



# 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:

2/22/2013

Project Type: Donated Data

Project ID:

OR\_OLCKeno\_2012

Project Description:

The dataset encompasses portions of Jackson, Klamath, and Siskiyou Counties. The bare earth digital elevation model (DEM) represents 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 3 international feet. The elevation units are in international feet. Some elevation units have been interpolated across areas in the ground model where there is no elevation data (e.g. over water, over dense vegetation). WSI collected the LiDAR and created this data set for the Oregon Department of Geology and Mineral Industries (DoGAMI).

Project Alias(es):

OLC Keno

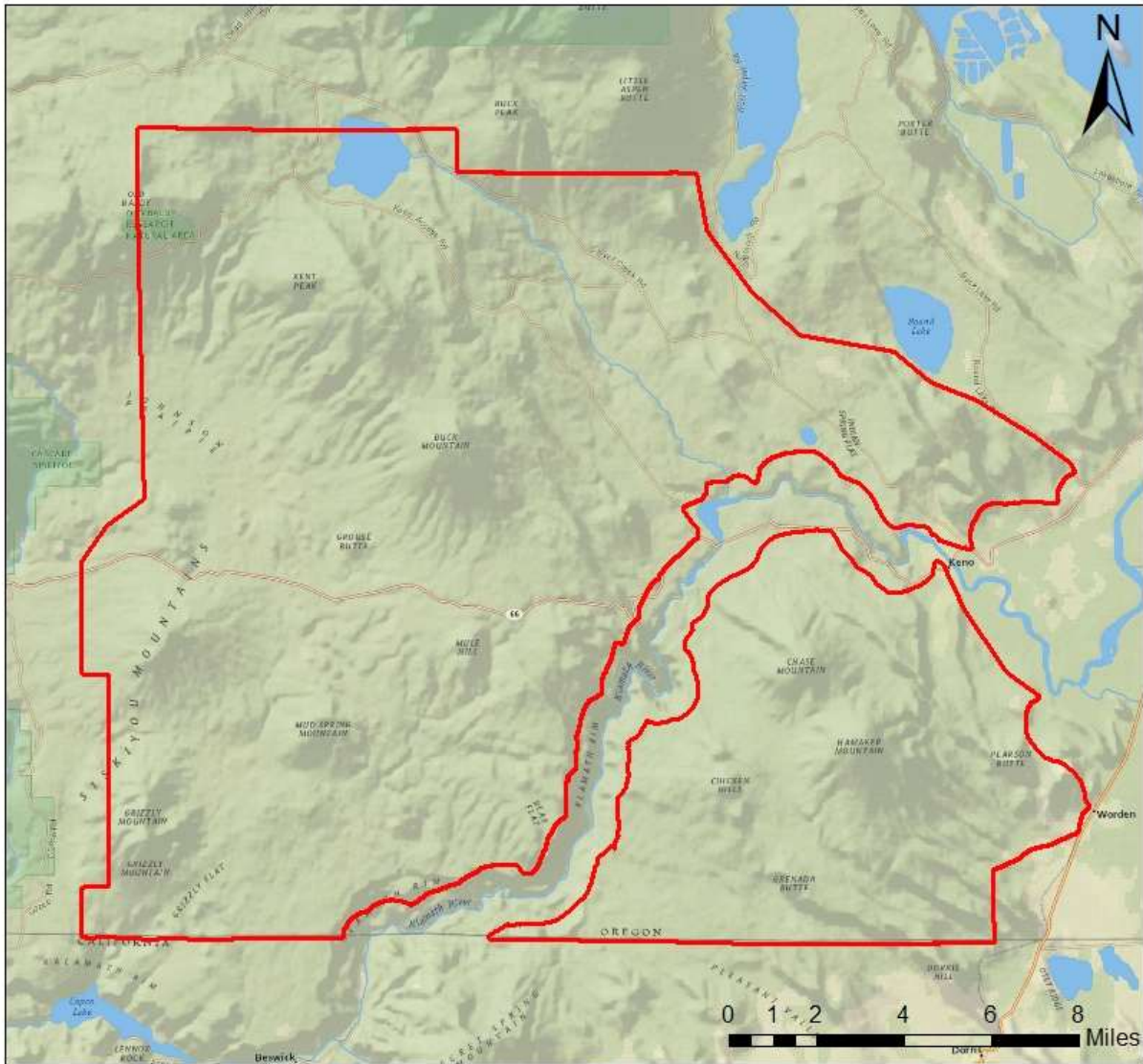
Year of Collection: 2012

Lot 1 of 1 lots.

