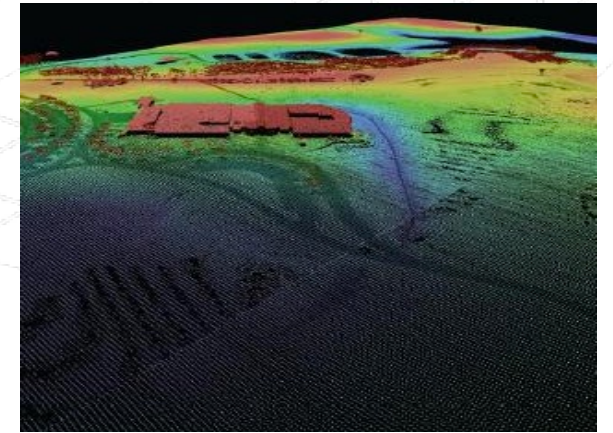
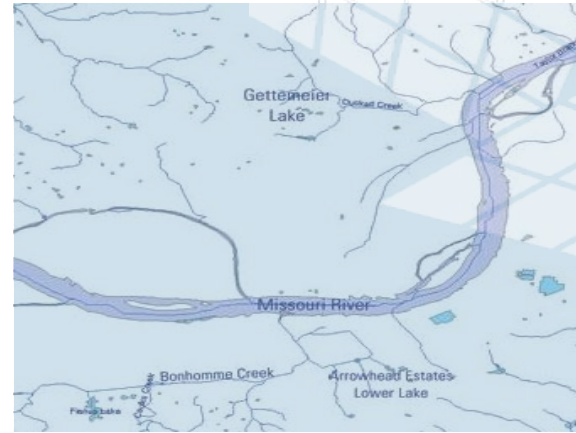
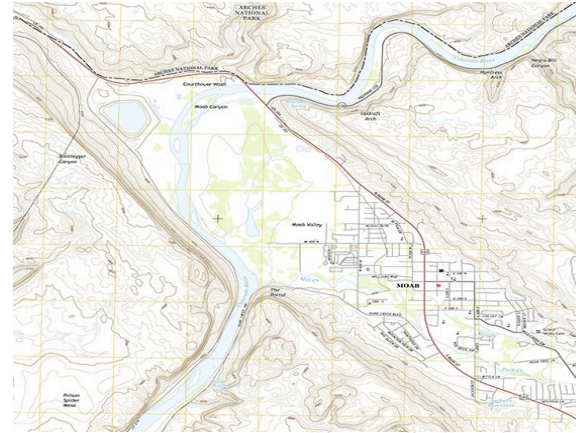




GPSC Technical Exchange



Josh Nimetz

National Geospatial Program | National Geospatial Technical Operations Center

Virtual Web Conference

July 13, 2021



+ Topics for discussion

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- QL0 requirements
- LBS 2021 rev. A
 - Revise use of the overlap bit flag
 - Use of the LAS withheld flag to include only points that cannot be reasonably interpreted as valid surface returns
 - Use of withheld flag *proof of performance* – points identified as non-valid surface returns are flagged as withheld (see MSHR)
 - Maximum Surface Height Raster (a type of DSM) – suggested to meet abovementioned withheld flag *proof of performance*
 - Lidar Mapping Report
 - Checkpoints within DPA – point of clarification only
 - Checkpoint ground photo update
 - Swath separation imagery update
- Open Q&A

+ QL0 Requirements

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- Relative accuracy two times better than QL1...
- This means smooth surface and interswath accuracy statistics are to be \leq half that of QL1
- Swath separation imagery for QL0 must be created with a color ramp of 0.04 m or 0.13 ft
- Checkpoints need to be surveyed at a positional accuracy that will support the reported absolute vertical accuracy class
- 5.0 cm RMSEz target lidar accuracy \rightarrow 1.7 cm RMSEz for the checkpoints

Lidar Base Specification: Tables (usgs.gov)

Table 2: Relative vertical accuracy for light detection and ranging swath data.

Quality level	Smooth surface repeatability, RMSD _z (m)	Swath overlap difference, RMSD _z , (m)
QL0	≤ 0.03	≤ 0.04
QL1	≤ 0.06	≤ 0.08
QL2	≤ 0.06	≤ 0.08
QL3	≤ 0.12	≤ 0.16

ASPRS Positional Accuracy Standards for Digital Geospatial Data

(EDITION 1, VERSION 1.0. - NOVEMBER, 2014)

NGS-58, *Guidelines for Establishing GPS-Derived Ellipsoid Heights (Standards: 2 cm and 5 cm)*, or equivalent. NGS-58 establishes ellipsoid height accuracies of 5 cm at the 95% confidence level for network accuracies relative to the geodetic network, as well as ellipsoid height accuracies of 2 cm and 5 cm at the 95% confidence level for accuracies relative to local control.

