



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:
4/30/2012

Project ID:
MO_NewMadrid-DOGAMI_2012

Project Alias(es):
New Madrid Mo.

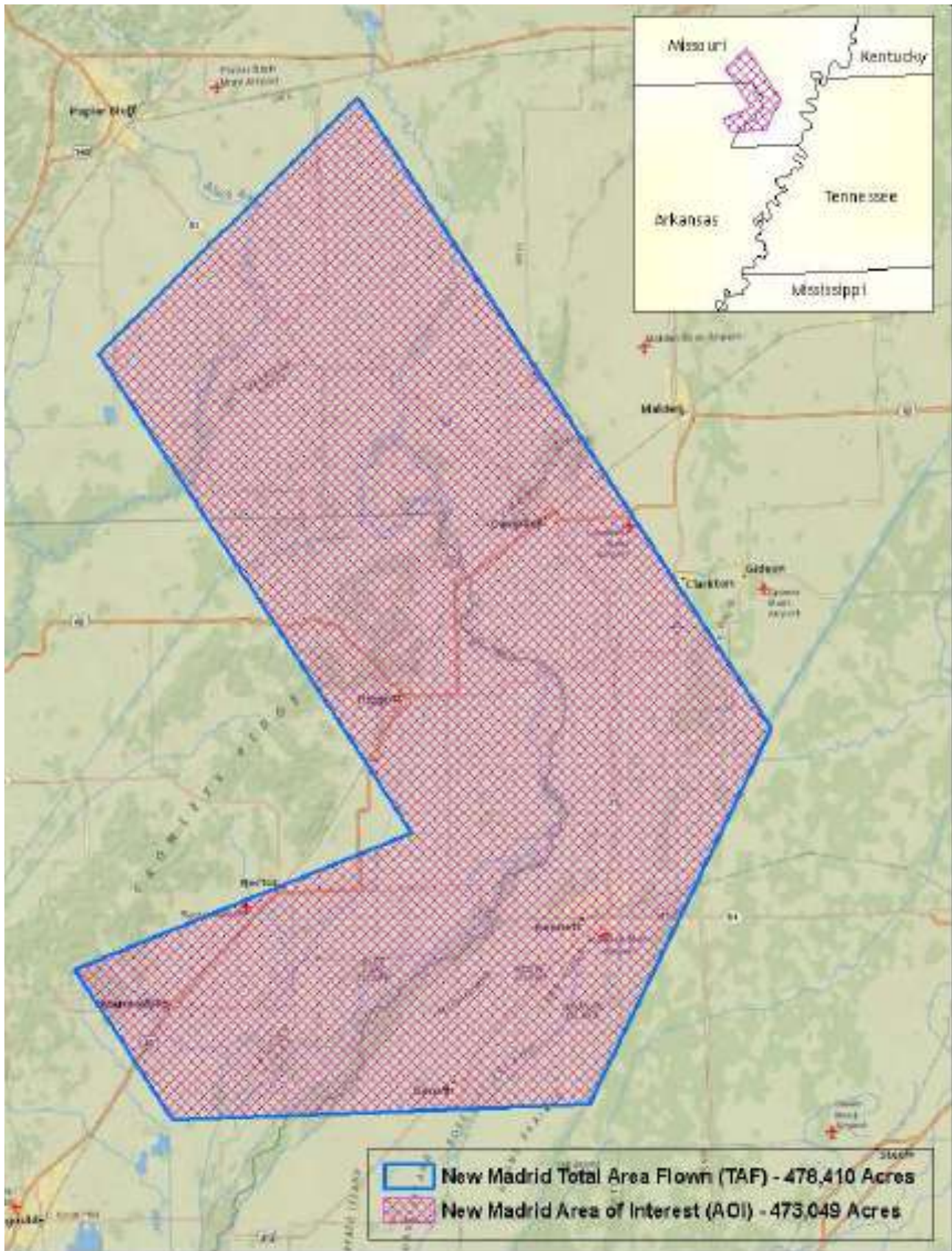
Project Type: Donated Data

Project Description:
Watershed Sciences, Inc. has collected Light Detection and Ranging (LiDAR) data of the New Madrid Study Area for the Oregon Department of Geology and Mineral Industries (DOGAMI).
The New Madrid seismic zone (NMSZ) has been responsible for producing some of the largest intraplate earthquakes on record. Risk management, hazard mitigation, and the advancement of the body of knowledge in geologic research for the NSMZ support the critical relevance for high accuracy, high resolution environmental data for this area, represented by the present dataset.

