

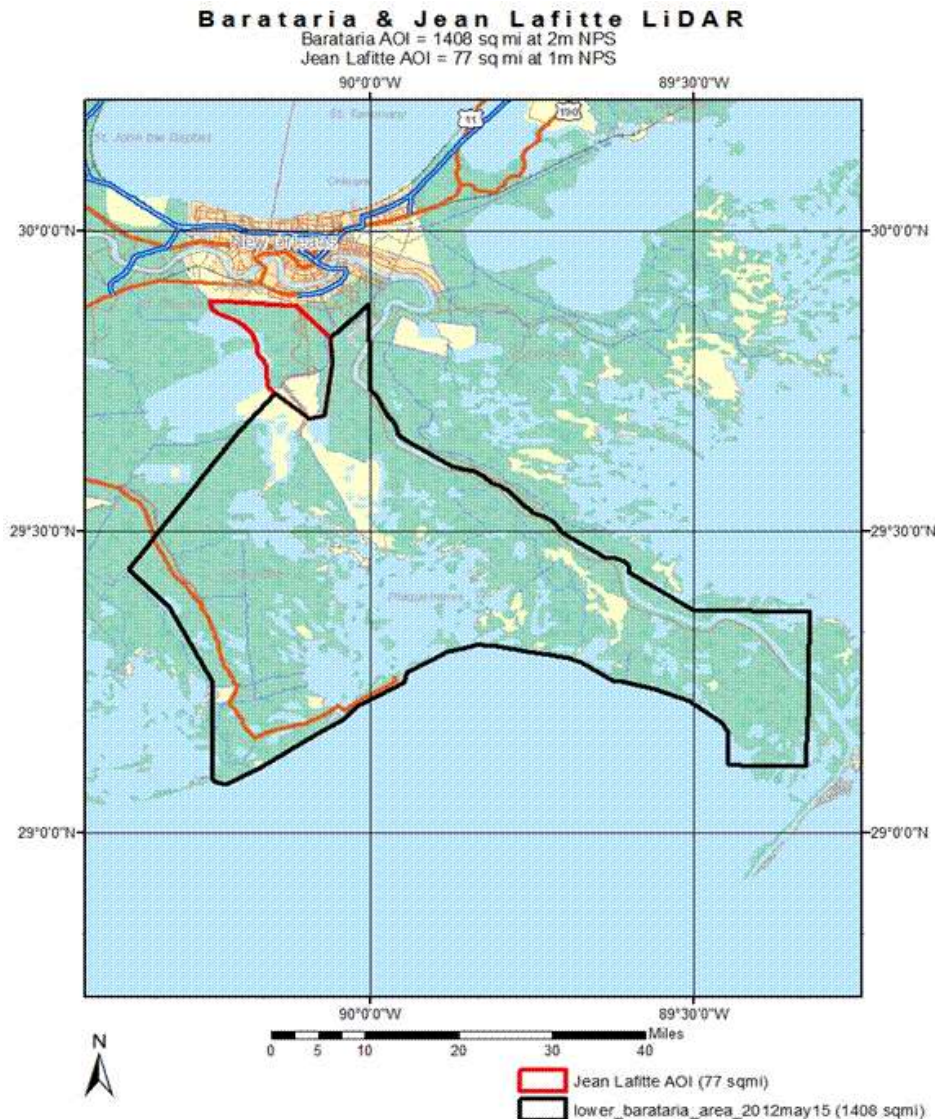


# LiDAR Quality Assessment Report

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. 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.

## LA Barataria 2.0 meter LiDAR

NGTOC



# Project Information

Project: LA Barataria 2.0 meter LiDAR

Contractor: Digital Aerial Solutions

Project Type:  
GPSC

Applicable Specification:  
NGP LiDAR Base Specification V 1.0

Project Points of Contact:

Name:	Type:	Email:
Pat Emmett	CPT	pemmett@usgs.gov

## REPORT QUALIFICATION SUMMARY:

<b>Task Order Overall:</b> Meets Requirements
<b>Metadata:</b> 1 of 1 Reviews Accepted 0 Reviews Not Accepted
<b>Vertical Accuracy:</b> 1 of 1 Reviews Accepted 0 Reviews Not Accepted
<b>Swath/Raw LAS:</b> 1 of 1 Reviews Accepted 0 Reviews Not Accepted
<b>Tiled/Classified LAS:</b> 1 of 1 Reviews Accepted 0 Reviews Not Accepted
<b>Breakline:</b> 1 of 1 Reviews Accepted 0 Reviews Not Accepted
<b>DEM(s):</b> 1 of 1 Reviews Accepted 0 Reviews Not Accepted
<b>NED Review:</b> 1 of 1 DEM tile reviews recommended for NED 1/3rd 1 of 1 DEM tile reviews recommended for NED 1/9th

Project Delivery Lots: None

Dates Collected Range:

Collection Start: 3/5/2013

Collection End: 3/8/2013

Project Aliases:

n/a

Licensing:

Public Domain

Project Description:

1. This task order is for Planning, Acquisition, processing, and derivative products of lidar data to be acquired for an area subdivided into two collection subareas. The majority of the area (Barataria), 1,408 mi<sup>2</sup>, will be collected at a nominal pulse spacing (NPS) of 2.0 meter. A NPS of 1.0 meter will be used to collect a smaller 77 mi<sup>2</sup> area (Jean Lafitte). Total area to be acquired is 1,485 square miles. Specifications listed below are based on the “U.S. Geological Survey National Geospatial Program Lidar Base Specification Version 1.0”, which is incorporated by reference into this task order. This specification may be viewed at <http://pubs.usgs.gov/tm/11b4/>. These lidar specifications are required baseline specifications. In addition to the requirements listed below, variations from the specifications will be shown and noted below. For any item, which is not specifically addressed, the referenced Version 1.0 specifications will be the required specification authority.

This task order requests LiDAR surveys be collected over two AOIs titled “Barataria” and “Jean Lafitte”, covering a total of approximately 1,485 square miles of the Barataria Basin south of New Orleans, Louisiana. These AOIs consist of 1) the Jean Lafitte National Park Barataria Preserve (JLNP) AOI, approximately 77 square miles and 2) the southern Barataria (SB) AOI approximately 1,408 square miles. Total acquisition area is 1,485 mi<sup>2</sup>. This regional LiDAR elevation mapping will be used for modeling, predicting coastal landscape change, promoting restoration of ecosystems, and mitigating risks associated with anthropomorphic and natural hazards.

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## Review Information

Reviewer:

Date

Delivered:

3rd Party QA

Date

Performed:

Assigned:

Action To Contractor Date:	Issue Description:	Return Date:
3/25/2014	- Metadata issues (see metadata section below) - Class 1 swath points - DEM errors	
4/22/2014	FVA issues	

Review Complete:

Dates Project Worked:

Start:	<input type="text" value="3/21/2014"/>
End:	<input type="text" value="5/5/2014"/>

## Project Materials Received

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 Section supervisor and informed of the problem. Processing will resume after the COTR has coordinated the deposition of remaining deliverables.

### METADATA

Deliverables	Delivered	XML Metadata	Required	Format	Quantity	Additional Details
Collection Report:	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	PDF	<input type="text" value="1"/>	<input type="text" value="Combined in 1 report"/>
Survey Report:	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	PDF	<input type="text" value="1"/>	<input type="text" value="Combined in 1 report"/>
Processing Report:	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	PDF	<input type="text" value="1"/>	<input type="text" value="Combined in 1 report"/>
QA/QC Report:	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	PDF	<input type="text" value="1"/>	<input type="text" value="Combined in 1 report"/>
Project Level XML Metadata:	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	XML	<input type="text" value="2"/>	This task was a combined lidar acquisition of 2m NPS(Barataria) and 1m NPS (JLNP). Listings of deliverables in this report include both deliveries.
Project Extent:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	.shp	<input type="text" value="2"/>	<input type="text" value="1 for JLNP; 1 for Barataria"/>
					<input type="text"/>	<input type="text"/>

Tile Scheme:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	.shp	2	1 for JLNP; 1 for Barataria
Control (Calibration) Points:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Select...		
Check (Validation) Points:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	.shp	1	Combined in 1 shapefile
Additional Comments:						