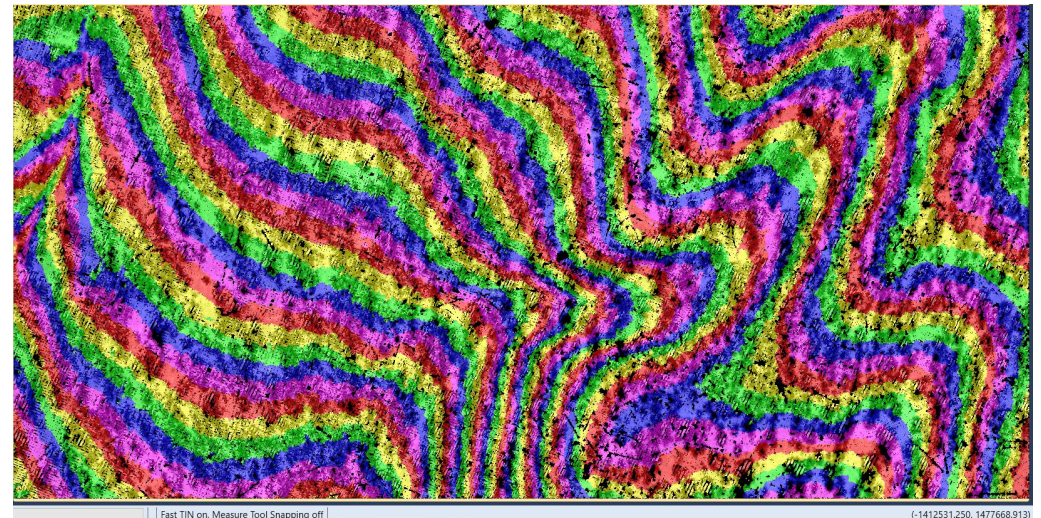
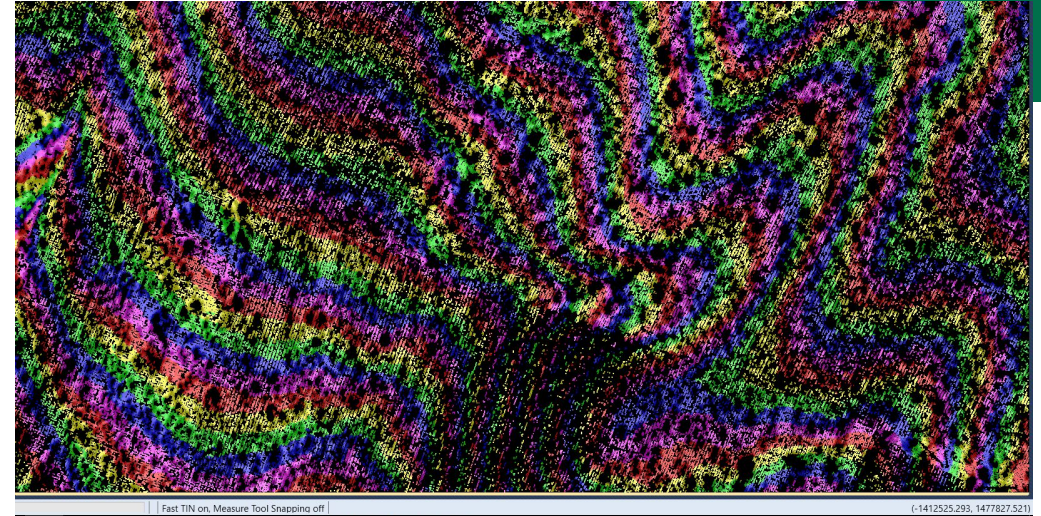
As with horizontal accuracy testing, vertical checkpoints should be three times more accurate than the required accuracy of the elevation data set being tested.

