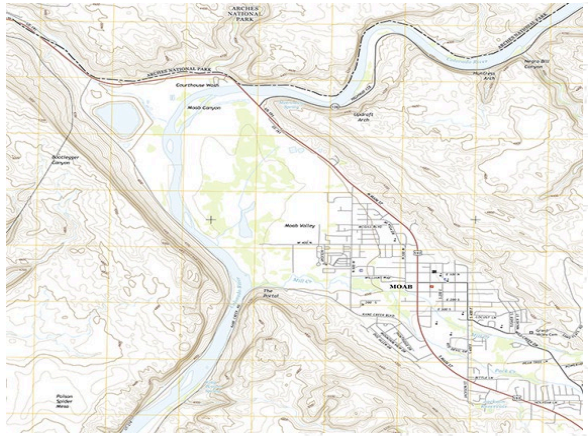
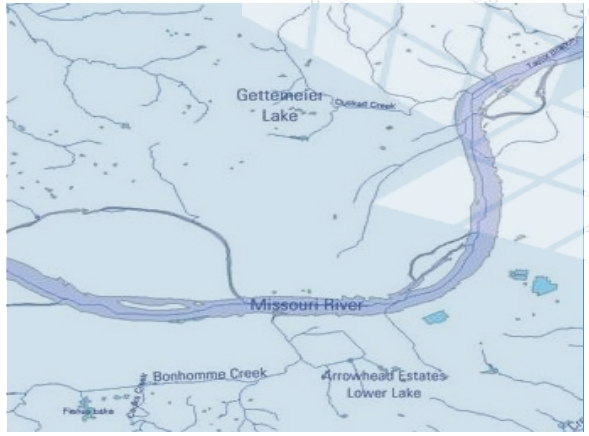
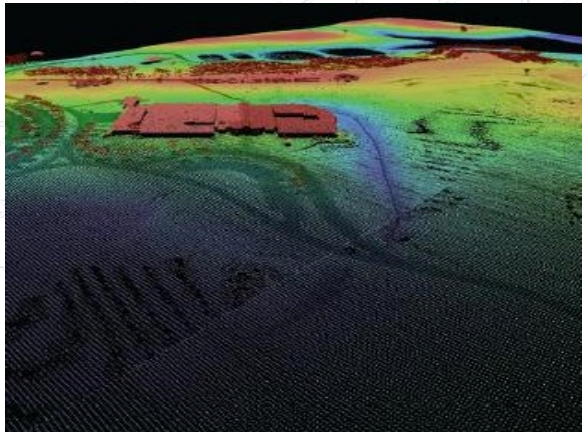
GPSC Technical Exchange







