Dewberry

Dewberry's Response to USGS' Review

Of the

PAgis V13 LiDAR Processing Project

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G11PD01289

Prepared for:
USGS

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Table of Contents

1 Executive Summary

The primary purpose of this project was to develop a consistent and accurate surface elevation dataset derived from recently acquired high-accuracy Light Detection and Ranging (LiDAR) data set of 576 square miles for the USGS Pulaski County project area.

Deliverables for this project included LAS, breaklines, a terrain dataset, 3D contours and bare earth Digital Elevation Models (DEMs). USGS' review of these deliverables resulted in twenty-seven calls to modify breaklines, eight calls to add culverts back to ground, twenty comments about bridge artifacts, one call to verify that the delivered contours contain 3D geometry, one call to clip terrains to the project boundary and one general call for the ESRI file GDBs to all be version 9.3. All fifty-eight calls and comments were addressed and the necessary corrections were made to both the LAS and DEM files. The twenty comments about bridge artifacts did not result in any modifications to the data.

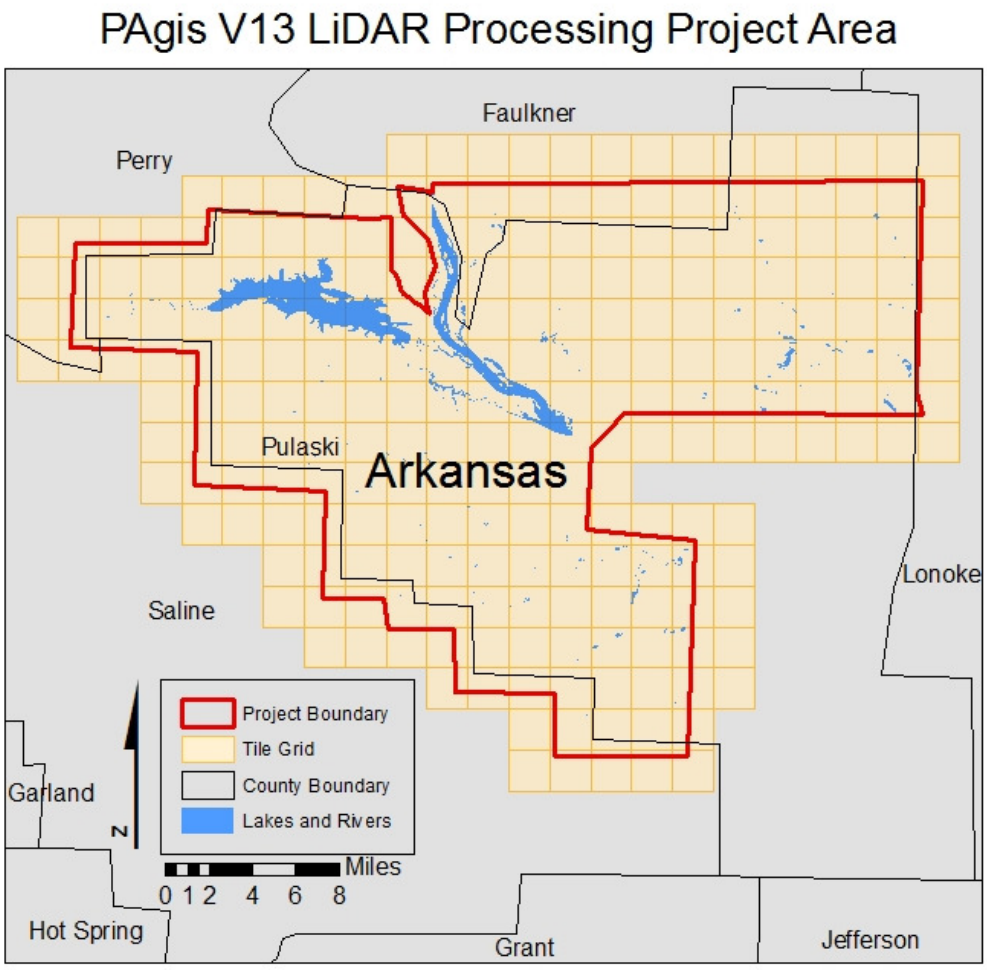

Figure 1: Project Map

2 Edit Calls

Three main types of edit calls were made in USGS' review of the USGS PAgis V13 LiDAR project. The first type of call was for breakline adjustments. The second type of call was for culverts removed from the ground surface. The last type of call was for bridge removal artifacts. The edit calls that required corrections impacted both the LAS and DEM files.

