Federal Geographic Data Committee (FGDC), 1998) and ASPRS Guidelines for Vertical Accuracy Reporting for Lidar Data V1.0 (American Society for Photogrammetry and Remote Sensing (ASPRS), 2004).
• Contractor’s assessment of pulse density over the project area, including maps showing
design pulse density by quarter-quadrangle tile and histogram of density parameters and
statistics for percentage of populated cells (as described in Section 2.4 (i)).

• Summary table of deliverables, listing file formats and total number and data volume of
each deliverable, and a standardized description of the data tiling scheme.

2.2(c) Aircraft trajectory data. Recorded aircraft trajectory data (Smoothed
Best Estimate of Trajectory (SBET) files) must be American Standard Code for Information
Interchange (ASCII) point files and Esri® shape files, with aircraft position (easting, northing,
elevation), attitude (heading, pitch, roll) and GPS time recorded at regular intervals of 1 second
or less. The data files may include additional attributes, such as temperature and humidity. Lidar
flightlines shall also be provided in Esri® shapefile format, attributed with project name, Point
Source ID # that is associated with LAS point header information, and date of acquisition of each
flightline.

2.2(d) All-return point cloud. The point cloud must be delivered as laser data
(LAS) 1.2 or most commonly distributed LAS format files, as specified in a Purchase Order,
listing all valid returns, with all fields populated LAS attributes must include, at a minimum,
class number, class name, line number, Adjusted GPS time, echo label (only, last, etc.), easting,
northing, elevation, intensity, scan angle, echo number, and system gain or scanner. Red, Green,
Blue (RGB) values must be attributed with co-acquired orthoimagery or latest NAIP imagery
when applicable. No duplicate entries are permitted. Time must be reported to the nearest
microsecond or better. Easting, northing, and elevation must be reported to nearest 0.01 meter
(near 0.01 feet). Classification of ground returns must be as complete as is feasible and
without avoidable return misclassification. Point-Cloud LAS data must be delivered in 1/100th
USGS 7.5-minute quadrangle (0.75 minute by 0.75 minute) tiles or as specified in a Purchase
Order.

2.2(e) Bare-earth surface model: Raster of ground surface, interpolated via
triangulated irregular network from identified ground points. Grids must conform to the
following specifications:

Esri®  32 bit pixel depth floating point grid, 3 foot (1 meter if UTM projection
specified) cell size, snapped to (0,0), full USGS 7.5-minute quadrangle (7.5
minute by 7.5 minute) tiles, unless otherwise specified in a Purchase Order.

The triangulated irregular networks from which ground surface raster models are interpolated
may not include breaklines derived from other data sources. Surface models must not have tiling
artifacts or gaps at tile boundaries, or artifacts such as pits, birds, striping or aliasing.

2.2(f) Full-feature DEM: Raster of first-return surface, cell heights are highest
first return within that cell, cells without first returns shall be coded as NoData. Must conform to
the same file and grid formats as Bare-earth DEM; full USGS 7.5-minute quadrangle (7.5 minute
by 7.5 minute) tiles.
2.2(g) **Intensity image:** Raster of 1st-return intensity. Intensity shall have been normalized if the sensor or combination of sensors used on the project allow. Grids must conform to the following specifications:

Georeferenced 16-bit pixel depth grayscale GEOTIFF, 1.5 ft pixel size, Full USGS 7.5-minute quadrangle (7.5 minute by 7.5 minute) tiles.

2.2(h) **Formal metadata:** GIS-compatible data and files must be accompanied by extensible markup language (XML) format metadata that adheres to DOGAMI’s lidar metadata content standard for digital geospatial data. DOGAMI has provided Contractor a standardized metadata document for 3DEP compliant and non 3DEP compliant data that include instructions for completing all required metadata fields. Contractor shall reformat and re-deliver any data that: fails to meet format specification; files with inconsistent or unreadable internal formats; or consists of GIS data with incomplete or incorrect associated projection files.

### 2.3 Delivery Schedule

Contractor shall provide digital data to DOGAMI on new portable hard drives at Contractor’s expense. Contractor shall make final delivery no later than 110 business days from end of data acquisition. DOGAMI will include a target data acquisition time period in the PO for each project, with the understanding that there may be delays due to weather. Contractor should attempt in good faith to deliver lidar data sequentially as it becomes available rather than all at one time. DOGAMI will review and accept or reject lidar data within 30 business days of delivery.

Following a thorough quality control review by DOGAMI, data will be accepted or rejected based on specifications in this Exhibit A. Contractor shall reprocess or re-fly problem areas without additional cost to DOGAMI if it is determined that the lidar data does not meet these specifications.

### 2.4 Data Quality

Survey data must meet or exceed the requirements described in this Exhibit A for all data, including without limitation within-swath reproducibility, swath-to-swath reproducibility, fundamental vertical accuracy of lidar points, absolute accuracy of bare earth DEMs, completeness, and DEM surface quality. DOGAMI may reject data if the data does not meet specifications. DOGAMI may, in its discretion, either require Contractor to rework rejected data (including re-acquisition if necessary), or refuse payment. At DOGAMI’s discretion, it may agree to partial payment for partially satisfactory data. Contractor shall not charge, and DOGAMI will not pay, any additional costs for any re-acquisition arising because the data does not meet these specifications.

