



# 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:

Project Type:

Project ID:

Project Description:

Project Alias(es):

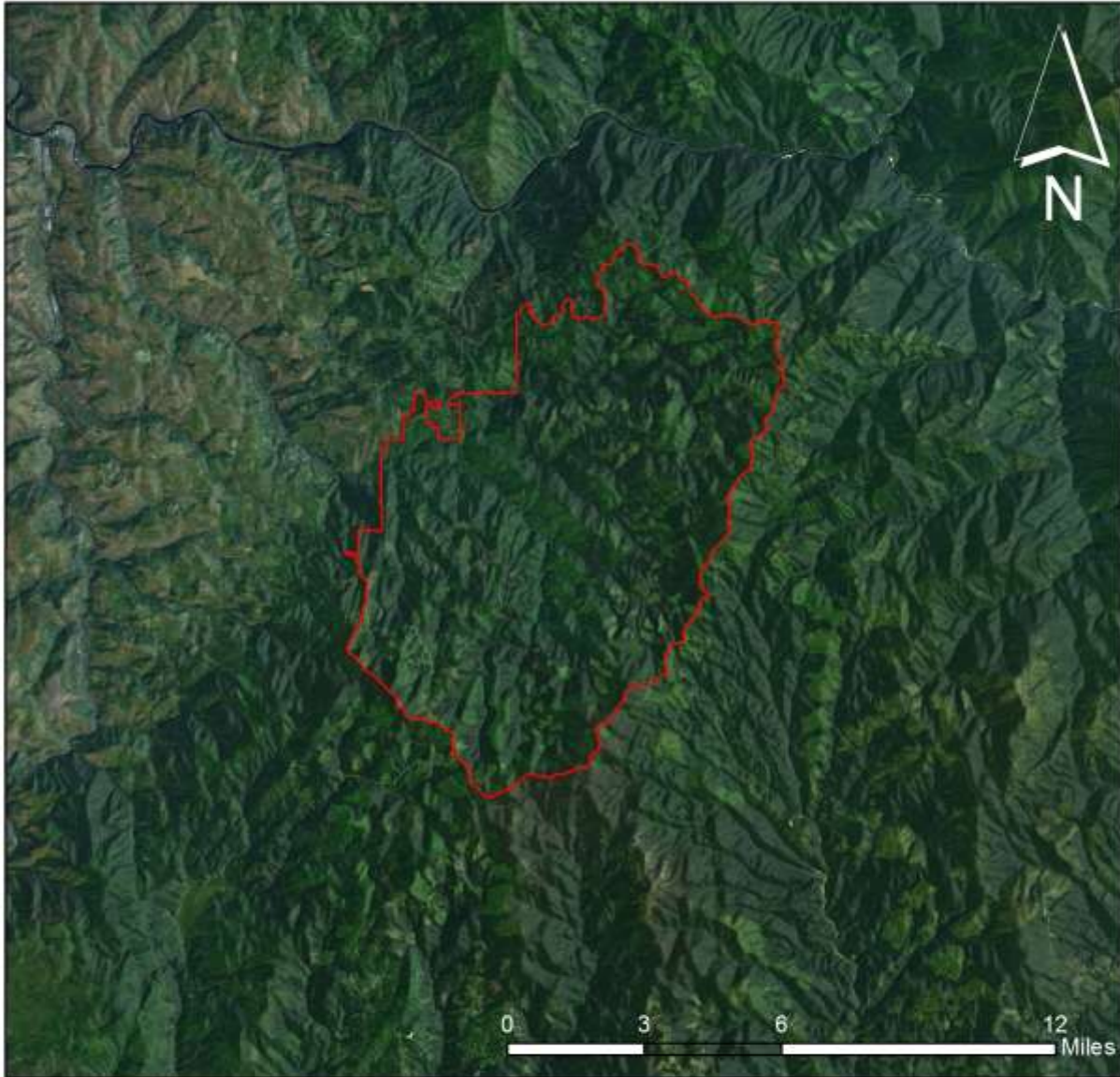
Year of Collection:

Lot  of  lots.

Project Extent:


Project Extent image?