Year of Collection: 2012

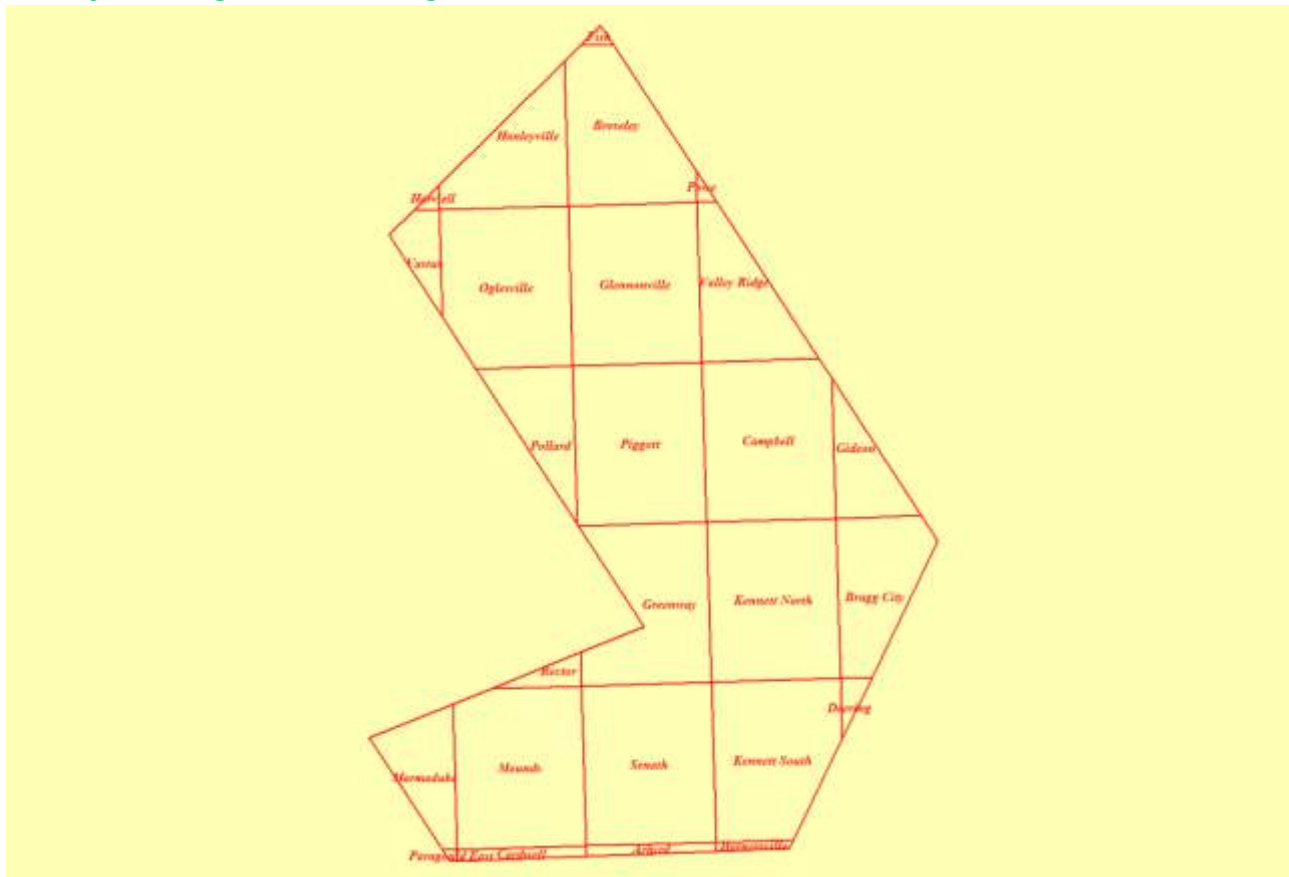
Lot 1 of 1 lots.

Project Extent:
 Project Extent image?