2.1 Breakline Adjustments

There are twenty-seven locations where Dewberry interpreted a feature as water and included the feature in the collected breaklines. USGS identified some of these features as ground, not water. USGS also identified areas of water that were not included in the collected breaklines. While the interpretation of the feature may be questionable in the intensity imagery, Dewberry agrees with twenty of the calls after reviewing color imagery. These twenty instances identified by USGS have been corrected. An example is shown below.

Figure 2: Tile 15WU2617, Delivery 1. Portions of the identified feature was originally interpreted as a hydro and removed from the ground surface. The LAS and DEM has been corrected by adding portions of this feature back to the ground surface, shown below.

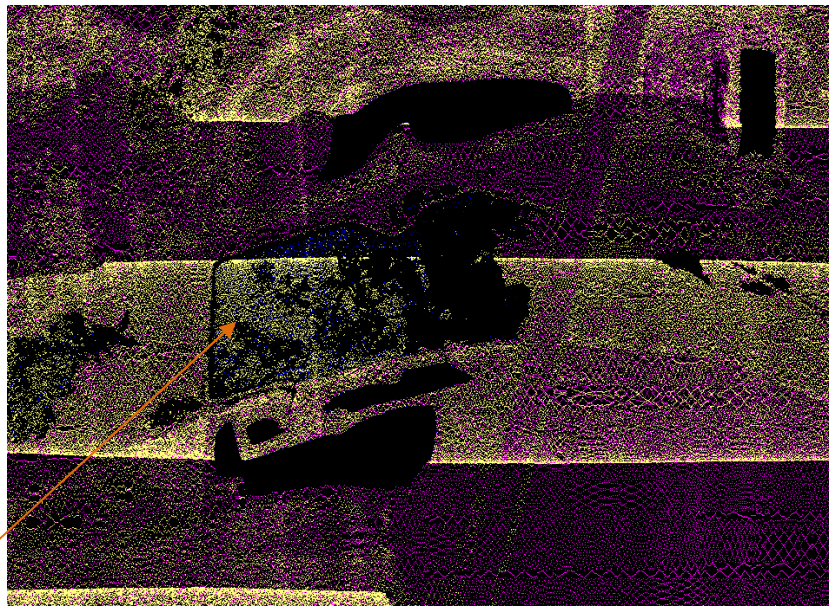

Figure 3: Tile 15WU2617. The LiDAR points shown above confirm that the breaklines delivered to USGS should be modified to include additional ground data. The black area is where no points were returned due to the presence of water but the yellow points just west of the feature show several points were returned indicating the presence of ground.

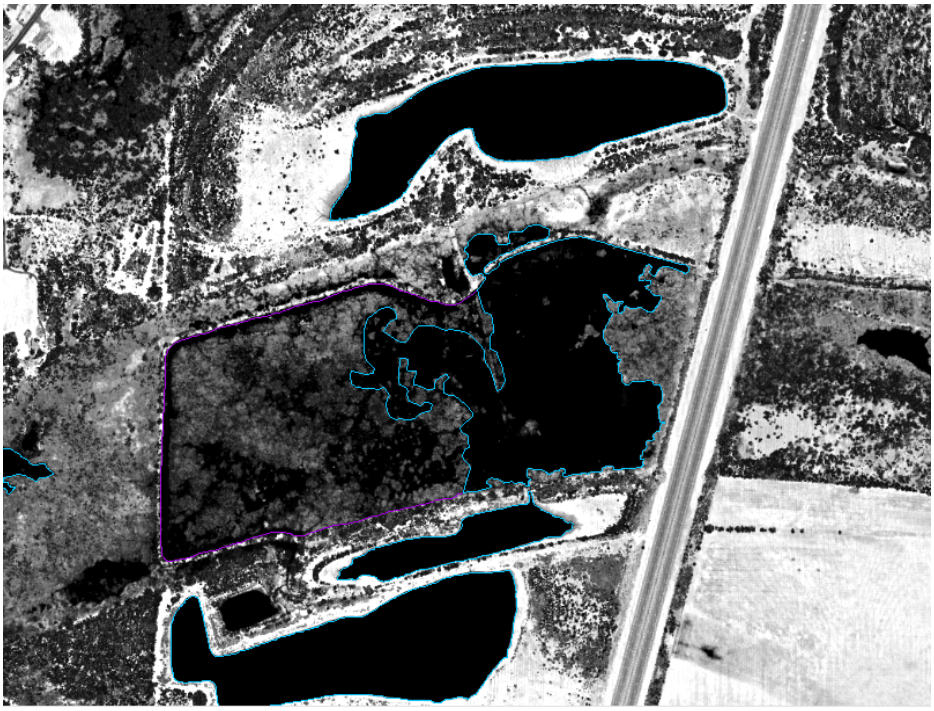

Figure 4: Tile 15WU2617. The intensity image showing the collected breaklines from the first delivery in purple and the modified breaklines from this delivery in blue.