Project Extent:

Project Extent image?

# OR\_OLCKeno\_2012



Date: 3/7/2013

## Legend

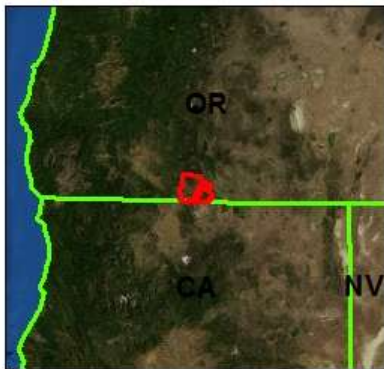
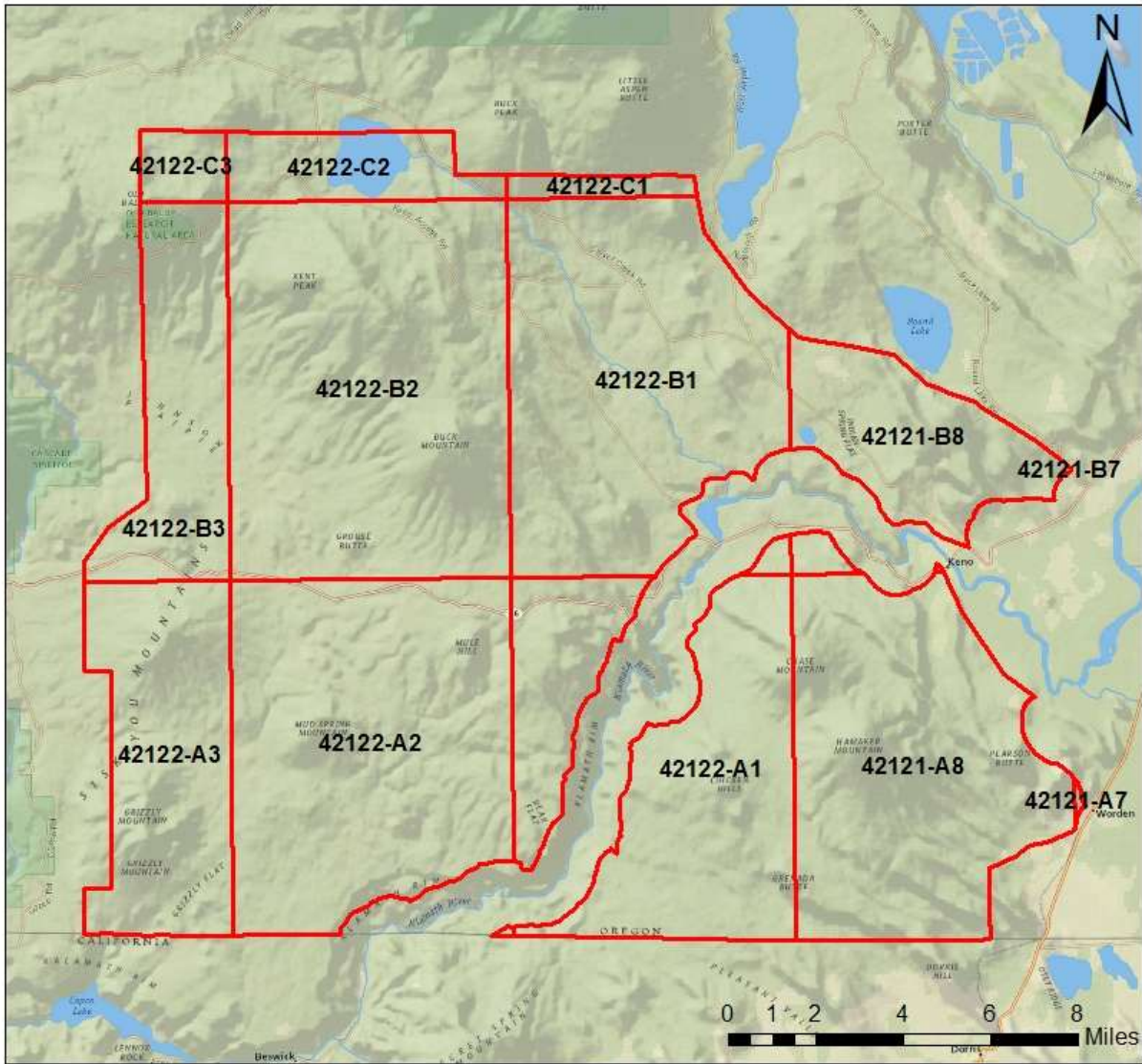
 OR\_OLCKeno\_2012\_DEM\_ProjectFootprint\_fromTiles