Project Tiling Scheme:

Project Tiling Scheme image?



Contractor:

Watershed Sciences Inc.

Applicable Specification:

version 12 is assumed, information is n...

Licensing Restrictions:

Third Party Performed QA?

Project Points of Contact:

POC Name	Type	Primary Phone	E-Mail
Ray Fox	NSDI Liaison	573-308-3744	rfox@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?	
<input checked="" type="checkbox"/> Intensity Image Files <input type="checkbox"/> Required?	1355
<input checked="" type="checkbox"/> Tiled LAS Files <input checked="" type="checkbox"/> Required? <input type="checkbox"/> XML Metadata?	1355
<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?	26

Ground Density Rasters, Highest Hit (All points DEMS), Intensity .tifs

Errors, Anomalies, Other Issues to document? Yes No

Missing Deliverables:

FGDC compliant .las and project Metadata
Swath/Flightline .las
Breaklines & metadata (project has not been hydro flattened)
Supporting documentation such as
Survey Report
Calibration Report
QA QC reports

Other problems and issues:

DEMs have not been hydro flattened
DEM tiles overlap
DEM tiles are not all the same size
DEM and LAS have different tiling schemes
Project collection methods specification and version are not provided in Metadata
Control points provided are not randomly spaced, are all attributed as Hard Surface, collected in clusters along the shoulder of paved highways.
Nominal Point Spacing (NPS) is not provided in any of the provided documentation

Project Geographic Information

Areal Extent: Sq Mi

Grid Size: meters

Tile Size:

Nominal Pulse Spacing: Select...

Vertical Datum: Select...

Horizontal Datum: Select...

Project Projection/Coordinate Reference System: 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 checked="" 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 |

NOT PROVIDED WITH DELIVERY
 Classified LAS XML Metadata CRS
 NOT PROVIDED WITH DELIVERY
 Breakline XML Metadata CRS
 NOT PROVIDED WITH DELIVERY
 Swath LAS Files CRS
 NOT PROVIDED WITH DELIVERY
 Breakline Files CRS
 NOT PROVIDED WITH DELIVERY

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.

Project XML Metadata was not provided with the delivery...

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

```
Error (line 2): City is not permitted in Metadata
Error (line 2): Country is not permitted in Metadata
Error (line 3): City is not permitted in Metadata
Error (line 3): Country is not permitted in Metadata
Error (line 3): City is not permitted in Metadata
Error (line 3): Country is not permitted in Metadata
Error (line 2): Identification_Information is required in Metadata
Error (line 2): Metadata_Reference_Information is required in Metadata
8 errors: 6 misplaced, 2 missing
```