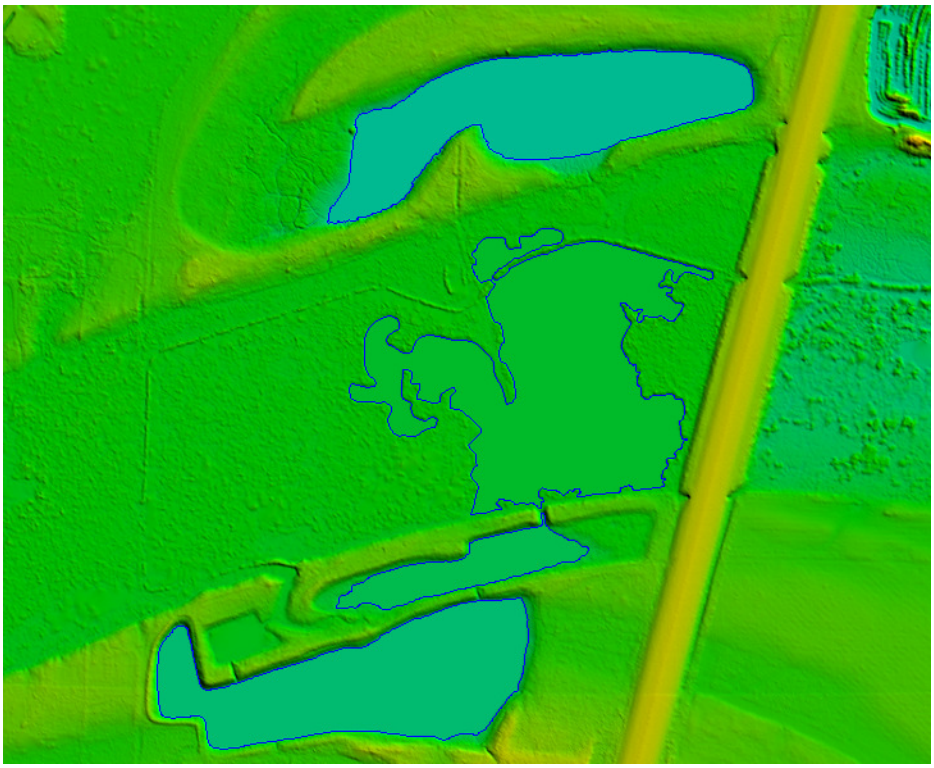

Figure 5: Tile 15WU2617, Delivery 2. Portions of the identified feature was originally interpreted as a hydro and removed from the ground surface. The LAS and DEM has been corrected by adding portions of this feature back to the ground surface.

There are seven locations called out by USGS where, after reviewing the LiDAR, Dewberry confirmed that the breaklines accurately capture the existing water and no changes were necessary. Examples are shown below.

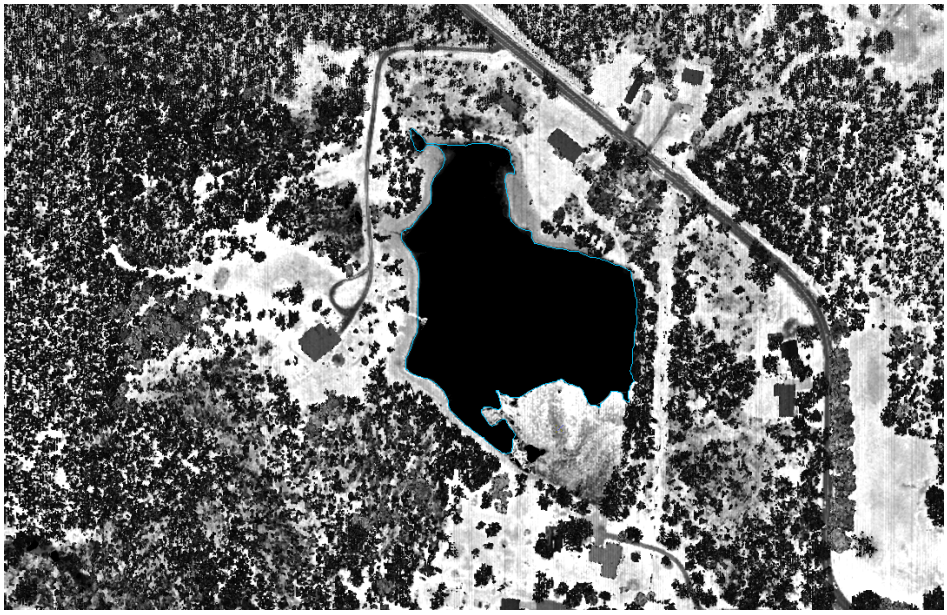

Figure 6: Tile 15WU2419. As the intensity imagery shows, the breaklines delivered to USGS correctly capture existing waterbodies.