# ID\_ClearCreek\_2009



Date: 6/27/2013

## Legend

 boundary\_Clear\_Creek

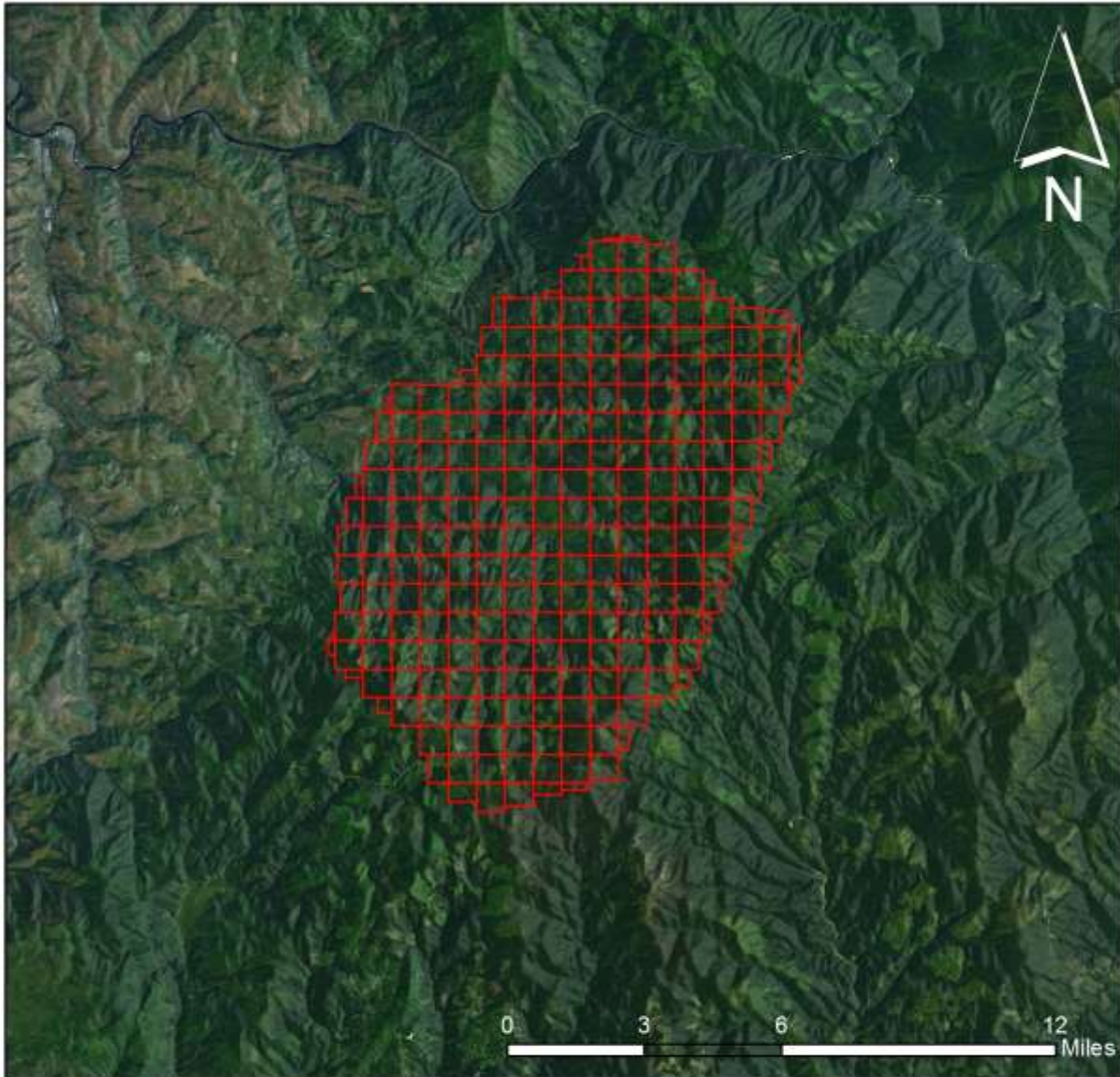
Coordinate System: NAD 1983 UTM Zone 11N  
Projection: Transverse Mercator  
Datum: North American 1983  
False Easting: 500,000.0000  
False Northing: 0.0000  
Central Meridian: -117.0000  
Scale Factor: 0.9996  
Latitude Of Origin: 0.0000  
Units: Meter

Project Tiling Scheme:



Project Tiling Scheme image?

## ID\_ClearCreek\_2009



Date: 6/27/2013

### Legend

 tilemap

Coordinate System: NAD 1983 UTM Zone 11N  
Projection: Transverse Mercator  
Datum: North American 1983  
False Easting: 500,000.0000  
False Northing: 0.0000  
Central Meridian: -117.0000  
Scale Factor: 0.9996  
Latitude Of Origin: 0.0000  
Units: Meter

Contractor:

Applicable Specification:

Earth Eye

V13

Licensing Restrictions:

Third Party Performed QA?