Project QA/QC Report Review

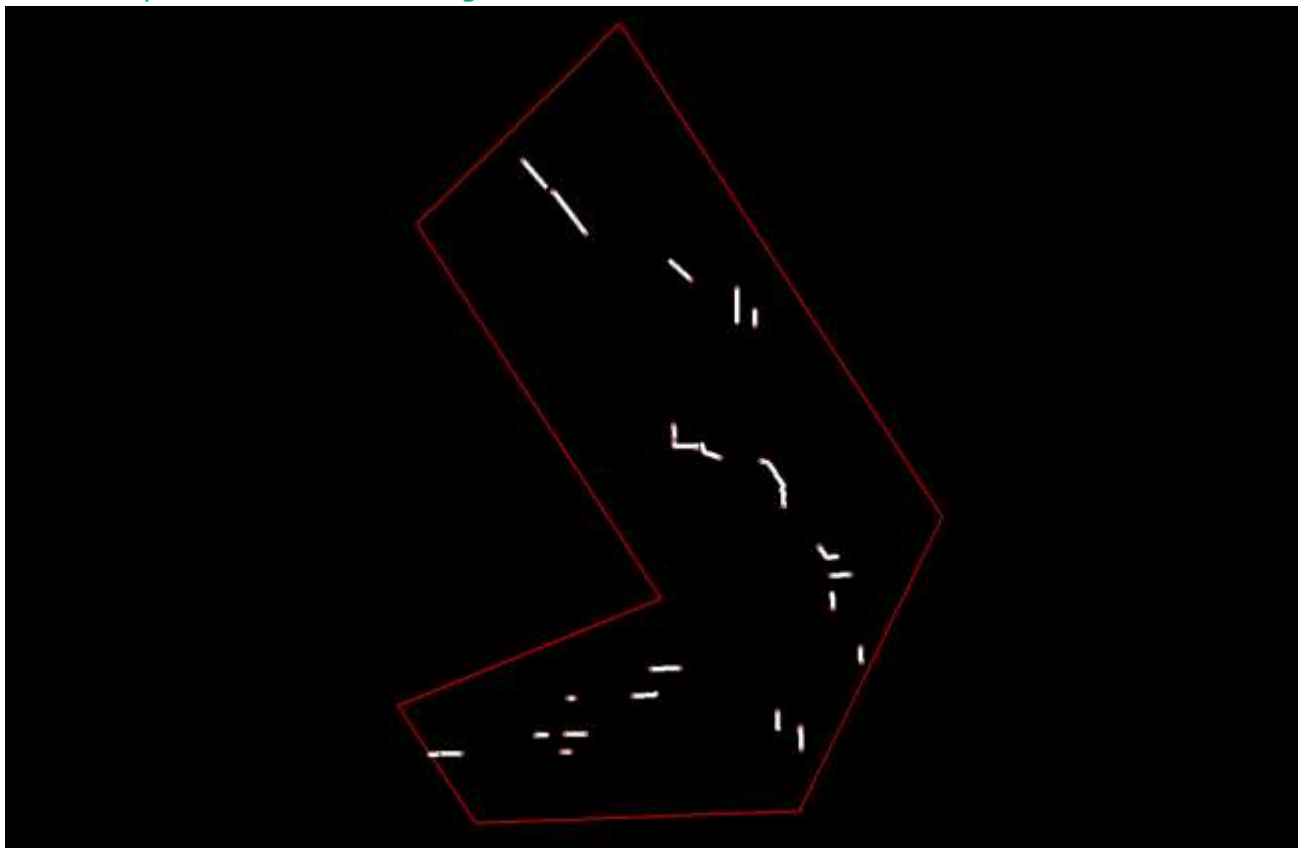
ASPRS recommends that checkpoint surveys be used to verify the vertical accuracy of LiDAR data sets. Checkpoints are to be collected by an independent survey firm licensed in the particular state(s) where the project is located. While subjective, checkpoints should be well distributed throughout the 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?