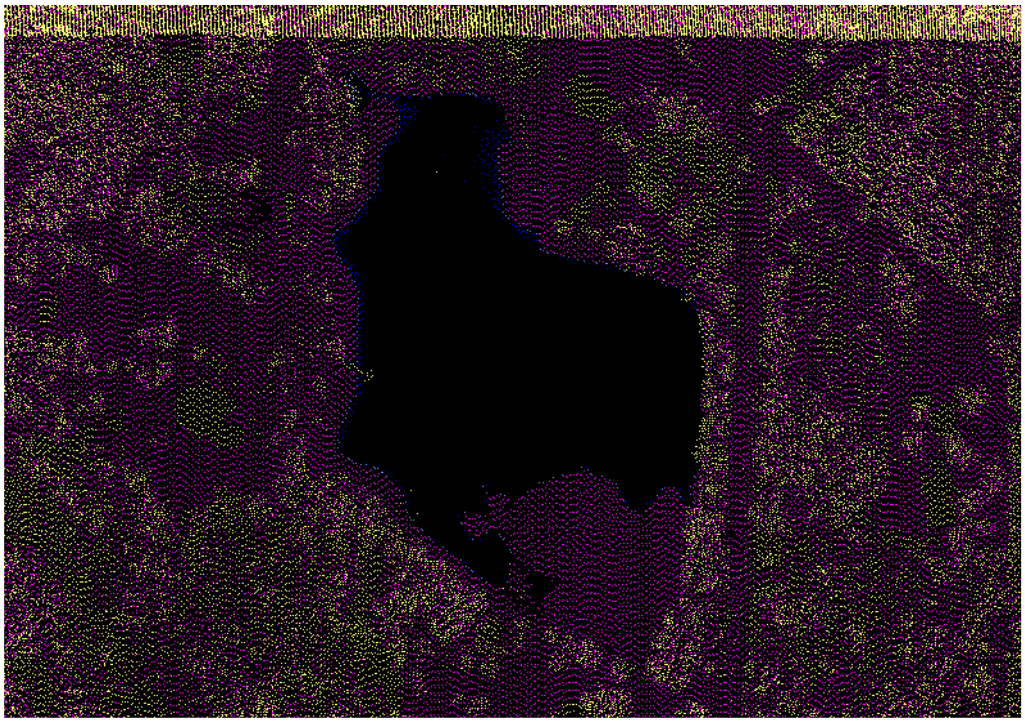

Figure 7: Tile 15WU2419. The LiDAR points shown above confirm that the breaklines delivered to USGS correctly capture the waterbody. The black area is where no points were returned due to the presence of water but the pink points just south of the feature show several points were returned indicating the presence of ground.