USGS science for a changing world

The National Map
Your Source for Topographic Information

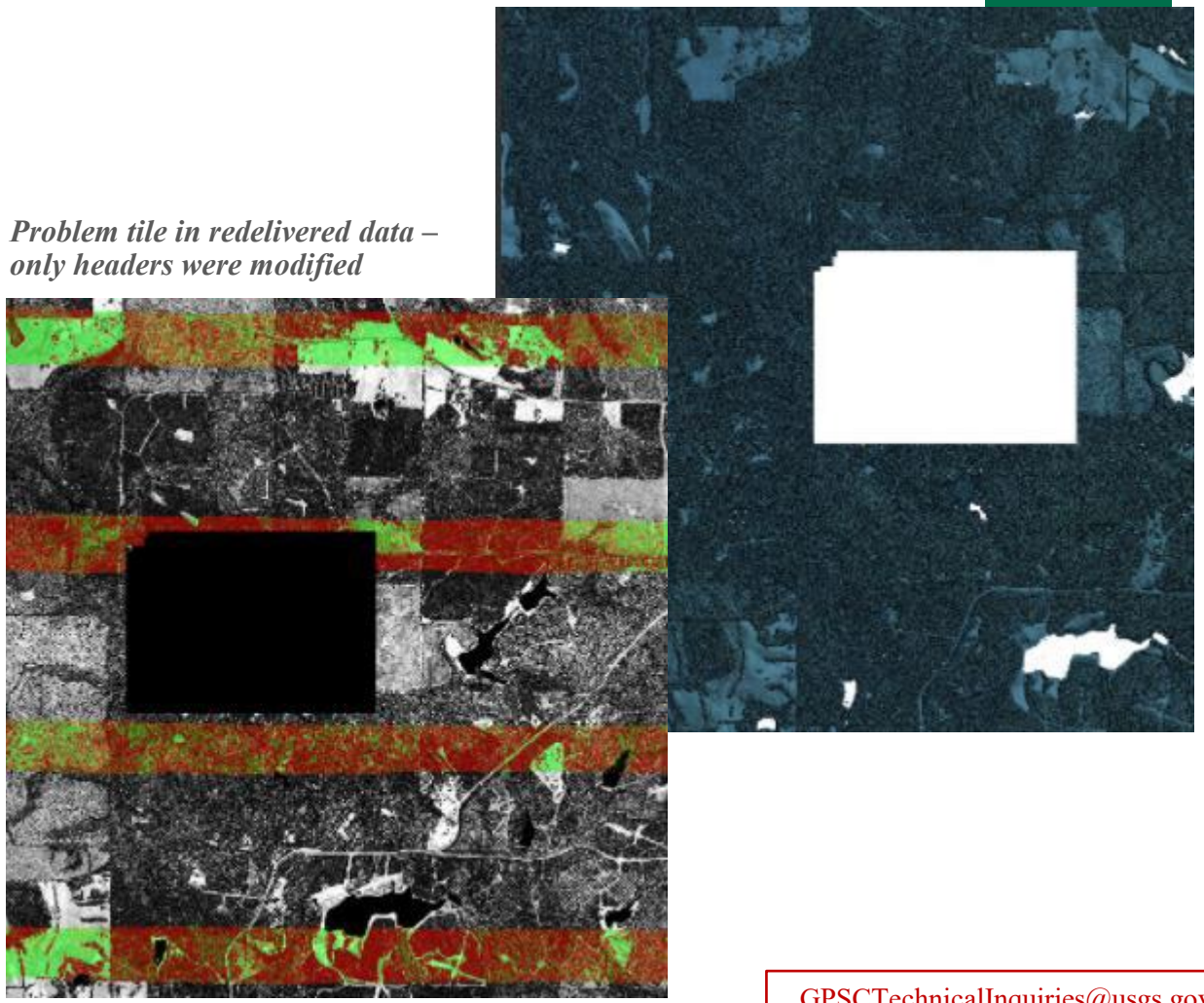
Josh Nimetz
National Geospatial Program | National Geospatial Technical Operations Center
Virtual Web Conference
January 20, 2022

Topics for discussion

- **ESRI AGOL contractor acquisition and production tracking system – instructional overview by ESRI**
- Introducing Milena Janiec as NGTOC Elevation Section Chief
- Redelivery of tiled datasets
  - Full and partial datasets
  - Derivative rasters for redelivered LPC data
- USGS data validation using the 50/25/10 rule
- Variable water surfaces due to temporal range of collection
- Use of temporal exclusion class 22 vs. water class 9 for variable water levels
- Low confidence polygons
- Folder structure
- Work unit overlap
- Delivery of point cloud datasets in LAZ format

Redelivery of Tiled Datasets

- USGS is challenged with efficiently reviewing 3DEP source data and duplication of effort is generally discouraged
- USGS reviews all delivered data unless there is a compelling reason not to do so
- It can be problematic when complete datasets are delivered if USGS is expecting redelivery of only a subset of tiles
  - Please communicate in advance why a complete redelivery is being provided
  - Knowing this information can help USGS decide to what extent new files should be reviewed
- Any redelivery of LPC files requires a correlated SSI and MSHR



