



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:

8/31/2012

Project ID:

VA_FEMA-lidar-Lot7_2011

Project Alias(es):

FEMA Virginia LiDAR

Project Type: GPSC

Project Description:

This task order is for Planning, Acquisition, processing, and derivative products of lidar data to be collected at a nominal pulse spacing (NPS) of 0.7 meters, resulting in a point density of 2 points per square meter. Lidar data, and derivative products produced in compliance with this task order are based on the “*U.S. Geological Survey National Geospatial Program Base Lidar Specification, Version 13 (ILMF)*”, of which sections I through IV are incorporated by reference to this task order. This specification may be viewed at [http://lidar.cr.usgs.gov/USGS-NGP Lidar Guidelines and Base Specification v13\(ILMF\).pdf](http://lidar.cr.usgs.gov/USGS-NGP_Lidar_Guidelines_and_Base_Specification_v13(ILMF).pdf). 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 13 specifications will be the required specification authority. This task order requests LiDAR surveys be collected over several counties and cities in southeast Virginia; Southampton, Prince George,

Charles City, New Kent, King William, Essex, Richmond, Westmoreland, King George, Stafford, Prince William counties, and the cities of Manassas, Manassas Park, Hampton, Portsmouth, Fredericksburg, and Franklin City. Additionally, Hoopers Island in Dorchester County, Maryland and a portion of Worcester County, Maryland is to be acquired. The total area of all AOI's is approximately 3,341 square miles. This data is to be used for FEMA flood mapping purposes. This project includes coastal shoreline, and will require hydro-flattening.

Year of Collection: 2011

Lot 7 of 7 lots.

Project Extent:

Project Extent image?



Project Tiling Scheme:

- Project Tiling Scheme image?



Contractor:

Dewberry

Applicable Specification:

V13

Licensing Restrictions:

n/a

Third Party Performed QA?

Project Points of Contact:

POC Name	Type	Primary Phone	E-Mail
Pat Emmett	CPT	308-3587	pemmett@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 checked="" type="checkbox"/> Swath LAS Files <input checked="" type="checkbox"/> Required? <input checked="" type="checkbox"/> XML Metadata?	299
<input checked="" type="checkbox"/> Intensity Image Files <input checked="" type="checkbox"/> Required?	918
<input checked="" type="checkbox"/> Tiled LAS Files <input checked="" type="checkbox"/> Required? <input type="checkbox"/> XML Metadata?	918
<input checked="" type="checkbox"/> Breakline Files <input checked="" type="checkbox"/> Required? <input checked="" type="checkbox"/> XML Metadata?	3
<input checked="" type="checkbox"/> Bare-Earth DEM Files <input checked="" type="checkbox"/> Required? <input checked="" type="checkbox"/> XML Metadata?	918

Additional Deliverables

Errors, Anomalies, Other Issues to document? Yes No

None.

Project Geographic Information

Areal Extent:

719

Sq Mi

Grid Size:

2.5

U.S. Feet

Tile Size:

5000 x 5000

U.S. feet

Nominal Pulse Spacing:

0.5

meters

Vertical Datum: NAVD88 U.S. feet

Horizontal Datum: NAD83_HARN U.S. feet

Project Projection/Coordinate Reference System: Virginia South (FIPS 4502) 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 checked="" type="checkbox"/> Checkpoints Shapefile/Geodatabase | <input checked="" type="checkbox"/> Swath LAS Files |
| <input checked="" type="checkbox"/> Project XML Metadata File | <input checked="" type="checkbox"/> Classified LAS Files |
| <input checked="" 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 |

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:

A. Lowe

Review Start Date:

10/1/2012

Action to Contractor Date	Issue Description	Return Date
10/5/2012	DEM Corrections, Fundamental Vertical Accuracy exceeds required value using the small subset of checkpoints provided.	10/22/2012

Review Complete: 10/30/2012

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 withouterrors.

The Swath 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?

