



LiDAR Quality Assessment Report

The USGS National Geospatial Technical Operations Center, Data Operations Branch is responsible for conducting reviews of all Light Detection and Ranging (LiDAR) point-cloud data and derived products delivered by a data supplier before it is approved for inclusion in the National Elevation Dataset and the Center for LiDAR Information Coordination and Knowledge. The USGS recognizes the complexity of LiDAR collection and processing performed by the data suppliers and has developed this Quality Assessment (QA) procedure to accommodate USGS collection and processing specifications with flexibility. The goal of this process is to assure LiDAR data are of sufficient quality for database population and scientific analysis. Concerns regarding the assessment of these data should be directed to the Chief, Data Operations Branch, 1400 Independence Road, Rolla, Missouri 65401 or NGTOCooperations@usgs.gov.

Materials Received:

5/8/2012

Project Type: NSDI Agreement

Project ID:

OR_OLC-EaglePoint_2010

Project Description:

The dataset encompasses areas including and surrounding Eagle Point, Oregon. The bare earth digital elevation models (DEM) represent the earth's surface with all vegetation and human-made structures removed. The bare earth DEMs were derived from LiDAR data using TIN processing of the ground point returns. The DEM grid cell size is 1 meter. The elevation units are in meters. Some elevation values have been interpolated across areas in the ground model where there is no elevation data (e.g. over water, over dense vegetation). Watershed Sciences, Inc. collected the LiDAR and created this data set for the Oregon Department of Geology and Mineral Industries (DoGAMI)

Project Alias(es):