Project Points of Contact:

POC Name	Type	Primary Phone	E-Mail
Scott Van Hoff	NSDI Liaison	208-387-1351	svanhoff@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/Orthoimagery 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 type="checkbox"/> Control Point Shapefile/Gdb                    |
| <input type="checkbox"/> QA/QC Report                   | <input type="checkbox"/> Breakline Shapefile/Gdb                        |
| <input 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 checked="" type="checkbox"/> Required? <input type="checkbox"/> XML Metadata?	
<input type="checkbox"/> Intensity Image Files <input type="checkbox"/> Required?	
<input checked="" type="checkbox"/> Tiled LAS Files <input checked="" type="checkbox"/> Required? <input type="checkbox"/> XML Metadata?	249
<input type="checkbox"/> Breakline Files <input checked="" type="checkbox"/> Required? <input type="checkbox"/> XML Metadata?	
<input checked="" type="checkbox"/> Bare-Earth DEM Files <input checked="" type="checkbox"/> Required? <input type="checkbox"/> XML Metadata?	1

## Additional Deliverables

	Item
<input checked="" type="checkbox"/>	Original DEM in Arc GRID format
<input checked="" type="checkbox"/>	Round 1 Corrections DEM from 02/28/2013 (in TIF format, it appears identical to the ...

Errors, Anomalies, Other Issues to document?  Yes  No

None.

# Project Geographic Information

Areal Extent:

66.89

Sq Mi

Grid Size:

1

meters

Tile Size:

1 x 1

kilometers

Nominal Pulse Spacing: 0.5 meters

Vertical Datum: NAVD88 meters

Horizontal Datum: NAD83 meters

Project Projection/Coordinate Reference System: UTM Zone 11 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 type="checkbox"/> Bare-Earth DEM XML Metadata File |
| <input 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  |

Check Point Shapefile/Geodatabase CRS

Not Delivered

Project XML Metadata CRS

Not Delivered

Swath LAS XML Metadata CRS

Not Delivered

Classified LAS XML Metadata CRS

Not Delivered

Breakline XML Metadata CRS

Not Delivered

DEM XML Metadata CRS

Not Delivered

Swath LAS Files CRS

Not Delivered

Classified LAS Files CRS

SRS not defined in headers, but files lie in the correct position in UTM 11 N

Breakline Files CRS

Not 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.

Review Start Date:

6/27/2013

Action to Contractor Date	Issue Description	Return Date
6/27/2013	While the DEMs are accepted it would be great if we could receive the following: 1. If Possible send missing data, chiefly FGDC Compliant XML Metadata and Swath Strip LAS data. 2. If any corrections to any data formats have been made since this review or will be made in light of this review, please send them to the USGS.	

Review Complete: 6/27/2013

## 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.

Not Delivered





# Project QA/QC Report Review

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.