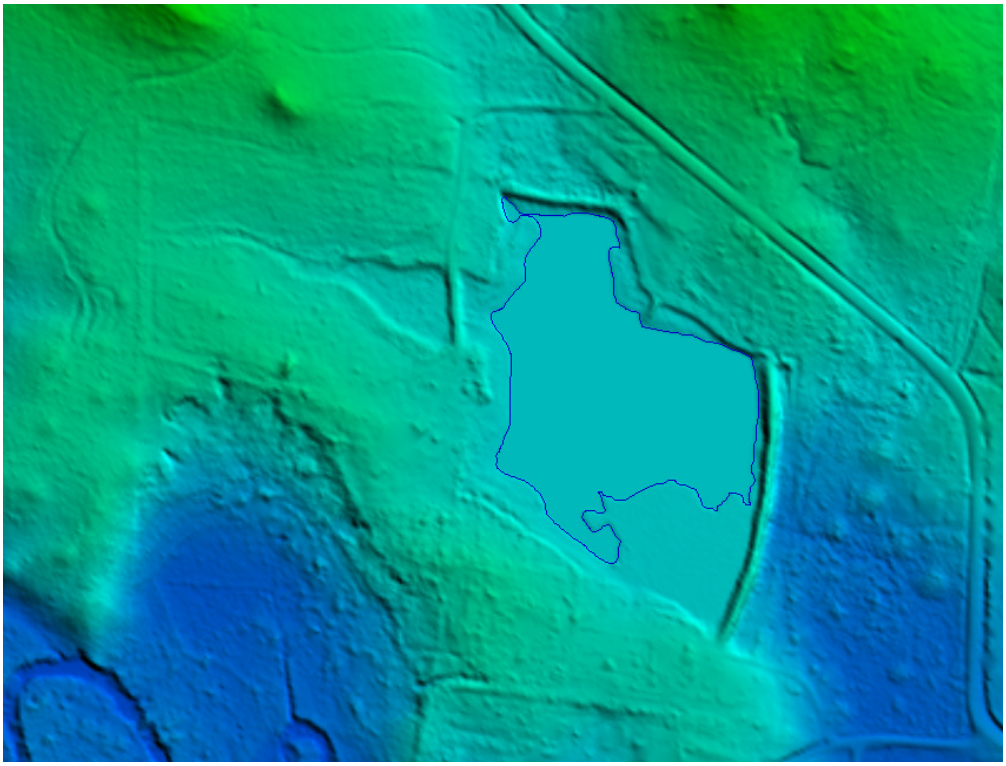

Figure 8: Tile 15WU2419. The breaklines delivered to USGS correctly capture existing waterbodies. No change was made to the breaklines or DEM surface.

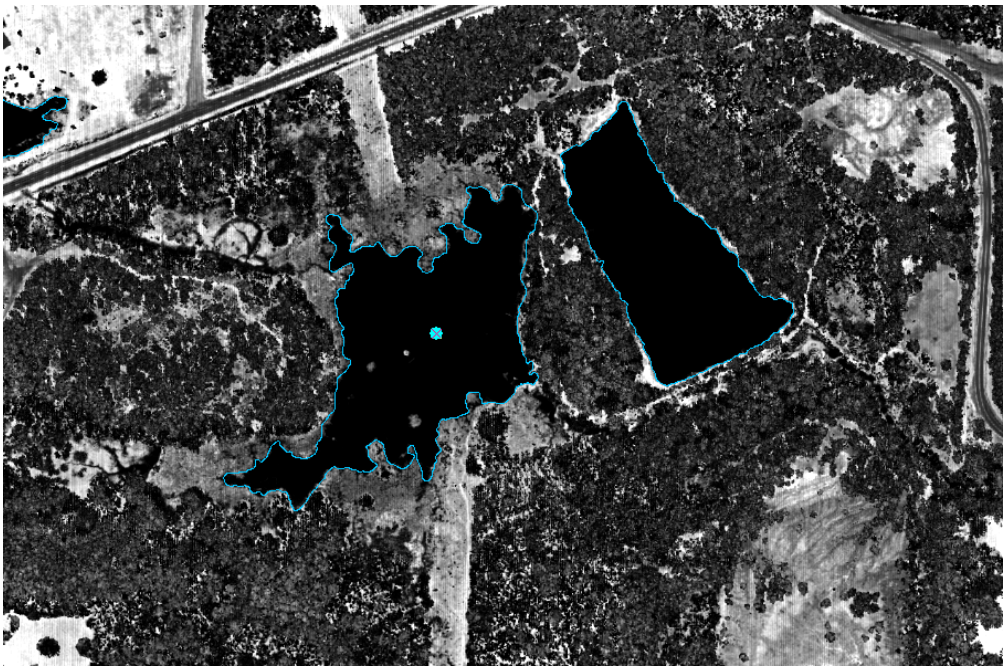

Figure 9: As the intensity imagery shows, the breaklines delivered to USGS correctly capture existing waterbodies. No change was made to the breaklines or DEM surface.

