



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:
5/18/2011

Project Type: Donated Data

Project ID:
ARRA Contract # W912EE-07-D-0005

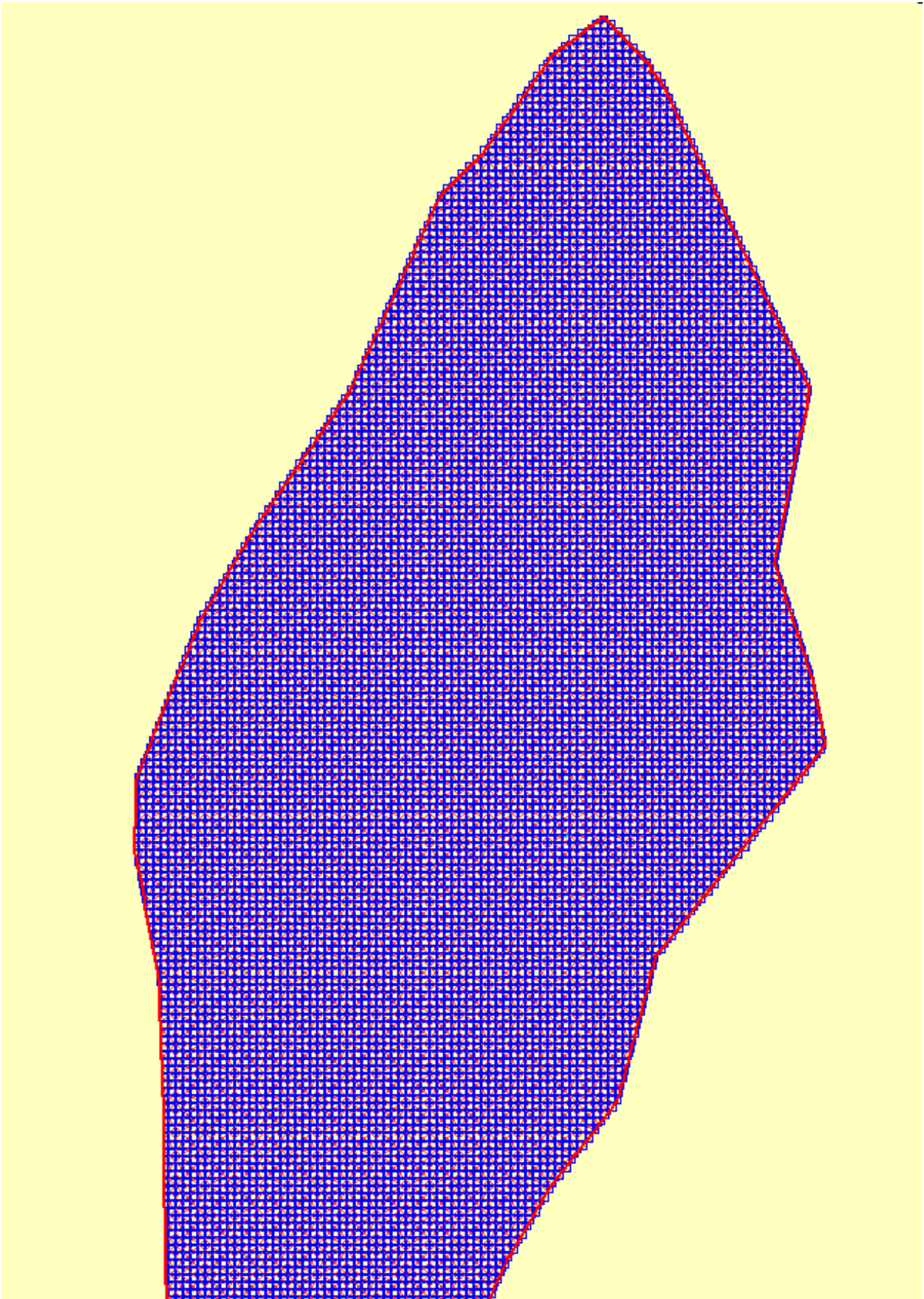
Project Description:
MS Delta Yazoo Phase 1 2009-2010 LiDAR encompassing all of Tunica, Coahoma, Quitman, Tallahatchie, Leflore, Sunflower, Bolivar, Washington, Humphreys, Sharky and Issaquena Cos., and the western-central area of Warren, Yazoo, Holmes, Carroll, Grenada, Yalobusha, Panola, Tate and Desoto Cos. in Mississippi. Contract W912EE-07-D-0005

Project Alias(es):

Year of Collection: 2009-2010

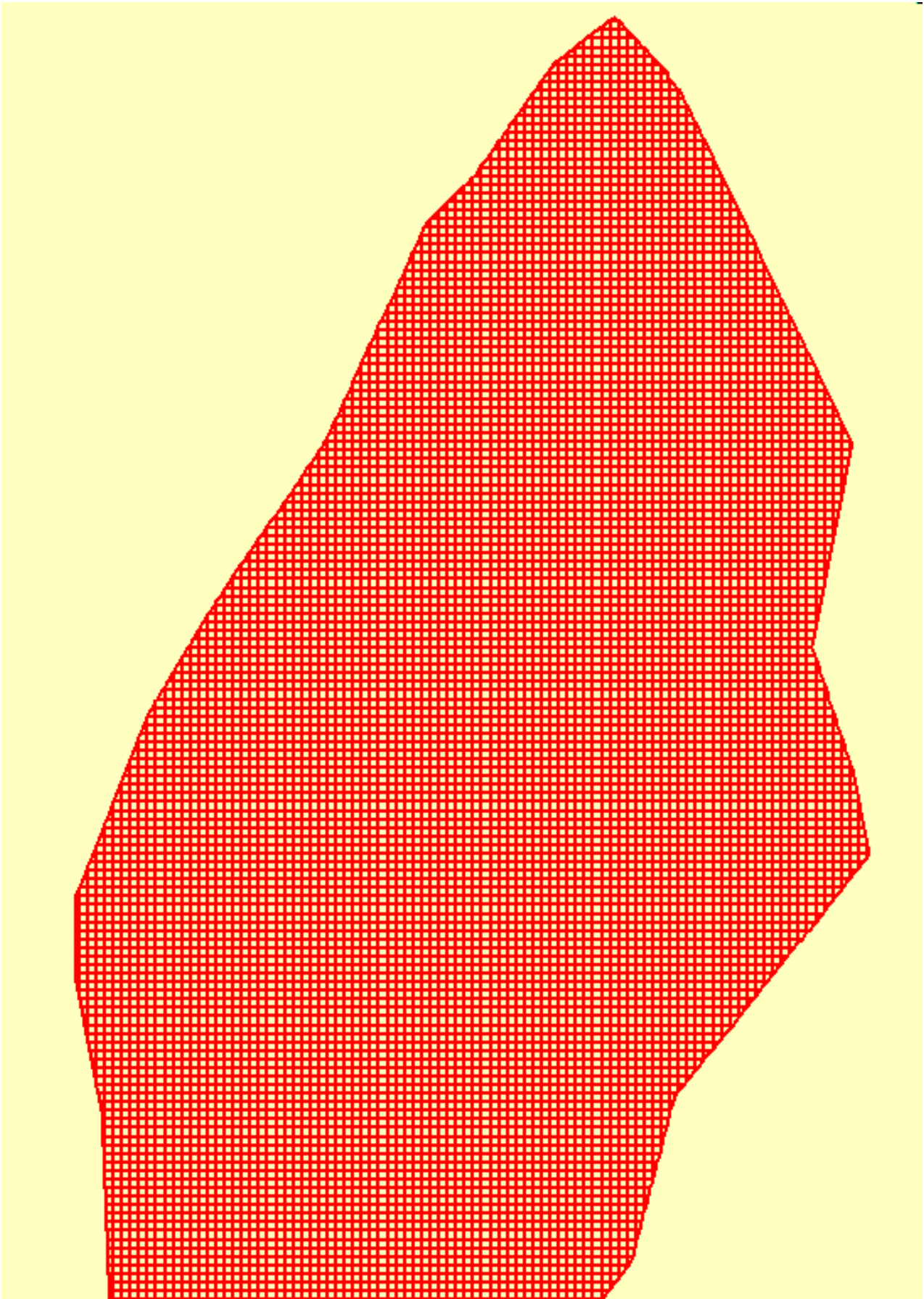
Lot 1 of 2 lots.