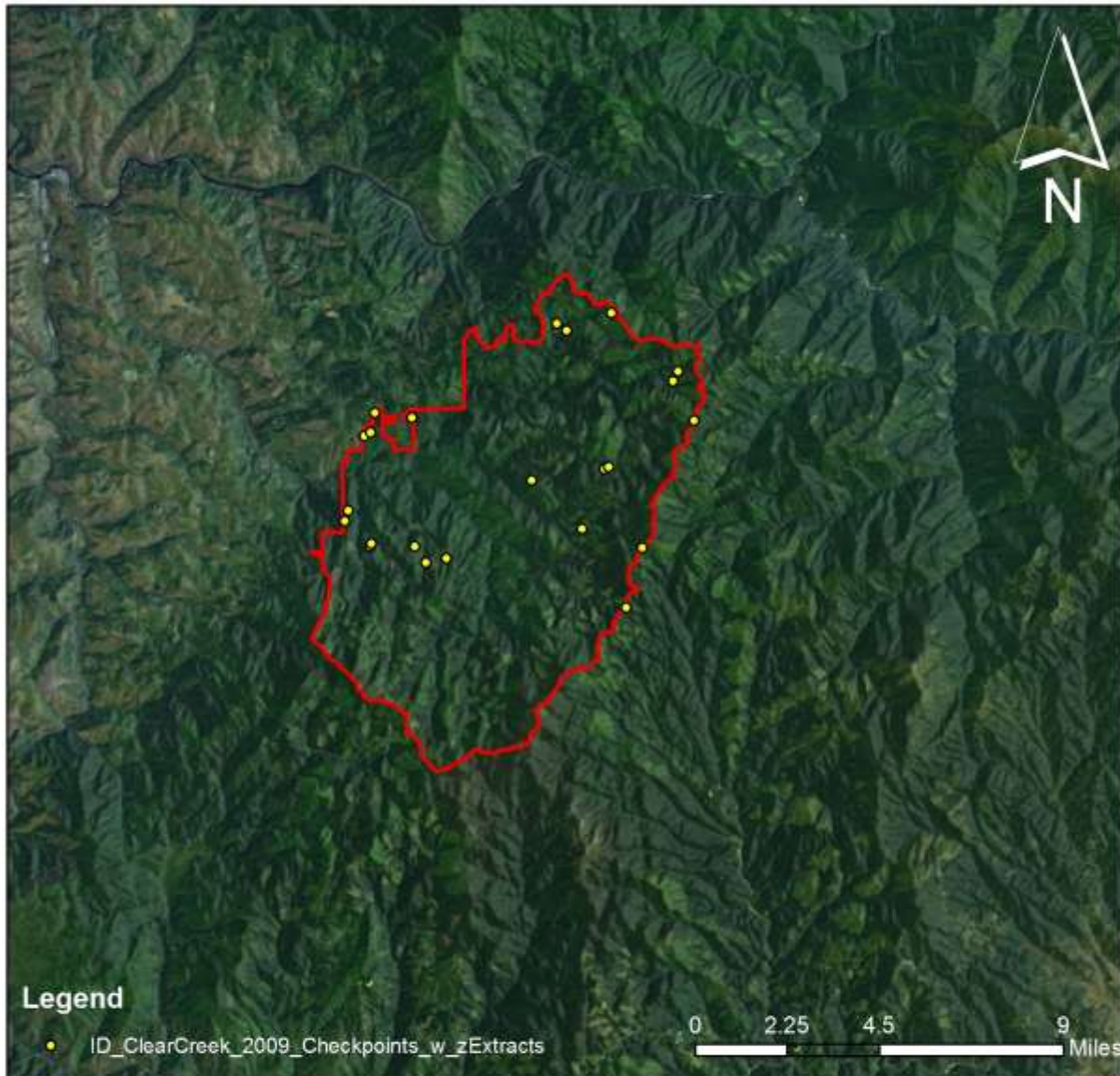
NSSDA and ASPRS require that a minimum of twenty checkpoints (thirty is preferred) are collected for each major land cover category represented in the LiDAR data. Checkpoints should be selected on flat terrain, or on uniformly sloping terrain in all directions from each checkpoint. They should not be 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?

# ID\_ClearCreek\_2009



Date: 6/27/2013

Coordinate System:  
NAD 1983 UTM Zone 11N  
Projection: Transverse Mercator  
Datum: North American 1983  
False Easting: 500,000.0000  
False Northing: 0.0000  
Central Meridian: -117.0000  
Scale Factor: 0.9996  
Latitude Of Origin: 0.0000  
Units: Meter