Coordinate System: NAD 1983 UTM Zone 10N  
 Projection: Transverse Mercator  
 Datum: North American 1983  
 False Easting: 500,000.0000  
 False Northing: 0.0000  
 Central Meridian: -123.0000  
 Scale Factor: 0.9996  
 Latitude Of Origin: 0.0000  
 Units: Meter

Project Tiling Scheme:


Project Tiling Scheme image?

# OR\_OLCKeno\_2012



Date: 3/7/2013

## Legend

 OLC\_KENO\_7\_5\_UTM10\_quads

Coordinate System: NAD 1983 UTM Zone 10N  
Projection: Transverse Mercator  
Datum: North American 1983  
False Easting: 500,000.0000  
False Northing: 0.0000  
Central Meridian: -123.0000  
Scale Factor: 0.9996  
Latitude Of Origin: 0.0000  
Units: Meter

Contractor:

Applicable Specification:

Watershed Sciences Inc.

V13+DOGAMI+Custom

Licensing Restrictions:

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	sschneid@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.

- Collection Report
- Survey Report
- Processing Report
- QA/QC Report
- Control and Calibration Points
- Project Shapefile/Geodatabase
- Project Tiling Scheme Shapefile/Gdb
- Control Point Shapefile/Gdb
- Breakline Shapefile/Gdb
- Project XML Metadata

## Multi-File Deliverables

File Type	Quantity
<input type="checkbox"/> Swath LAS Files <input type="checkbox"/> Required? <input type="checkbox"/> XML Metadata?	0
<input checked="" type="checkbox"/> Intensity Image Files <input type="checkbox"/> Required?	660
<input checked="" type="checkbox"/> Tiled LAS Files <input checked="" type="checkbox"/> Required? <input type="checkbox"/> XML Metadata?	660
<input type="checkbox"/> Breakline Files <input type="checkbox"/> Required? <input type="checkbox"/> XML Metadata?	0
<input checked="" type="checkbox"/> Bare-Earth DEM Files <input checked="" type="checkbox"/> Required? <input checked="" type="checkbox"/> XML Metadata?	13

## Additional Deliverables

	Item
<input checked="" type="checkbox"/>	Ground Density Rasters, 660, GRID
<input checked="" type="checkbox"/>	Highest Hit Rasters, 13, GRID
<input checked="" type="checkbox"/>	Trajectories, 257, .trj

Errors, Anomalies, Other Issues to document?  Yes  No

A Separate Tiling Scheme was used for LAS, Intensity Images and Ground Density Rasters. DEMs and Highest Hits share a 7.5 Minute tiling scheme.

# Project Geographic Information

Areal Extent:

312.89

Sq Mi

Grid Size:

3

Int'l Feet

Tile Size:

10.4

kilometers

Nominal Pulse Spacing: 0.35  
35 meters

Vertical Datum: NAVD88 int'l feet

Horizontal Datum: NAD83\_HARN int'l feet

Project Projection/Coordinate Reference System:

NAD\_1983\_HARN\_Oregon\_Statewide\_Lambert\_Feet\_Intl international feet.