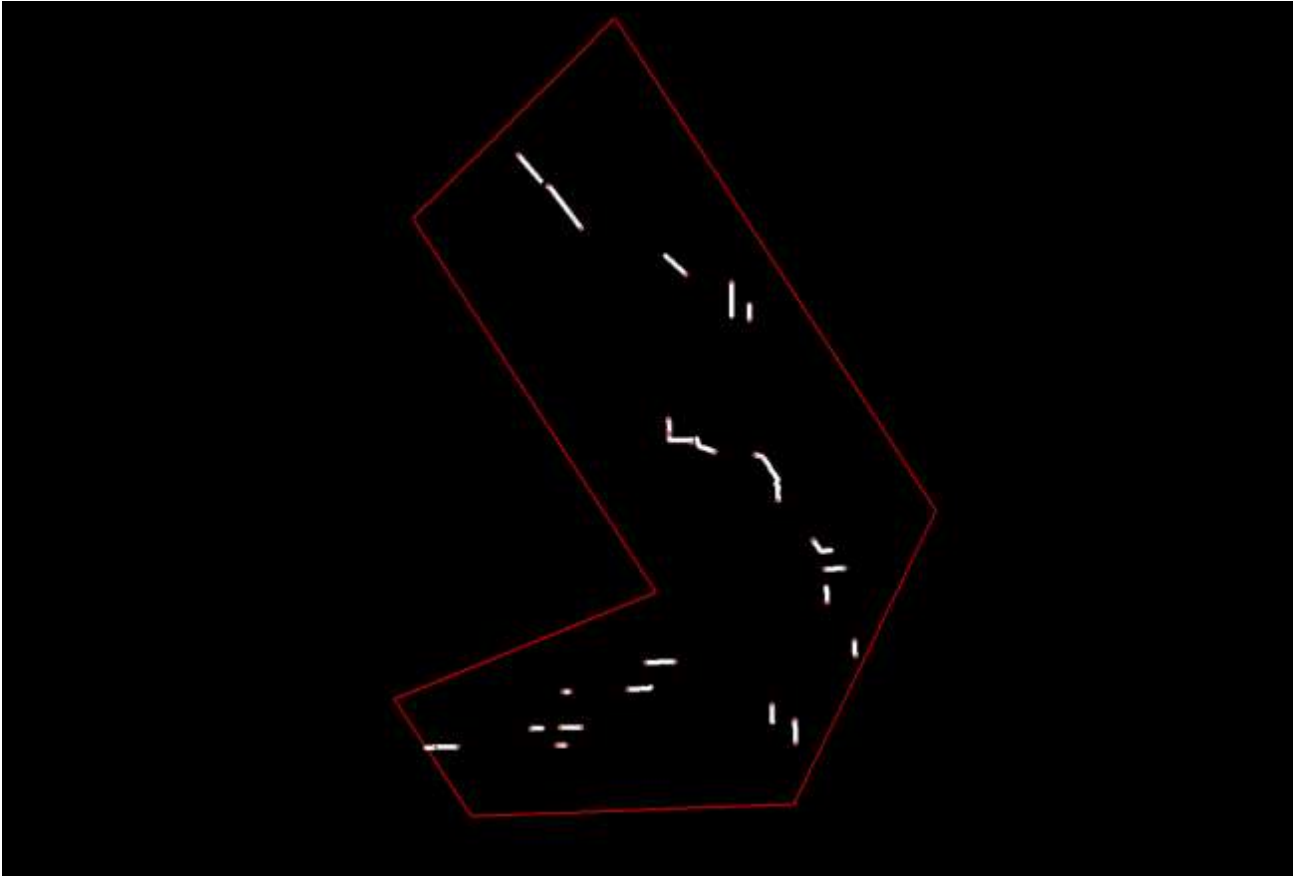
The following land cover classes are represented in this dataset (uncheck any that do not apply):

- 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 does not accept at this time the quality of the checkpoint data for these LiDAR datasets.

Errors, Anomalies, Other Issues to document? Yes No

Image?



Points are not randomly distributed throughout the dataset. All points have been collected as hard surface and appear to have all been collected on the shoulder of paved roads and or highways.

Image?

3.2 Fundamental Vertical Accuracy

FVA accuracy reporting is designed to meet guidelines presented in the National Standard for Spatial Data Accuracy (NSSDA) (FGDC, 1998). FVA compares known RTK ground survey points to the closest laser point. FVA uses ground control points in open areas where the LiDAR system has a "very high probability" that the sensor will measure the ground surface and is evaluated at the 95% percentile of $RMSE_z$. For the New Madrid Study Area, 7,463 RTK points were collected for data delivered to date.

For this project, no independent survey data were collected, nor were reserved points collected for testing. As such, vertical accuracy statistics are reported as "Compiled to Meet," in accordance with the ASPRS Guidelines for Vertical Accuracy Reporting for LiDAR Data V1.0 (ASPRS, 2004). Fundamental Vertical accuracy is reported for the portion of the study area shown in Figure 3.4 and reported in Table 3.1 below. Histogram and absolute deviation statistics are reported in Figures 3.5 and 3.6.

Table 3.1. *Fundamental Vertical Accuracy - Deviation between laser points and RTK survey points.*

Sample Size (n): 7,463	
Root Mean Square Error (RMSE): 0.03 m	
Fundamental Vertical Accuracy: Compiled to Meet 0.33 ft. (0.10m) fundamental vertical accuracy at 95% confidence level ($1.96 \times RMSE_z$) in	
Standard Deviations	Deviations
1 sigma (σ): 0.02 m	Minimum Δz : -0.08
2 sigma (σ): 0.03 m	Maximum Δz : 0.07 m
	Average Δz : -0.01

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

The reported CVA of this data set is: N/A meters.

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?

All classified LAS appear to be version 1.2
Classified .las is either 1 unclassified or 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 = not known due to 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="0.058"/>		
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?