None

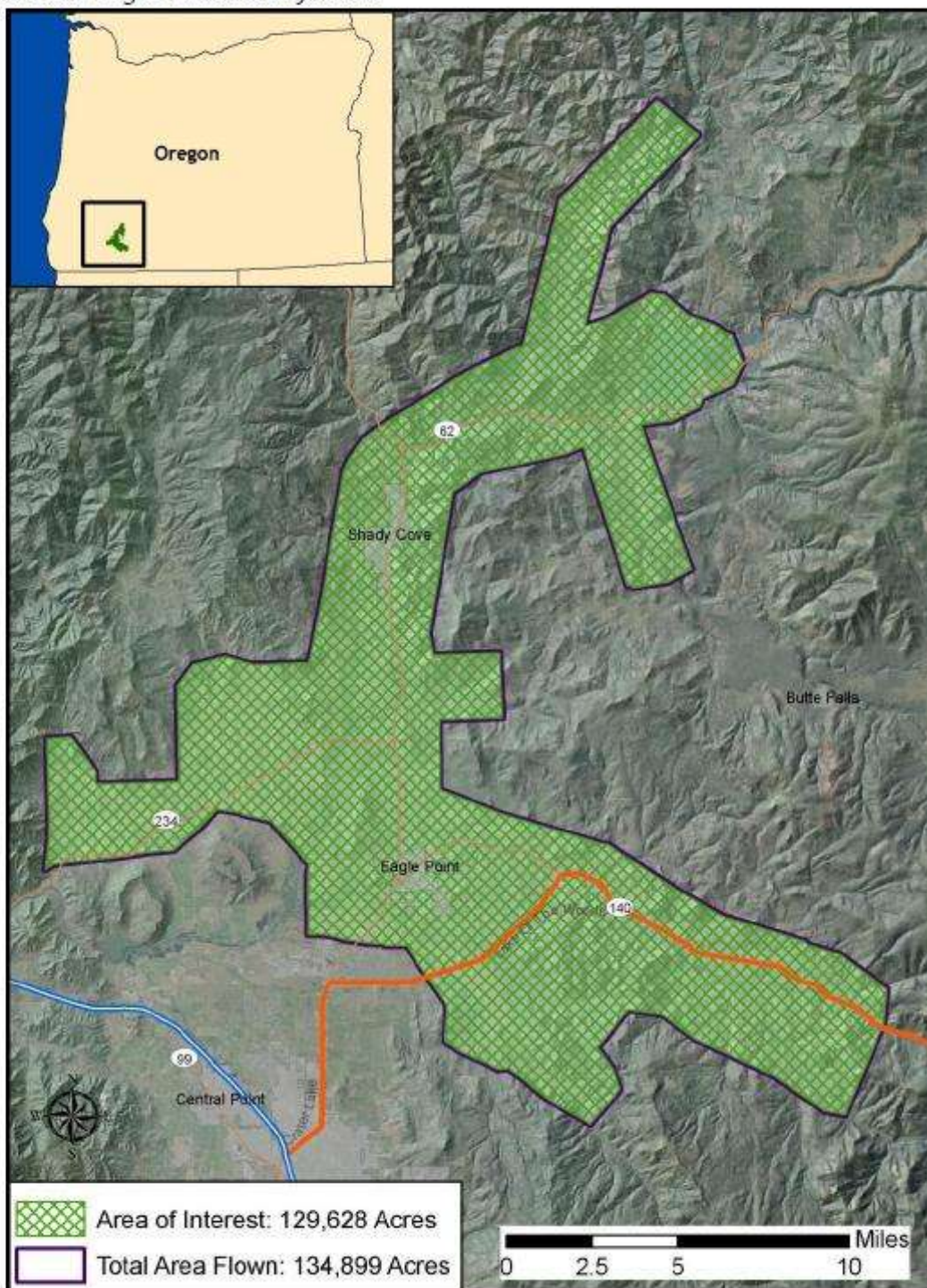
Year of Collection: 2010

Lot 1 of 1 lots.

Project Extent:

Project Extent image?

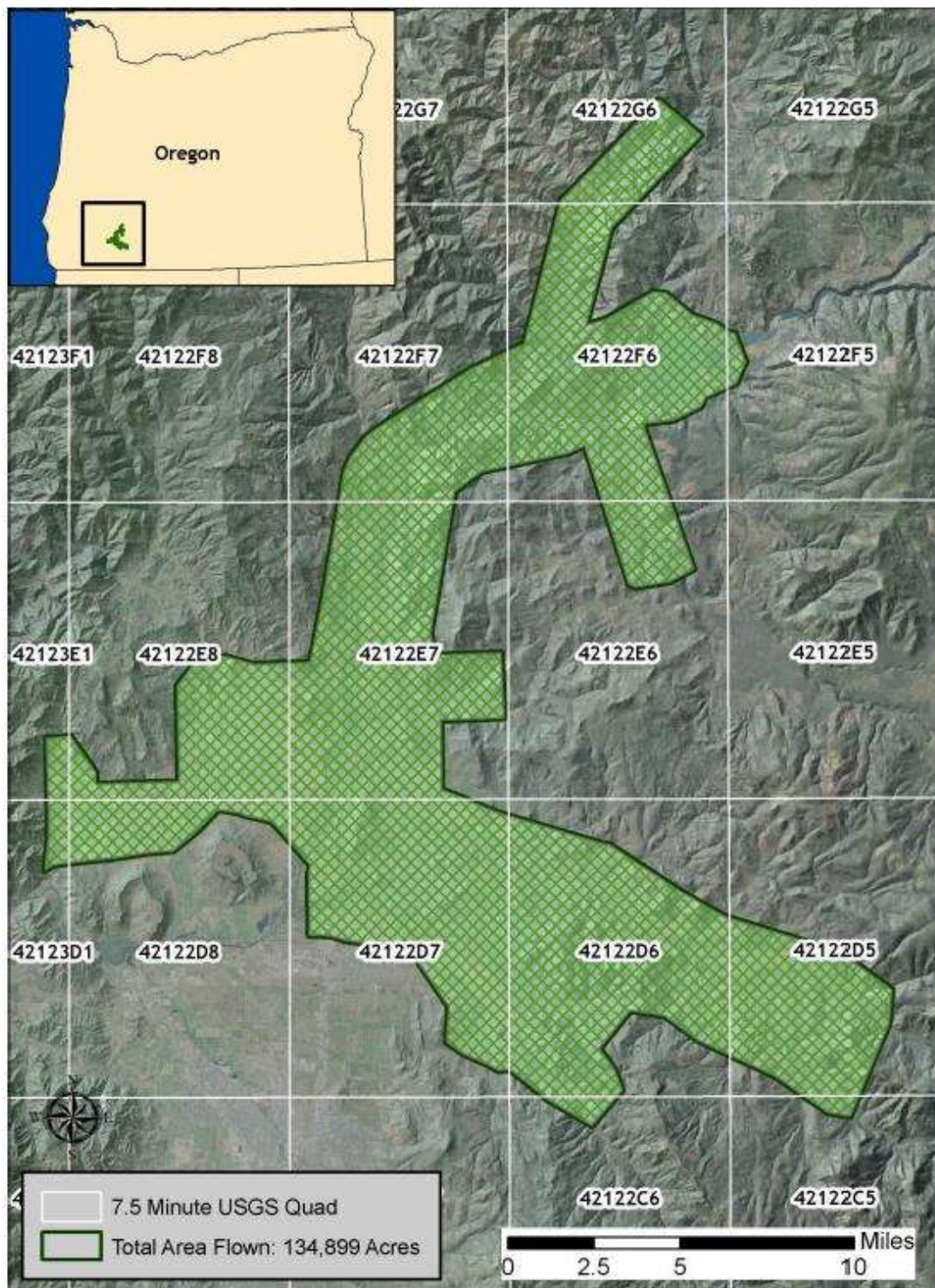
Figure 1.1. DOGAMI Eagle Point Study Area.