Appendix A, Guidance for Aerial Mapping and Surveying, to FEMA’s “Guidelines and Specifications for Flood Hazard Mapping Partners” requires a minimum of 60 test points -- 20 each in a minimum of three land cover categories representative of the floodplain. FEMA’s Procedure Memorandum No. 61 – “Standards for Lidar and Other High Quality Digital Topography” -- specifies that the positional accuracy of LiDAR shall be in accordance with ASPRS/NDEP standards for accuracy testing as well as the USGS “Lidar Guidelines and Base Specifications, v13.” All of these standards and guidelines require testing for Fundamental Vertical Accuracy (FVA), Supplemental Vertical Accuracy (SVA), and Consolidated Vertical Accuracy (CVA), using a minimum of 20 checkpoints each in a minimum of three land cover categories for a minimum total of 60 QA/QC checkpoints. Although tentative tests are performed on smaller subareas with fewer than 20 QA/QC checkpoints, Dewberry’s final results will not be official until all areas are merged for testing of the total area with all project checkpoints.

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
Tall Weeds and Crops	<input type="text" value="0.29"/>	<input type="text" value="U.S. feet"/>
<i>Brush Lands and Low Trees</i>	<input type="text" value=""/>	<input type="text" value="U.S. feet"/>
Forested Areas Fully Covered by Trees	<input type="text" value="0.42"/>	<input type="text" value="U.S. feet"/>
<i>Urban Areas with Dense Man-Made Structu...</i>	<input type="text" value=""/>	<input type="text" value="U.S. feet"/>

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 .

Based on this review, the USGS accepts the LAS swath file data.

Yes No

Image?

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?

There is a LAS tile within the project boundary that was not included with this delivery due to the fact that it was delivered with the King William County project (Lot 4). This tile has been copied from the King William County project folder and included in this project's folder to provide complete coverage within the project boundary. The name of this tile is LAS_S13_9752_40.las. This brings the total of classified LAS tiles up to 919.

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	<u>Fundamental Vertical Accuracy @95% Confidence Interval</u>	<u>Supplemental Vertical Accuracy @95th Percentile Error</u>	<u>Consolidated Vertical Accuracy @95th Percentile Error</u>

	Points	(Accuracy _z) Required FVA = 0.6 or less.	Target SVA = 1.19 or less.	Required CVA = 1.19 or less.
Open Terrain	11	0.53		
Tall Weeds and Crops	13		0.29	
<i>Brush Lands and Low Trees</i>	↓		↓	
Forested Areas Fully Covered by Trees	12		0.42	
<i>Urban Areas with Dense Man-Made Structures</i>	↓		↓	
Consolidated	36			.78

QA performed Accuracy Calculations?

Calculated Accuracies

Land Cover Category	# of Points	Fundamental Vertical Accuracy @95% Confidence Interval (Accuracy _z) Required FVA = 0.6 or less.	Supplemental Vertical Accuracy @95th Percentile Error Target SVA = 1.19 or less.	Consolidated Vertical Accuracy @95th Percentile Error Required CVA = 1.19 or less.
Open Terrain	12	0.53		
Tall Weeds and Crops	13		0.48	
<i>Brush Lands and Low Trees</i>	↓		↓	
Forested Areas Fully Covered by Trees	12		.68	
<i>Urban Areas with Dense Man-Made Structures</i>	↓		↓	
Consolidated	37			.66