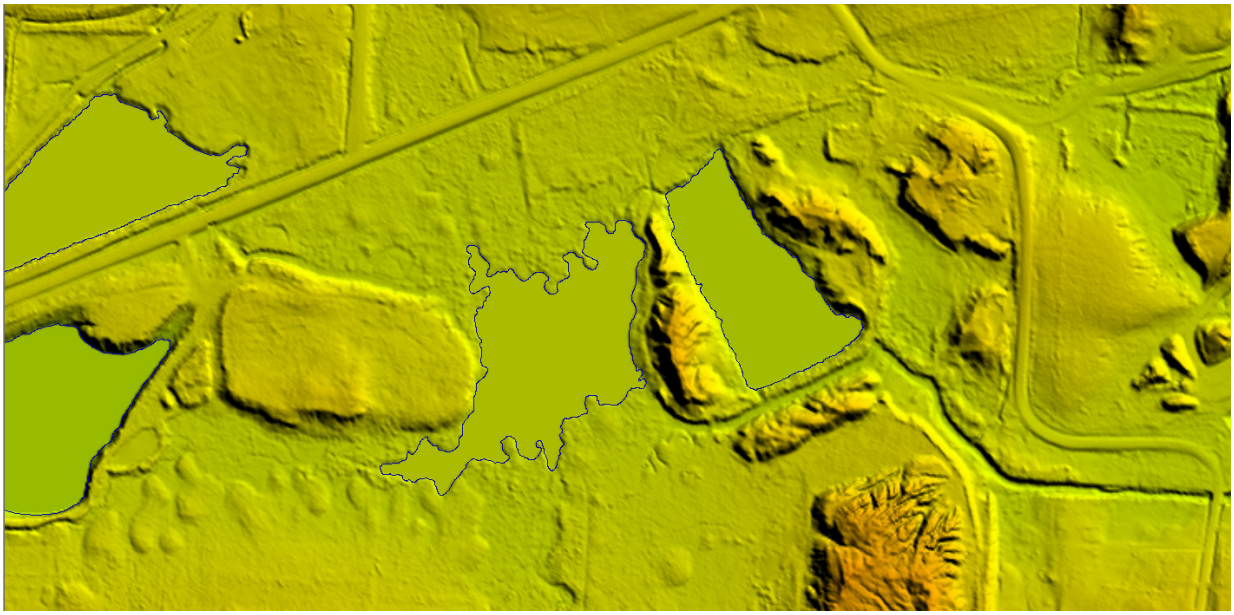

Figure 10- Tile 15WU221 and 15WU2311. The DEM shows a visual artifact because the surface model is interpolating from the slope leading to the bridge to the hydrographic banks. The surface model must make a continuous model and in order to do so, points are connected through interpolation. This can cause visual artifacts when there are features with large elevation differences.

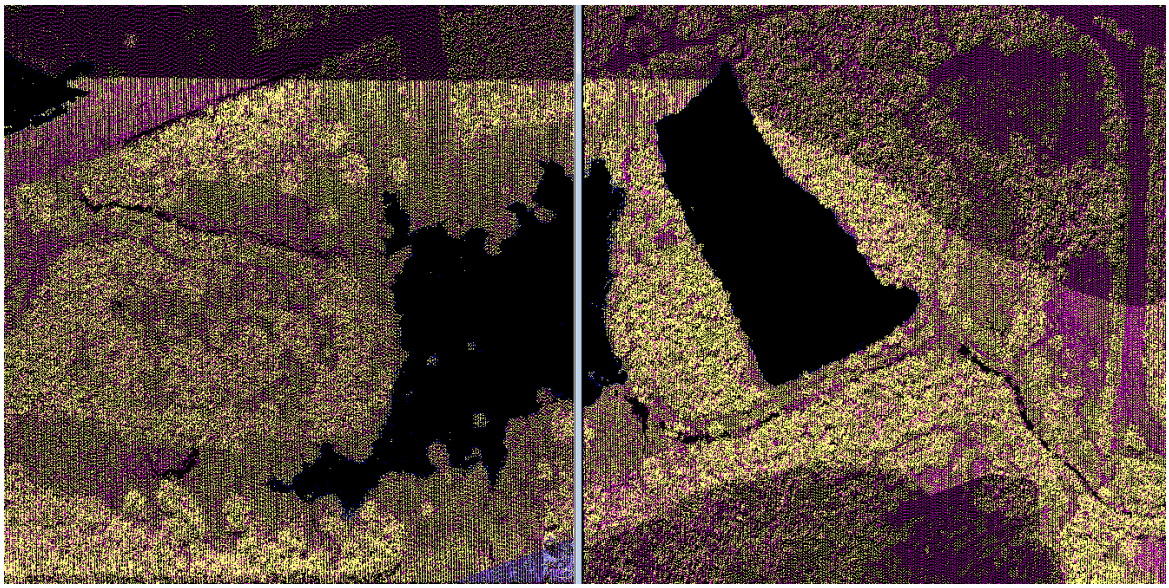

Figure 11- Tile 15WU221 and 15WU2311. The profile view shows the LiDAR points, colored by class, of this particular feature. All bridge points have been removed from ground (pink) and are unclassified (yellow). There are no ground points that can be modified to correct this visual artifact.

2.2 Culverts Removed from the Ground Surface

There are eight locations where Dewberry interpreted a feature as a bridge and removed the feature from the ground surface. USGS identified these features as culverts, not bridges. Dewberry agrees with all eight calls and all eight instances identified by USGS have been corrected. An example is shown below.