Project Tiling Scheme:

Project Tiling Scheme image?

Figure 1.2. Eagle Point Study Area, illustrating the delivered 7.5 minute USGS quads.



Contractor:
Watershed Sciences

Applicable Specification:
DOGAMI

Licensing Restrictions:

None

Third Party Performed QA?

Third Party QA Performed By:
DOGAMI

Project Points of Contact:

POC Name	Type	Primary Phone	E-Mail
Sheri Schneider	NSDI Liaison	503-310-1531	sschneider@usgs.gov

Project Deliverables

All project deliverables must be supplied according to collection and processing specifications. The USGS will postpone the QA process when any of the required deliverables are missing. When deliverables are missing, the Contracting Officer Technical Representative (COTR) will be contacted by the Elevation/Ortho imagery Section supervisor and informed of the problem. Processing will resume after the COTR has coordinated the deposition of remaining deliverables.

- | | |
|--|---|
| <input checked="" type="checkbox"/> Collection Report | <input checked="" type="checkbox"/> Project Shapefile/Geodatabase |
| <input checked="" type="checkbox"/> Survey Report | <input checked="" type="checkbox"/> Project Tiling Scheme Shapefile/Gdb |
| <input checked="" type="checkbox"/> Processing Report | <input checked="" type="checkbox"/> Control Point Shapefile/Gdb |
| <input checked="" type="checkbox"/> QA/QC Report | <input type="checkbox"/> Breakline Shapefile/Gdb |
| <input checked="" type="checkbox"/> Control and Calibration Points | <input type="checkbox"/> Project XML Metadata |

Multi-File Deliverables

File Type	Quantity
<input type="checkbox"/> Swath LAS Files <input type="checkbox"/> Required? <input type="checkbox"/> XML Metadata?	
<input checked="" type="checkbox"/> Intensity Image Files <input checked="" type="checkbox"/> Required?	491
<input checked="" type="checkbox"/> Tiled LAS Files <input checked="" type="checkbox"/> Required? <input type="checkbox"/> XML Metadata?	491
<input type="checkbox"/> Breakline Files <input type="checkbox"/> Required? <input type="checkbox"/> XML Metadata?	
<input checked="" type="checkbox"/> Bare-Earth DEM Files <input checked="" type="checkbox"/> Required? <input checked="" type="checkbox"/> XML Metadata?	15

Additional Deliverables

	Item
<input checked="" type="checkbox"/>	Highest Hit Rasters, 15
<input checked="" type="checkbox"/>	Ground Density Rasters, 491
<input checked="" type="checkbox"/>	Total area flown in shapefile format, 1
<input checked="" type="checkbox"/>	Processing Bins, dgn and shp format, 1
<input checked="" type="checkbox"/>	Ground las files, 491

Errors, Anomalies, Other Issues to document? Yes No

According to page 3 of the OLC Eagle Point Delivery Acceptance Report provided by DOGAMI, all deliverables are to be in Oregon Lambert, NAD83 (HARN), Intl Feet with the exception of trajectory files. All deliverables received by reviewer at NGTOC were in NAD83 UTM Zone 10N, units in meters.

Project Geographic Information

Areal Extent: 203 Sq Mi

Grid Size: 1 meters

Tile Size: 7.5 min quads, 100th quads Select...

Nominal Pulse Spacing: 1 meters

Vertical Datum: NAVD88 meters

Horizontal Datum: NAD83 meters

Project Projection/Coordinate Reference System: UTM Zone 10 N meters.

This Projection Coordinate Reference System is consistent across the following deliverables:

- | | |
|---|--|
| <input checked="" type="checkbox"/> Project Shapefile/Geodatabase | <input type="checkbox"/> Breaklines XML Metadata File |
| <input checked="" type="checkbox"/> Project Tiling Scheme Shapefile/Gdb | <input checked="" type="checkbox"/> Bare-Earth DEM XML Metadata File |
| <input checked="" type="checkbox"/> Checkpoints Shapefile/Geodatabase | <input type="checkbox"/> Swath LAS Files |
| <input type="checkbox"/> Project XML Metadata File | <input type="checkbox"/> Classified LAS Files |
| <input type="checkbox"/> Swath LAS XML Metadata File | <input type="checkbox"/> Breaklines Files |
| <input type="checkbox"/> Classified LAS XML Metadata File | <input checked="" type="checkbox"/> Bare-Earth DEM Files |

Project XML Metadata CRS

No Project XML Metadata delivered.

Swath LAS XML Metadata CRS

No swath LAS XML Metadata delivered.