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

- |  |   |
|--|---|
| <input type="checkbox"/> Project Shapefile/Geodatabase       | <input type="checkbox"/> Breaklines XML Metadata File     |
| <input 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  |

Project Shapefile/Geodatabase CRS

Not Delivered

Project Tiling Scheme Shapefile/Geodatabase CRS

NAD\_1983\_UTM\_Zone\_10N

Check Point Shapefile/Geodatabase CRS

NAD\_1983\_UTM\_Zone\_10N

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

Tile Level, Not Defined

Swath LAS Files CRS

Not Delivered

Classified LAS Files CRS

Matches, but not defined in header.

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:

3/7/2013

Action to Contractor Date	Issue Description	Return Date
3/4/2013	DOGAMI Checkpoints Requested	3/14/2013

Review Complete: 3/27/2013

## 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 witherrors.

Not Delivered. Best Use Metadata would be any of the Tile Level DEM XML files.

The Bare-Earth DEM XML Metadata file parsed witherrors.

Type	Description or line numbers	Line(s) (or count)
Severity 5: Misplaced elements		
Error	City (10.4.3) is not permitted in <u>Metadata</u> (0)	2



		2	
		2	
Error	<u>Country</u> (10.4.6) is not permitted in <u>Metadata</u> (0)	2	
		2	
		2	
Severity 3: Missing elements			
Error	<u>Identification Information</u> (1) is required in <u>Metadata</u> (0)	2	
Error	<u>Metadata Reference Information</u> (7) is required in <u>Metadata</u> (0)	2	

This is from one sample tile level XML file.

# 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.

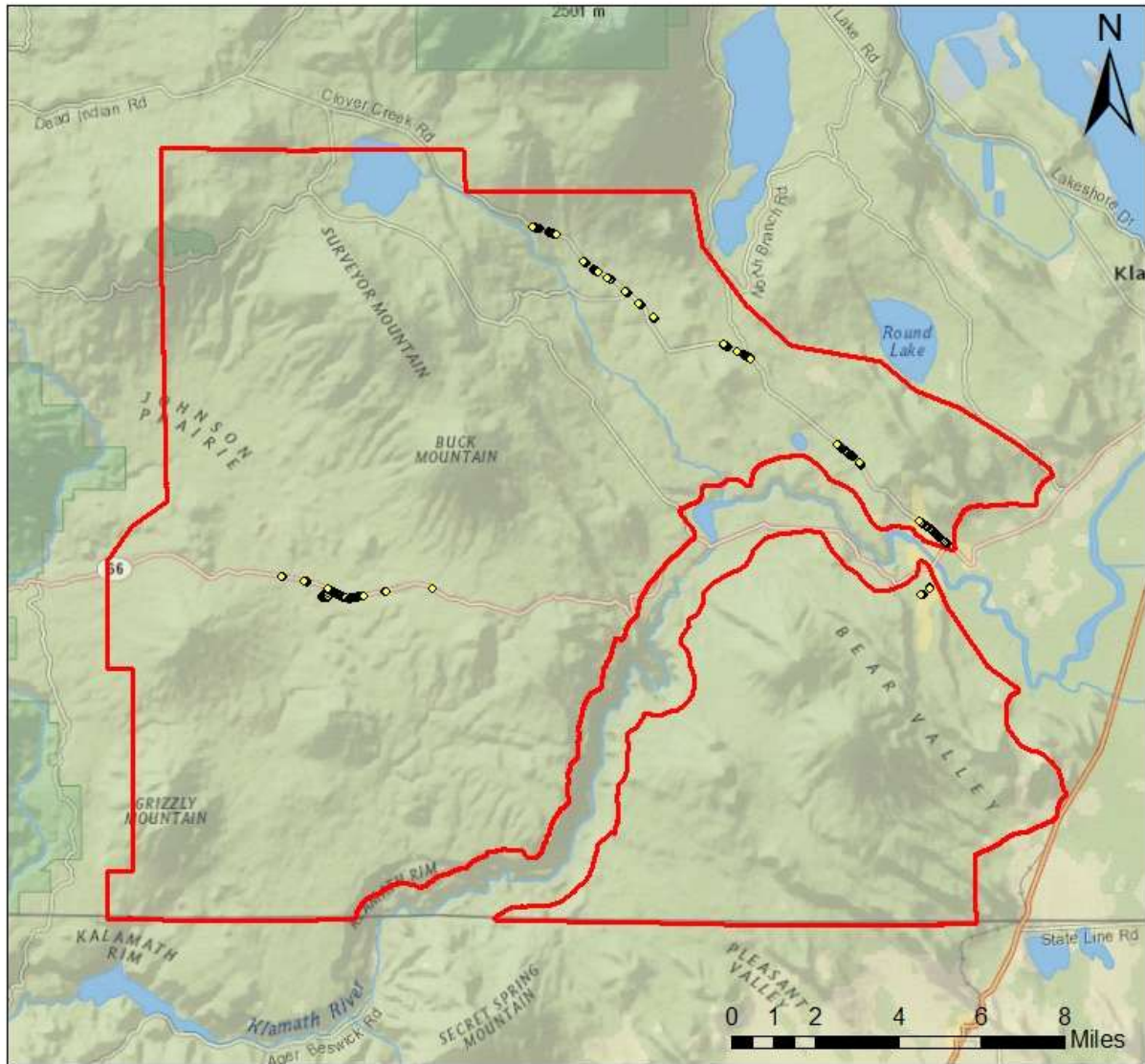
NSSDA and ASPRS require that a minimum of twenty checkpoints (thirty is preferred) are collected for each major land cover category represented in the LiDAR data. Checkpoints should be selected on flat terrain, or on uniformly sloping terrain in all directions from each checkpoint. They should not be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