**LIDAR DATA**

Deliverables	Delivered	XML Metadata	Required	Format	Quantity	Additional Details
Swath Data:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	.las	106	Barataria 79; JLNP 27
Classified/ Tiled Data:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	.las	1,916	Barataria 1791; JLNP 125
Additional Comments:						

**DERIVED DELIVERABLES**

Deliverables	Delivered	XML Metadata	Required	Format	Quantity	Additional Details
DEM Tiles:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	TIF	1,919	Barataria 1795; JLNP 124
Breaklines:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	.shp	2	2 shapefiles for JLNP; 1 .gdb for Barataria
Additional Comments:						

**OTHER**

Additional Comments:	
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**Geographic Information**

Area Extent:  Sq. Miles

Tile Size:  Meters

DEM/DTM Grid Spacing:  Meters

Coordinate Reference System:

[Empty text box for Coordinate Reference System]

Projection:

UTM Zone 15.

Horizontal Datum:

NAD83

- Meters
- U.S. Feet
- Int'l Feet

Vertical Datum:

NAVD88

- Meters
- U.S. Feet
- Int'l Feet

**THIS PROJECTION COORDINATE REFERENCE SYSTEM IS CONSISTENT ACROSS THE FOLLOWING DELIVERABLES**

- |  |   |
|--|---|
| <input checked="" type="checkbox"/> Project Extent                   | <input checked="" type="checkbox"/> Tiled/Classified XML Metadata |
| <input checked="" type="checkbox"/> Project Extent XML Metadata      | <input checked="" type="checkbox"/> Tiled/Classified LiDAR        |
| <input checked="" type="checkbox"/> Project Tile Scheme              | <input checked="" type="checkbox"/> Swath/Raw LiDAR XML Metadata  |
| <input checked="" type="checkbox"/> Project Tile Scheme XML Metadata | <input checked="" type="checkbox"/> Swath/Raw LiDAR               |
| <input checked="" type="checkbox"/> Control Points                   | <input checked="" type="checkbox"/> DEM(s)                        |
| <input checked="" type="checkbox"/> Control Points XML Metadata      | <input checked="" type="checkbox"/> DEM XML Metadata              |
| <input checked="" type="checkbox"/> Checkpoints                      | <input checked="" type="checkbox"/> Breakline(s)                  |
| <input checked="" type="checkbox"/> Checkpoint XML Metadata          | <input checked="" type="checkbox"/> Breakline XML Metadata        |
| <input checked="" type="checkbox"/> Project Level XML Metadata       |   |

Additional Comments:

[Empty text box for Additional Comments]

**Collection Information**

Configured Project Nominal Pulse Spacing:

2 Meters

Additional Comments:

[Empty text box for Additional Comments]

**Metadata Review Accepted**

Vendor 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.

Parser can be found @ <http://geo-nsdi.er.usgs.gov/validation/>

**The Project Level XML Metadata parsed without errors.**

Check if 'Best Use' metadata for NED:

**The Project Extent XML Metadata parsed without errors.**

Check if 'Best Use' metadata for NED:

**The Project Tile Scheme XML Metadata parsed without errors.**

Check if 'Best Use' metadata for NED:

**The Control Point XML Metadata parsed without errors.**

Check if 'Best Use' metadata for NED:

**The Check Point XML Metadata parsed without errors.**

Check if 'Best Use' metadata for NED:

**The Swath XML Metadata parsed without errors.**

Check if 'Best Use' metadata for NED:

**The Classified XML Metadata parsed without errors.**

Check if 'Best Use' metadata for NED:

**The DEM XML Metadata parsed without errors.**

Check if 'Best Use' metadata for NED:

**The Breakline XML Metadata parsed without errors.**

Check if 'Best Use' metadata for NED:

Additional  
Comments:

#### Metadata issues fixed by vendor

- All metadata is essentially copies of each other.
- No LAS classifications included in classified LAS or project level metadata
- SVA and CVA should be included in project level metadata
- No hydroflattening techniques included in breakline metadata
  - Why is vertical accuracy included in breakline metadata as well as LiDAR scans and LAS format?
- **"Tested 12.2 cm (0.4 ft.) vertical accuracy at the 95% confidence level in open terrain, based on open terrain."** Based on open terrain...in water?
- Raw point cloud metadata missing info required in Base Specifications v1.0:  
*Each Lift: Describing the extents of the lift, the swaths included in the lift, locations of GPS base stations and control for the lift, preprocessing and calibration details for the lift, adjustment and fitting processes applied to the lift in relation to other lifts, and other lift-specific information*
- All raw las lift metadata are duplicates of each other.