Classified LAS XML Metadata CRS

No classified LAS XML Metadata delivered.

Breakline XML Metadata CRS

No breakline XML Metadata delivered.

Swath LAS Files CRS

No swath LAS files delivered.

Classified LAS Files CRS

Unknown coordinate system.

Breakline Files CRS

No breakline files delivered.

Review Cycle

This section documents who performed the QA Review on a project as well as when QA reviews were started, actions passed, received, and completed.

Reviewer: Review Start Date:

Action to Contractor Date	Issue Description	Return Date
<input type="text"/>	<input type="text"/>	<input type="text"/>

Review Complete:

Metadata Review

Provided metadata files have been parsed using 'mp' metadata parser. Any errors generated by the parser are documented below for reference and/or corrective action.

The Project XML Metadata file parsed with errors.

The Bare-Earth DEM XML Metadata file parsed with errors.

Original Metadata Parser Results-OR_OLC-Eagle-Point_2010

```
Executing: mp G:\LiDAR\Projects\Oregon\OLC_EAGLE_POINT_2010
\USGS\metadata.xml # # #
Start Time: Fri May 25 09:23:00 2012
Running script mp...
"C:\ArcGIS\bin\mp.exe" metadata.xml 2>&1
mp metadata.xml
: mp 2.9.6 - Peter N. Schweitzer (U.S. Geological Survey)
: Info: input file = metadata.xml
: Error (line 10): improper value for Publication_Date
: Error (line 22): improper value for Beginning_Date
: Error (line 22): improper value for Ending_Date
: Error (line 48): Place_Keyword_Thesaurus is required in Place
: Error (line 51): Stratum_Keyword_Thesaurus is required in Stratum
: Error (line 51): Stratum_Keyword is required in Stratum
: Error (line 51): Temporal_Keyword_Thesaurus is required in Temporal
: Error (line 51): Temporal_Keyword is required in Temporal
: Error (line 83): Horizontal_Positional_Accuracy_Report is required in
Horizontal_Positional_Accuracy
: Error (line 84): Horizontal_Positional_Accuracy_Value is required in
Quantitative_Horizontal_Positional_Accuracy_Assessment
: Error (line 88): Vertical_Positional_Accuracy_Report is required in
Vertical_Positional_Accuracy
: Error (line 90): improper value for Vertical_Positional_Accuracy_Value
: Error (line 96): Process_Date is required in Process_Step
: Error (line 101): Process_Date is required in Process_Step
: Error (line 136): Entity_Type_Label is required in Entity_Type
: Error (line 136): Entity_Type_Definition is required in Entity_Type
: Error (line 136): Entity_Type_Definition_Source is required in Entity_Type
: Error (line 146): Attribute_Definition is required in Attribute
: Error (line 146): Attribute_Definition_Source is required in Attribute
: Error (line 146): Attribute_Domain_Values is required in Attribute
: Error (line 149): Attribute_Definition is required in Attribute
: Error (line 149): Attribute_Definition_Source is required in Attribute
: Error (line 149): Attribute_Domain_Values is required in Attribute
: Error (line 154): Distribution_Liability is required in
Distribution_Information
```

```
: Error (line 156): Contact_Voice_Telephone is required in
Contact_Information
: Error (line 161): Address_Type is required in Contact_Address
: Error (line 171): Fees is required in Standard_Order_Process
: Error (line 172): Digital_Transfer_Option is required in Digital_Form
: Error (line 173): Format_Name is required in Digital_Transfer_Information
: 29 errors: 25 missing, 4 bad_value
Completed script mp...
Executed (mp) successfully.
End Time: Fri May 25 09:23:00 2012 (Elapsed Time: 0.00 seconds)
```

Reviewer at NGTOC corrected as many errors as possible and again ran the file through the metadata parser with the following results:

NGTOC Corrected Metadata Parser Results-OR_OLC-Eagle-Point_2010

```
Executing: mp G:\LiDAR\Projects\Oregon\OLC_EAGLE_POINT_2010
\USGS\metadata.xml # # #
Start Time: Fri May 25 09:46:47 2012
Running script mp...
"C:\ArcGIS\bin\mp.exe" metadata.xml 2>&1
mp metadata.xml
: mp 2.9.6 - Peter N. Schweitzer (U.S. Geological Survey)
: Info: input file = metadata.xml
: Error (line 86): improper value for Horizontal_Positional_Accuracy_Value
: Error (line 101): Process_Date is required in Process_Step
: Error (line 145): improper value for Attribute_Value_Accuracy
: Error (line 146): Attribute_Definition is required in Attribute
: Error (line 146): Attribute_Definition_Source is required in Attribute
: Error (line 146): Attribute_Domain_Values is required in Attribute
: Error (line 149): Attribute_Definition is required in Attribute
: Error (line 149): Attribute_Definition_Source is required in Attribute
: Error (line 149): Attribute_Domain_Values is required in Attribute
: Error (line 156): Contact_Voice_Telephone is required in
Contact_Information
: Error (line 161): Address_Type is required in Contact_Address
: Error (line 172): Digital_Transfer_Option is required in Digital_Form
: 12 errors: 10 missing, 2 bad_value
Completed script mp...
Executed (mp) successfully.
End Time: Fri May 25 09:46:47 2012 (Elapsed Time: 0.00 seconds)
```