(a) **Within-swath reproducibility.**

Within-swath reproducibility is defined as “longitudinal and along-track planarity of elevations for a single swath across a uniform, flat surface, and is a measure of sensor and inertial motion unit system calibration and stability.” Contractor shall provide a description of system calibration during sensor installation as well as resulting average range bias, and RMSE of vertical departure from planarity for finalized calibration as part of the report of survey. Average departure from planarity within any 10 meters by 10 meters area shall be no greater than 5 cm.
Contractor’s reports must show system reproducibility within the specified range.

(b) **Swath-to-swath reproducibility.** Absent changes in surface elevation between successive measurements, the standard deviation (1 sigma) of vertical error as determined by Contractor using the internal reproducibility of a survey must not exceed 10 cm. Contractor shall establish this value by averaging of reproducibility determined from suitable (high resolution) near-planar ground classified areas across an entire AOI. Vertical errors may be greater on sloping surfaces, owing to physical horizontal uncertainty in the laser footprint, generating apparent vertical errors. In addition, no arbitrary 1 km by 1 km area may have estimated slope-normalized vertical RMSE less than or equal to 20 cm.

(c) **Fundamental Vertical Accuracy of Lidar Point Data.** Contractor shall calculate fundamental vertical accuracy of lidar point data by comparing GCPs on flat surfaces in areas where ground classified point resolution is both high, and the ground surface is open, smooth and without vegetation, to a local triangulated irregular network (TIN) surface of ground classified points. The fundamental vertical accuracy must not exceed 9.25 cm RMSE.

(d) **Absolute Accuracy of Bare-Earth DEMs.** Bare-earth DEMs, as tested by Contractor against independent GCPs, on flat surfaces, in areas where ground control resolution is both high, and likely to truly characterize the ground surface, must have a vertical RMSE no greater than 9.25 cm. If the absolute accuracy fails to meet the specification, Contractor and DOGAMI will investigate all statistics and distribution of ground control points to assess the nature and causes of outliers influencing the overall accuracy of the data.

(e) **Completeness of data.**

1. Coverage: No voids between swaths.
2. Coverage: No voids because of cloud cover or instrument failure.
3. Swath Overlap: Less than or equal to 10% no-overlap area per project area.
4. Swath Overlap: No randomly selected 500 meter by 500 meter area with less than 50% double coverage.

(f) **Aggregate first return density:** Barring non-scattering areas (e.g. open water, wet asphalt) aggregate first return pulse density must meet the following requirements:

1. For every project area at least 90 % of cells with dimensions twice the area of nominal point spacing (for 8 ppsqm this equals 0.70 meter cells) shall contain at least 1 lidar point. Density is calculated by using first return points within the geometrically usable center part (typically 95%) of each individual swath. Pulses per square meter is shown as “ppsqm.”

2. If a LAS delivery tile does not meet requirement #1, the delivery tile’s aggregate first return density must be greater than or equal to 95% design pulse density (8 ppsqm design is 7.6). This is calculated using all first return LAS points from multiple swaths.
3. If an area of the project does not meet both requirements, the data will be returned to Contractor for re-examination, correction, and possibly re-acquisition.

(g) DEM and DSM Surface quality. There must be no tile-boundary artifacts, no voids between DEM tiles, and no avoidable misclassification of returns. DEMs must be free of other artifacts such as pits and spikes caused by anomalous high or low points and striping due to inadequate flight line calibration.

2.5 Optional Services. The following additional lidar-related services, or specification changes may be requested by DOGAMI in a Purchase Order. Prices for these additional services are specified in Table 1 in Section 2.6.

(a) Addition of 4-band ortho imagery and infusion of imagery-derived RGBI values into point cloud. If this option is requested, Contractor shall collect four-band (color infrared, i.e. red-green-blue-near infrared) orthophotographic imagery utilizing a specialized camera designed for aerial surveys, as near in time to the collection of the lidar data as feasible, and shall use that imagery as a source of color values with which to populate the RGB (red-green-blue) attributes of the lidar point cloud.

In addition, Contractor will populate the "user defined" (or most currently appropriate) field in the LAS file with the infrared values from the orthoimage. The photo acquisition must occur when the sun is at least 30 degrees above the horizon, and under clear conditions with no cloud cover and less than 10% cloud shadow. Orthoimagery flights will be planned with appropriate overlap to reduce parallax of buildings and trees, especially in areas of high relief. Flight plans must be provided to DOGAMI upon request at any time to verify proper planning.

Contractor must use an orthophotographic workflow which incorporates camera specific external and interior orientation parameters and creates and applies aero triangulation solutions to aerial imagery. All orthophotography created by Contractor must be orthorectified using lidar derived elevation models collected to specifications in this Exhibit A. Seam line artifacts between mosaiced orthorectified images must be adjusted to remove gross offsets between vertical features (i.e. bridges, buildings, etc.). Seam lines must be offset in areas of forests. Individual orthorectified images must be mosaiced using the one-hundredth-quadrangle tiling and naming scheme specified in sections 2.2 and 2.3 of this Exhibit A, except that the tile units shall be one-half of each, divided into a north half and south half, and with the suffix "S" or "N" applied to the tile name to indicate which half tile is which.