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

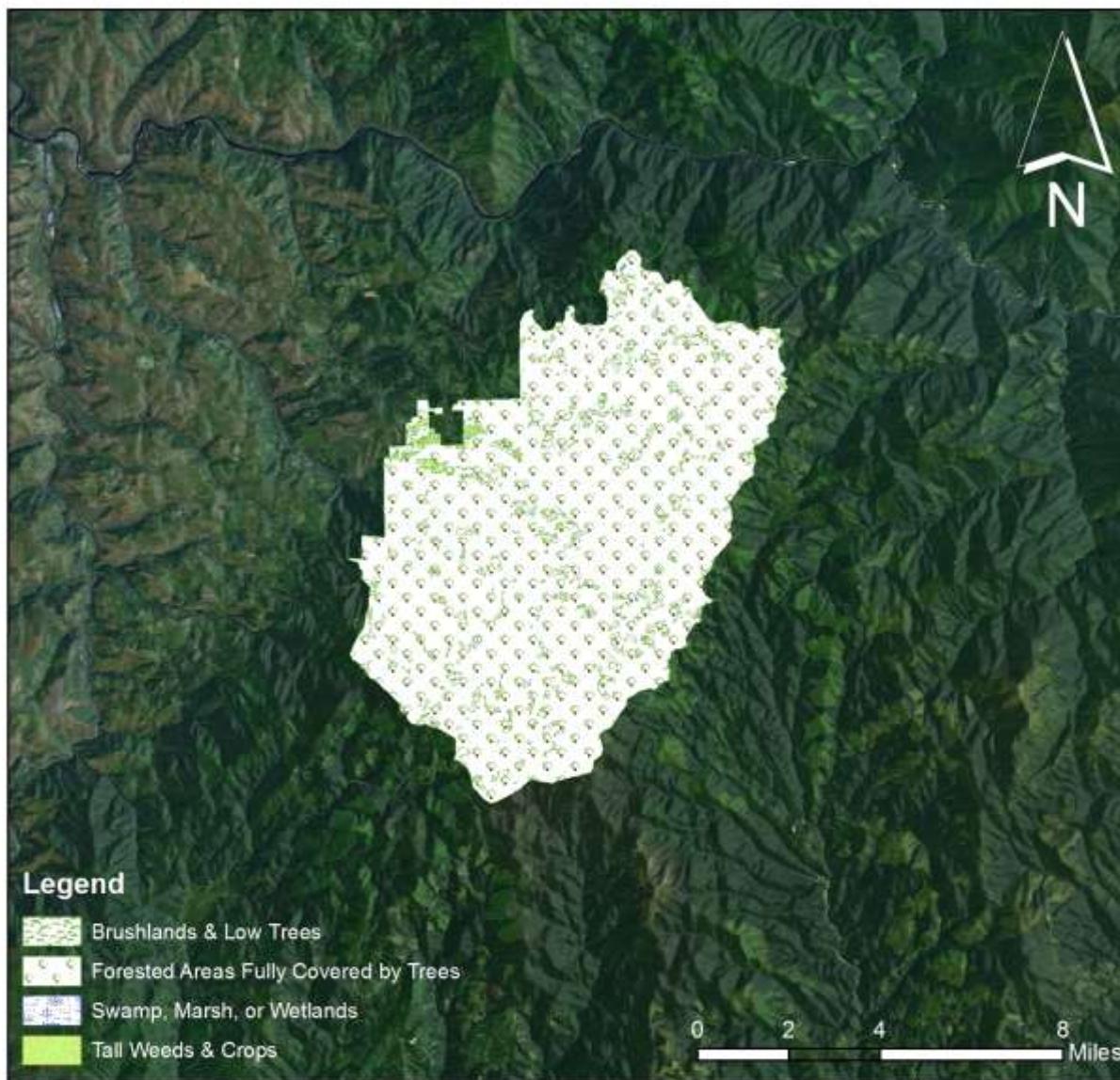
There are a minimum of 20 checkpoints for each land cover class represented. Points within each class are uniformly distributed throughout the dataset. USGS was able to locate independent checkpoints for this analysis. USGS accepts the quality of the checkpoint data for these LiDAR datasets.

Errors, Anomalies, Other Issues to document?  Yes  No

Image?



# ID\_ClearCreek\_2009



Date: 6/27/2013

Coordinate System:  
NAD 1983 UTM Zone 11N  
Projection: Transverse Mercator  
Datum: North American 1983  
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Scale Factor: 0.9996  
Latitude Of Origin: 0.0000  
Units: Meter

Landcovers from aggregated 2006 NLCD that lie within the projects AOI. Landcovers occupying more than 10% of the project AOI include: "Forested Areas Fully Covered by Trees".

Image?

USGS pulled the checkpoints listed in the "Nez Pierce Final Report" PDF and generated a shapefile from the values listed in the report's absolute accuracy table to check the accuracy of the provided DEM.

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>		N/A
<i>Brush Lands and Low Trees</i>		N/A
Forested Areas Fully Covered by Trees		meters
<i>Urban Areas with Dense Man-Made Structur...</i>		N/A

The reported CVA of this data set is:  .

## LAS Swath File Review

LAS swath files or raw unclassified LiDAR data are reviewed to assess the quality



control used by the data supplier during collection. Furthermore, LAS swath data are checked for positional accuracy. The data supplier should have calculated the Fundamental Vertical Accuracy using ground control checkpoints measured in clear open terrain. The following was determined for LAS swath data for this project:

#### LAS Version

- LAS 1.2       LAS1.3       LAS 1.4

#### Swath File Characteristics

- Separate folder for LAS swath files
- Each swath files <= 2GB
- \*If specified, \*.wdp files for full waveform have been provided

The reported FVA of the LAS swath data is  .

Based on this review, the USGS does not accept at this time the LAS swath file data.

Yes  No

Image?

## 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?

Additional classifications in this data set.

- 3 - Tall weeds and crops (low vegetation)
- 4 - Brush lands and low trees (medium vegetation)
- 5 - Forested areas fully covered by trees
- 6 - Urban area with dense man-made structures

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

Errors, Anomalies, Other Issues to document?  Yes  No

Image?

Spatial Reference not defined in the LAS files headers.

Image?

Global Encoder ID not set to 1 and should be if adjusted GPS time was used.

Image?

There is one extra las tile. Two las tiles are present for pt000092.las with the second being named: pt000092\_nIntensity.las, which appears identical except for the fact that it takes intensity values.

Image?

Scan Angles not attributed in the point cloud.

Image?

Class 5 represents canopy or all above ground features in this dataset.