This is the best-use metadata for the project. Reviewer at NGTOC renamed the file bestuse.xml. The files will be delivered to EROS in the Metadata-Documents folder.

ASPRS recommends that checkpoint surveys be used to verify the vertical accuracy of LiDAR data sets. Checkpoints are to be collected by an independent survey firm licensed in the particular state(s) where the project is located. While subjective, checkpoints should be well distributed throughout the dataset. National Standards for Spatial Data Accuracy (NSSDA) guidance states that checkpoints may be distributed more densely in the vicinity of important features and more sparsely in areas that are of little or no interest. Checkpoints should be distributed so that points are spaced at intervals of at least ten percent of the diagonal distance across the dataset and at least twenty percent of the points are located in each quadrant of the dataset.

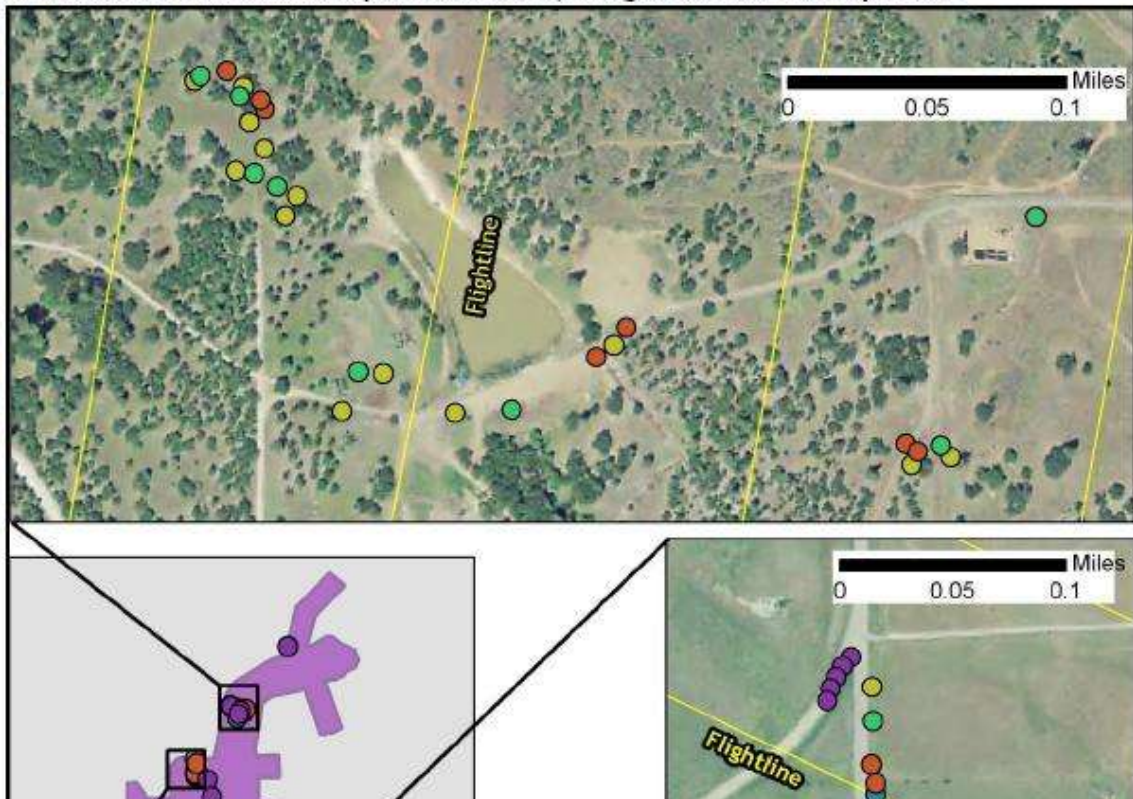
NSSDA and ASPRS require that a minimum of twenty checkpoints (thirty is preferred) are collected for each major land cover category represented in the LiDAR data. Checkpoints should be selected on flat terrain, or on uniformly sloping terrain in all directions from each checkpoint. They should not be selected near severe breaks in slope, such as bridge abutments, edges of roads, or near river bluffs. Checkpoints are an important component of the USGS QA process. There is the presumption that the checkpoint surveys are error free and the discrepancies are attributable to the LiDAR dataset supplied.