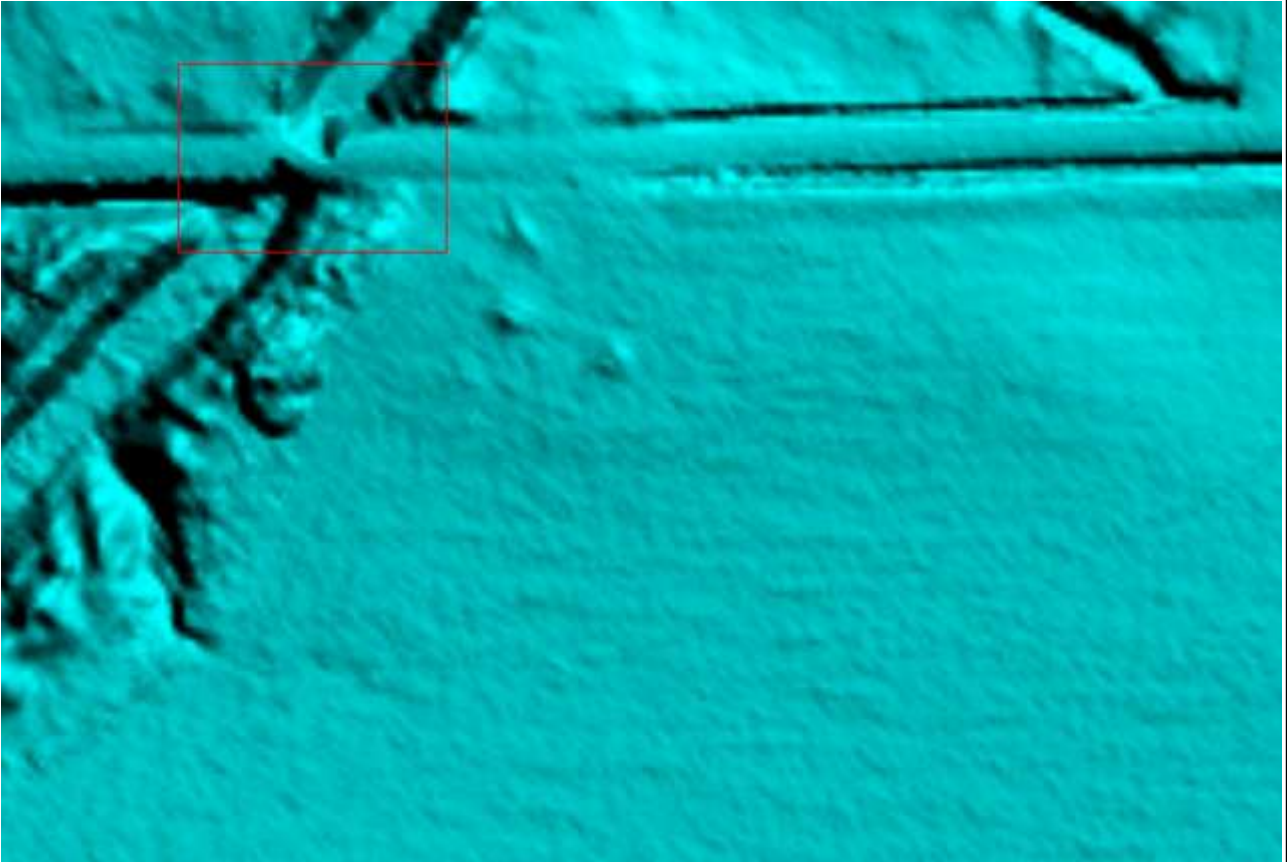
Based on this review, the USGS does not recommend the bare-earth DEM files for inclusion in the 1/3 Arc-Second National Elevation Dataset.

Based on this review, the USGS does not accept at this time the bare-earth DEM files.

Bare-Earth DEM Anomalies, Errors, Other Issues

Errors, Anomalies, Other Issues to document? Yes No

Image?



one culvert was found partially removed. culverts are not required to be removed.
culvert location 36° 30' 55.9113" N, 90° 14' 29.1895" W

Internal Note:

This project is recommended for CLICK only. DEM files for this project HAVE NOT been hydro flattened....and therefore are not recommended for inclusion into the NED.

NGTOC did not perform accuracy testing. Blind points were not provided for this project.

This is the end of the report.

QA Form V1.4 12OCT11.xsn