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## Breakline File Review

Breaklines are vector feature classes that are used to hydro-flatten the bare earth Digital Elevation Models.

### Breakline File Characteristics

- Separate folder for breakline files
- All breaklines captured as PolylineZ or PolygonZ features
- No missing or misplaced breaklines

Based on this review, the USGS does not accept at this time the breakline files.

Errors, Anomalies, Other Issues to document?  Yes  No

Image for error?

Not Delivered.

## 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	<u>Fundamental Vertical Accuracy @95% Confidence Interval (Accuracy<sub>z</sub>)</u> Required FVA = 0.245 or less.	<u>Supplemental Vertical Accuracy @95th Percentile Error</u> Target SVA = 0.363 or less.	<u>Consolidated Vertical Accuracy @95th Percentile Error</u> Required CVA = 0.363 or less.
Open Terrain	26	0.08526		
Tall Weeds and Crops	1			
Brush Lands and Low Trees	1			
Forested Areas Fully Covered by Trees	1			
Urban Areas with Dense Man-Made Structures	1			
Consolidated	26			

QA performed Accuracy Calculations?

**Calculated Accuracies**

Land Cover Category	# of Points	<u>Fundamental Vertical Accuracy @95% Confidence Interval (Accuracy<sub>z</sub>)</u> Required FVA = 0.245 or less.	<u>Supplemental Vertical Accuracy @95th Percentile Error</u> Target SVA = 0.363 or less.	<u>Consolidated Vertical Accuracy @95th Percentile Error</u> Required CVA = 0.363 or less.
Open Terrain	23	0.2081		
Tall Weeds and Crops	1			
Brush Lands and Low Trees	1			
Forested Areas Fully Covered by Trees	1			
Urban Areas with Dense Man-Made Structures	1			
Consolidated	23			

Based on this review, the USGS recommends 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

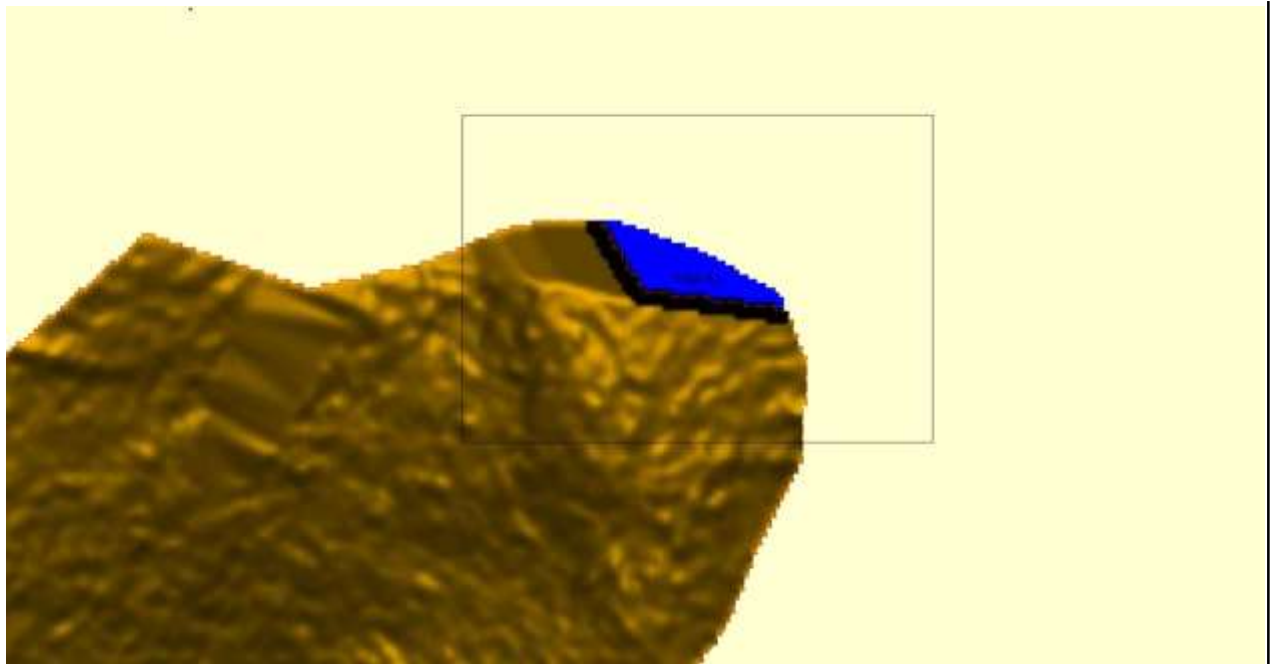
Errors, Anomalies, Other Issues to document?  Yes  No

Image?