Problem tile in redelivered data – only headers were modified

GPSCTechnicalInquiries@usgs.gov

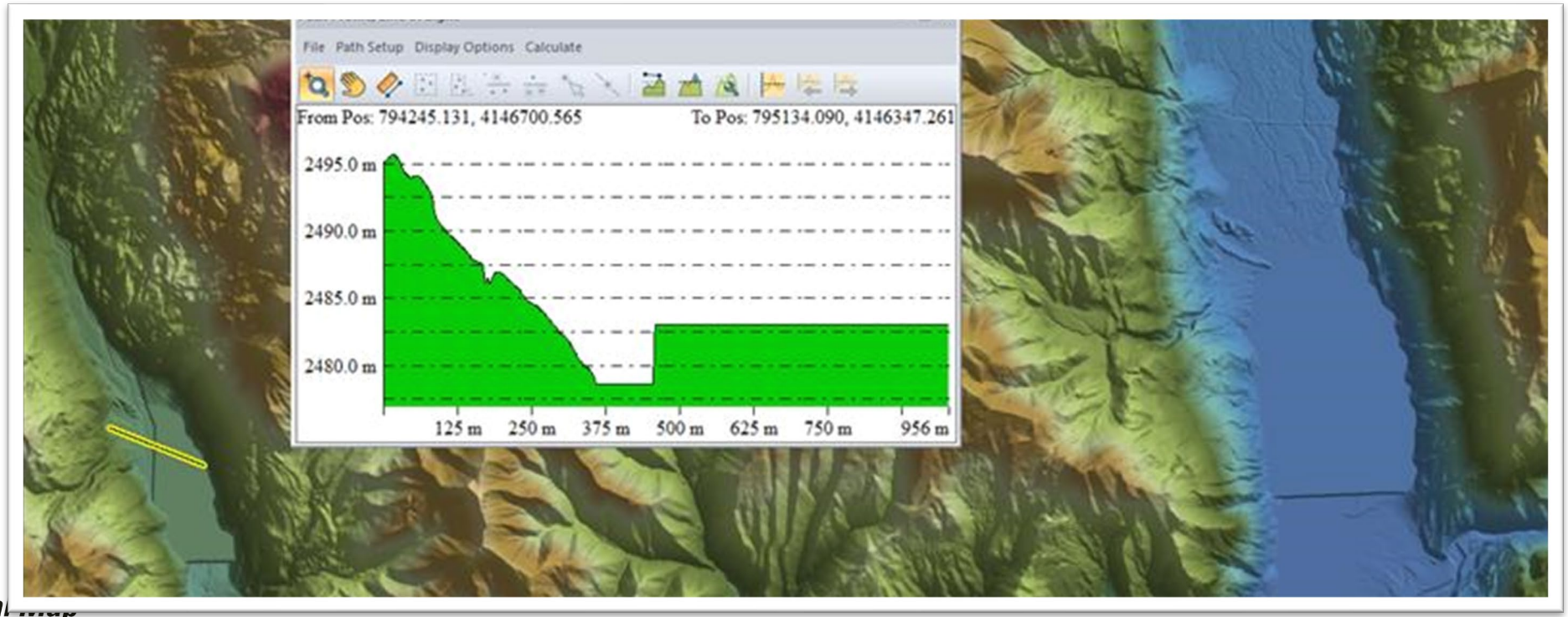
USGS Data Validation Process

- **The 50/25/10 rule**
- Established to improve efficiencies in data validation
- USGS validates data but does not perform quality control on source elevation data sets – this is the responsibility of the data producer

+ Variable water surfaces in point cloud

- Temporal nature of airborne lidar may lead to variable water levels in point cloud
- Exposed ground surface takes priority over aesthetics/cartographic products
- If choosing swaths when tiling the data, prioritize exposed ground for purpose of classifying ground

Two reservoirs collected before and after dam release. Exposed ground prioritized in tiled data