Project Extent:
 Project Extent image?



Project Tiling Scheme:

Project Tiling Scheme image?



Contractor:

Photo Science, Inc.

Applicable Specification:

unknown

Licensing Restrictions:

Third Party Performed QA?

Third Party QA Performed By:

Third Party QA review and accepted by The Army Corps of Engineers at Vicksburg MS.

Project Points of Contact:

POC Name	Type	Primary Phone	E-Mail
George Heleine	NSDI Liaison	601 -933-2950	gheleine@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 type="checkbox"/> Collection Report | <input checked="" type="checkbox"/> Project Tiling Scheme Shapefile/Gdb |
| <input type="checkbox"/> Survey Report | <input checked="" type="checkbox"/> Breakline Shapefile/Gdb |
| <input type="checkbox"/> Processing Report | <input checked="" type="checkbox"/> Project XML Metadata |
| <input type="checkbox"/> QA/QC Report | <input type="checkbox"/> Swath LAS XML Metadata |
| <input type="checkbox"/> Control and Calibration Points | <input checked="" type="checkbox"/> Classified LAS XML Metadata |
| <input checked="" type="checkbox"/> Project Shapefile/Geodatabase | <input checked="" type="checkbox"/> Breakline XML Metadata |
| <input type="checkbox"/> Control Point Shapefile/Gdb | <input checked="" type="checkbox"/> Bare -Earth DEM XML Metadata |

Multi-File Deliverables

File Type	Quantity
<input type="checkbox"/> Swath LAS Files	0
<input type="checkbox"/> Intensity Image Files	0
<input checked="" type="checkbox"/> Tiled LAS Files	11305
<input checked="" type="checkbox"/> Breakline Files	9270
<input checked="" type="checkbox"/> Bare-Earth DEM Files	11300

Additional Deliverables

	Item
<input checked="" type="checkbox"/>	10 foot Contours; ASCII LP (all shots) Elipsoidal and Orthometric; Arc Generated bre...

Errors, Anomalies, Other Issues to document? Yes No

The version for which the data was collected and processed is not provided in the metadata.

Project Geographic Information

Areal Extent:

9855
<u>Sq Mi</u>
Grid Size:
5
<u>U.S. Feet</u>
Tile Size:
5010x5005
<u>U.S. feet</u>
Nominal Pulse Spacing :
1
<u>meters</u>
Vertical Datum: <input type="text" value="NAVD88"/> <u>Select...</u>
Horizontal Datum: <input type="text" value="NAD83"/> <u>Select...</u>

Project Projection/Coordinate Reference System:
 U.S. feet.

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

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

<input type="text" value="Check Point Shapefile/Geodatabase CRS"/>
<input type="text" value="Control points were not provided with this project"/>
<input type="text" value="Swath LAS XML Metadata CRS"/>
<input type="text" value="Swath metadata was not provided with this project"/>
<input type="text" value="Swath LAS Files CRS"/>
<input type="text" value="Swath was not provided with this project"/>

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:

S. Ruhl / T. Jerris

Review Start Date:

11/23/2011

Action to Contractor Date	Issue Description	Return Date
12/1/2011	<p>A total of 147 errors were found:</p> <p>These errors include floating water, seams, stream segments and water bodies that need flattened, bridge remnants, improperly processed or missing data in complete tiles, steep shorelines due to wrongly attributed breaklines, and spikes.</p> <p>An example of each error has been provided in the Bare Earth Tile Review section.</p> <p>An error shapefile of all errors found has been created.</p>	12/5/2011
6/12/2012	<p>**All the errors noted above have been fixed by the vendor; additional errors were encountered after a secondary review of the dataset. Images and explanations of the errors may be found in this report.</p>	

Review Complete: 9/26/2012

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 without errors.

The Swath LAS XML Metadata file parsed without errors.

The Classified LAS XML Metadata file parsed withouterrors.

The Breakline XML Metadata file parsed withouterrors.

The Bare-Earth DEM XML Metadata file parsed withouterrors.

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?

Control points were not provided with this dataset

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

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 meters.

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

Errors, Anomalies, Other Issues to document? Yes No

Image?

Swath was not delivered with this dataset

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 or other issues Yes No

Image?

Class 12 exists in classified LAS.

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 accepts the breakline files.

Errors, Anomalies, Other Issues to document? Yes No

None.

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 ₂) Required FVA = 0.15 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="0.09"/>		
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 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

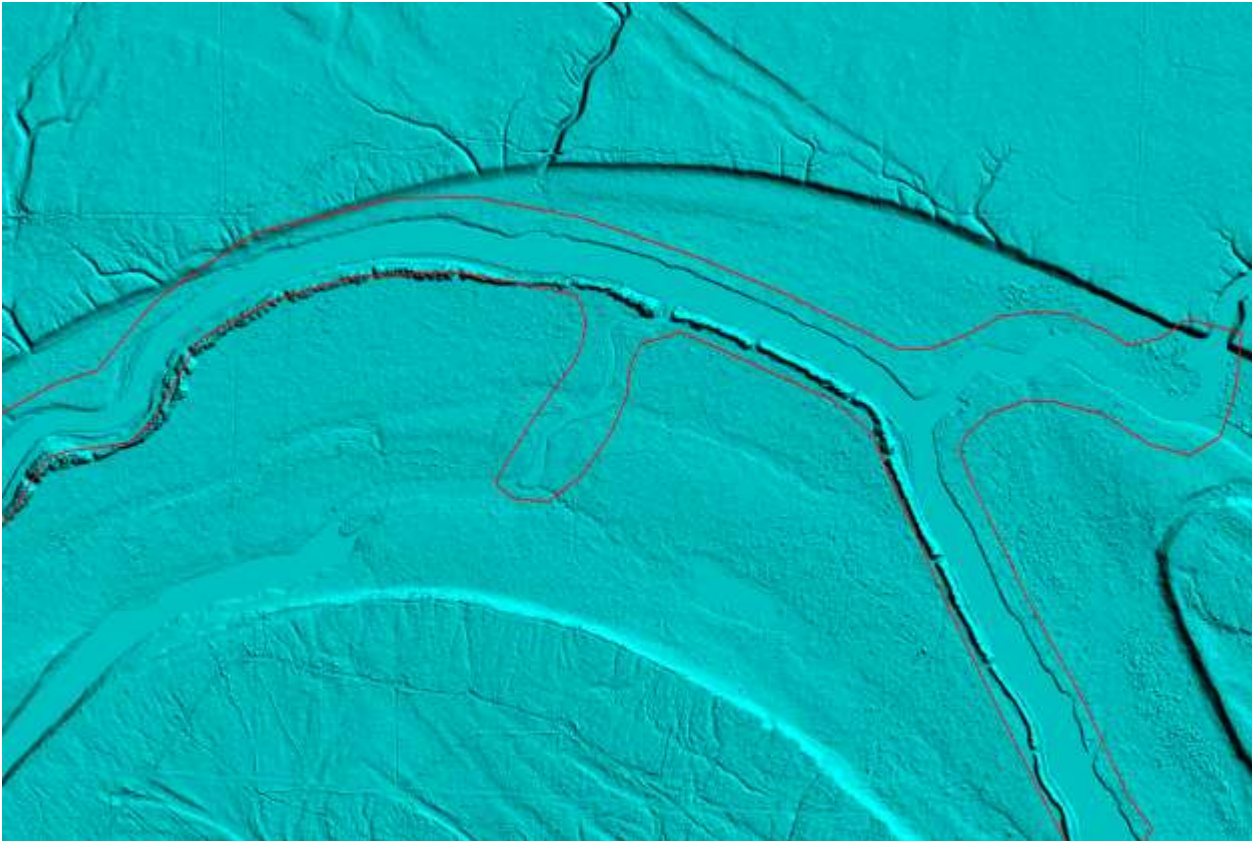
Errors, Anomalies, Other Issues to document? Yes No

Image?

There are a total of 147 errors found in the DEM. Representative examples of each error are shown below.

Photo Science bridge removal for this project "overall" is excellent.