Images must be calibrated by Contractor to specific geometric, gain and exposure settings associated with each captured image. The corrected images must be saved in 16-bit Geotiffs format for input into subsequent processes. Photo position and orientation must be calculated by linking the time of image capture, the corresponding aircraft position and attitude, and the smoothed best estimate of trajectory (SBET) data. Automated aerial triangulation must be performed to tie images together and adjust block to align with ground control. Adjusted images must then be draped upon a ground model and orthorectified. Individual orthorectified tiff files
must be blended together to remove seams and corrected for any remaining radiometric differences between images. Horizontal accuracy statistics must be calculated.

Orthoimagery must be registered by Contractor with the accompanying lidar imagery. The location of static features visible in both the orthoimagery and the corresponding lidar intensity imagery must match to within one pixel dimension of the intensity image. Orthoimagery coverage within the project boundary must provide 100% coverage. There must be no obvious tile boundary artifacts between orthoimagery tiles.

Orthoimagery will be collected and processed so that the delivered product has a either pixel size of 3 inches or less (7.6 cm or less), or 6 inches or less (15.2 cm or less), with the pixel size specified in a Purchase Order (under the pricing in Section 2.6). For both image resolutions, the horizontal accuracy of the imagery will be RMSE XY less than or equal to 1-foot, and less than or equal to 2-foot at the 95% confidence level. In order to ensure the horizontal accuracy of the imagery, aerial targets must be installed by Contractor or identified (if permanent) by Contractor before the flight at a distribution of two per GPS monument within a 2 nautical mile (nm) radius. Contractor’s field crew must collect ground check points using GPS procedures described in Exhibit A Section 2.1(d)2, except that baselines may be placed 37 km apart when utilizing a camera with a built-in navigation system using high-grade internal navigation software. For each aerial target, Contractor must collect one to five points per target, one for permanent Target Check Points (TCPs) and 5 for temporary TCPs. The expected accuracy of the TCPs is $\text{RMSE}_{\text{XYZ}}$ less than or equal to 1.5 cm (deviation from monument coordinates).

In situations where the area of interest has been covered by lidar collected under this Agreement within the preceding two years, the orthoimagery may be collected without new lidar. Pricing for this option is provided in the price table in Section 2.6.

For projects which include this option, the report of survey shall include a section describing the photo acquisition parameters, equipment, primary processing steps and software, and accuracy statistics. The coordinates of the aerial targets must be included in a table or as a digital appendix.

2.5(b) **Collection of higher resolution data:** Under this option, the design pulse density of the project must be greater than or equal to 15 pulses per square meter.

2.5(c) **Addition of Hydro-flattened DEM.**

DOGAMI may choose to have additional bare-earth DEMs created in which water bodies have been modified by Contractor. All standard bare-earth DEM specifications apply except that in addition Contractor will apply hydro-flattening to all water impoundments, natural or man-made, that are larger than 2 acres in area, to all streams that are nominally wider than 100 feet, and to all non-tidal boundary waters bordering the project area regardless of size. All bare-earth DEMs will be hydro-flattened as described in “Lidar Base Specification Version 1.2” (U.S. Geological Survey (USGS), 2012).
For water bodies whose surfaces are horizontal, lidar points must be sampled to arrive at an elevation threshold defining the water surface at the time of acquisition. Contractor must use this threshold to classify points in the localized area. Generalized three-dimensional polylines must be created to encompass all areas considered to be water and are assigned the water surface elevation value determined previously. All “islands” greater than 1 acre shall be retained in the DEM.

Centerlines must be digitized for all water surfaces that are not horizontal. A minimum of one point for every 10 meters along the stream and channel centerlines must be sampled to give them three-dimensional z values. A smoothing algorithm must then be applied to ensure the centerlines consistently run downstream. Lidar points must be classified as “water” using the z threshold values of the appropriate centerlines. A bounding polygon must be created around the water points with discontinuities (e.g., bridges, overhanging vegetation, etc.), defined as having an elevation above the earth, removed. Z-values must be applied to the bounding polygon based on the elevation values of the associated centerlines.

The bare-earth DEMs must be created by triangulating all “ground” classified points and inserting 3-D breaklines. Any ground points within the nominal pulse spacing of the breaklines must be reclassified to “ignored-ground” before triangulation.

The highest-hit DEMs must be generated from “ground” and “default” classified points. In instances where “water” classified points is the highest elevation value, the water surface elevation from the bare-earth raster must be used.

Delivery of the breaklines used in hydro-flattening must also be provided, projected in the same coordinate reference system and units as the DEM, and saved in Esri® feature class format with appropriate metadata.

2.5(d) Addition of hydro-enforced bare earth DEM.

DOGAMI may choose to have additional hydro-enforced bare-earth DEMs created in which Contractor flattens reservoirs and lakes, creates stream centerlines, and further modifies the DEM to allow for continuous downhill surface flow in such a way that it can be utilized for advanced hydrologic and hydraulic modeling. Hydro-enforcement must be performed to produce the appropriate downhill gradient of stream and river centerlines. Additional modifications to the DEM are performed to remove obstructions from the natural flow of water, enabling an accurate depiction of continuous water flow throughout the drainage basin represented in the DEM.

Common examples of artificial flow obstructions include road crossings over streams (culverts), which are represented as a solid ground surface in the bare-earth DEM. When flow is routed on the bare earth DEM, it will reach a point where a culvert exists, but is then forced to follow an angle and follow the road side. Similarly artificial pits or sinks will prevent accurate flow modeling by retaining some of the flow artificially, rather than allowing it to travel downhill.
Some water networks such as elevated canals and transverse canal systems are unable to be enforced, and therefore Contractor is not required to hydro-enforce these structures.