+ Variable water surfaces in point cloud

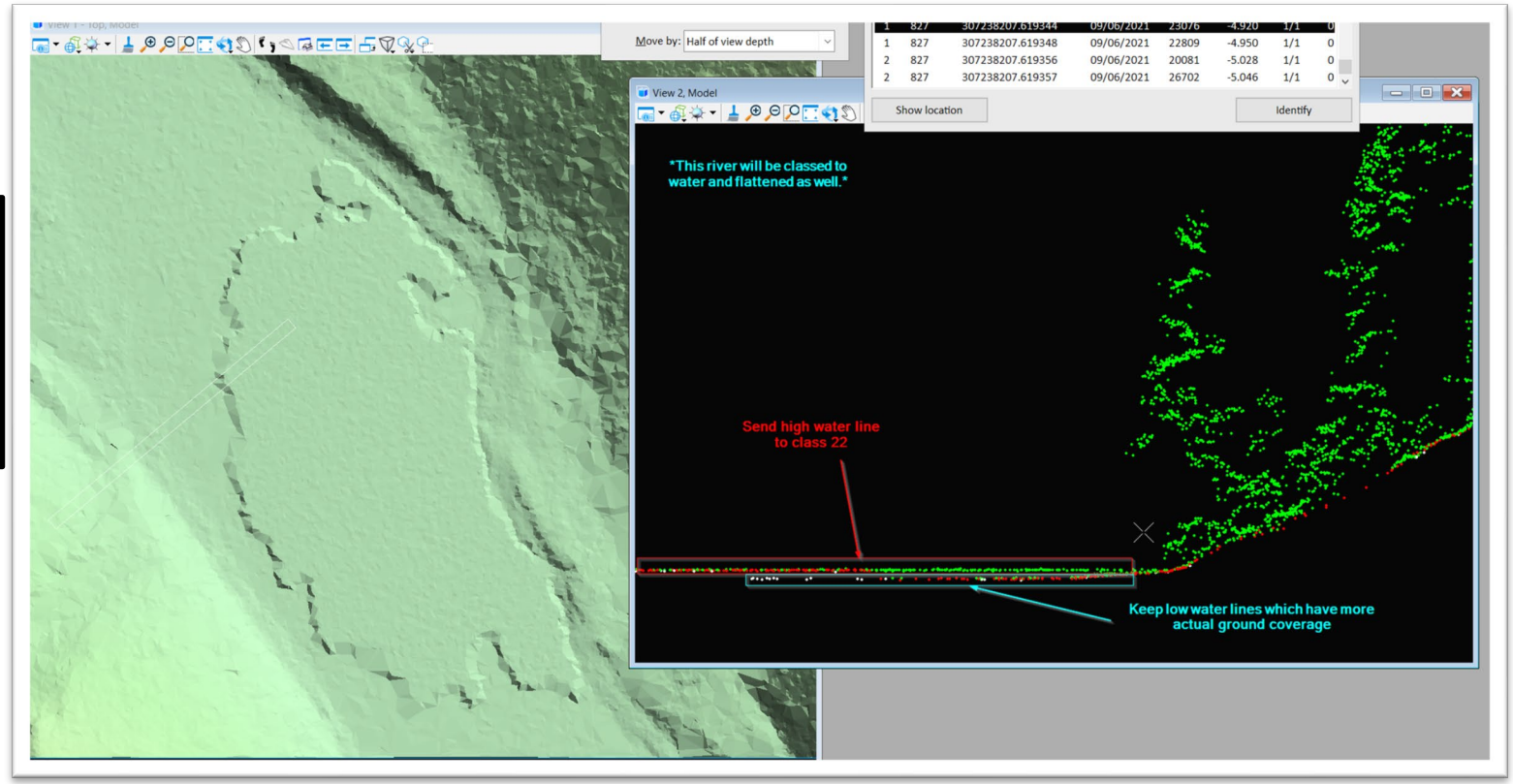
- If tiling multiple swaths with variable water levels, apply water class (9) to corresponding hydro-flattening breaklines
  - Temporal exclusion class (22) may be applied to other water returns

From LAS 1.4 r15

22 Temporal Exclusion Features excluded due to changes over time between data sources – e.g., water levels, landslides, permafrost

USGS will accept use of temporal exclusion class (22) where appropriate and as long as documented in metadata

Multiple swaths with variable water returns in tiled data. Lower ground and water returns properly classified. Upper water level classified as temporal exclusion (22).



USGS science for a changing world

The National Map
Your Source for Topographic Information

+ Use of Low Confidence Polygons

- Low confidence polys necessary to delineate areas with known data issues such as
  - Poor ground density due to flooded conditions
  - Poor ground density due to dense vegetation
- While there isn't currently a ground density requirement for 3DEP, data are expected to be collected under proper conditions and ground density should support creation of bare earth DEMs
  - USGS acknowledges this is a vague requirement
  - Future ASPRS standards and LBS will hopefully address the correlation between ground density and bare earth DEMs

- **Low confidence polys are not a suitable replacement for collecting data under ideal conditions**
- However, we understand that perfect collection conditions don't always exist
  - If not feasible to collect to current LBS collection requirements, low confidence polys should be provided to notify users of low confidence in the data for delineated areas

Collection Conditions

- Atmospheric conditions shall be cloud and fog free between the aircraft and ground during all collection operations.
- Ground conditions will be snow free. Very light, undrifted snow may be acceptable with prior approval.
- Ground conditions shall be free of extensive flooding or any other type of inundation.
- Leaf-off vegetation conditions are preferred.
- Penetration to the ground shall be adequate to produce an accurate and reliable bare-earth surface for the prescribed QL.
- Collections planned for leaf-on collections shall be approved by the USGS–NGP/3DEP prior to issuance of a task order or contract.