C.6 TESTING AND REPORTING OF HORIZONTAL ACCURACIES

+ Overlap Flag

- No longer to be used
- That's right! Please do not set the overlap flag for lidar data sets intended for delivery to USGS
- All ground-classified points not flagged as withheld shall be used in the creation of the bare-earth DEM
- Why have we made this decision?
 - Overage points have not been consistently defined, as was the original intention for the overlap flag
 - More points on the ground is better for ground modeling

Ground-classified points without (top) and with overlap-flagged points (bottom)



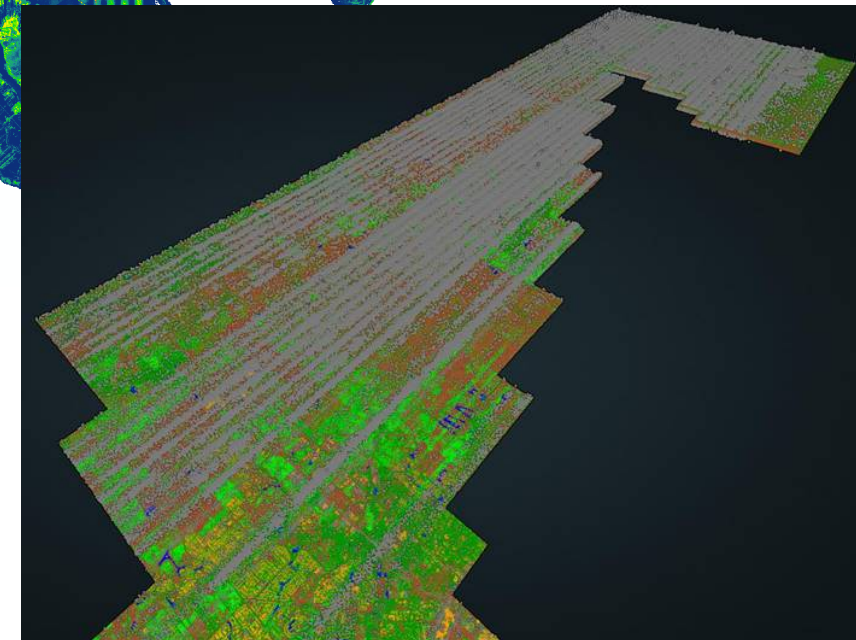
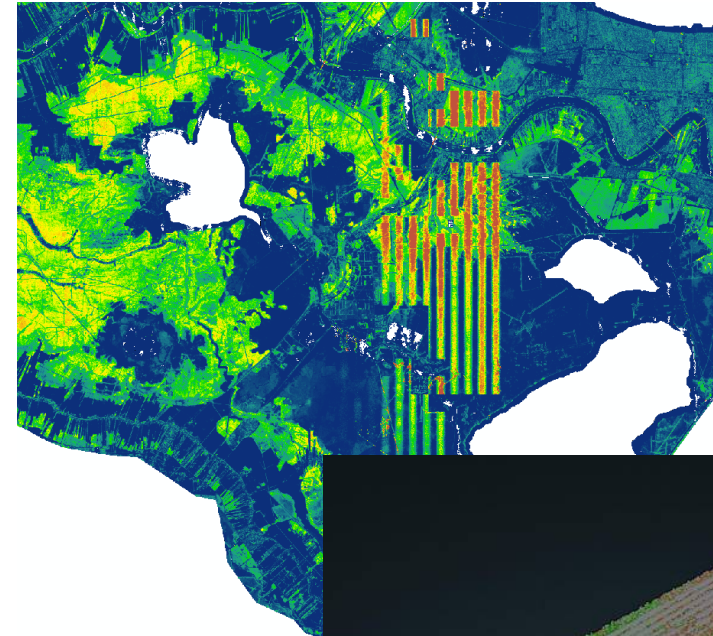
+ Clarification on use of the withheld flag

- Withheld flag *only* to be used to delineate points not reasonably interpreted to be valid surface returns
- Examples of invalid surface returns include outliers, blunders, geometrically unreliable points, aerosol back-scatter, laser multi-path, airborne objects, and sensor anomalies.

+ Proof of proper use of the withheld flag and Maximum Surface Height Rasters

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- What is the point of ensuring proper flagging of withheld points?
- 3DEP data users do not want invalid surface return points left in the viable point cloud
- Bad points left as ‘unclassified’ and not flagged as withheld are problematic
- Withheld flag needed to isolate and remove these points from feature extraction and modeling applications



+ Proof of proper use of the withheld flag and Maximum Surface Height Rasters

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Proper use of the withheld flag... “proof of performance”

The usage of the LAS Withheld Bit Flag is of such importance that proof of performance is required. This proof shall be provided as	
•	<i>Preferred:</i> Maximum Surface Height Rasters as detailed in the appendix (link).
•	Other test or metadata as agreed to by the USGS in advance and documented in the project Task Order.