The final hydro-enforced DEM shall have all culverts and obstructions removed, centerlines of streams and rivers which continuously flow downhill “burned” into the DEM, spurious pits or sinks filled, and water bodies such as lakes and reservoirs leveled according to hydro-flattened DEM standards as described in Exhibit A Section 2.5(c).

Delivery of the bounding polygons of reservoirs and lakes, along with stream and river centerlines will also be provided, projected in the same coordinate reference system and units as the DEM, and delivered in Esri® file geodatabase with appropriate metadata per “Lidar Base Specifications Version 1.2” (USGS, November 2014).

2.5(e)  Corridor acquisition.

Under this option, DOGAMI may specify as the project area of interest a linear feature like a road, stream or utility corridor. These features typically produce AOIs that do not meet the requirements for compactness in section 2.1(b). Corridor lidar will meet all other specifications for standard lidar, but are subject to the option pricing in Section 2.6 by the linear mile of survey. The calculation of linear mile and final price is location dependent and requires a quote based on needs of the customer. All other options may be applied to corridor lidar.

2.5(f)  Bathymetric lidar:

Under this option, Contractor must employ a green-wavelength ($\lambda = 532$ nanometer (nm)) bathymetric lidar system to collect simultaneous elevation data for a stream or lake bed and its adjacent shorelines.

Specifications and products must be the same as for the standard lidar services with the following exceptions:

1. Because of sensor limits, data voids for stream and lake bed areas underwater are allowed where water depth and turbidity prevent the lidar pulses from reaching the bottom surface.
2. Corrections will be made for refraction.
3. Classification of lidar returns will include classification of water.
4. Vertical accuracy standards for submerged topography will be relaxed to 30 cm RMSEz.
5. Pulse density requirements for submerged topography will be reduced to 5/m².

Contractor’s deliverables include classified LAS files, Esri® feature class vector shapefiles of waterlines and submerged topography density (confidence intervals), and a surface model that includes topography and bathymetry (DTM) in the same requested projections as other deliverables.

2.5(g)  Forward looking video.
Aerial video must be gyro-stabilized by Contractor so the motion of the aircraft and vibration are not visible in the final product. Video must be high definition (at least 1920 x 1080 pixels) with a high (greater than 12 stops) dynamic range and greater than 24 frames per second capabilities. Video must be time- and geo-synched based at the time of capture utilizing on-board GPS receivers. Video must be acquired with a varied above ground altitude to allow for the entire width of the corridor to be captured within the field of view at all times. Video start and stop locations, along with preferred route will be specified at the time of PO if possible. Contractor must provide flight plans upon request to verify desired video coverage.

The video must be annotated by Contractor with the name of the project, acquisition date and time, coordinates of the area displayed on screen, and basic aircraft information. Additional annotations of utility structures, planned construction, sensitive habitat, or other relevant project information shall be determined by Contractor and requested at the time of the PO. The final deliverable shall be provided to DOGAMI in digital format (mp4, wmv, or DVD video format) upon request.

2.5(h) **Thermal Infrared Imagery.**

Under this option, Contractor will acquire thermal infrared data (TIR) as closely in time as possible to the lidar collection. The TIR data must have a native spatial resolution of 0.5-1 meter (as specified in a PO) and a thermal resolution of 0.5 degrees Centigrade. The TIR data must be orthorectified using the lidar data and delivered as Geotiffs in the same coordinate system as the lidar data. Detailed acquisition specifications for the TIR data are as follows:

Thermal infrared sensors must be scientific-grade and designed for aerial surveys. Sensors must record at a minimum rate of one frame per second. On-board real-time GPS positioning and pre-planned navigation must be utilized throughout the flight. Depending on the purpose of the thermal infrared survey, DOGAMI may order either of the following two options:

1. Thermal infrared imagery collected for the purpose of water temperature analysis of rivers and streams must be collected during peak summer temperatures, during the warmest time of the day, with weather conditions of 10% or less cloud cover and relatively low humidity (in the Pacific Northwest this is typically mid-July through early September from 1400 to 1800 hours). The survey is normally conducted in an upstream direction to ensure that headwaters with the highest temperature variability throughout the day are surveyed last, providing an accurate representation of the longitudinal temperature profile throughout the reach. The acquisition platform and corresponding speed and altitude must be tailored to the particular area with regards to valley configuration, stream or floodplain width, and sinuosity. Acquisition and processing must be performed based on the "airborne thermal remote sensing for water temperature assessment in rivers and streams" publication by Torgersen et.al. (2001).

2. Thermal infrared imagery may also be ordered for the purpose of large-scale thermal anomaly identification (such as geothermal activity or infrastructure analysis). Acquisition for these surveys must be conducted by fixed-wing aircraft only without restriction to flight pattern or direction. Depending on the anomaly of interest, night flights may be requested.
Any seasonal or timeframe restrictions may be determined by DOGAMI, and specified in a PO.

During any thermal infrared imagery survey, appropriate ground-based measurement must be taken in the form of submerged thermostats, heat blankets, and meteorological data collection. This data must be used by Contractor to verify and calibrate the thermal imagery. Thermal variance values will be converted to temperatures using standard Planck's radiation law and sensor calibration curves. Thermal imagery will then be color-coded to assist with the visual inspection and interpretation of temperature variation.

