# 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.

FL_Osceola_2015

NGTOC
2016-12-07
Brent Marz
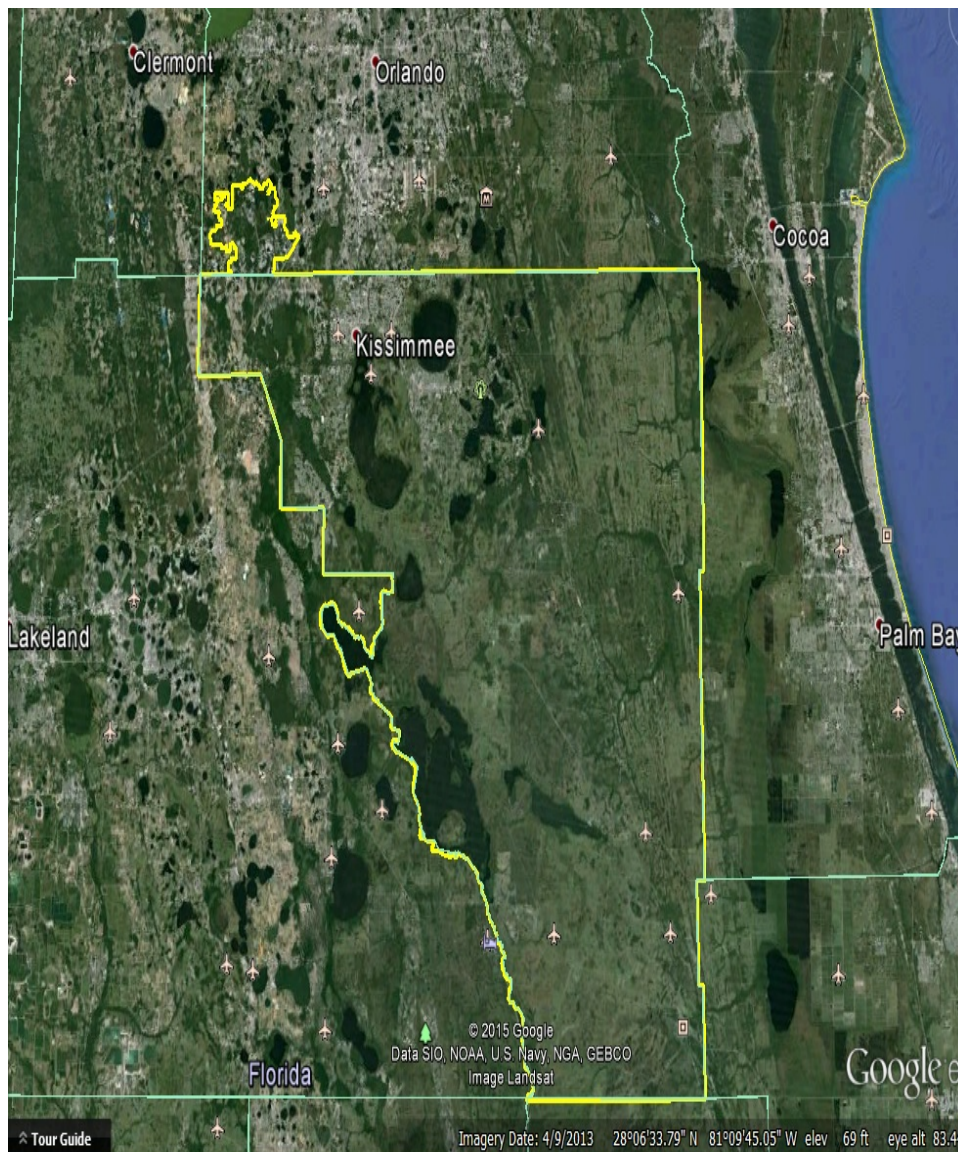
Project Information

Project: FL_Osceola_2015

Contractor: Dewberry

Project Type:
  GPSC

Applicable Specification:
  NGP LiDAR Base Specification V 1.2

Project Points of Contact:

Name:	Type:	Email:
Gail Dunn	CPT	gdunn@usgs.gov

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

Project Subdivision: Lots

List Subdivision:
  ● 1
of: 1

Dates Collected Range:
Collection Start: 1/21/2016
Collection End: 4/13/2016

Project Aliases:

Licensing:
Public Domain

Project Description:

This task order is for Planning, Acquisition, Processing, and Derivative Products of lidar data to be collected at an aggregate nominal pulse spacing (ANPS) of **0.5 meters (4 ppsm)**, including overlap. Lidar data, and derivative products produced in compliance with this task order shall adhere to the specifications listed below, and are based on "U.S. Geological Survey National Geospatial Program Lidar Base Specification, Version 1.2." These lidar specifications are required baseline specifications. In addition to the Specification Requirements, this task order shall meet NEEA QL2. For any item which is not specifically addressed, the referenced Version 1.2 specifications will be the required specification authority.