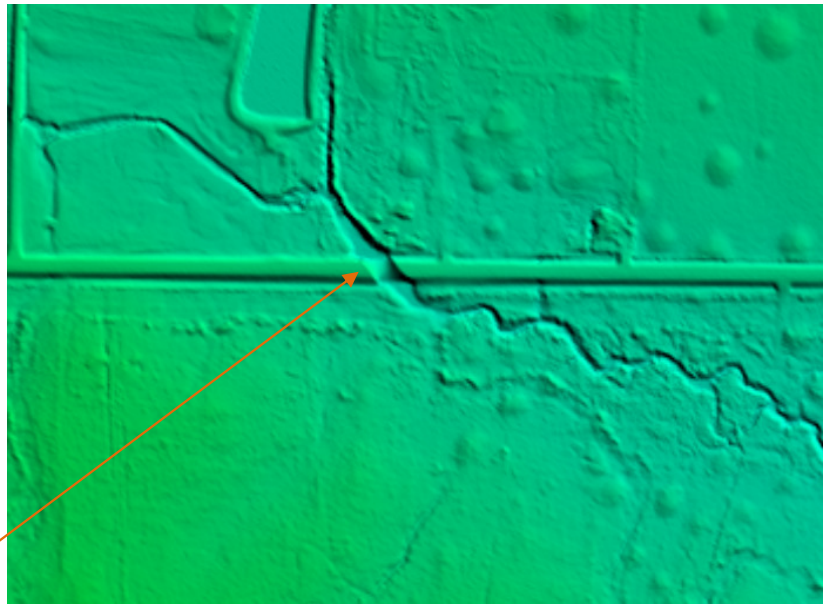

Figure 12- Tile 15WU2322, Delivery 1. The feature identified was originally interpreted as a bridge and removed from the ground surface. USGS identified this feature as a culvert. The LAS and DEM has been corrected by adding this feature back to the ground surface, shown below.

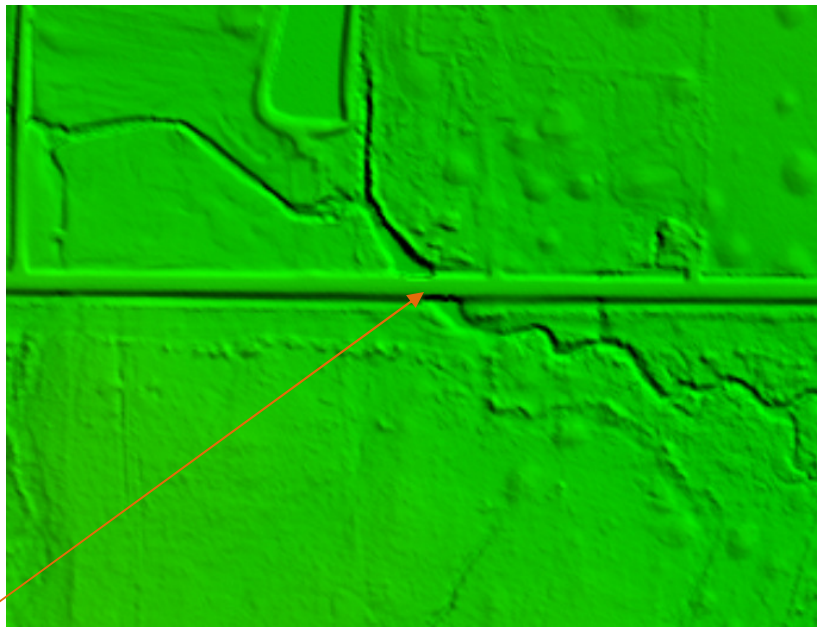

Figure 13- Tile 15WU2322, Delivery 2. The culvert has been added back to the ground surface.

2.3 Bridge Removal Artifacts

There are twenty locations where comments were made for bridge removal artifacts. The DEM surface models are created from TINs or Terrains. TINs and Terrain models create continuous surfaces from the inputs, in this instance LiDAR ground points and breaklines. 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 make the model appear to contain a bridge even though points have been removed from ground. This can also cause visual artifacts or "saddles," as labeled in the USGS review document. As these "artifacts" are only visual and do not exist in the LiDAR points or breaklines, no modifications were made to the LAS or DEMs in these areas. Examples are shown below.