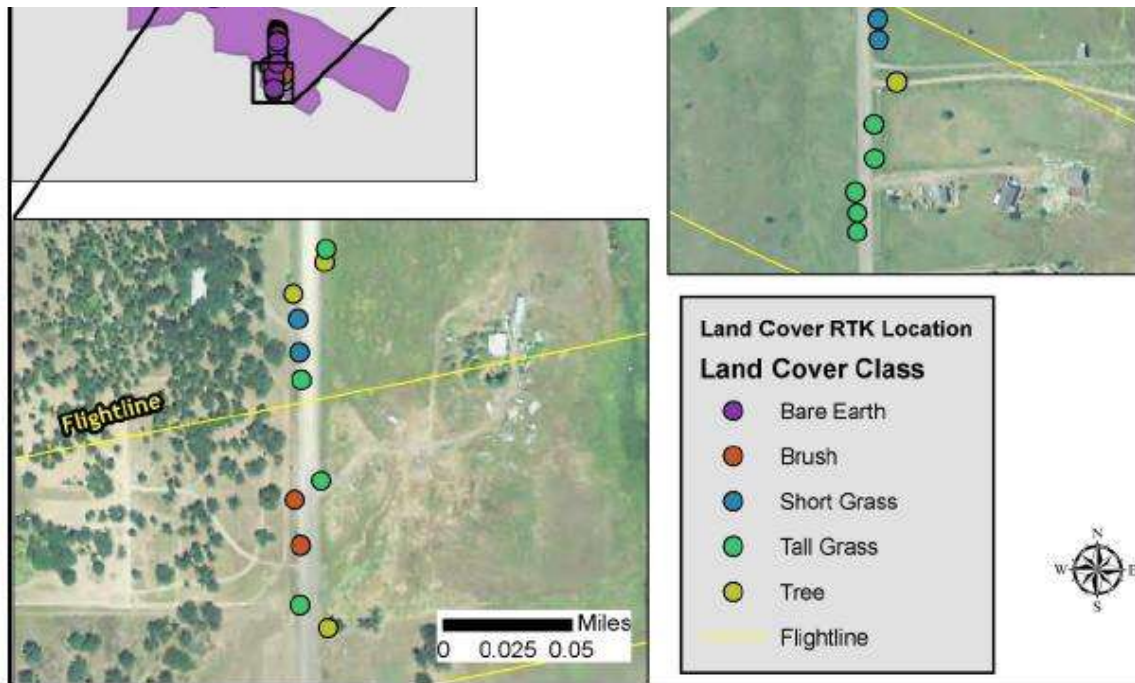
For this dataset, USGS checked the spatial distribution of checkpoints with an emphasis on the bare-earth (open terrain) points; the number of points per class; the methodology used to collect these points; and the relationship between the data supplier and checkpoint collector. When independent control data are available, USGS has incorporated this into the analysis.

Checkpoint Shapefile or Geodatabase:

Checkpoint Distribution Image?

Figure 2.4 Selected land cover RTK point locations; images are NAIP orthophotos.





The following land cover classes are represented in this dataset (uncheck any that do not apply):

- Bare Earth
- Tall Weeds and Crops
- Brush Lands and Low Trees
- Forested Areas Fully Covered by Trees
- Urban Areas with Dense Man-Made Structures

There are a minimum of 20 checkpoints for each land cover class represented. Points within each class are uniformly distributed throughout the dataset. USGS was not able to locate independent checkpoints for this analysis. USGS accepts the quality of the checkpoint data for these LiDAR datasets.

Errors, Anomalies, Other Issues to document? Yes No

Image?

In the "Accuracy by Land Cover" section of the report submitted by Watershed Sciences, the following land cover classes are included in Table 3.2: Bare Earth, Grass-short, Grass-tall, Brush, and Tree. However, the shapefile delivered to the reviewer at NGTOC contains the following land cover classes: Dirt, Marsh, Shrub, Stump, Tree, Tall Grass/Thistle, Tall Grass, Short Grass, and Grass. Watershed Sciences collected all checkpoints used in this analysis of vertical accuracy, therefore the checkpoints are not independent.

Image?

DOGAMI conducted their own vertical accuracy analysis which consisted of differencing control data and the delivered DEMs to expose offsets. Control data for the analysis was collected by DOGAMI, therefore these checkpoints are independent. These offsets were used to produce a mean vertical error and vertical RMSE value for the entire delivered data set. Project specifications list the maximum acceptable mean vertical offset to be 0.20 meters (0.65 feet). A total of 1670 measured GCP's were obtained in the delivery region and compared with Bare-Earth DEMs. DOGAMI reports the RMSE as 0.036 meters (0.117 ft).