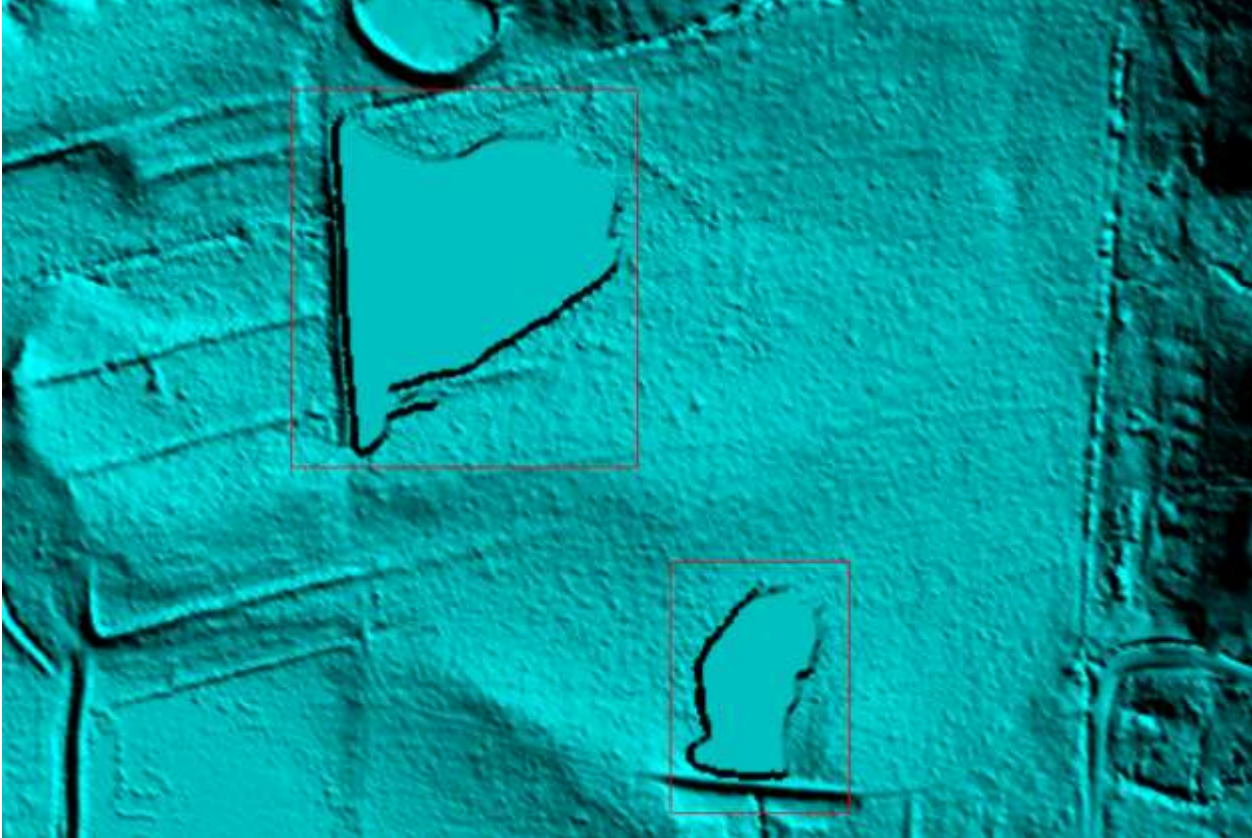
Image?



Floating water in stream located @ 32° 29' 18.5772" N, 90° 54' 36.6213" W

**Fixed by vendor.

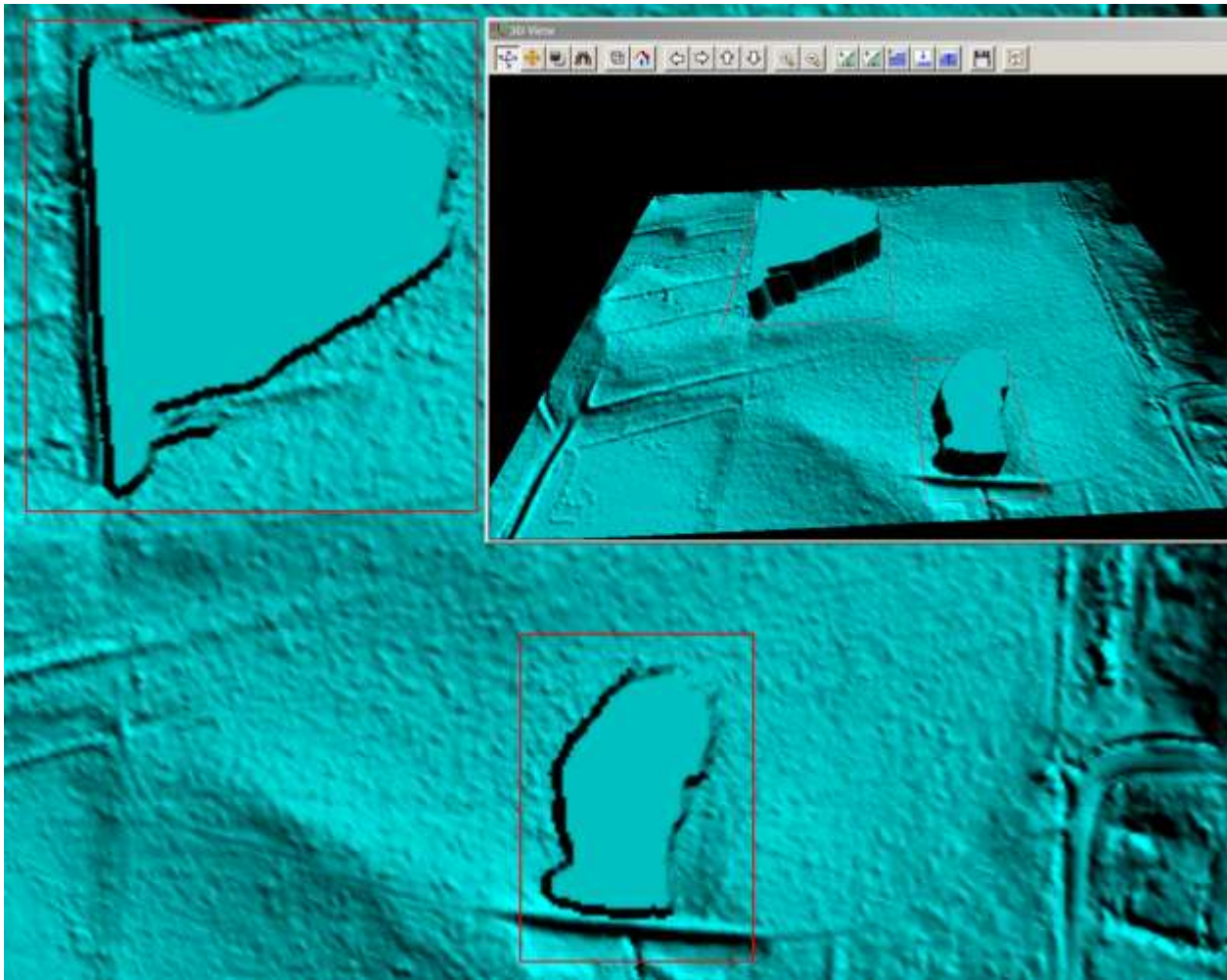
Image?