**Based on this review, the USGS accepts the xml metadata provided.**

End of Metadata Review

### Vertical Accuracy Review Accepted

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.

### Required Vertical Accuracy

Yes  No

#### REQUIRED FUNDAMENTAL VERTICAL ACCURACY FOR SWATH AND DEM FILES

Confidence Interval Required:  th % CI  
 Required Unit:   
 Required # of checkpoints:   
 Required RMSEz:   
 Required Vertical Accuracy (RMSEz \* .% CI)

#### REQUIRED SUPPLEMENTAL VERTICAL ACCURACY FOR DEM FILES

SVA Statistic Required: Percentile

SVA Confidence Level/Percentile Required:

Class	# of Checkpoints	SVA Required	
		95 th Percentile	
Tall Weeds & Crops	<input type="text" value="22"/>	<input type="text" value="36.3"/>	<input type="text" value="Centimeters"/>
Brushlands & Low Trees	<input type="text" value="12"/>	<input type="text" value="36.3"/>	<input type="text" value="Centimeters"/>
Forested Areas Fully Covered by Trees	<input type="text" value="6"/>	<input type="text" value="36.3"/>	<input type="text" value="Centimeters"/>
Urban Areas with Dense Man Made Structures	<input type="text" value="9"/>	<input type="text" value="36.3"/>	<input type="text" value="Centimeters"/>

#### REQUIRED CONSOLIDATED VERTICAL ACCURACY FOR DEM FILES

CVA Statistic Required: Percentile

CVA Confidence Level/Percentile Required:

Total number of checkpoints:

Required CVA:   at the  th Percentile

Additional Required Vertical Accuracy Information:

Ground Truth data was collected of the three major vegetative cover classes and "urban" dispersed within the area of interest. Land cover categories; urban, forested fully grown, brush lands represents less than 10% of the project land cover class in this project so a minimum 20 points in each categories could not be collected; however, a total 110 points were collected in all of the four classes.

### Reported Vertical Accuracy

Yes  No

#### REPORTED FUNDAMENTAL VERTICAL ACCURACY FOR SWATH LIDAR FILES

Confidence Interval Reported:  th % CI



Reported Unit:

Reported # of checkpoints:

Reported RMSEz:

Reported Vertical Accuracy (RMSEz \* .% CI)

**REPORTED FUNDAMENTAL VERTICAL ACCURACY FOR DEM FILES**

Confidence Interval Reported:  th % CI

Reported Unit:

Reported # of checkpoints:

Reported RMSEz:

Reported Vertical Accuracy (RMSEz \* .% CI)

**REPORTED SUPPLEMENTAL VERTICAL ACCURACY FOR DEM FILES**

SVA Statistic Reported: Percentile

SVA Confidence Level/Percentile Reported:

Class	# of Checkpoints	SVA Reported 95 th Percentile	
Tall Weeds & Crops	22	0.208	Meters
Brushlands & Low Trees	12	0.210	Meters
Forested Areas Fully Covered by Trees	6	0.121	Meters
Urban Areas with Dense Man Made Structures	9	0.146	Meters

**REPORTED CONSOLIDATED VERTICAL ACCURACY FOR DEM FILES**

CVA Statistic Reported: Percentile

CVA Confidence Level/Percentile Reported:

Total number of checkpoints:

Reported CVA:  Meters at the 95 th Percentile

Additional Reported Vertical Accuracy Information:

Ground Truth data was collected of the three major vegetative cover classes and "urban" dispersed within the area of interest. Land cover categories; urban, forested fully grown, brush lands represents less than 10% of the project land cover class in this project so a minimum 20 points in each categories could not be collected; however, a total 110 points were collected in all of the four classes.