2.5(i)  **Hyperspectral imagery.**

Under this option, Contractor will acquire hyperspectral reflectance (HS) imagery as closely in time as possible to the lidar collection. The HS data must have a spectral range of about 400-2450 nm, with a native spatial resolution of 0.6 meter per pixel or better, and at least a 12 bit image depth. The HS sensor will collect at least 200 spectral channels. The HS data must be geo-referenced using the lidar data. Detailed acquisition specifications for the HS data are as follows:

1. HS imagery must be collected during the optimum flight collection window of +/- 2 hours of solar noon or a time period with solar elevation angles greater than or equal to 40 degrees, whichever is longest. During data collection, the signal will be optimized to ensure maximum attainable signal/noise ratio while minimizing data saturation of target materials. In addition, areas within the survey or targets with known spectral signatures may be used in support of data validation when determined necessary. Acquisition must be planned to reduce saturation and bidirectional reflectance.

2. Image processing must consist of sensor calibration in accordance with industry best practices. Data will be converted from radiance to reflectance using established atmospheric correction techniques and models. Measured spectra will be checked to match known atmospheric absorption features. Data will be processed in such a way that further analysis utilizing known spectral signatures can be performed.

3. Deliverables include the calibrated and georectified reflectance data-cube of all bands in ENVI® data format and user defined single band thematic type layers delivered as a raster or vector datasets. User defined bands would be determined by project goals, such as forest stress analysis, precision agriculture, and, mineral maps determined by industry standard spectral signature databases.

2.5(j)  **Full Classification of Lidar Point Cloud.**

Under this option, Contractor must fully classify all lidar returns in the point cloud. The classification categories must be the following, or as otherwise stated in a PO.

0. Created, never classified
1. Unclassified
2. Ground
3. Low vegetation
4. Medium vegetation
5. High Vegetation
6. Building
7. Low noise
8. Model Key Points
9. Water

Further classifications may be stated in a PO, including without limitation:

Pavement (not road)
Paved Road
Unpaved Road
Rail
Bridge Deck
Vineyard
Orchard
Lamp post
Other Structure
Vehicle
Fence
Wall
Substation
Guy Wire
Crossing Wire
Other Wire
Transmission Wire
Shield Wire
Underbuild Wire
Transmission Tower
Crossing Tower
Other Tower

Bathymetric features (as stated in a PO).

Full classification of the lidar point cloud must be performed after the completion of data calibration and ground model creation. Vegetation must be classified as low, medium, or high or as specified in a PO. Buildings are defined as structures larger than 10 square meters. Above-ground structures that are neither vegetation nor buildings must be classified as default points unless further classification is requested. Quality assurance must be performed by Contractor using a random sample methodology and visual inspection with the assistance of available most recent associated imagery. Classification accuracy must achieve the following standards: no points shall be delivered as class 0 (never classified), within any 1 km x 1 km area no more than 2 % of points will demonstrate erroneous classification values, points remaining in class 1 that must be classified as other specified classes will be counted towards this 2 % threshold. Point classification must be consistent throughout the dataset. Lidar classification shall follow

Amendment 7 to Lidar Agreement 8865
Page 17 of 25
2.5(k) **Supplemental Vertical Accuracy Assessment.**

DOGAMI may request supplemental vertical accuracy assessments of land cover types based on the USGS Base Specification 1.2 for geospatial accuracy standards. The USGS specifications for vertical accuracy are based on the American Society for Photogrammetry and Remote Sensing (ASPRS) Positional Accuracy Standards for Digital Geospatial Data (American Society for Photogrammetry and Remote Sensing, 2014), which characterizes lidar accuracy in terms of Non-vegetated vertical accuracy (NVA) and vegetated vertical accuracy (VVA). This system separates the overall system and measurement uncertainties observed in non-vegetated areas from the additional uncertainties introduced when trying to distinguish measurements of the bare earth from measurements of vegetation.

Contractor must collect the USGS and ASPRS total number of check points for a given project size. Under ASPRS, a minimum of 20 check points in each of the land cover categories as they exist within the project area [must be collected], for a total of 60-100 supplemental vertical check points. 100 supplemental vertical check points must be collected for the first 2,500 square kilometers of the project area. For vertical testing of areas greater than 2500 sq. km, an additional five vertical check points must be collected for each additional 500 sq. km area. Check points within each land cover category must be well-distributed across the entire project area. Typically the land cover categories are: bare-earth and low grass, high grass and crops, brush land and low trees, forest, and urban areas, but must be adjusted based on the predominate land cover classes of the study area. The resulting vegetative vertical accuracy at 95th percentile for each land class shall be targeted to be no greater than 29.4 cm as required to meet USGS Lidar Base Specification 1.2. All methodology shall be performed by Contractor to adhere to standards as described in the ASPRS Guidelines: Vertical Accuracy Reporting of Lidar Data V1.0 (ASPRS, 2004), and USGS Lidar Bas Specification version 1.2.

2.5(l) **Image Compression Rate.**

DOGAMI may choose to have compression of digital imagery products. The cost in Table 1 below indicates the additional price per square mile to be added to standard project costs to be paid by DOGAMI to the Contractor for imagery data compression.