2 extremely high floating water bodies @ 33° 45' 29.7636" N, 89° 46' 35.9173" W

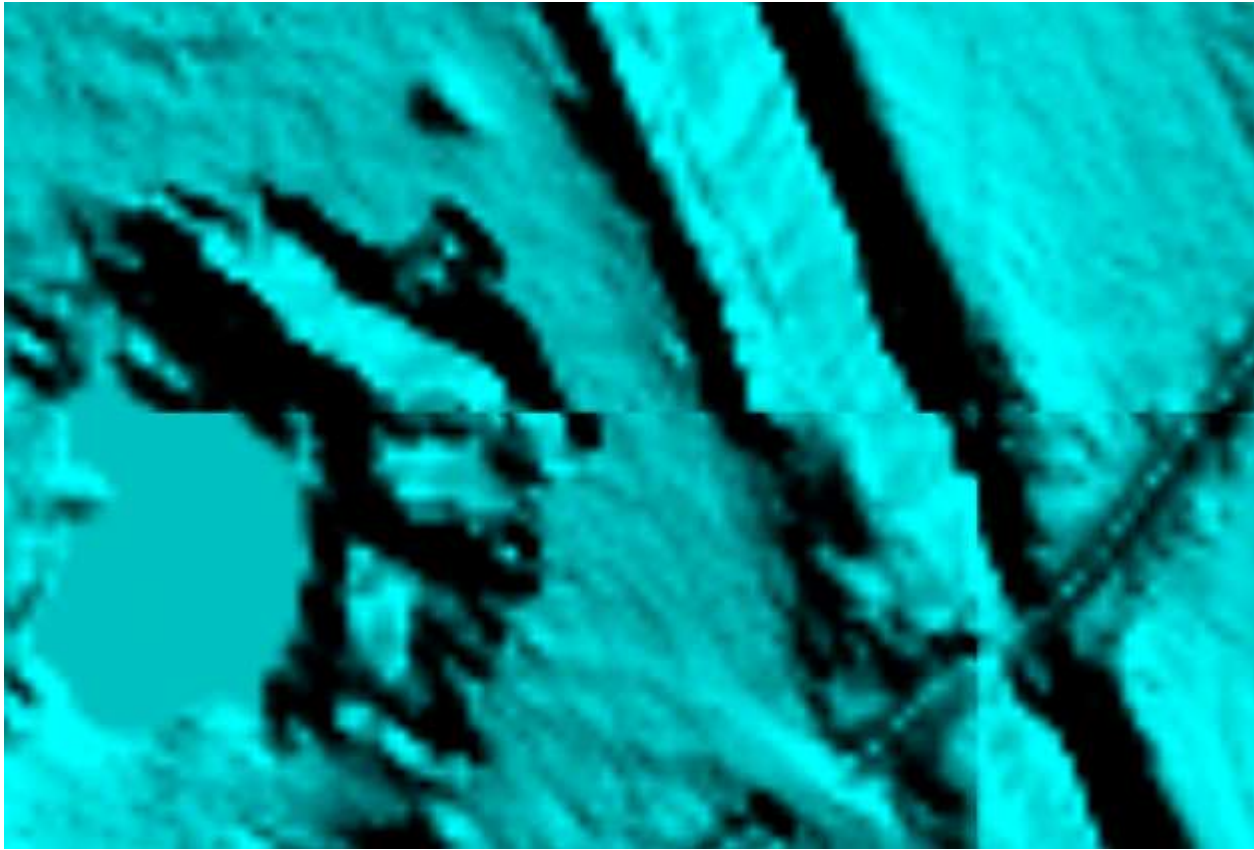
**Fixed by vendor.

Image?



extremely high floating water bodies in 3 D

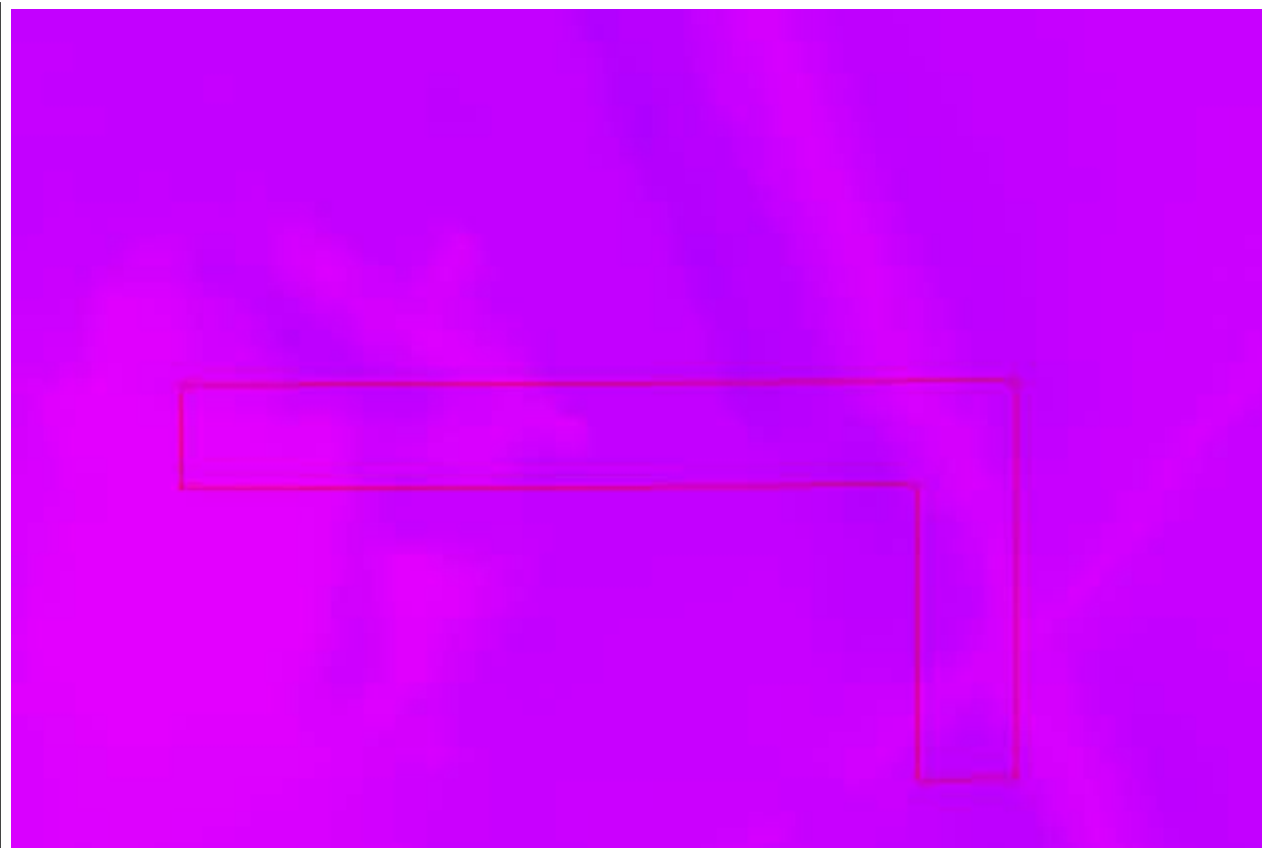
Image?



Seam visible in DEM @ 34° 09' 58.2775" N, 90° 32' 12.9043" W

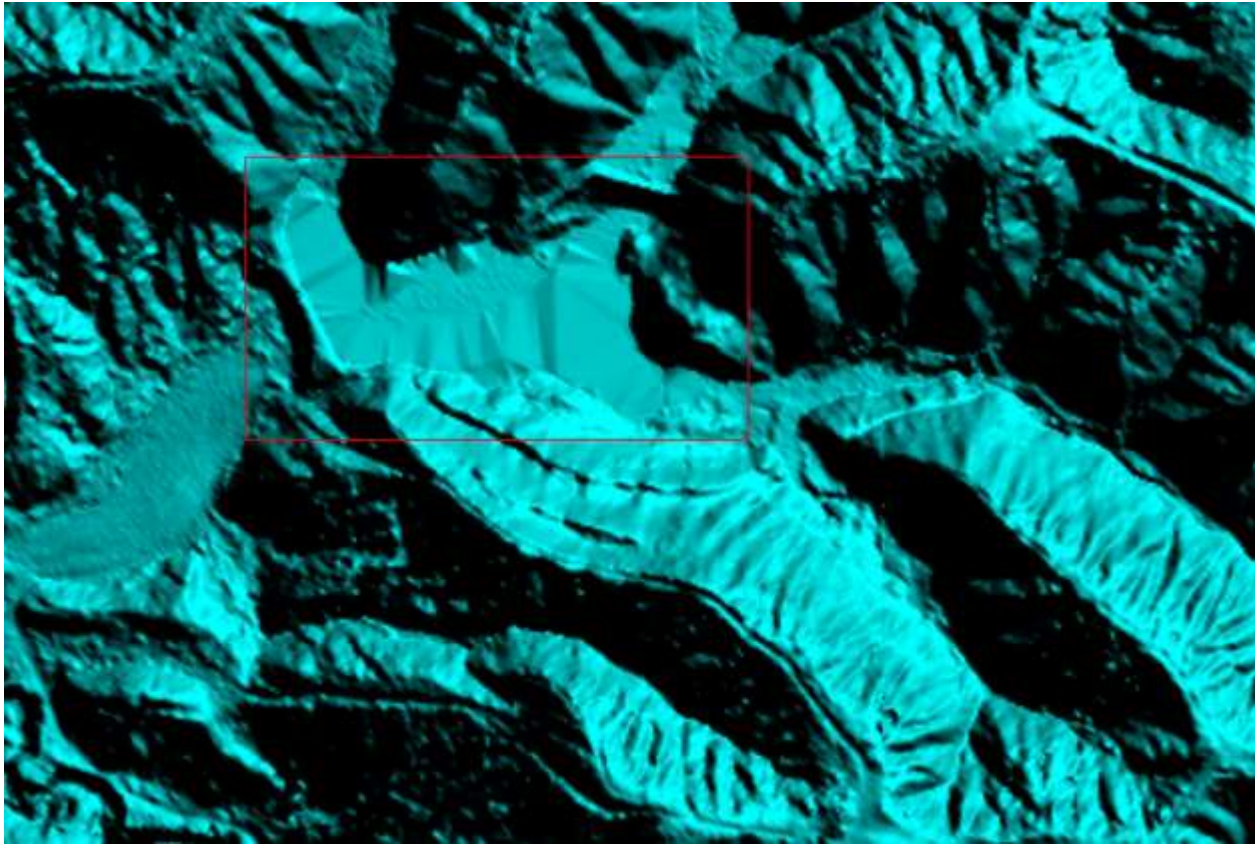
**Fixed by vendor.