USGS pulled the checkpoints listed in the "Nez Pierce Final Report" PDF and generated a shapefile from the values listed in the report's absolute accuracy table to check the accuracy of the provided DEM. However, only 23 points were found to lie within the DEMs AOI.

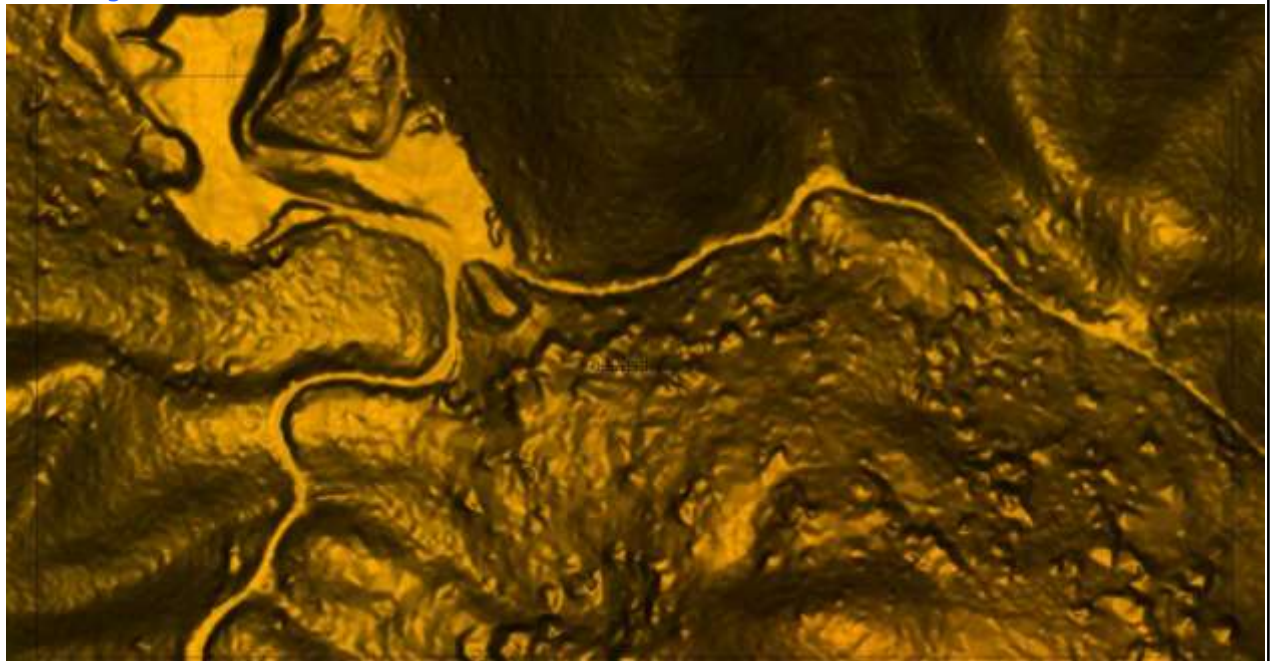
Image?





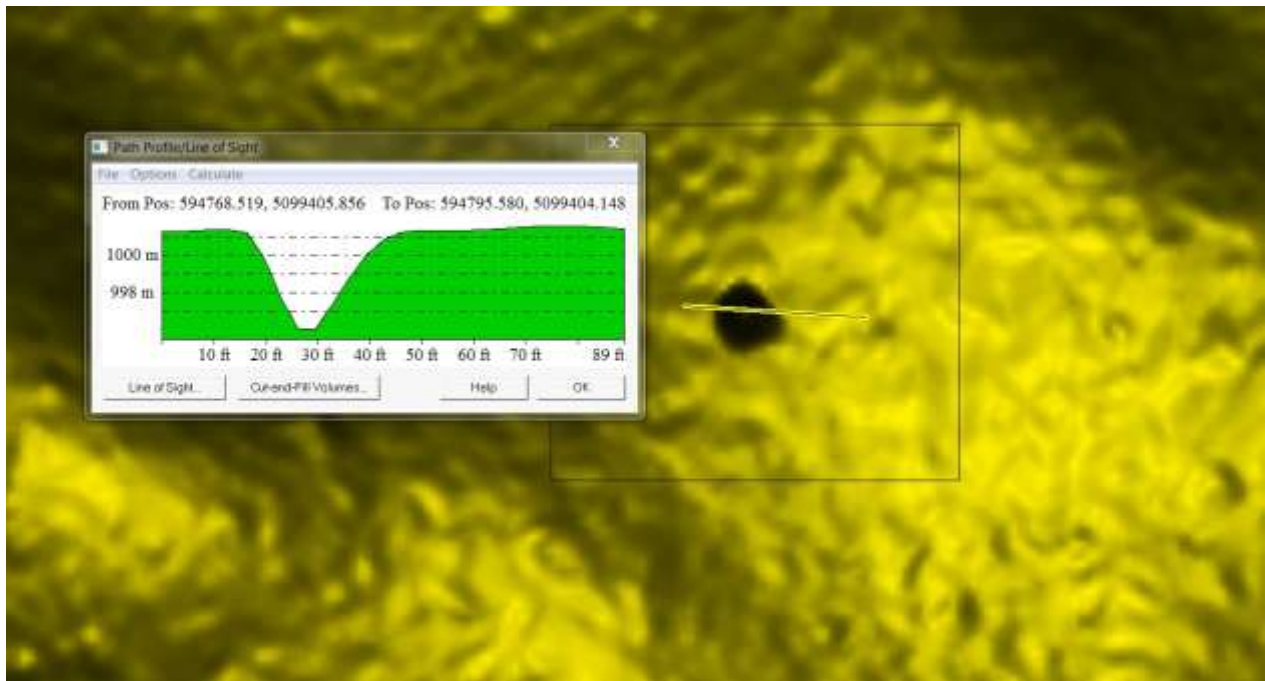
There are a few instances of gridded drop offs to 0 meters, these pits can easily be trimmed.