+ Use of Low Confidence Polygons

https://www.asprs.org/a/society/committees/standards/Positional_Accuracy_Standards.pdf

- Low confidence polys may be manually placed or placed using an automated approach, such as what is recommended in ASPRS positional accuracy standards (Nov 2014)
  - Please make note of specific process and intent of low confidence polys in metadata

7.6 Low Confidence Areas for Elevation Data

If the VVA standard cannot be met, low confidence area polygons shall be developed and explained in the metadata. For elevation data derived from imagery, the low confidence areas would include vegetated areas where the ground is not visible in stereo. For elevation data derived from lidar, the low confidence areas would include dense cornfields, mangrove or similar impenetrable vegetation. The low confidence area polygons are the digital equivalent to using dashed contours in past standards and practice. Annex C, Accuracy Testing and Reporting Guidelines, outlines specific guidelines for implementing low confidence area polygons.

USGS is looking for low confidence polygons where appropriate, not only where VVA fails

ASPRS approach is an option, however, is not required at this time

distribution suitable for RMSE statistical analyses, and vegetated terrain where errors do not necessarily follow a normal distribution and where the 95th percentile value more fairly estimates vertical accuracy at a 95% confidence level.

C.8 LOW CONFIDENCE AREAS

For stereo-compiled elevation data sets, photogrammetrists should capture two-dimensional closed polygons for "low confidence areas" where the bare-earth DTM may not meet the overall data accuracy requirements. Because photogrammetrists cannot see the ground in stereo beneath dense vegetation, in deep shadows or where the imagery is otherwise obscured, reliable data cannot be collected in those areas. Traditionally, contours within these obscured areas would be published as dashed contour lines. A compiler should make the determination as to whether the data being digitized is within NVA and VVA accuracies or not; areas not delineated by an obscure area polygon are presumed to meet accuracy standards. The extent of photogrammetrically derived obscure area polygons and any assumptions regarding how NVA and VVA accuracies apply to the photogrammetric data set must be clearly documented in the metadata.

Low confidence areas also occur with lidar and IFSAR where heavy vegetation causes poor penetration of the lidar pulse or radar signal. Although costs will be slightly higher, ASPRS recommends that "low confidence areas" for lidar be required and delivered as two-dimensional (2D) polygons based on the following four criteria:

1. Nominal ground point density (NGPD);
2. Cell size for the raster analysis;
3. Search radius to determine average ground point densities; and
4. Minimum size area appropriate to aggregate ground point densities and show a generalized low confidence area (minimum mapping unit).

This approach describes a raster-based analysis where the raster cell size is equal to the Search Radius listed for each Vertical Data Accuracy Class. Raster results are to be converted into polygons for delivery.

This section describes possible methods for the collection or delineation of low confidence areas in elevation data sets being created using two common paradigms. Other methodologies currently exist, and additional techniques will certainly emerge in the future. The data producer may use any method they deem suitable provided the detailed technique is clearly documented in the metadata.

Table C.2 lists the values for the above low confidence area criteria that apply to each vertical accuracy class.

Low confidence criteria and the values in Table C.2 are based on the following assumptions:

- **Ground Point Density**: Areas with ground point densities less than or equal to ¼ of the recommended nominal pulse density (pulse per square meter) or twice the nominal pulse spacing are candidates for Low Confidence Areas. For example: a specification requires an NPS of 1 meter (or an NPD of 1 ppsm) but the elevation data in some areas resulted in a nominal ground point density of 0.25 point per square meter (nominal ground point spacing of 2 meters). Such areas are good candidate for "low confidence" areas.
- **Raster Analysis Cell Size**: Because the analysis of ground point density will most likely be raster based, the cell size at which the analysis will be performed needs to be specified. The recommendation is that the cell size equals the search radius.
- **Search Radius for Computing Point Densities**: Because point data are being assessed, an area must be specified in order to compute the average point density within this area. The standards recommend a search area with a radius equal to 3 * NPS (*not the Low Confidence NGPS*). This distance is small enough to allow good definition of low density areas while not being so small as to cause the project to look worse than it really is.
- **Minimum Size for Low Confidence Polygons**: The areas computed with low densities should be aggregated together. Unless specifically requested by clients, structures/buildings and water should be removed from the aggregated low density polygons as these features are not true Low Confidence.

Aggregated polygons greater than or equal to the stated minimum size as provided in Table C.2 should be kept and defined as Low Confidence Polygons. In certain cases, too small an area will "checker board" the Low Confidence Areas; in other cases too large an area will not adequately define Low Confidence Area polygons. These determinations should be a function of the topography, land cover, and final use of the maps.