Image?

Reviewer at NGTOC was unable to locate the 1670 checkpoints used by DOGAMI in the vertical accuracy analysis.

Accuracy values are reported in terms of Fundamental Vertical Accuracy (FVA), Supplemental Vertical Accuracy(s) (SVA), and Consolidated Vertical Accuracy (CVA).

Accuracy values are reported in:

Required FVA Value is or less.

Target SVA Value is or less.

Required CVA Value is or less.

The reported FVA of the LAS Swath data is .

The reported FVA of the Bare-Earth DEM data is .

SVA are required for each land cover type present in the data set with the exception of bare-earth. SVA is calculated and reported as a 95th Percentile Error.

Land Cover Type	SVA Value	Units
<i>Tall Weeds and Crops</i>	<input type="text" value=""/>	meters
<i>Brush Lands and Low Trees</i>	<input type="text" value=""/>	meters
<i>Forested Areas Fully Covered by Trees</i>	<input type="text" value=""/>	meters
<i>Urban Areas with Dense Man-Made Structur...</i>	<input type="text" value=""/>	meters

The reported CVA of this data set is: .

LAS Tile File Review

Classified LAS tile files are used to build digital terrain models using the points classified as ground. Therefore, it is important that the classified LAS are of sufficient quality to ensure that the derivative product accurately represents the landscape that was measured. The following was determined for classified LAS files for this project:

Classified LAS Tile File Characteristics

- Separate folder for Classified LAS tile files
- Classified LAS tile files conform to Project Tiling Scheme
- Quantity of Classified LAS tile files conforms to Project Tiling Scheme
- Classified LAS tile files do not overlap
- Classified LAS tile files are uniform in size
- Classified LAS tile files have no points classified as '12'

- Point classifications are limited to the standard values listed below :

Code	Description
1	Processed, but unclassified
2	Bare-earth ground
7	Noise (low or high, manually identified, if needed)
9	Water
10	Ignored ground (breakline proximity)
11	Withheld (if the "Withheld" bit is not implemented in processing software)

Buy up?

Based on this review, the USGS accepts the classified LAS tile file data.

Errors, Anomalies, Other Issues to document? Yes No

Image?

Classified las include only the following classes: 1=unclassified, 2=ground.

Bare-Earth DEM Tile File Review

The derived bare-earth DEM file receives a review of the vertical accuracies provided by the data supplier, vertical accuracies calculated by USGS using supplied and independent checkpoints, and a manual check of the appearance of the DEM layer.

Bare-Earth DEM files provided in the following format:

Bare-Earth DEM Tile File Characteristics

- Separate folder for bare-earth DEM files
- DEM files conform to Project Tiling Scheme
- Quantity of DEM files conforms to Project Tiling Scheme
- DEM files do not overlap
- DEM files are uniform in size
- DEM files properly edge match
- Independent check points are well distributed

All accuracy values reported in .

Reported Accuracies

Land Cover Category	# of Points	Fundamental Vertical Accuracy @95% Confidence Interval (Accuracy _z) Required FVA = N/A or less.	Supplemental Vertical Accuracy @95th Percentile Error Target SVA = N/A or less.	Consolidated Vertical Accuracy @95th Percentile Error Required CVA = N/A or less.
Open Terrain	<input type="text" value="20"/>	<input type="text" value="N/A"/>		
Tall Weeds and Crops	<input type="text" value=""/>			
Brush Lands and Low Trees	<input type="text" value=""/>			
Forested Areas Fully Covered by Trees	<input type="text" value=""/>			
Urban Areas with Dense Man-Made Structures	<input type="text" value=""/>			
Consolidated	<input type="text" value="20"/>			<input type="text" value="N/A"/>

QA performed Accuracy Calculations?

Based on this review, the USGS does not recommend the bare-earth DEM files for inclusion in the 1/3 Arc-Second National Elevation Dataset.

Based on this review, the USGS accepts the bare-earth DEM files.

Bare-Earth DEM Anomalies, Errors, Other Issues

Errors, Anomalies, Other Issues to document? Yes No

Image?

In the "Accuracy by Land Cover" section of the report submitted by Watershed Sciences, the following land cover classes are included in Table 3.2: Bare Earth, Grass-short, Grass-tall, Brush, and Tree. However, the shapefile delivered to the reviewer at NGTOC contains the following land cover classes: Dirt, Marsh, Shrub, Stump, Tree, Tall Grass/Thistle, Tall Grass, Short Grass, and Grass. Watershed Sciences collected all checkpoints used in this analysis of vertical accuracy, therefore the checkpoints are not independent.