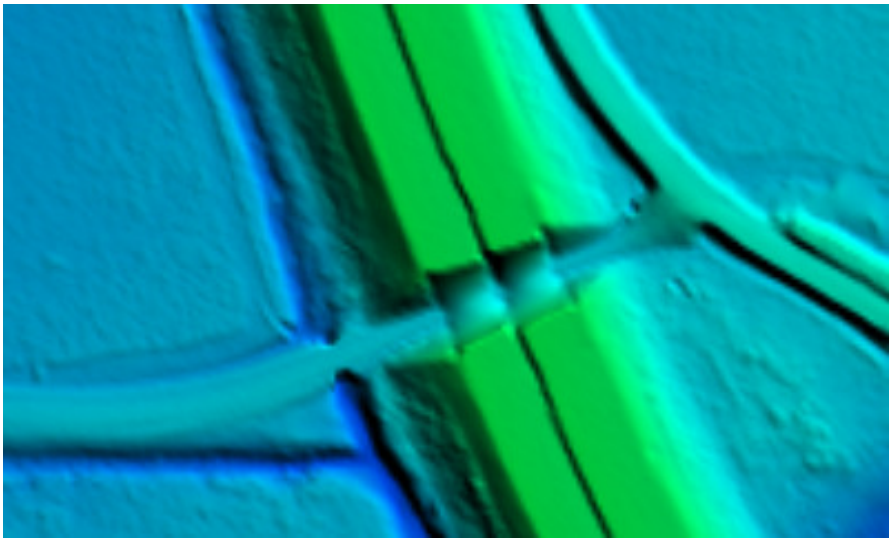

Figure 14- Tile 15WU1822. The DEM above shows a visual artifact, or "saddle" as labeled in the USGS review report, because the surface model is interpolating across the bridge gap. The surface model must make a continuous model and in order to do so, points are connected through interpolation. This can cause visual artifacts or loss of detail when the surface model must interpolate across removed features, such as bridges, where there are few or no ground LiDAR points.

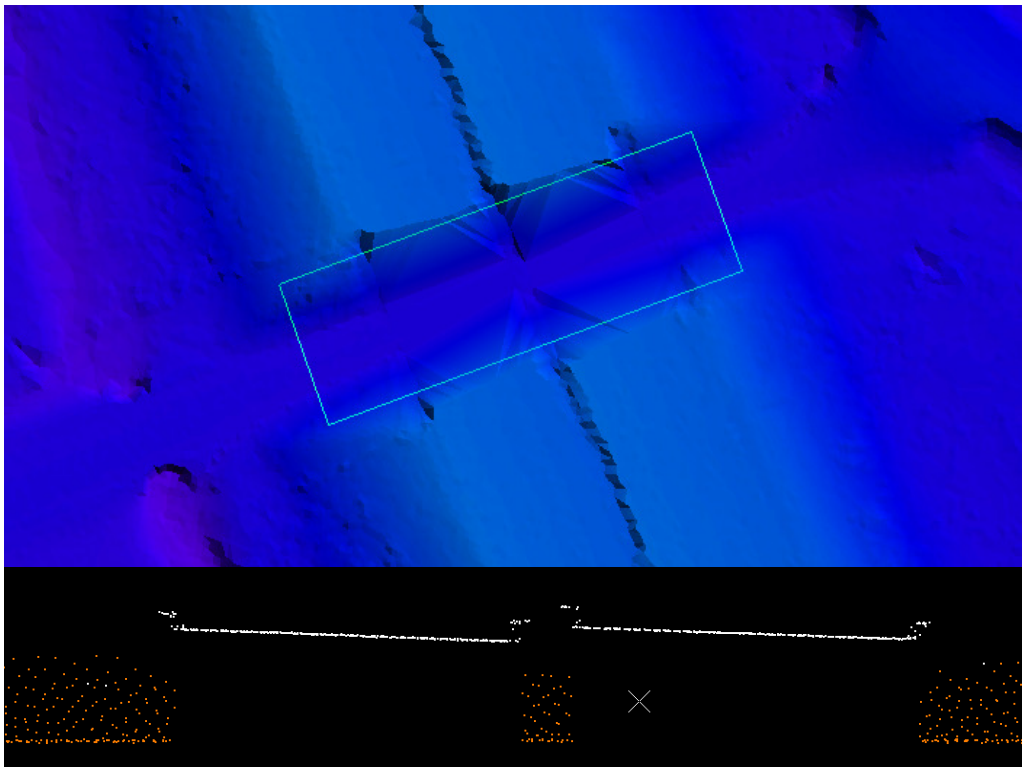

Figure 15- Tile 15WU1822. The DEM in the top view shows a visual artifact because the surface model is interpolating from the slope leading to the bridge to the hydrographic banks. The surface model must make a continuous model and in order to do so, points are connected through interpolation. This can cause visual artifacts when there are features with large elevation differences. The profile in the bottom view shows the LiDAR points, colored by class, of this particular feature. All bridge points have been removed from ground (orange) and are unclassified (white). There are no ground points that can be modified to correct this visual artifact.

3 Summary of Edit Calls

There were twenty-seven calls to adjust breaklines. Twenty of these issues have been corrected. There are seven calls to adjust breaklines where no changes were necessary. There were eight edit calls referring to culverts that should have been left in the ground surface. All eight of these issues have been corrected. No modifications were made to data in reference to the twenty bridge removal artifacts that were identified by USGS as these artifacts are a result of the DEM interpolation process and not due to erroneous LiDAR points or breaklines. The contours have been modified to contain 3D geometry, the terrain has been clipped to the project boundary and all ESRI file GDBs in this delivery are version 9.3.