**Reviewed Vertical Accuracy**

Yes  No

**CHECKPOINT REVIEW**

Checkpoints are well distributed?

Enough checkpoints for task order?

Checkpoints meet USGS LiDAR base-spec in quantity and quality?

**REVIEWED FUNDAMENTAL VERTICAL ACCURACY FOR SWATH LIDAR FILES**

Confidence Interval Reviewed:  th % CI

Reviewed Unit:

Reviewed # of checkpoints:

Reviewed RMSEz:

Reviewed Vertical Accuracy (RMSEz \* .% CI)

**REVIEWED FUNDAMENTAL VERTICAL ACCURACY FOR DEM FILES**

Confidence Interval Reviewed:  th % CI

Reviewed Unit:

Reviewed # of checkpoints:

Reviewed RMSEz:

Reviewed Vertical Accuracy (RMSEz \* .% CI)

**REVIEWED SUPPLEMENTAL VERTICAL ACCURACY**

SVA Statistic Reviewed: Percentile

SVA Confidence Level/Percentile Reviewed:

Class	# of Checkpoints	SVA Reviewed	
		95 th Percentile	
Tall Weeds	<input type="text" value="22"/>	<input type="text" value="0.208"/>	<input type="text" value="Meters"/>
Urban Areas	<input type="text" value="9"/>	<input type="text" value="0.139"/>	<input type="text" value="Meters"/>
Forested Areas Fully Covered by Trees	<input type="text" value="6"/>	<input type="text" value="0.110"/>	<input type="text" value="Meters"/>
Brushlands & Low Trees	<input type="text" value="12"/>	<input type="text" value="0.208"/>	<input type="text" value="Meters"/>

**REVIEWED CONSOLIDATED VERTICAL ACCURACY**

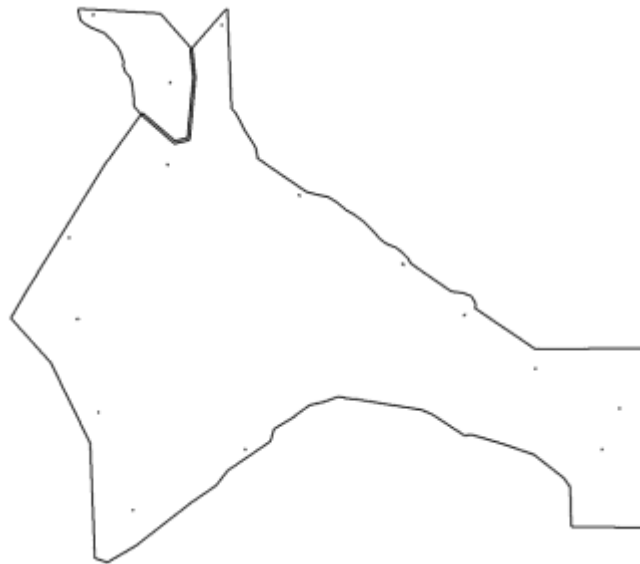
CVA Statistic Reviewed: Percentile

CVA Confidence Level/Percentile Reviewed:

Total number of checkpoints:

Reviewed CVA:   at the 95 th Percentile

Checkpoint Distribution Image



Vertical Accuracy Results:

Additional Reviewed  
Vertical Accuracy  
Information:

Due to difficulties accessing swampy interior portions of the project area, the quantity of checkpoints is smaller than required number for each SVA class. USGS accepts the lower number of checkpoints for this project.

Vertical accuracy values are for both Barataria and Jean Lafitte combined.

**Based on this review, the USGS accepts the vertical accuracy.**

End of Vertical Accuracy Review

### Raw-Swath LiDAR Review **Accepted**

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 (see Vertical Accuracy Review Section).