- If you have a different raster for confirming proper use of the withheld flag, that is okay as well
- USGS has not done a lot of research into this raster and is open to alternative suggestions
- MSHR is suggested because it seems to do a decent job providing visual cues for high points not flagged as withheld

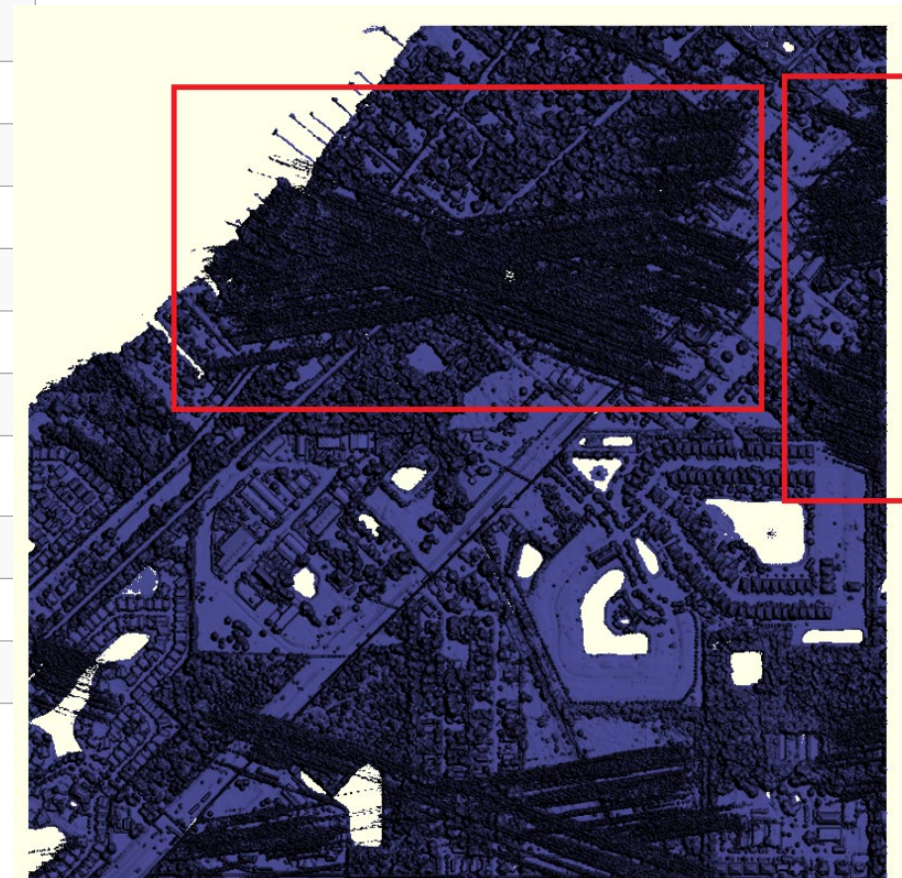
+ Proof of proper use of the withheld flag and Maximum Surface Height Rasters

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Maximum Surface Height Rasters

Maximum Surface Height Rasters	
•	Raster creation:
a.	Spatial resolution (pixel dimension) of the images shall be identical to the ground sample distance of the DEM deliverable in the project's linear unit (meters or feet).
b.	The MSHR shall be representative of the associated data delivery.
c.	The raster shall be in the same coordinate reference system (CRS) as the point cloud data to ensure alignment with the point cloud.
d.	All returns shall be used to create the raster.
e.	Points flagged as withheld shall be excluded.
f.	The raster shall be built with the highest elevation point value from each pixel.
g.	The raster shall be 32-bit, floating point.
•	Raster file formats and version control:
a.	The Maximum Surface Height Raster shall be delivered as a GeoTIFF file by tile.
b.	The tile size and naming convention shall match the point cloud and DEM deliverables.
c.	Any change in the withheld flags in the point data record shall require re-creation of the MSHR for that tile.