# OR\_OLCKeno\_2012



Date: 3/27/2013

## Legend

- ◊ Keno\_RTK
- OR\_OLCKeno\_2012\_DEM\_ProjectFootprint\_fromTiles

Coordinate System: NAD 1983 UTM Zone 10N  
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 Datum: North American 1983  
 False Easting: 500,000.0000  
 False Northing: 0.0000  
 Central Meridian: -123.0000  
 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

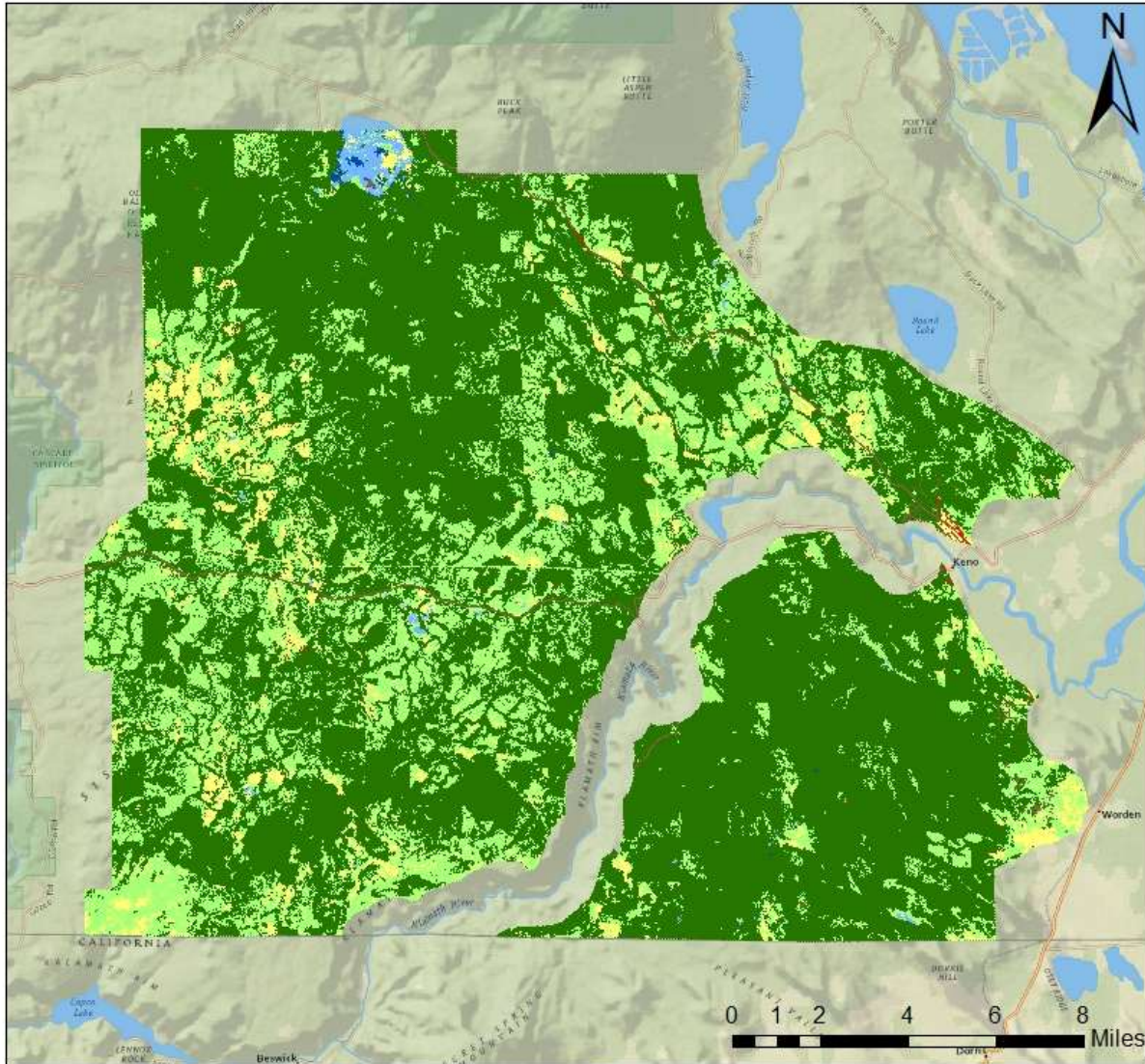
There are a minimum of 20 checkpoints for each land cover class represented. Points within each class are uniformly distributed throughout the dataset. USGS was able to locate independent checkpoints for this analysis. USGS accepts the quality of the checkpoint data for these LiDAR datasets.

Errors, Anomalies, Other Issues to document?  Yes  No

Image?



# OR\_OLCKeno\_2012



Date: 3/7/2013

## Legend

- Bare Earth
- Brushlands & Low Trees
- Forested Areas Fully Covered by Trees
- Open Water
- Swamp, Marsh, or Wetlands
- Tall Weeds & Crops
- Urban Areas with Dense Man Made Structures

Coordinate System: NAD 1983 UTM Zone 10N  
 Projection: Transverse Mercator  
 Datum: North American 1983  
 False Easting: 500,000.0000  
 False Northing: 0.0000  
 Central Meridian: -123.0000  
 Scale Factor: 0.9996  
 Latitude Of Origin: 0.0000  
 Units: Meter

Landcovers within the AOI.

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  international feet or less.

Target SVA Value is  international feet or less.

Required CVA Value is  international feet or less.

The reported FVA of the LAS Swath data is  international feet.

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

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

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?

Though swath was not delivered, swath FVA is given as: "Compiled to meet 0.24 ft. (0.07m) accuracy at 95% confidence level in open terrain."

Image?

Spatial Reference Information not defined in header.

Image?

Global Encoder ID not set to 1.

Image?

Tiles Overlap.