Review Required:  Yes  No

#### RAW-SWATH LIDAR FILE CHARACTERISTICS

Separate folder for swath/raw LiDAR files

LAS Version: 1.2

Point Record Format: 1

Each swath file  $\leq 2$  GB and properly segmented

Correct and properly formatted georeference information is included in all LAS file headers

Adjusted GPS time used with the global encoder id set to 1

Scan Angles conform to USGS base-spec recommendations

All points set to class '0' (not classified)

Additional comments:

**Based on this review, the USGS accepts the swath/raw LiDAR data.**

End of Swath/Raw LiDAR Review

## Tiled/Classified LiDAR Review Accepted

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. Classified LAS Tiles are comprised as follows, "all project swaths, returns, and collected points, fully calibrated, adjusted to ground, and classified and cut, by tiles, excluding calibration swaths, cross-ties, and other swaths not used, or intended to be used, in product generation".

Review Required:  Yes  No

### CLASSIFIED LIDAR TILE CHARACTERISTICS

Separate folder for classified/tiled LiDAR files

LAS Version: 1.2

Point Record Format: 1

- 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
- Correct and properly formatted georeference information is included in all LAS file headers
- Adjusted GPS time used with the global encoder id set to 1
- Classified LAS tile files have no points classified as '12' (Overlap)
- Point classifications are limited to the standard values listed below:

Code	Description	Used
1	Processed, but unclassified	<input checked="" type="checkbox"/>
2	Bare-earth/Ground	<input checked="" type="checkbox"/>
7	Noise(low or high, manually identified, if needed)	<input checked="" type="checkbox"/>
8	Model key points	<input type="checkbox"/>
9	Water	<input checked="" type="checkbox"/>
10	Ignored ground (breakline proximity)	<input checked="" type="checkbox"/>
11	Withheld (if the "Withheld Bit" is not implemented in the processing software)	<input checked="" type="checkbox"/>

#### Additional Classes:

Class	Description
17	reserve (Overlap ground)
18	reserve Overlap default)

Additional comments:

Based on this review, the USGS accepts classified/tiled LiDAR data.

End of Tiled/Classified LiDAR Review

## Breakline Review Accepted

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

Review Required:  Yes  No

### BREAKLINE FILE CHARACTERISTICS:

Separate folder for breakline files.

Breaklines contain elevation values.

Elevation values stored in Geometry and Attribute Table

Units: U.S. Feet

Waterbody Breaklines.

Polyline  Polygon

Single elevation value per waterbody feature.

Required.

Waterbody Elevations were created via Unknown waterbody level techniques.

Double Line Stream Breaklines (Streams Approximately > 100 ft).

Polyline  Polygon

Downstream DLS Flow is Select...

Required.

Single Line Breaklines.

No missing or misplaced breaklines.

**Based on this review, the USGS accepts the breakline files.**

End of Breakline Review

## DEM Review Accepted

The derived bare-earth file(s) receive a review of the vertical accuracies provided by the data supplier, vertical accuracies calculated by the USGS using supplied and independent checkpoints (*see the prior Vertical Accuracy Review Section*), and a thorough visual review for any anomalies or inconsistencies in assessing the quality of the DEM(s).