Acres should be used as the unit of measurement for the Low Confidence Area polygons as many agencies (USGS, NOAA, USACE, etc.) use acres as the mapping unit for required polygon collection. Approximate square meter equivalents are provided for those whose work is exclusively in the metric system. Smoothing algorithms could be applied to the Low Confidence Polygons, if desired.

TABLE C.2 LOW CONFIDENCE AREAS

Vertical Accuracy Class	Recommended Project Min NPD (pls/m²) (Max NPS (m))	Recommended Low Confidence Min NGPD (pts/m²) (Max NGPS (m))	Search Radius and Cell Size for Computing NGPD (m)	Low Confidence Polygons Min Area (acres (m²))
1-cm	20 (0.22)	5 (0.45)	0.67	0.5 (2,000)
2.5-cm	16 (0.25)	4 (0.50)	0.75	1 (4,000)
5-cm	8 (0.35)	2 (0.71)	1.06	2 (8,000)
10-cm	2 (0.71)	0.5 (1.41)	2.12	5 (20,000)
15-cm	1 (1.0)	0.25 (2.0)	3.00	5 (20,000)
20-cm	0.5 (1.4)	0.125 (2.8)	4.24	5 (20,000)
33.3-cm	0.25 (2.0)	0.0625 (4.0)	6.0	10 (40,000)
66.7-cm	0.1 (3.2)	0.025 (6.3)	9.5	15 (60,000)
100-cm	0.05 (4.5)	0.0125 (8.9)	13.4	20 (80,000)
333.3-cm	0.01 (10.0)	0.0025 (20.0)	30.0	25 (100,000)