## 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</u> @95% Confidence Interval (Accuracy <sub>2</sub> ) Required FVA = 0.804	<u>Supplemental Vertical Accuracy</u> @95th Percentile Error Target SVA = 1.191 or less.	<u>Consolidated Vertical Accuracy</u> @95th Percentile Error Required CVA = 1.191 or less.

		or less.		
Open Terrain	752	0.4797		
<i>Tall Weeds and Crops</i>				
Brush Lands and Low Trees				
Forested Areas Fully Covered by Trees				
<i>Urban Areas with Dense Man-Made Structures</i>				
Consolidated	752			

QA performed Accuracy Calculations?

### Calculated Accuracies

Land Cover Category	# of Points	Fundamental Vertical Accuracy @95% Confidence Interval (Accuracy <sub>z</sub> ) Required FVA = 0.804 or less.	Supplemental Vertical Accuracy @95th Percentile Error Target SVA = 1.191 or less.	Consolidated Vertical Accuracy @95th Percentile Error Required CVA = 1.191 or less.
Open Terrain	752	0.48201		
<i>Tall Weeds and Crops</i>				
Brush Lands and Low Trees				
Forested Areas Fully Covered by Trees				
<i>Urban Areas with Dense Man-Made Structures</i>				
Consolidated	752			0.450195

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.

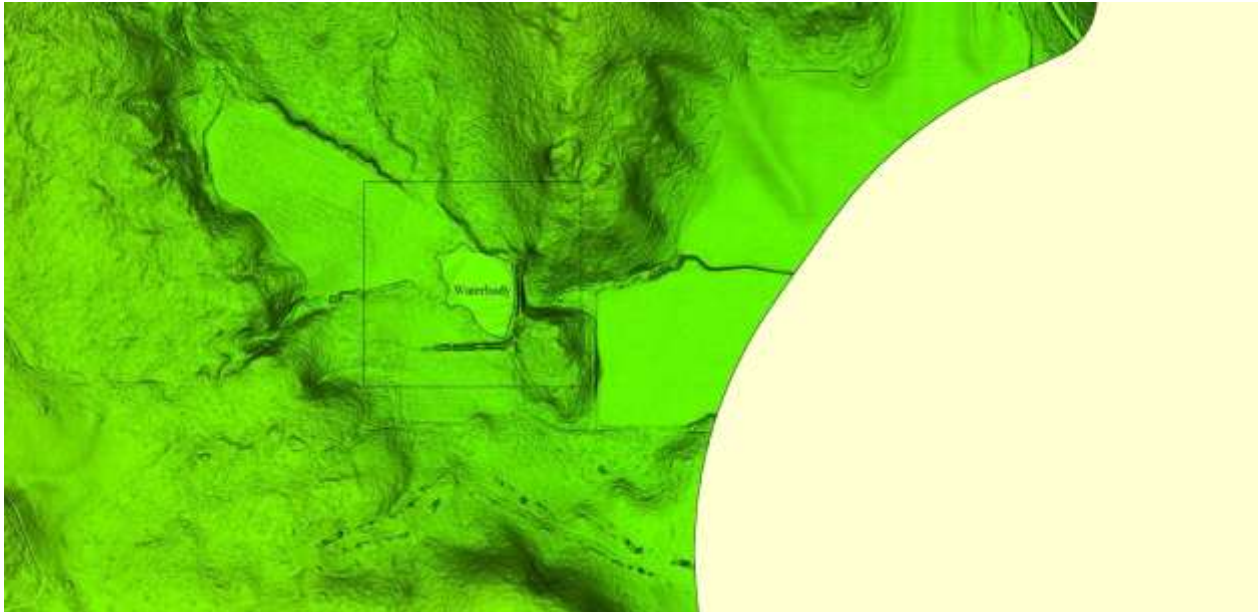
Bare-Earth DEM Anomalies, Errors, Other Issues

Errors, Anomalies, Other Issues to document?  Yes  No

Image?

Tiles Overlap, no edge artifacts observed, Final to NED Mosaic not impacted.

Image?



A few areas with Waterbodies greater than 2 Acers were detected, as hydroflattening was not performed on this project, USGS, decided to flatten these in the final to NED mosaic because there were only a few waterbodies in question.

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

QA Form V1.4 12OCT11.xsn