### BARE-EARTH DEM TILE CHARACTERISTICS:

Separate folder for bare-earth DEM files

Raster File Type: TIF

Raster Cell Size: 2 Meters

Tile bit depth/pixel Type: 32\_BIT\_FLOAT

Interpolation or Resampling Technique: Unknown

DEM tiles do not overlap

DEM tiles conform to Project Tiling Scheme

Quantity of DEM files conforms to Project Tiling Scheme

DEM tiles are uniform in size

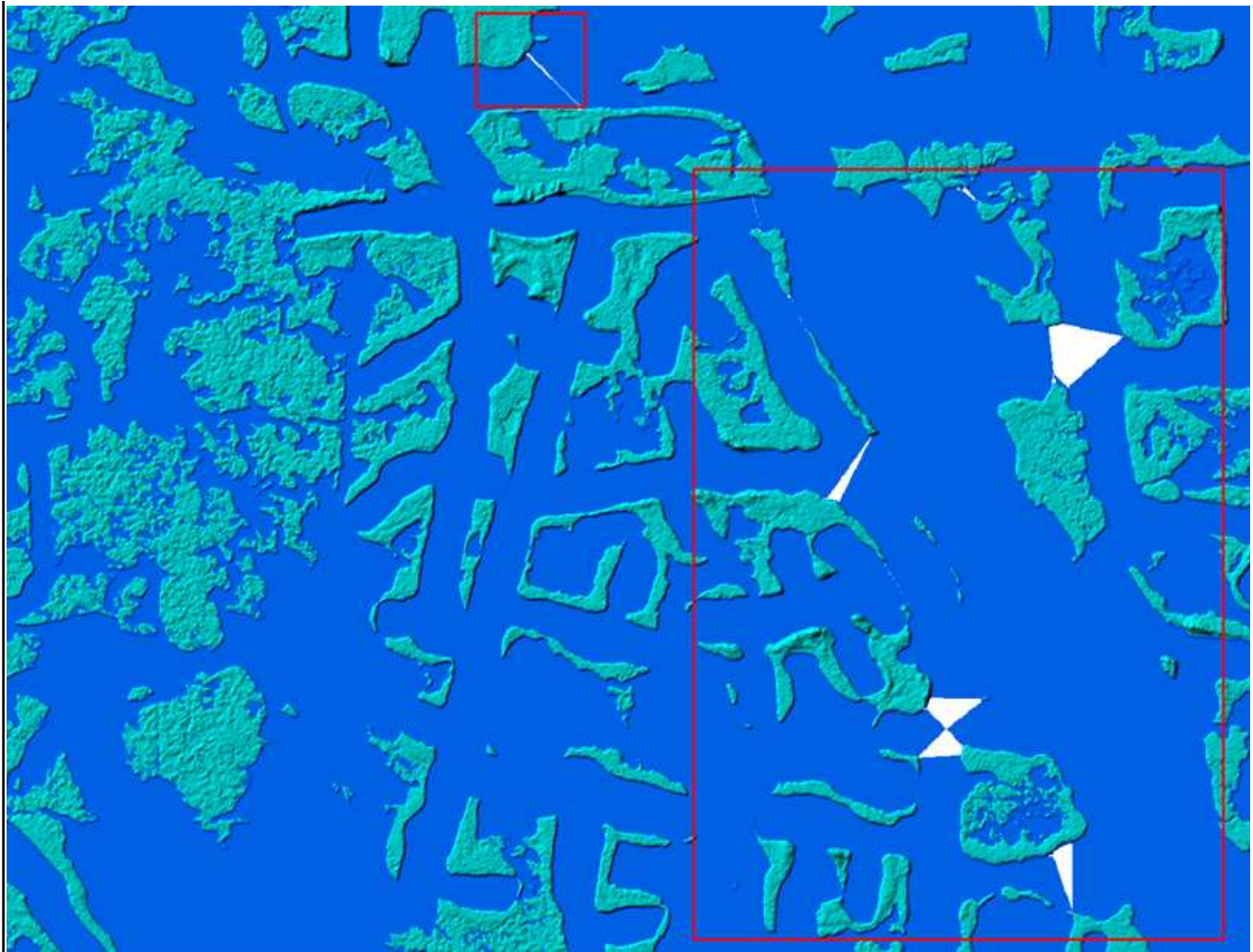
DEM tiles properly edge match and free of edge artifacts

Tiles are free from Spikes and Pits

Tiles are free from Data Holidays (*voids due to processing or collection errors*)

### Error was fixed by contractor

Several areas of missing data exist, although points exist here in the swath data. See error shapefile for locations of missing data.