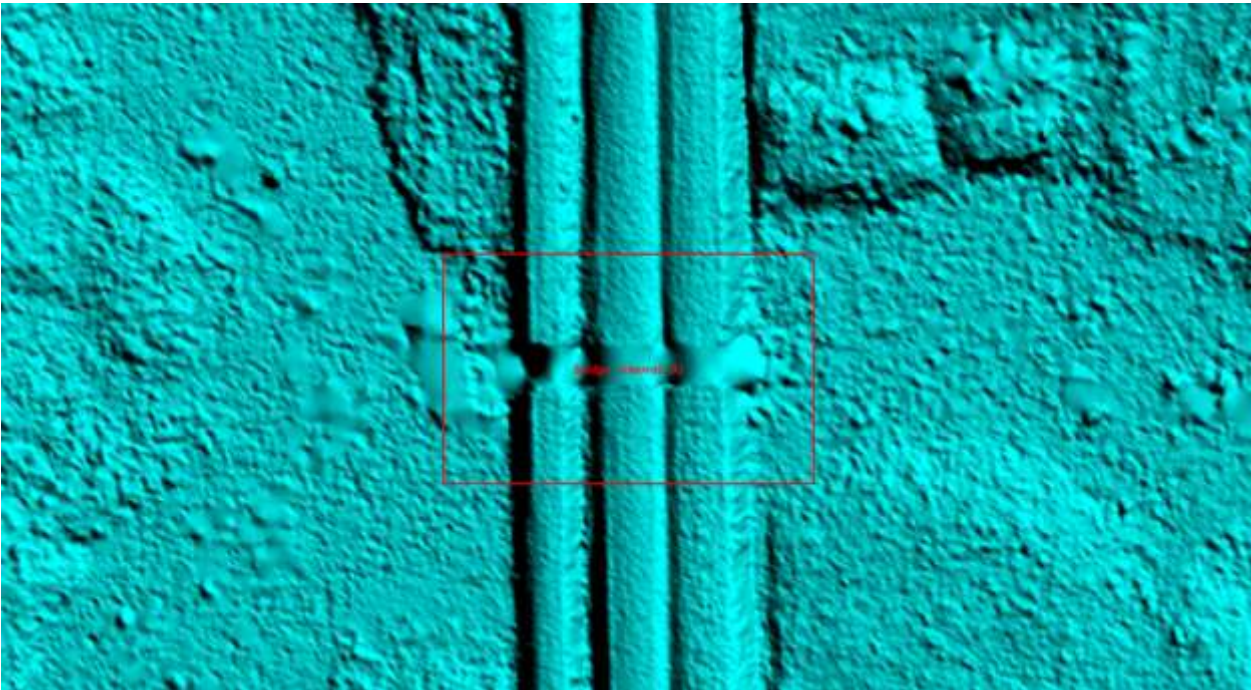
Based on this review, the USGS recommends the bare-earth DEM files for inclusion in the 1/3 Arc-Second National Elevation Dataset.

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

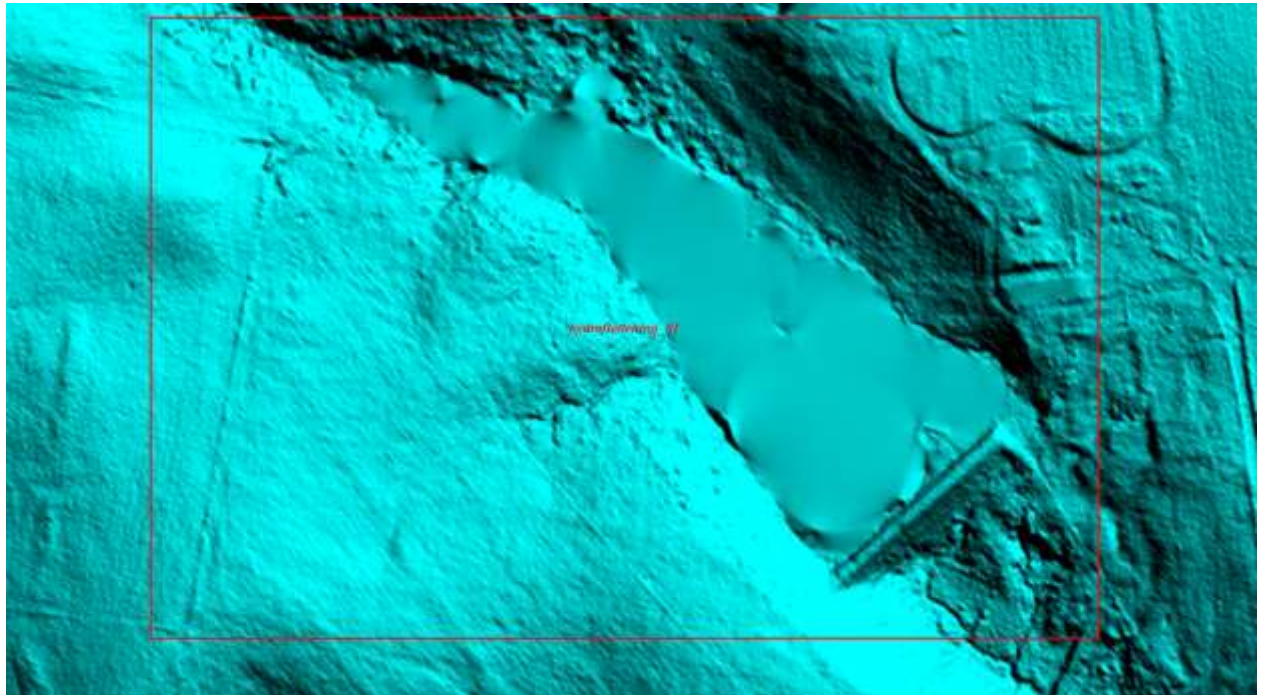
Image?