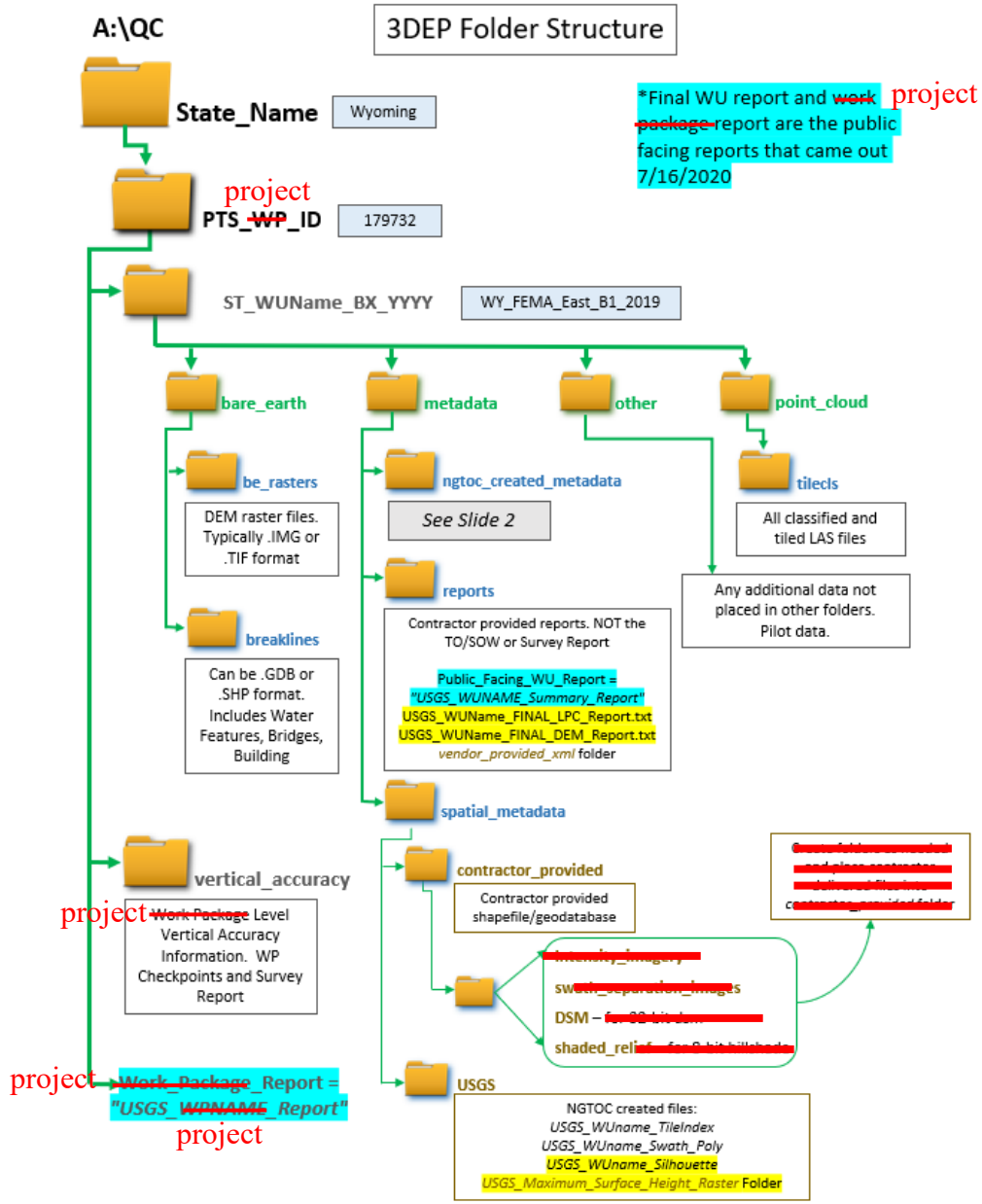
USGS science for a changing world

The National Map Your Source for Topographic Information

GPSCTechnicalInquiries@usgs.gov

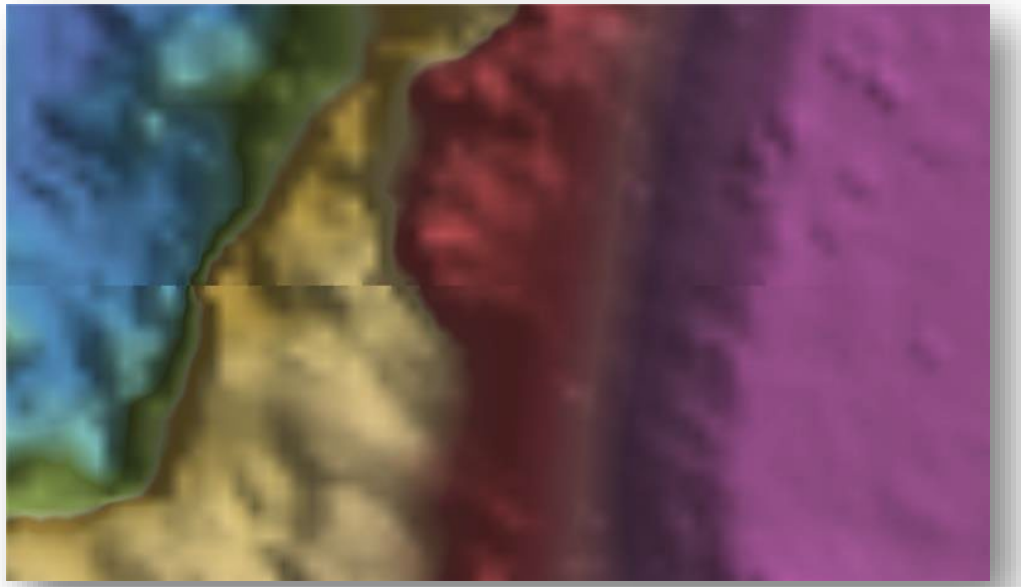
Folder Structure

- Please use folder structure for all 3DEP deliverables to USGS
- A template of the folders will be emailed following this meeting
  - We are also working on posting this template online for access