This task order requests winter LiDAR surveys to be collected over approximately 1535 square miles affecting Osceola County and contiguous jurisdiction of the Reedy Creek Improvement District in Florida. This project will require hydro-flattening. Every effort shall be made to eliminate edge artifacts and seam-lines between this task and existing DEM data that is present in the USGS National elevation Dataset (NED) and the NOAA US Interagency Elevation Inventory (USIEI).

Review Information

Reviewer:	Brent Marz	Date Delivered:	10/25/2016
3rd Party QA Performed:	☐	Date Assigned:	11/7/2016

Action To Contractor Date:	Issue Description:	Return Date:
12/7/2016		

Review Complete:

12/7/2016

Dates Project Worked:

Start:	11/10/2016
End:	12/7/2016

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:	☑		☑	*PDF*	*1*	Part of project report
Survey Report:	☑		☑	*PDF*	*1*	
Processing Report:	☑		☑	*PDF*	*1*	
QA/QC Report:	☑		☑	*PDF*	*1*	Part of project report
Project Level XML Metadata:	☑		☑	*XML*	*1*	
Project Extent:	☑	☑	☑	*.shp*		
Tile Scheme:	☑	☑	☑	*.shp*		
Control (Calibration) Points:	☑	☑	☑	*.shp*		

Check (Validation) Points:	☑	☑	☑	*.shp*		
Additional Comments:						

LIDAR DATA

Deliverables	Delivered	XML Metadata	Required	Format	Quantity	Additional Details
Swath Data:	☑	☑	☑	.las	*1,078*	31 lifts
Classified/ Tiled Data:	☑	☑	☑	.las	*7,292*	
Additional Comments:						

DERIVED DELIVERABLES

Deliverables	Delivered	XML Metadata	Required	Format	Quantity	Additional Details
DEM Tiles:	☑	☑	☑	IMG	*7,292*	
Breaklines:	☑	☑	☑	FGD	*1*	
Additional Comments:	Hydro-flattened and Bridge breaklines delivered					

OTHER

Additional Deliverables	Delivered	XML Metadata	Required	Format	Quantity	Additional Details
Contours	☑	☑	☑	FGD	1	
Intensity Images	☑	☑	☑	TIFF	7,292	
Low Confidence Polygons	☑	☑	☑	Shape	0	NONE Met Criteria
Additional Comments:						

Geographic Information

Area Extent:	1535	*Sq. Miles*
Tile Size:	2500 x 2500	*Feet*

DEM/DTM Grid Spacing:	2.5	*U.S. Feet*

Coordinate Reference System:

Florida State Plane East (FIPS 901)

Projection: Lambert

Horizontal Datum: | NAD83 | ○ Meters
HARN 2007 is in the task order, but the 2011 adjustment was approved by customer in technical clarification | ◉ U.S. Feet
| | ○ Int'l Feet

Vertical Datum: | NAVD88 | ○ Meters
Geoid 12B | ◉ U.S. Feet
| | ○ Int'l Feet

THIS PROJECTION COORDINATE REFERENCE SYSTEM IS CONSISTENT ACROSS THE FOLLOWING DELIVERABLES

☑ *Project Extent*   ☑ *Tiled/Classified XML Metadata*
☑ *Project Extent XML Metadata*   ☑ *Tiled/Classified LiDAR*
☑ *Project Tile Scheme*   ☑ *Swath/Raw LiDAR XML Metadata*
☑ *Project Tile Scheme XML Metadata*   ☑ *Swath/Raw LiDAR*
☑ *Control Points*   ☑ *DEM(s)*
☑ *Control Points XML Metadata*   ☑ *DEM XML Metadata*
☑ *Checkpoints*   ☑ *Breakline(s)*
☑ *Checkpoint XML Metadata*   ☑ *Breakline XML Metadata*
☑ *Project Level XML Metadata*

Additional Comments:

Collection Information

Quality Level: 2
Configured Nominal Pulse Spacing:

.5   Meters

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 <u>without</u> errors.

Check if 'Best Use' metadata for NED: ☐

The Check Point XML Metadata parsed <u>without</u> errors.

Check if 'Best Use' metadata for NED: ☐

The Swath XML Metadata parsed <u>without</u> errors.

Check if 'Best Use' metadata for NED: ☐

The Classified XML Metadata parsed <u>without</u> errors.

Check if 'Best Use' metadata for NED: ☐

The DEM XML Metadata parsed <u>without</u> errors.

Check if 'Best Use' metadata for NED: ☑

The Breakline XML Metadata parsed <u>without</u> errors.