2.5(m) **Collection of Volcanoes and Conical Peaks**

Under this option, DOGAMI will pay an additional cost per square mile [as shown in Table 1 below] to be added to the base lidar survey rate in section 2.1 to 2.4 to the Contractor for the acquisition of combined terrain characteristics of slope and relief similar to a Cascade Range composite volcano. This terrain is characterized by the conical geometry of a mountain with continuous slopes greater than 27 degrees within a nautical radius of less than five miles and relief greater than five thousand feet (5000 feet).

2.5(n) **Four Point per Square meter lidar rate**
DOGAMI may choose to purchase scaled per square mile rates for collection of lidar with density of 4 pulses per square meter. This product will meet the same resolution and accuracy requirements of Section 2.4.

2.5(o) **3DEP National Lidar Program Pricing Adjustments.**

DOGAMI may choose to purchase the following products and services, with pricing shown in Table 1, for OLC lidar data inclusion in the USGS's 3Dimensional Elevation Program (3DEP).

3DEP data deliverable must be consolidated to a single per square mile price, excluding hydro-flattening vector and flattening costs. Hydro flattening rate calculation is detailed below.

A single non-overlapping project tilling scheme is required for a USGS 3DEP project. All tiled deliverables must conform to the project tilling scheme and edge-match seamlessly without gaps. Contractor will deliver data in a (UTM) NAD83 (2011) or the most current horizontal datum. The vertical datum must be NAVD88. Z units must be identical to XY units (meters), and the Geoid must be the most current. Contractor must use a 750 meter by 750 meter project tilling scheme for all 3DEP products.

The costs in Table 1 indicate the price per square mile and project cost to be paid by DOGAMI to the Contractor for the services and deliverables purchased under POs which require compliance with USGS Lidar Base Specification 1.2 for the purposes of 3DEP.

**3DEP Hydro Flattening Rate Calculation.**

Hydroflattening costs will be calculated by assessing stream widths for streams 100 feet in width or greater. A centerline must be created from the most downstream point to the most upstream width where hydro flattening is required for rivers and streams within the project area. These lines are then buffered to create a 100 foot wide waterbodies representing the area of rivers and streams to be hydroflattened. National Hydro Dataset (NHD) water bodies (lakes/ponds) within the proposed project area are then merged with the river waterbodies. This combined polygon shapefile will be reviewed by DOGAMI and Contractor. The finalized version of the polygon shapefile will then be used to calculate the total waterbody area for calculating cost. A $1000 minimum hydro flattening fee is added to an area rate of $4.50 per acre multiplied by total estimated waterbody acres.

\[
$1000 + ($4.50 \times \text{waterbody acres})
\]

2.5(p) **Advanced Sensors**

DOGAMI may request to collect standard lidar with advanced sensors which will result in greater collection efficiencies and a lower unit rate for lidar. The availability of the advanced sensors will determine whether they are utilized for a project.

2.5 (q) **Building Footprints**
Under this option, DOGAMI may choose to purchase building footprints, delivered in Esri® polygon shapefile format. The building footprint is defined as the visible first floor projection, at grade, to the edge of the built area. The built area includes conditioned and non condition spaces: living area, above ground/raised decks and garages). The price of building footprint creation is based on the designation of urban and rural areas of Oregon. The urban and rural area delineation is based on US 2010 census block data and is defined by a shapefile available on request from DOGAMI. The cost for building footprint in urban areas is $90 per square mile. The cost of building footprint in rural areas is $40 per square mile. There is a minimum $2,000 cost for this product.

2.6 **Cost of Contractor Services and Deliverables.** The costs in Table 1 indicate the price per square mile to be paid by DOGAMI to Contractor for the Services and deliverables purchased under this Agreement, including for RGBI data and photographic images.

Table 1: Pricing of lidar services.

<table>
<thead>
<tr>
<th>Exhibit Section</th>
<th>Services</th>
<th>Wide-Area $ per Square Mile</th>
<th>Corridor $ per Square Mile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Size Brackets (Square Mile)</td>
<td>Minimum PO Sq Mi Required</td>
</tr>
<tr>
<td>2.1 - 2.4</td>
<td>Lidar Survey, greater than or equal to 8 points per square meter</td>
<td>$259</td>
<td>$604</td>
</tr>
<tr>
<td>2.5 a 1</td>
<td>3-inch pixel 4-band ortho imagery and infusion of imagery-derived RGBI values into Lidar point cloud, 30% overlap</td>
<td>$364</td>
<td>$241</td>
</tr>
<tr>
<td>2.5 a 2</td>
<td>3-inch pixel 4-band ortho imagery and infusion of imagery-derived RGBI values into Lidar point cloud, 60% OVERLAP</td>
<td>$583</td>
<td>$478</td>
</tr>
<tr>
<td>2.5 a 3</td>
<td>ORTHO ONLY: 3-inch 4-band ortho imagery ONLY: 30% OVERLAP</td>
<td>$433</td>
<td>$345</td>
</tr>
<tr>
<td>2.5 a 4</td>
<td>ORTHO ONLY: 3-inch pixel 4-band ortho imagery ONLY: 60% OVERLAP</td>
<td>$631</td>
<td>$508</td>
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<tr>
<td>2.5 a5</td>
<td>3-inch pixel 4-band ortho imagery (with or without Lidar) @ static corridor width</td>
<td>n/a</td>
<td>$21$</td>
</tr>
<tr>
<td>2.5 a6</td>
<td>3-inch pixel 4-band ortho imagery (with or without Lidar) @ variable corridor width</td>
<td>n/a</td>
<td>Determined per Purchase Order</td>
</tr>
<tr>
<td>2.5 a7</td>
<td>6-inch pixel 4-band ortho imagery and infusion of imagery-derived RGBI values into Lidar point cloud. 30% OVERLAP</td>
<td>$179$</td>
<td>$142$</td>
</tr>
<tr>
<td>2.5 b</td>
<td>Collection of higher resolution Lidar data (≈15 pulse per square mile)</td>
<td>$1,207$</td>
<td>$962$</td>
</tr>
<tr>
<td>2.5 c</td>
<td>Hydro-flattened Bare Earth DEM</td>
<td>$135$</td>
<td>$90$</td>
</tr>
<tr>
<td>2.5 d</td>
<td>Hydro-enforced Bare Earth DEM</td>
<td>$67$</td>
<td>$50$</td>
</tr>
<tr>
<td>2.5 e</td>
<td>Corridor lidar Acquisition (variable &amp; customized resolution)</td>
<td>n/a</td>
<td>Determined per Purchase Order</td>
</tr>
<tr>
<td>2.5 f</td>
<td>Bathymetric Lidar</td>
<td>Determined per Purchase Order</td>
<td>Determined per Purchase Order</td>
</tr>
<tr>
<td>2.5 g</td>
<td>Forward Looking HD Video</td>
<td>n/a</td>
<td>$20$</td>
</tr>
<tr>
<td>2.5 h</td>
<td>Thermal Infrared Imagery</td>
<td>Determined per Purchase Order</td>
<td>Determined per Purchase Order</td>
</tr>
<tr>
<td>2.5 i</td>
<td>Hyperspectral Imagery</td>
<td>Determined per Purchase Order</td>
<td>Determined per Purchase Order</td>
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</tbody>
</table>
### 2.5 Full Classification of Lidar point cloud.