Image?



seam visible in DEM with hillshade off

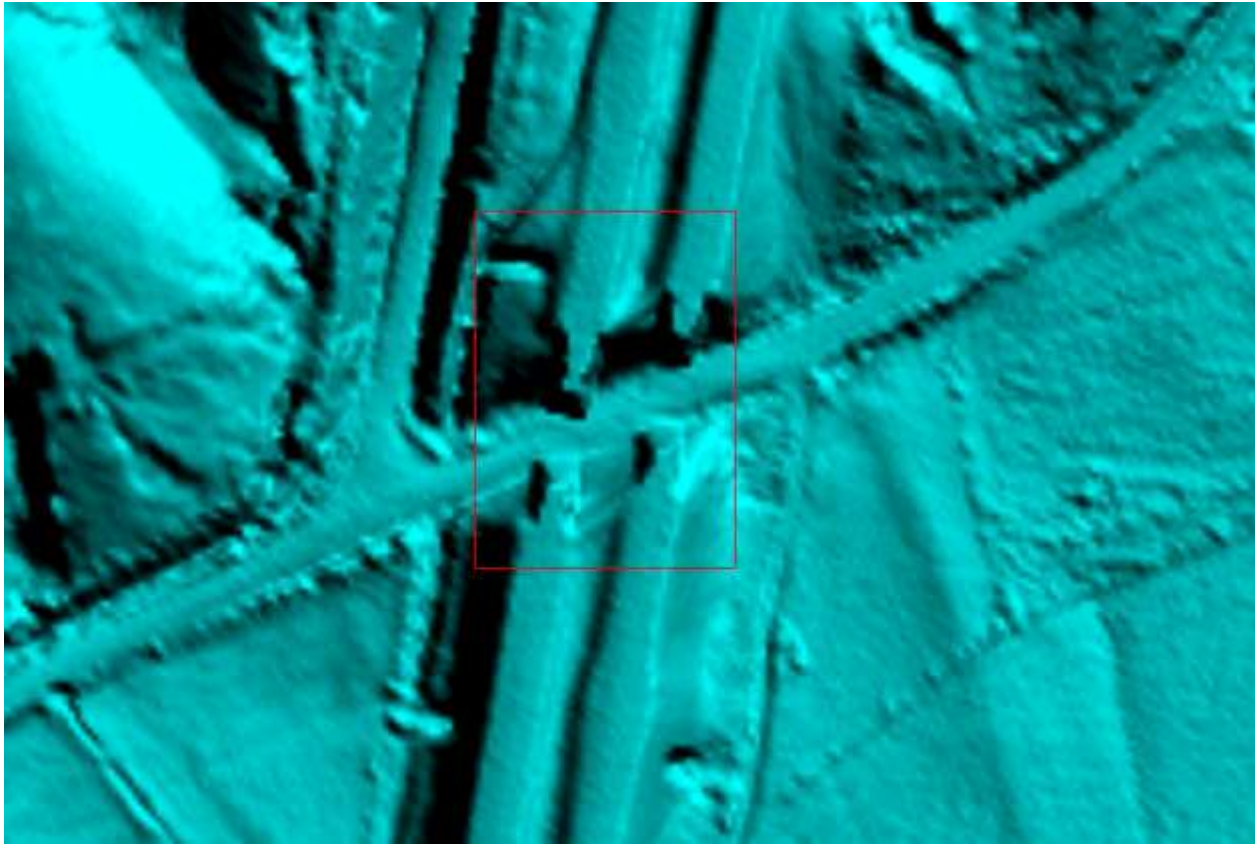
Image?



water body > 2 acres to be flattened @ 32° 34' 45.3030" N, 90° 36' 58.8762" W

**Fixed by vendor.

Image?



bridge remnants located @ 34° 22' 35.9114" N, 89° 54' 36.4581" W

**Fixed by vendor.

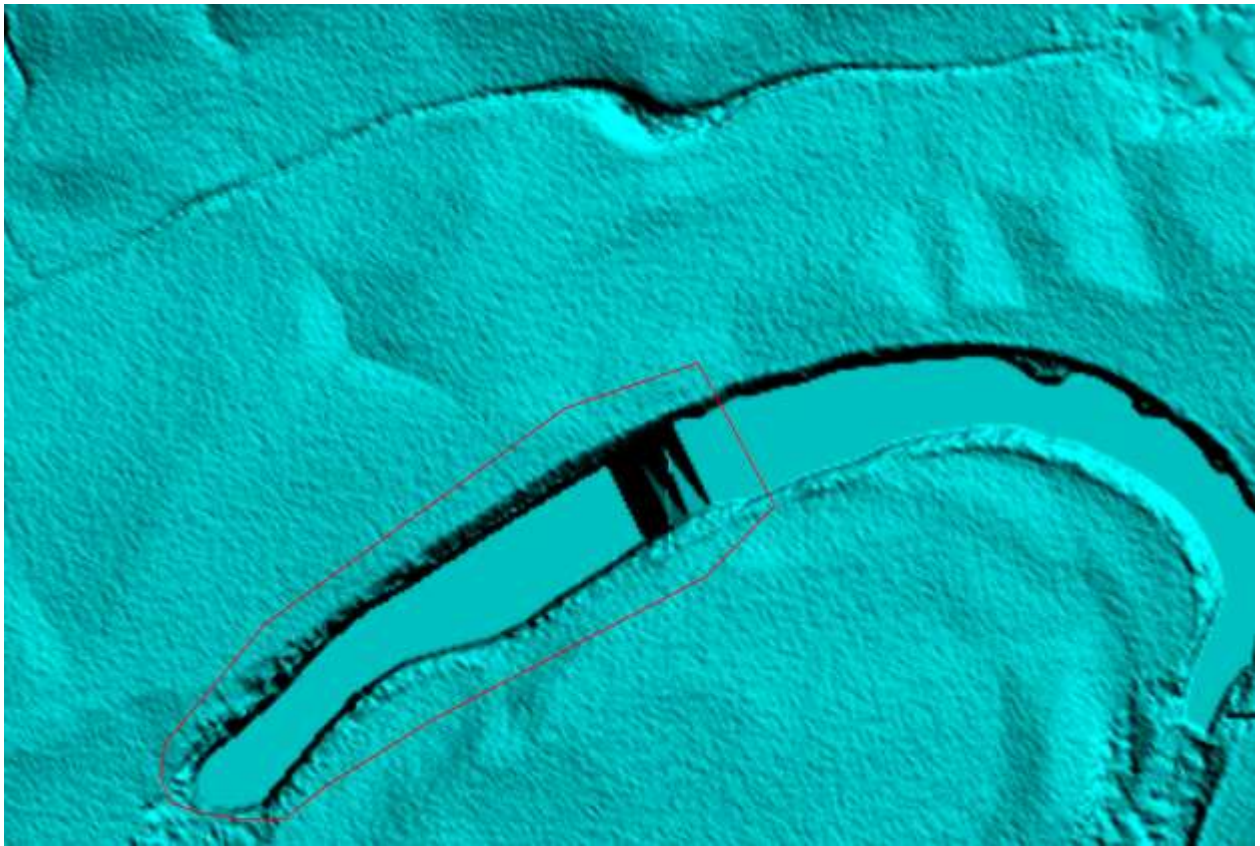
Image?