There are two bridges that were not removed; although, it appears that an attempt was made. The bare-earth surface is not represented in the DEM for this reason. (bridge_removal_01 & bridge_removal_02) BRIDGE REMOVAL WAS NOT ADDRESSED, SEE FOLLOWING EXPLANATION:

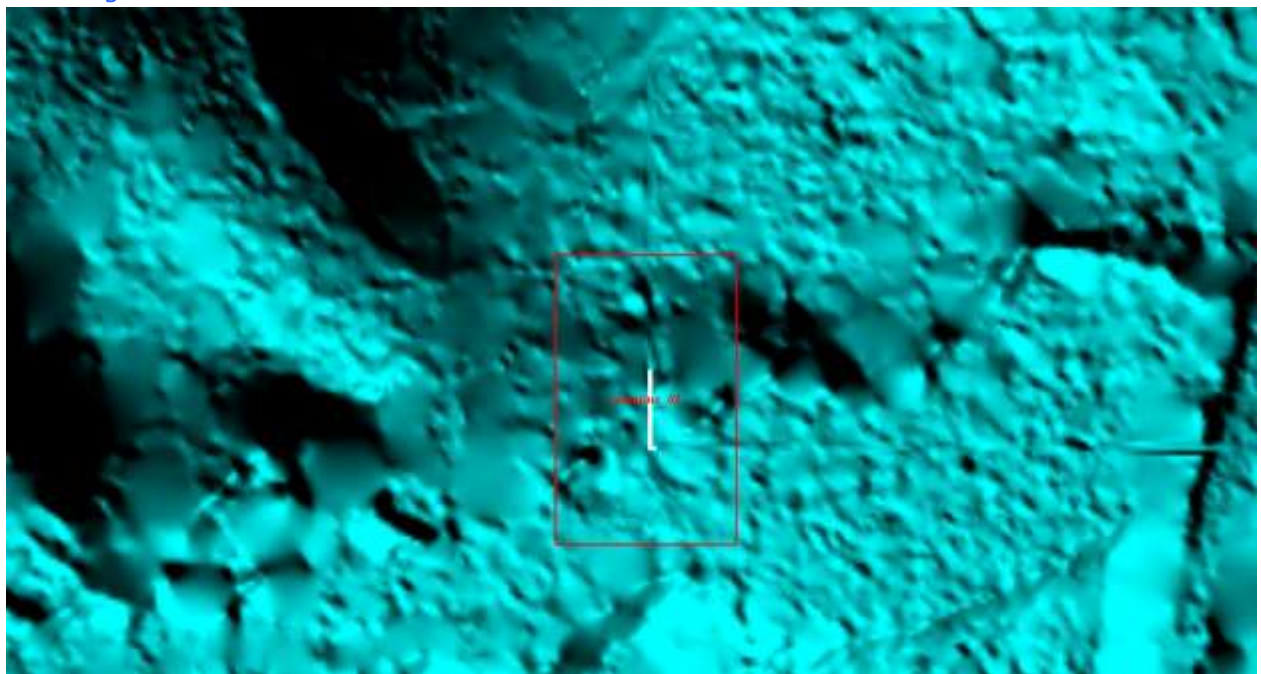
"The USGS identified two occurrences where it appeared bridges or portions of bridges were left in the bare-earth surface. Dewberry reviewed these bridges and verified that no bridge points were left in the ground surface. The DEM surface models are created from TINs or Terrains. TIN and Terrain models create continuous surfaces from the inputs. Because a continuous surface is being created, the TIN or Terrain will use interpolation to triangulate across a bridge opening from legitimate ground points on either side of the actual bridge. This can cause visual artifacts or "saddles." These "artifacts" are only visual and do not exist in the LiDAR points or breaklines. No points were modified at these locations."