<table>
<thead>
<tr>
<th></th>
<th>Urban</th>
<th>40</th>
<th>$189</th>
<th>100 ft - 300 ft</th>
<th>20</th>
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<tbody>
<tr>
<td>Rural</td>
<td>$106</td>
<td>40</td>
<td>$56</td>
<td>$33</td>
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<tr>
<td>Forest</td>
<td>$64</td>
<td>40</td>
<td>$23</td>
<td>$20</td>
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<table>
<thead>
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<th></th>
<th>Urban</th>
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<th>$387</th>
<th>100 ft - 300 ft</th>
<th>20</th>
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<tbody>
<tr>
<td>Rural</td>
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<td>40</td>
<td>$112</td>
<td>$66</td>
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</tr>
<tr>
<td>Forest</td>
<td>$138</td>
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<td>$5</td>
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### 2.5 Further Classification of Lidar point cloud.

<table>
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<tr>
<th></th>
<th>Supplemental vertical accuracy assessment</th>
<th>Determined per Purchase Order</th>
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<tr>
<td>$51</td>
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<td>$22</td>
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<td>$40</td>
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<table>
<thead>
<tr>
<th></th>
<th>Image Compression Rate</th>
<th>Determined per Purchase Order</th>
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<tbody>
<tr>
<td>$10</td>
<td>$9</td>
<td>$9</td>
<td>$8</td>
<td>$7</td>
</tr>
<tr>
<td>$40</td>
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<table>
<thead>
<tr>
<th></th>
<th>Collection of Volcanoes and Conical Peaks</th>
<th>Determined per Purchase Order</th>
<th>variable</th>
<th>n/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>$38</td>
<td>$31</td>
<td>$26</td>
<td>$24</td>
<td>$23</td>
</tr>
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<td>$40</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Lidar Survey 4 pulse per square meter &amp; Related Products</th>
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<th>variable</th>
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<tr>
<td>$601</td>
<td>$478</td>
<td>$414</td>
<td>$377</td>
<td>$357</td>
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<td>$40</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>750’ meter project tilling scheme for 3DEP deliverables excluding hydroflattening</th>
<th>Determined per Purchase Order</th>
<th>variable</th>
<th>n/a</th>
</tr>
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<tbody>
<tr>
<td>$85</td>
<td>$64</td>
<td>$51</td>
<td>$45</td>
<td>$37</td>
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<tr>
<td>$20</td>
<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>750’ meter project tilling scheme for USGS 3DEP Hydro-flattened Bare-Earth DSM</th>
<th>$1,000 + ($4.50 * waterbody acres)</th>
<th>n/a</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Advanced Lidar Sensor Acquisition</th>
<th>Determined per Purchase Order</th>
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</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Building Footprints</th>
<th>Unit rate based on whether area is designated urban or rural area. Urban rate: $90 per square mile. Rural rate: $40 per square mile. $2,000 minimum purchase</th>
<th>n/a</th>
</tr>
</thead>
</table>

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**Legend for Table 1:**

"n/a" means not applicable.

---

### 2.7 Price Determination per Purchase Order:

For items listed in the Table 1 (in Section 2.6) for which prices are determined per Purchase Order, the following process will occur. DOGAMI will provide the following information to Contractor in a PO:

1. A shapefile of the area of interest.
2. Requested data products and resolution specification.

Amendment 7 to Lidar Agreement 8865
Page 22 of 25
3. Timeline for acquisition.