improperly processed data in 2 tiles @ 33° 30' 49.2868" N, 90° 36' 4.9846" W

**Fixed by vendor.

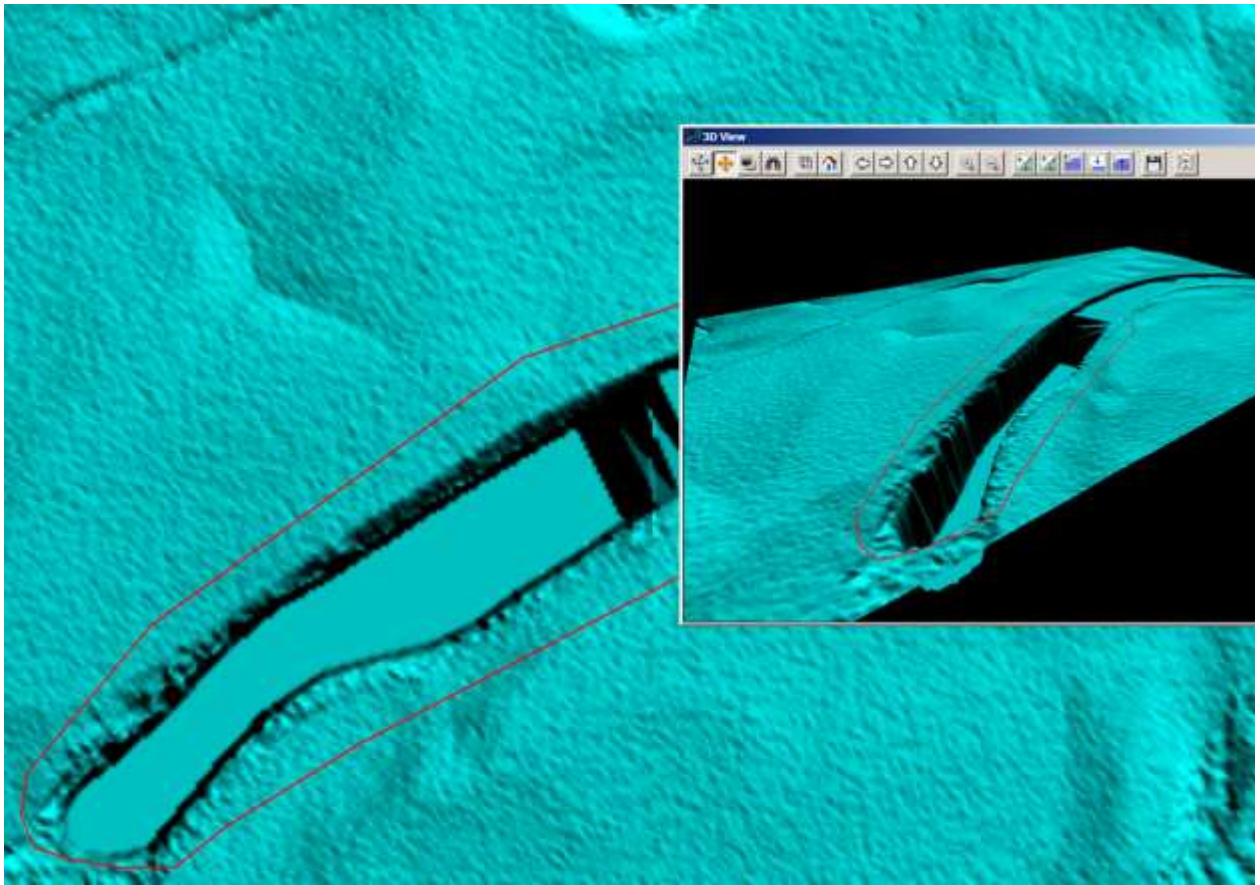
Image?



shoreline too deep due to breaklines @ 33° 49' 52.6121" N, 90° 09' 30.9743" W

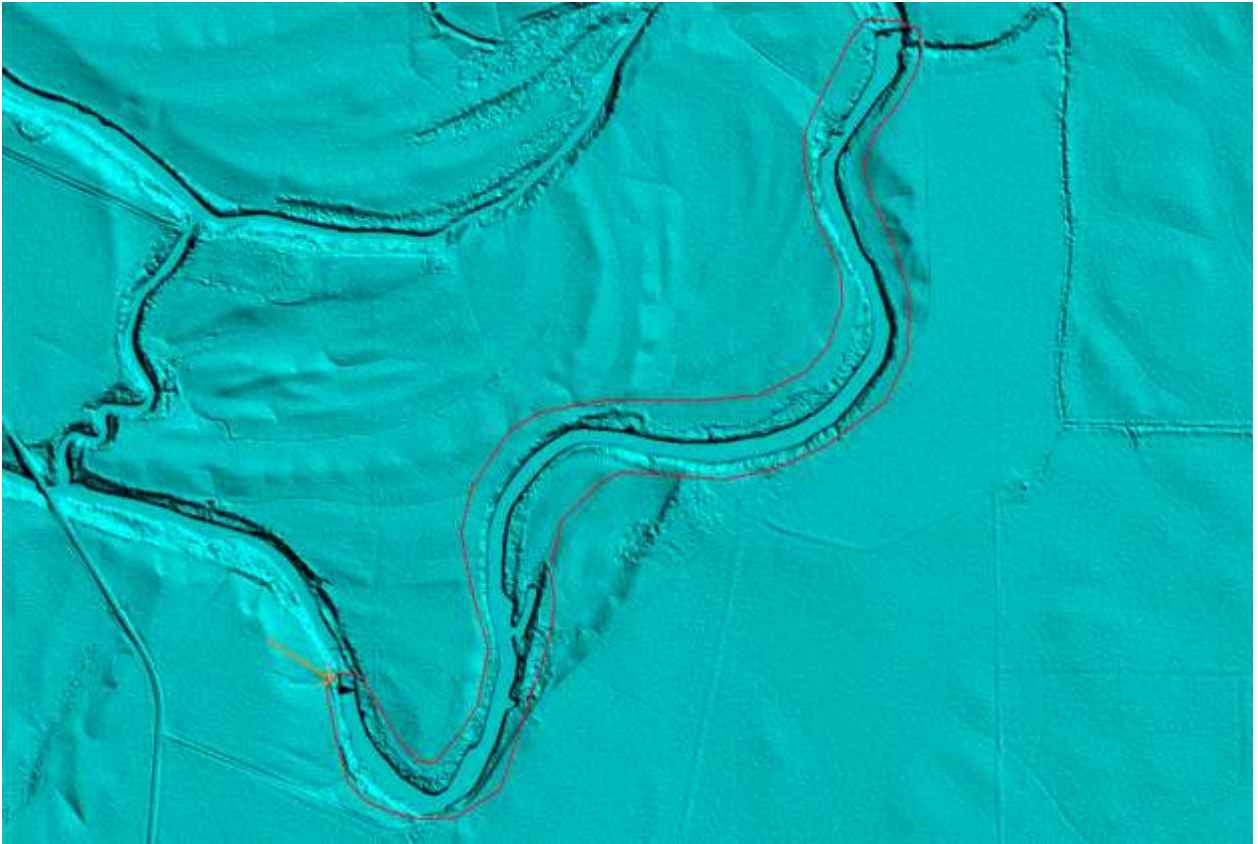
**Fixed by vendor.