Check if 'Best Use' metadata for NED: ☐

Additional Comments:

Based on this review, the USGS <u>accepts</u> 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 NON-VEGETATED VERTICAL ACCURACY FOR SWATH   AND DEM   FILES

Required Unit:	U.S. Feet
Required # of checkpoints:	20
Required RMSEz:	64
Required Vertical Accuracy (RMSEz * 95th CI)	0.6430

REQUIRED VEGETATED VERTICAL ACCURACY FOR DEM FILES

Required Unit:	U.S. Feet
Required # of checkpoints:	51
Required Vertical Accuracy (@ 95th percentile)	0.9646

Additional Required Vertical Accuracy Information:	

Reported Vertical Accuracy

◉ *Yes* ◯ *No*

REPORTED NON-VEGETATED VERTICAL ACCURACY FOR SWATH LIDAR FILES

Reported Unit:	U.S. Feet
Reported # of checkpoints:	91
Reported RMSEz:	0.29
Reported Vertical Accuracy (RMSEz * 95th CI)	0.56

REPORTED NON-VEGETATED VERTICAL ACCURACY FOR DEM FILES

Reported Unit:	U.S. Feet
Reported # of checkpoints:	91
Reported RMSEz:	0.14
Reported Vertical Accuracy (RMSEz * 95th CI)	0.27

REPORTED VEGETATED VERTICAL ACCURACY FOR DEM FILES

Reported Unit:	U.S. Feet
Reported # of checkpoints:	73

Reported Vertical Accuracy (95th percentile)	0.45
Additional Reported Vertical Accuracy Information:	

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 NON-VEGETATED VERTICAL ACCURACY FOR SWATH LIDAR FILES

Reviewed Unit:	U.S. Feet
Reviewed # of checkpoints:	91
Reviewed RMSEz:	0.14
*Reviewed Vertical Accuracy (RMSEz * 95th CI)*	0.260

REVIEWED NON-VEGETATED VERTICAL ACCURACY FOR DEM FILES

Reviewed Unit:	Select or type...
Reviewed # of checkpoints:	91
Reviewed RMSEz:	0.14
*Reviewed Vertical Accuracy (RMSEz * 95th CI)*	

REVIEWED VEGETATED VERTICAL ACCURACY

Required Unit:	U.S. Feet
Required # of checkpoints:	73
Reviewed Vertical Accuracy (95th percentile)	0.462

Checkpoint Distribution Image
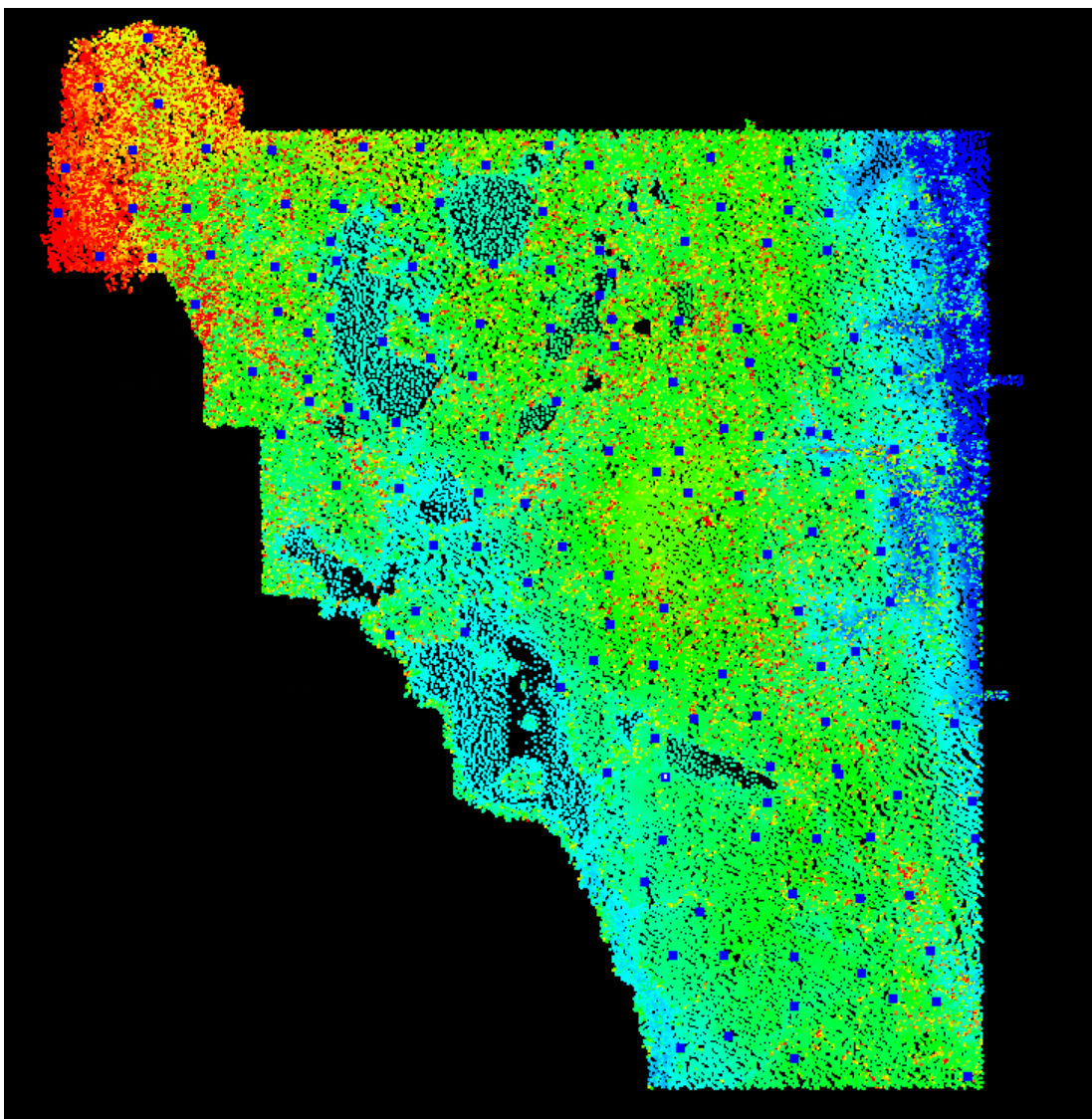
Vertical Accuracy Results:

*Additional Reviewed
Vertical Accuracy
Information:*

Based on this review, the USGS <u>accepts</u> 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 Non-Vegetated 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: <u>1.4</u>

Point Record Format: <u>6</u>

If specified, *.wpd files for full waveform data have been provided: <u>Select...</u>

☐ *Correct and properly formatted georeference information is included in all LAS file headers, including the use of OGC 2001 Well Known Text (WKT).*

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

Correctly set to 17

Additional comments:

Based on this review, the USGS <u>accepts</u> 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: <u>1.4</u>

Point Record Format: <u>6</u>

If specified, *.wpd files for full waveform data have been provided: <u>Select...</u>

☑ *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, including the use of OGC 2001 Well Known Text (WKT).*

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

Correctly set 17

☑ *Classified LAS tile files have no points classified as '12' (Overlap) and correctly use overlap bit.*

☐ *Point classifications are limited to the standard values listed below:*

Code	Description	Used
1	Processed, but unclassified	☑
2	Bare-earth/Ground	☑
7	Noise (low, manually identified, if needed)	☑

8	*Model key points*	☐
9	*Water*	☑
10	*Ignored ground (breakline proximity)*	☑
11	*Withheld (if the "Withheld Bit" is not implemented in the processing software*	☐
17	*Bridges*	☑
18	*Noise (high, manually identified, if needed)*	☐

Additional comments:

[ ]

Based on this review, the USGS <u>accepts</u> 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 <u>Geometery (ZEnabled)</u>   .

Units: <u>U.S. Feet</u>

☑ Waterbody Breaklines.

Polyline ☐ Polygon ☑
☐ Single elevation value per waterbody feature.
☑ Required.
Waterbody Elevations were created via <u>Unknown</u>   waterbody level techniques.

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

Polyline ☐ Polygon ☑
Downstream DLS Flow is <u>Proprietary</u>   .
☑ Required.

☑ Single Line Breaklines.

Lines are:
☐ Single Line Streams
☑ Bridge Cuts
☐ Culvert Connectors

Downstream SLS Flow is <u>Not Applicable</u>   .

☑ No missing or misplaced breaklines.

Based on this review, the USGS <u>accepts</u> 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: IMG

Raster Cell Size: 2.5 U.S. Feet

Tile bit depth/pixel Type: Select or type…

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*)
☑ Tiles do not exhibit systematic sensor error or cornrowing

Hydro Treatment: hydro-flattened

DEM tiles are properly Hydro Flattened ○ Yes ◉ No

☑ Waterbodies 2 Acres or greater are flattened
☑ Streams 100 ft. or greater are flattened in a downstream manner
☑ Tidal Boundaries/Shorelines are flattened

☑ No missing islands 1 Acre 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

ADDITIONAL COMMENTS, ERRORS, ANOMALIES, OR OTHER ISSUES:

Tiles recommended for NED 1/3rd: ◉ Yes. ○ No.
Tiles recommended for NED 1/9th: ○ Yes. ◉ No.

Tiles recommended for NED 1 Meter: ◉ Yes. ◯ No.

LAS dataset recommended for distribution: <u>tile classified</u>

Based on this review, the USGS <u>accepts</u> the DEM tiles.

<div align="center">End of DEM Review</div>

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

Additional Comments:

<div align="center">

INTERNAL COMMENTS

</div>

<div align="center">END OF REPORT (v2.4.0)</div>