Image?



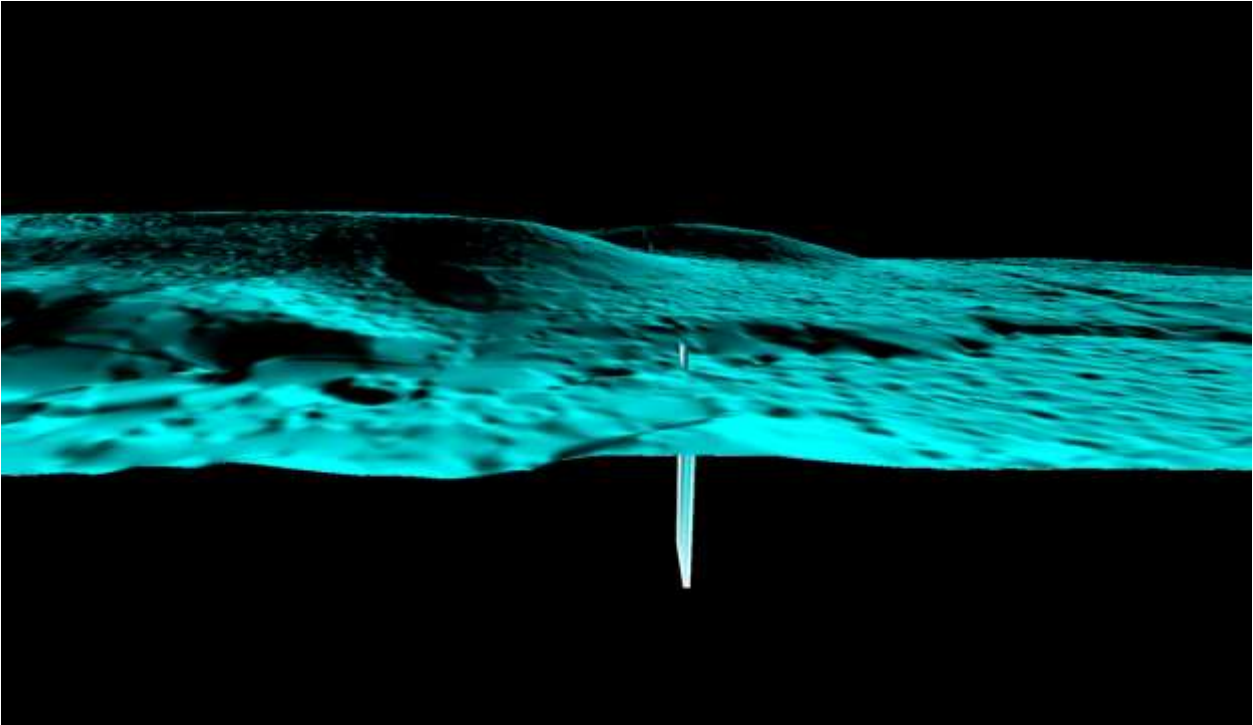
There are five water bodies that are greater than two acres in size, and have not been hydro-flattened. (hydroflattening_01 - hydroflattening_05) ALL HYDROFLATTENING ERRORS HAVE BEEN CORRECTED. (10/22/2012)

Image?