[Maximum Surface Height Rasters \(usgs.gov\)](https://www.usgs.gov/maximum-surface-height-rasters)



+ Lidar Mapping Report

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- Single report that replaces previous acquisition, production, and QAQC reports
- Delivered with each work unit
- Conveys information that may be helpful to users of the data
- Thank you to all who provided feedback to USGS regarding the lidar mapping report format!
- [Lidar Mapping Report \(usgs.gov\)](#)

+ Checkpoints within DPA

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- Checkpoints need to be within DPA
- Checkpoints cannot be outside DPA
- Not much more to say...
- [Checkpoints within DPA \(usgs.gov\)](#)

+ Checkpoint ground photo update

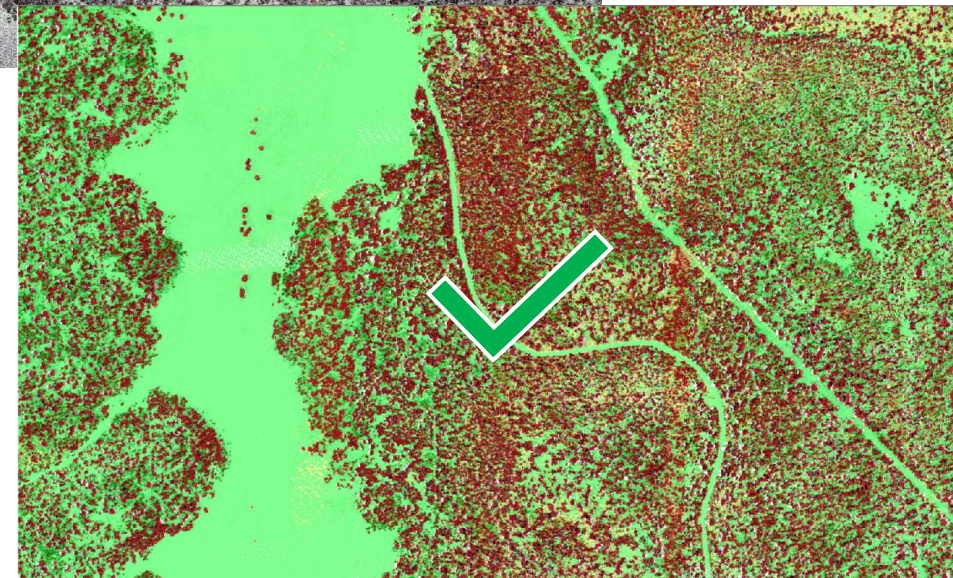
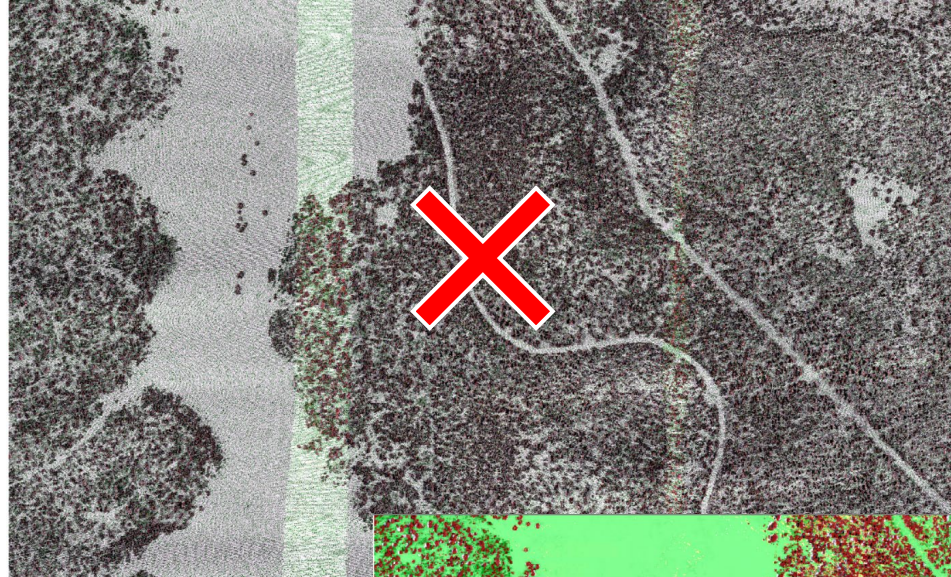
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- Checkpoint ground photos can now be delivered as loose JPGs in folders
- Embedding checkpoint ground photos in PDF is also acceptable
- In either case, checkpoints shall be appropriately labeled to include checkpoint ID
- [Checkpoint Photographs Update \(usgs.gov\)](#)

+ Swath Separation Imagery Update

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- Thank you to those of you who have provided feedback!
- We listened to you...
- All returns, single returns, or last returns shall be used to create the images
 - Previously only all-returns
- Spatial resolution shall be no greater than 4 times the NPS
 - Previously constrained to 2 – 4 times NPS
 - Continuous signal required! →



+ Walk-on Topics | Q&A

- Open Q&A

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