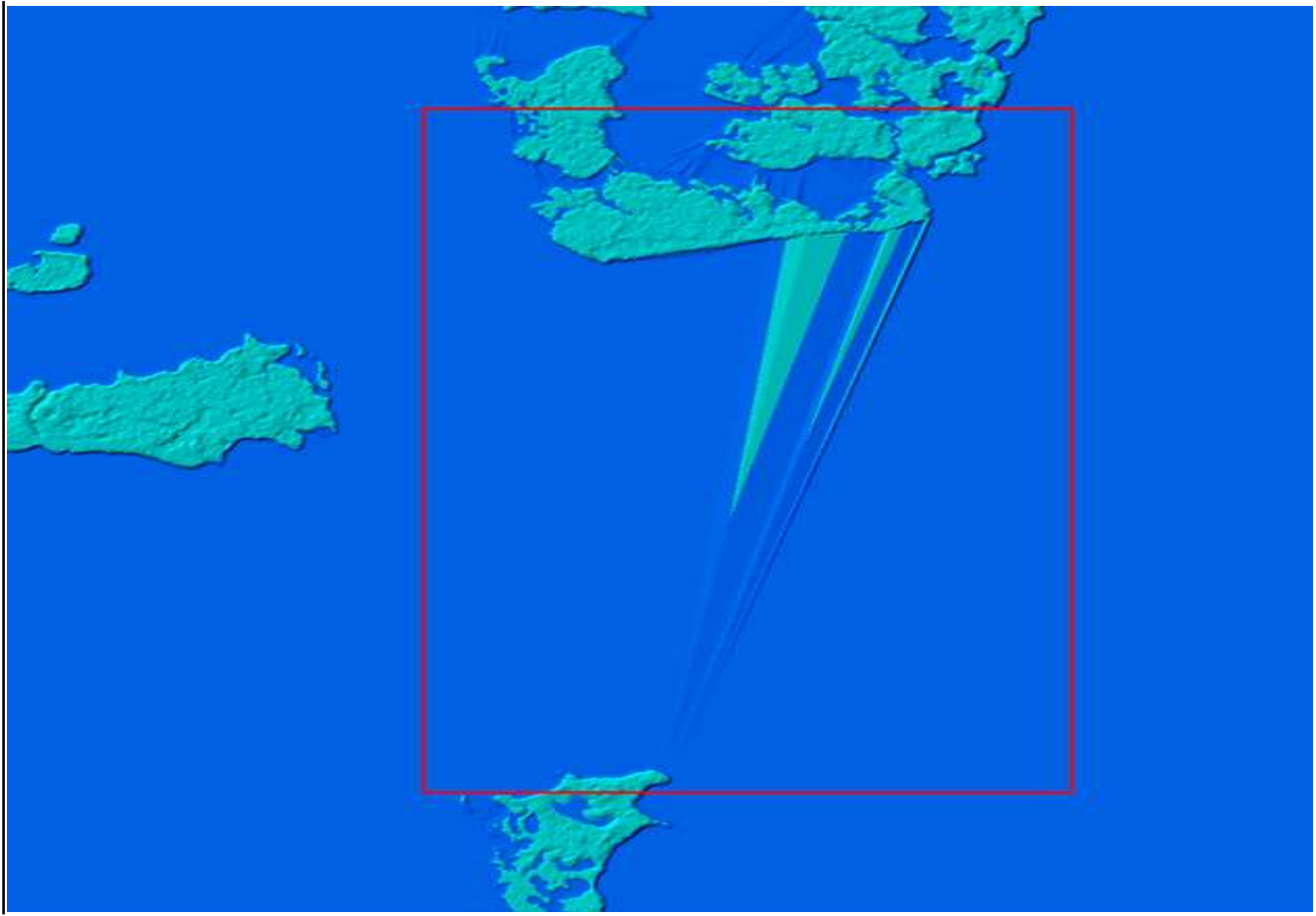
Tiles do not exhibit systematic sensor error or comrowing

DEM tiles are properly Hydro Flattened  Yes  No

Waterbodies  or greater are flattened

**Error was fixed by contractor**

Tinning of land across waterbody:



- Streams  or greater are flattened in a downstream manner
- Tidal Boundaries/Shorelines are flattened
  
- No missing islands  or larger
- Bridges/Overpasses are properly removed
- Culverts are maintained (Not Hydro Enforced)
- Depressions, Sinks, are not filled in (Not Hydro Conditioned)
- Vegetation properly removed
- Manmade structures properly removed

Tiles recommended for NED 1/3rd:  Yes.  No.

Tiles recommended for NED 1/9th:  Yes.  No.

**Based on this review, the USGS accepts the DEM tiles.**

End of DEM Review

Based on this review, the provided delivery Meets the Contract and/or Task Order requirements.

*Additional Comments:*

**INTERNAL COMMENTS**



END OF REPORT (v2.1.1)