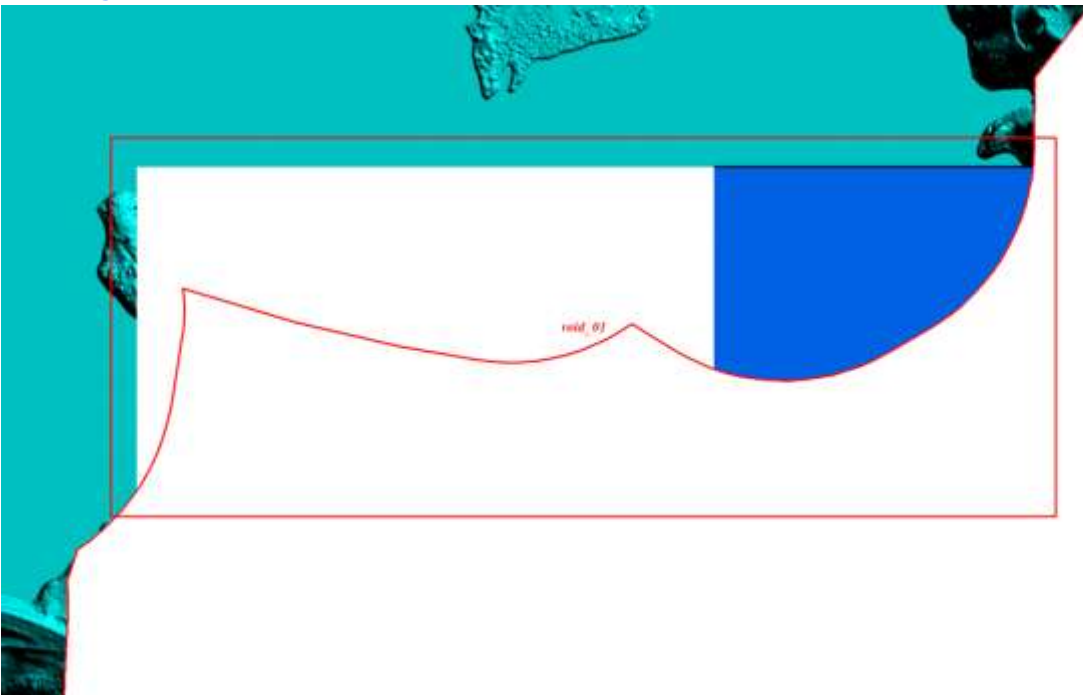
There are two seam lines where the DEM tiles do not properly edge match, giving the impression of a pit. (seamline_01 & seamline_02) ALL SEAMLINE ERRORS HAVE BEEN CORRECTED. (10/22/2012)

Image?



seamline_01_3D

Image?



There is a data void within the project boundary. This is in tile DO_S13_9658_10. (void_01) THE DATA VOID HAS BEEN CORRECTED. (10/22/2012)

Image?

There is a DEM tile within the project boundary that was not included with this delivery due to the fact that it was delivered with the King William County project (Lot 4). This tile has been copied from the King William County project folder and included in this project's folder to provide complete coverage within the project boundary. The name of this tile is DEM_S13_9752_40.img. This brings the total of bare-earth DEM tiles up to 919.

Based on this review, the deliverables provided meet the Task Order requirements.

Internal Note:

This is the end of the report.

QA Form V1.4 12OCT11.xsn