Contractor will review the specifications in the PO and address any question or clarifications necessary. Within five business days of receiving a PO, Contractor will provide DOGAMI with a line-item pricing menu for each product requested with individual prices, and list any interdependencies with the associated costs. DOGAMI will then provide feedback on the pricing and options. DOGAMI may change the boundaries of the area of interest, and the requested deliverables to reach a product specification, timeline and area of interest that will suit DOGAMI’s needs, and submit a revised PO to Contractor.

3. Other provisions.

3.1 Inspection of facilities. Contractor shall make its facilities and equipment, including its aircraft and aircraft maintenance facilities, available for inspection at any time by DOGAMI.

3.2 Ownership of data. All deliverables, reports, products, data, information, findings and documents prepared by Contractor or obtained by DOGAMI under the terms of this Agreement are the exclusive property of DOGAMI.

3.3 Access to land; flight plans; other. Contractor shall provide written notification to DOGAMI on the number and locations of GCPs used in this Agreement. Contractor shall provide site description with all monuments. Contractor shall determine land ownership encompassing those locations and, as required, obtain site access permission. Contractor shall notify landowners and coordinate with the appropriate personnel prior to on-site or over-site activities. Contractor shall be solely responsible for the requisite filing of flight plans and obtaining appropriate authority from the Federal Aviation Administration (FAA) and other agencies as necessary. Contractor shall be solely responsible for all aspects of aircraft operation, including but not limited to maintenance, safety and crew licensing and training.

3.4 Key Personnel. Contractor and DOGAMI agree that each individual specified below (each, a “Key Person”) is an individual whose special qualifications and involvement in Contractor’s performance of Services form part of the basis of agreement between the parties under this Agreement, and is an individual through whom Contractor shall provide to DOGAMI the expertise, experience, judgment, and personal attention required to perform Services. Each of the following is a Key Person under this Contract:

Project Manager: John English 503-505-5120 jenglish@quantumspatial.com
Land Surveyor: Evon Silvia 541-752-1204 esilvia@quantumspatial.com
Acquisition Manager: Ryan Lynch 503-505-5320 rlynch@quantumspatial.com

Neither Contractor nor any Key Person of Contractor shall delegate performance of Services under this Agreement to others without first obtaining DOGAMI’s written consent. Further, Contractor shall not, without first obtaining DOGAMI’s prior written consent, re-assign or transfer any Key Person to other duties or positions so that the Key Person is no longer available to provide DOGAMI with that Key Person’s expertise, experience, judgment, and personal attention. If Contractor requests DOGAMI to approve a re-assignment or transfer of a Key Person, DOGAMI has the right to interview, review the qualifications of, and approve or
disapprove the proposed replacement(s) for the Key Person. Any individual DOGAMI approves as a replacement for a Key Person is deemed a Key Person under this Agreement.

3.5 **Aircraft passengers.** Contractor shall not permit any persons, other than Contractor, employees of Contractor, or agents of Contractor, or DOGAMI personnel included under Contractor’s insurance coverage required under Exhibit C to this Contract, in any aircraft being operated by or on behalf of Contractor in the performance of Services under this Contract, without advance written consent from DOGAMI.

3.6 The Land Surveyor (listed above in Section 3.4 as a Key Person) must supervise and certify all services under this Agreement, and must be a State of Oregon registered and certified Professional Land Surveyor.

4. **Payment milestones.**

4.1 Milestone progress payments for completed Services. DOGAMI will pay Contractor all amounts due for Services completed and accepted by DOGAMI at the following milestones after its approval of Contractor’s invoice for those Services:

<table>
<thead>
<tr>
<th>% of payment</th>
<th>Payment milestone</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 40%</td>
<td>initial payment upon collection of data.</td>
</tr>
<tr>
<td>(b) 30%</td>
<td>payment upon first data delivery for QC pass/fail exam by DOGAMI.</td>
</tr>
<tr>
<td>(c) 30%</td>
<td>payment upon final acceptance.</td>
</tr>
</tbody>
</table>

4.2 DOGAMI will pay Contractor within thirty (30) days after the approval of an invoice by DOGAMI. DOGAMI will send payment to Contractor at the address specified in the invoice.

4.3 Contractor may assess overdue account charges per ORS 293.462.

4.4 DOGAMI is solely responsible for the payment of all amounts due to the Contractor. Contractor shall look only to DOGAMI and not to any other state agency for payment.

4.5 Prices for the Services may be adjusted only as described in the Agreement.

4.6 Contractor understands and agrees that DOGAMI’s payment of amounts under this Agreement is contingent on DOGAMI receiving funding, appropriations, limitations, allotments or other expenditure authority at levels sufficient to allow DOGAMI, in the exercise of its reasonable administrative discretion, to make payments under this Agreement.

5. **Pricing.** Contractor is entitled to receive the prices listed in Table 1 in Section 2.6 for its acceptable performance of the Services and deliverables.

6. **Default and Termination.** DOGAMI will be in default if it fails to pay undisputed invoiced charges in accordance with Exhibit B, and such invoices remain unpaid for sixty (60)
calendar days after the receipt of an invoice. If DOGAMI is in default, and regardless of whether Contractor elects to exercise its rights under Section 6.3 of the Agreement, Contractor’s sole remedy shall be a claim against DOGAMI for the unpaid Services delivered and accepted by DOGAMI, less previous amounts paid and any claims which DOGAMI has against Contractor. If previous amounts paid to Contractor exceed the amount due to Contractor, Contractor shall pay any excess to DOGAMI upon written demand.