Image?



shoreline too deep in 3D

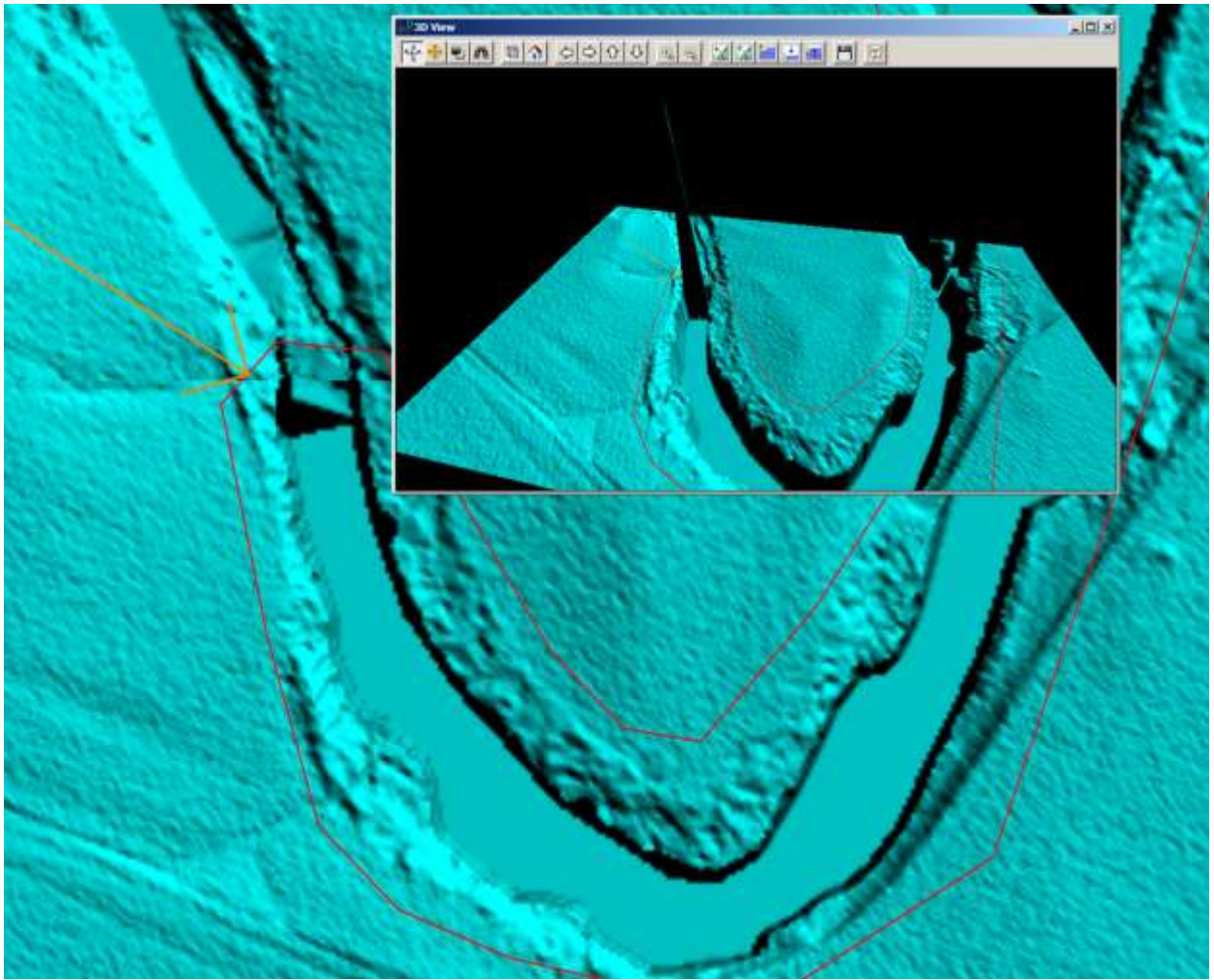
Image?



water body too deep & spike at seam line located @
33° 51' 49.7145" N, 90° 09' 26.3740" W

**Fixed by vendor.

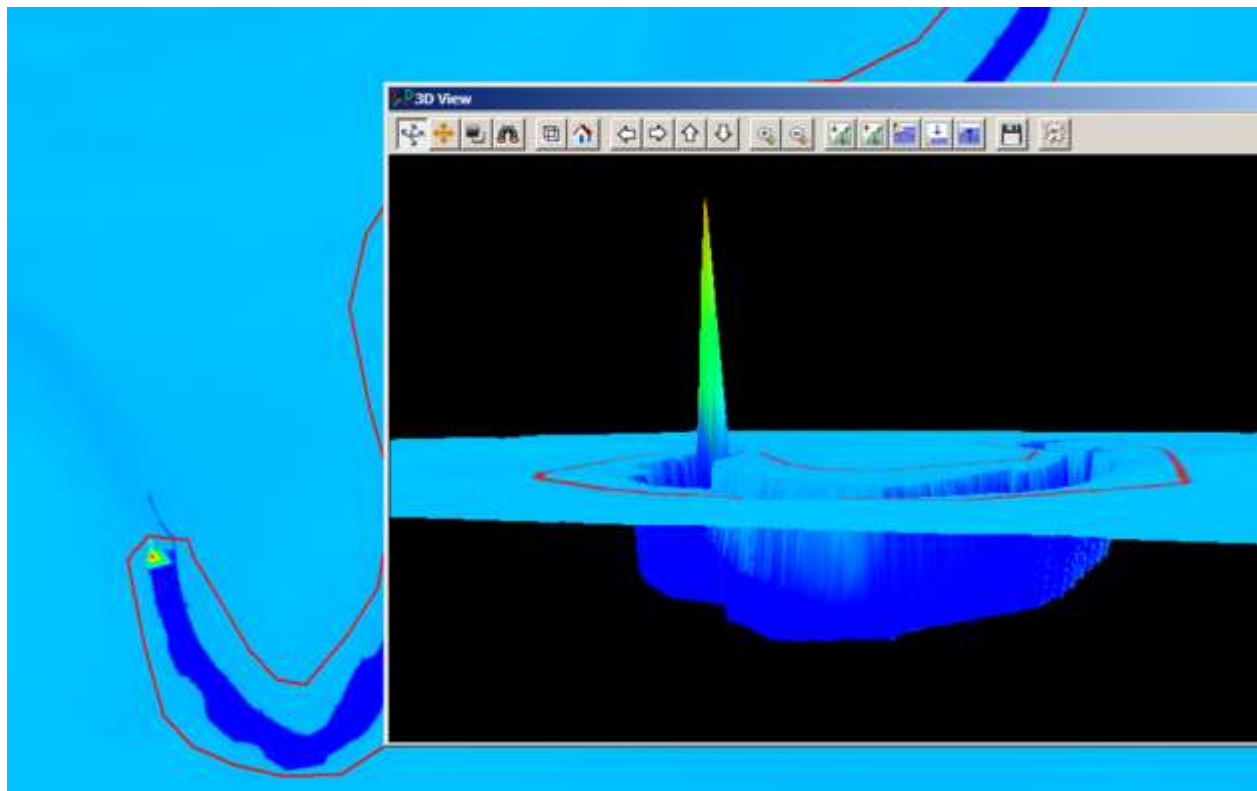
Image?