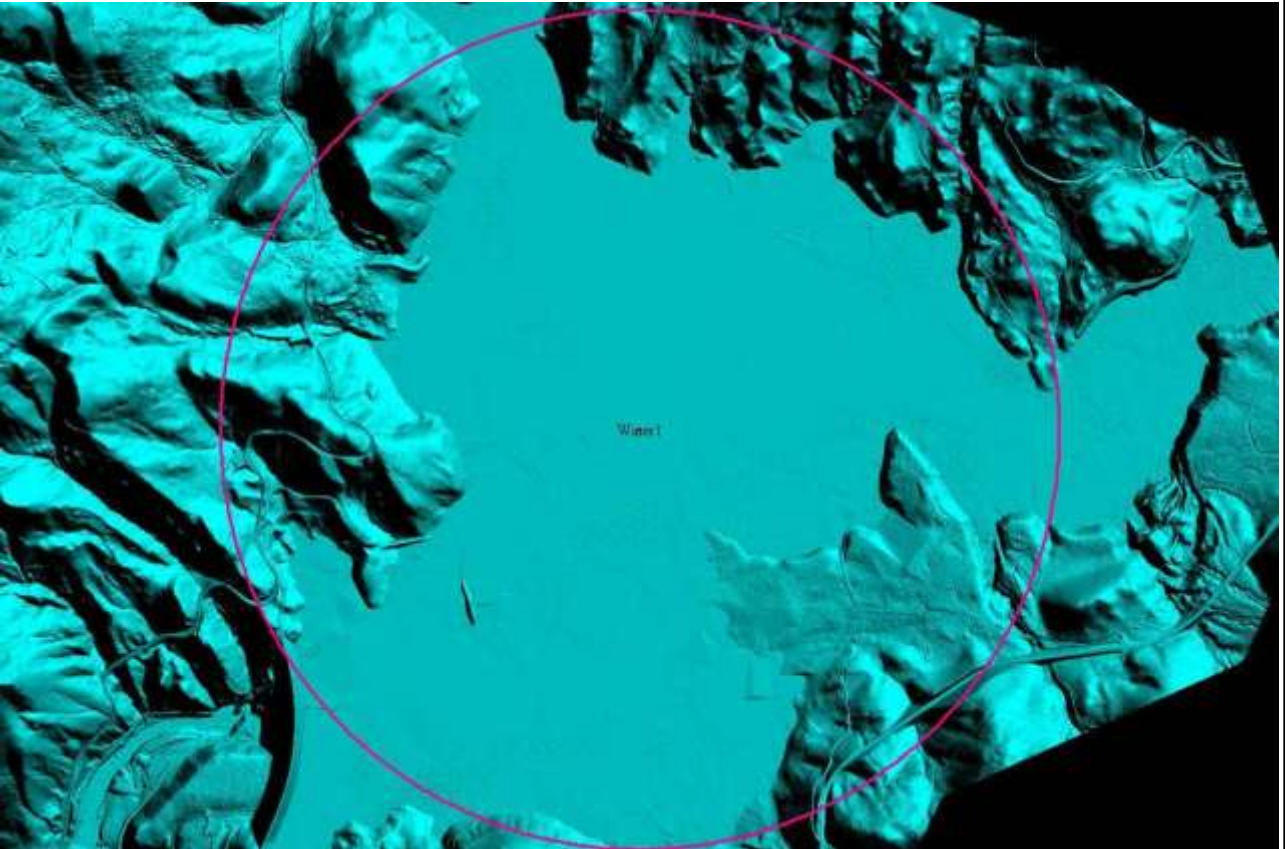
Image?

DOGAMI conducted their own vertical accuracy analysis which consisted of differencing control data and the delivered DEMs to expose offsets. Control data for the analysis was collected by DOGAMI, therefore these checkpoints are independent. These offsets were used to produce a mean vertical error and vertical RMSE value for the entire delivered data set. Project specifications list the maximum acceptable mean vertical offset to be 0.20 meters (0.65 feet). A total of 1670 measured GCP's were obtained in the delivery region and compared with Bare-Earth DEMs. DOGAMI reports the RMSE as 0.036 meters (0.117 ft).

Image?

Reviewer at NGTOC was unable to locate the 1670 checkpoints used by DOGAMI in the vertical accuracy analysis.

Image?



Waterbodies not flattened, not required.

Image?



Stream not flattened, not required.

Internal Note:

Reviewer made a shapefile documenting location of both water features detailed above. The shapefile is named "errors" and is located in the NED-Errors folder on the drive sent to EROS.

This is the end of the report.

QA Form V1.4 12OCT11.xsn