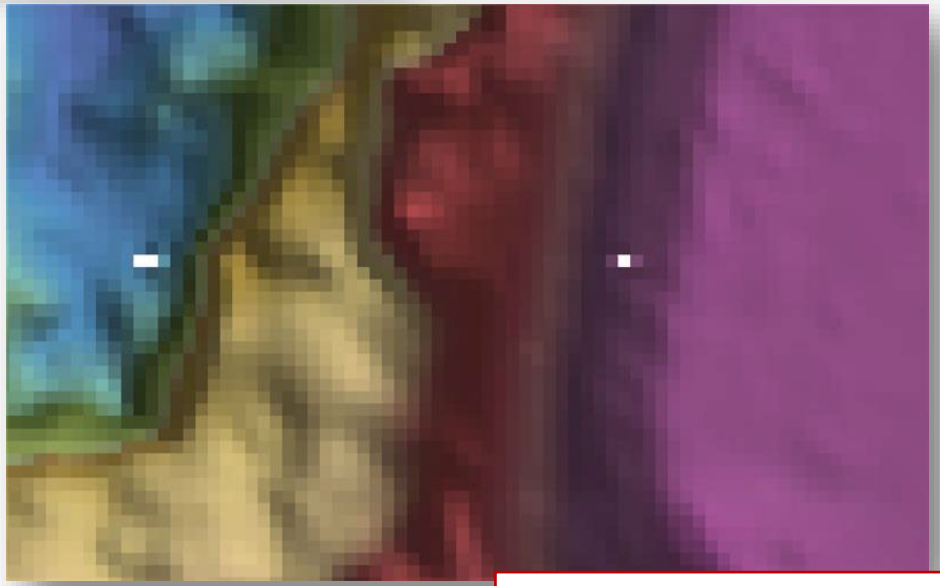
Overlap in Work Units

- USGS elevation operations is now requesting ≥ 100 pixel overlap between *all* work units
- This request is to ensure processing of derivative raster products in alternate coordinate reference system [NAD83(86) UTM or GCS, meters]
- Lack of overlap has resulted in pixel voids along WU boundaries
- Additional benefit – overlap between work units will facilitate evaluating goodness of fit between work units
  - Assuming data does not move!



Source bare earth DEM in native coordinate system. East-West WU boundary apparent in middle of graphic.

Derived USGS 1 m bare earth DEM [NAD83(86) UTM, meters] with pixel voids



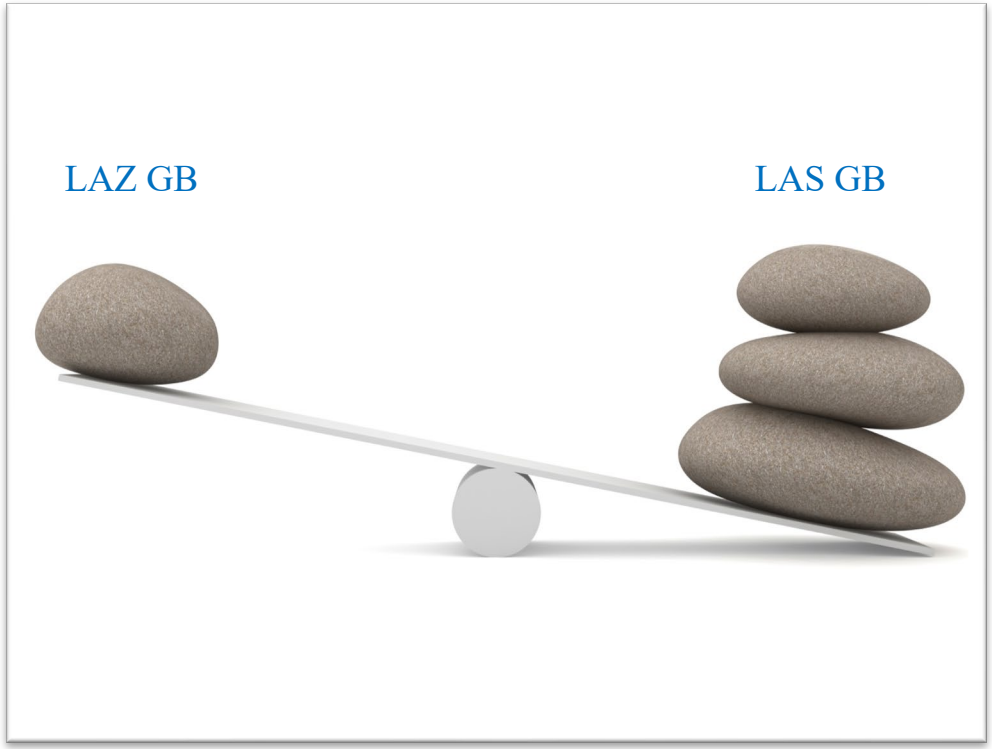
USGS science for a changing world

The National Map Your Source for Topographic Information

GPSCTechnicalInquiries@usgs.gov

Delivery of Point Cloud Data in LAZ format

- Workflow Enhancement
- LAZ file volume is approximately 20% size of LAS
  - Faster data transfer
  - Lowers storage requirements over duration of the project through USGS pipeline
  - Several USGS production processes can work with LAZ format
- USGS still reliant on COTS that works better with LAS
  - Temporary version of LAS will be created for viewing and interrogating point cloud
- Time and resources to uncompress to LAS for temporary viewing will offset time and resources in product generation to compress to LAZ



Thank You!
Let's Talk…

GPSCTechnicalInquiries@usgs.gov