Image?



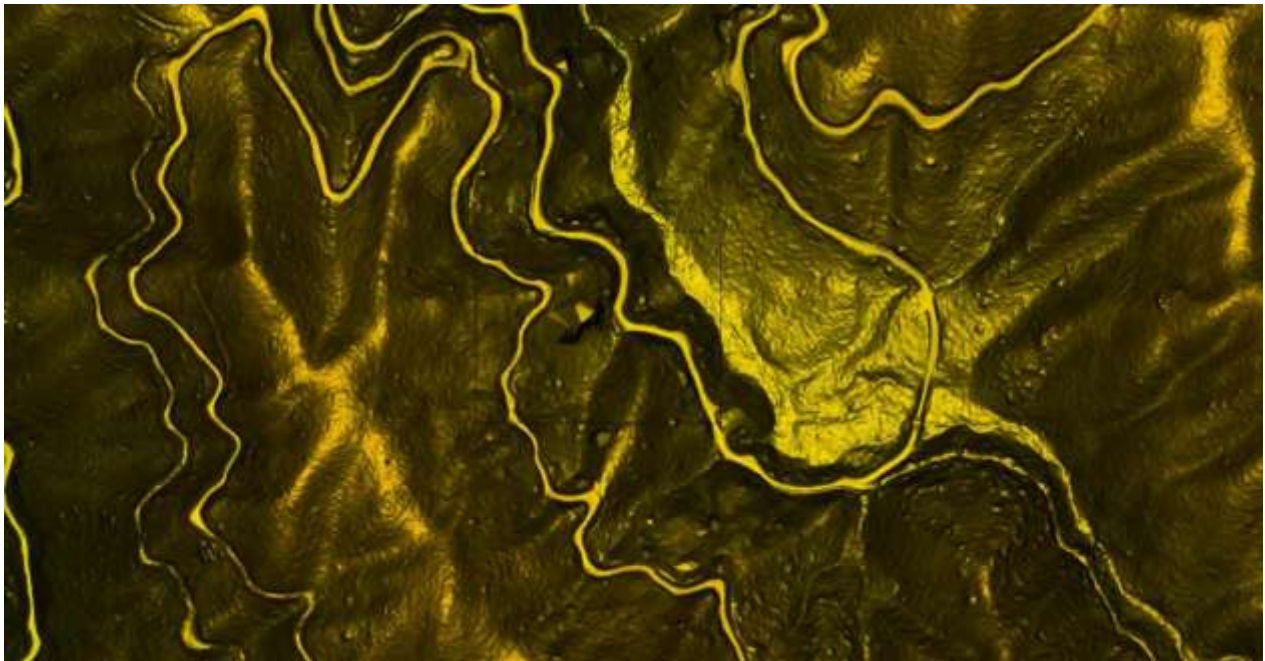
There is some question of how accurate the ground classification was as there is a fair amount of ground noise throughout parts of the dataset, chiefly in the form of small spikes and pits.

Image?



Here is an instance of a small, but deep pit that may be the result of classifying an erroneous low point as ground.

Image?



There are also small spikes on the data that may be the result of an over rigorous ground classification and the classification of some low vegetation as ground.

**This is the end of the report.**

QA Form V1.4 12OCT11.xsn