water body too deep & spike at seam line in 3 D

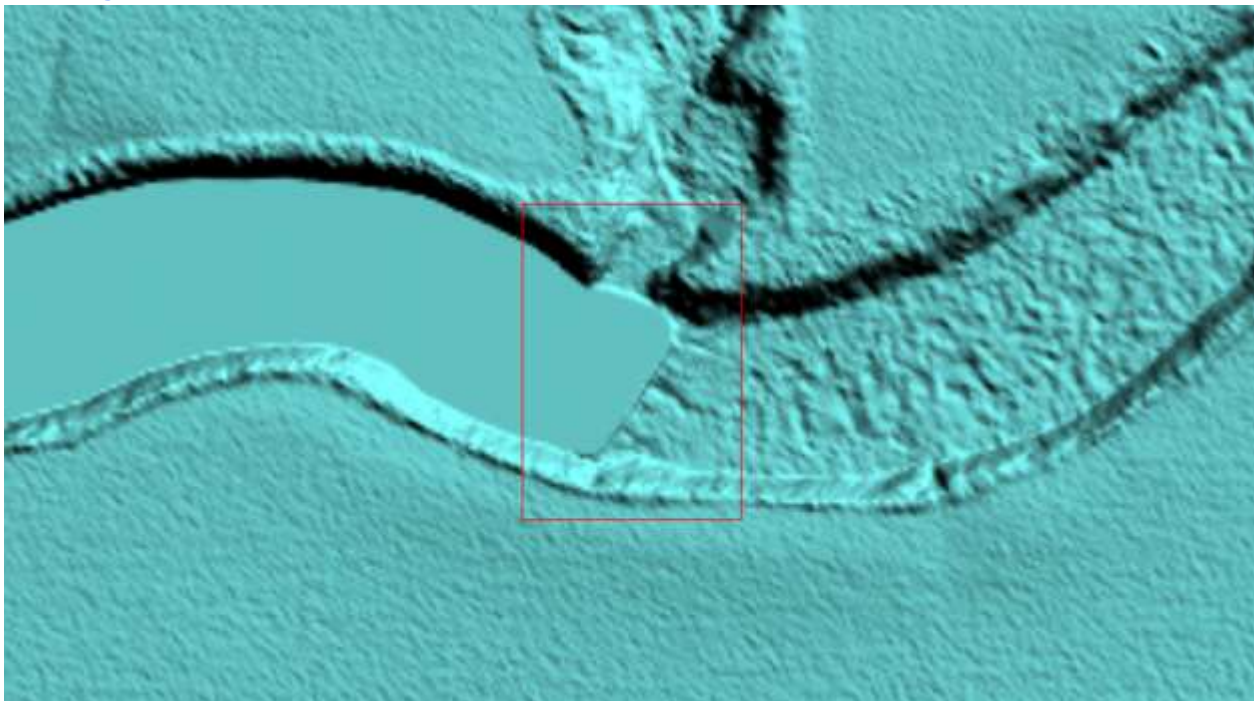
**Fixed by vendor.

Image?



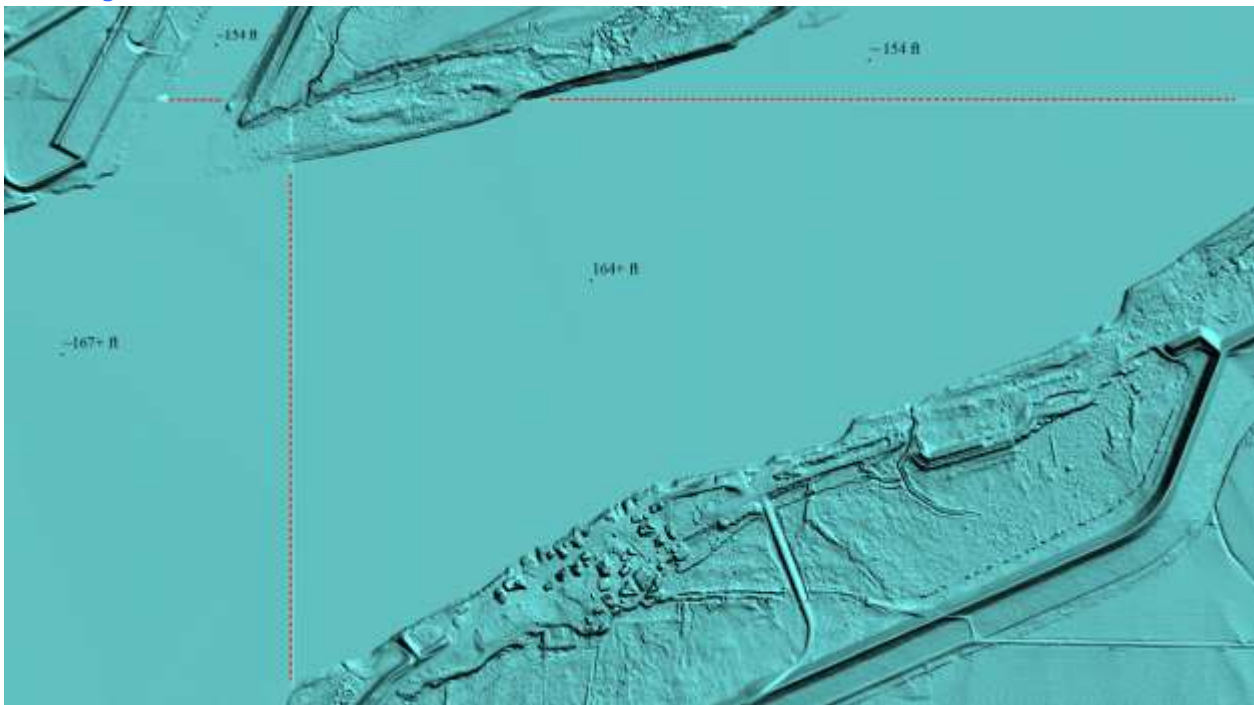
water body too deep & spike at seam line in 3 D

Image?



6/12/2012
Floating water - 34° 19' 19.8" N, 90° 21' 17" W.

Image?

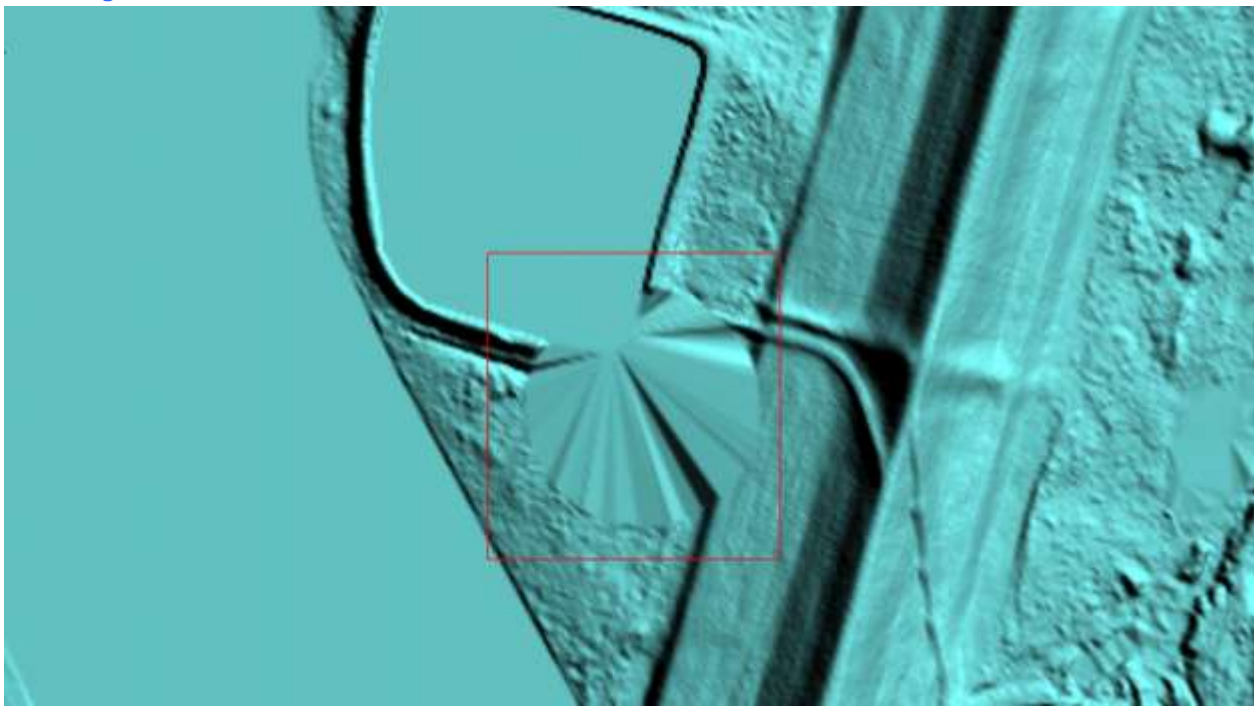


6/12/2012

Multi_water_elevations - 34° 23' 18.5" N, 90° 37' 36" W

Stretches along this river consist of different elevations; these elevation changes are not gradual, but abrupt.

Image?



6/12/2012
Unknown - 32° 49' 23.6" N, 91° 10' 10.6" W.

Image?



6/12/2012
Unknown_NAIP (for image above)

Image?

Internal Note:

Vertical accuracy tests were not performed at NGTOC. This data is donated data. Control and check points were not provided with the dataset. (SR)

Internal Note:

Photo Science bridge removal "overall" is excellent. (SR)

Internal Note:

The last few errors were not able to be fixed by vendor. Images of these errors are presented above. (TJ)

This is the end of the report.

QA Form V1.4 12OCT11.xsn