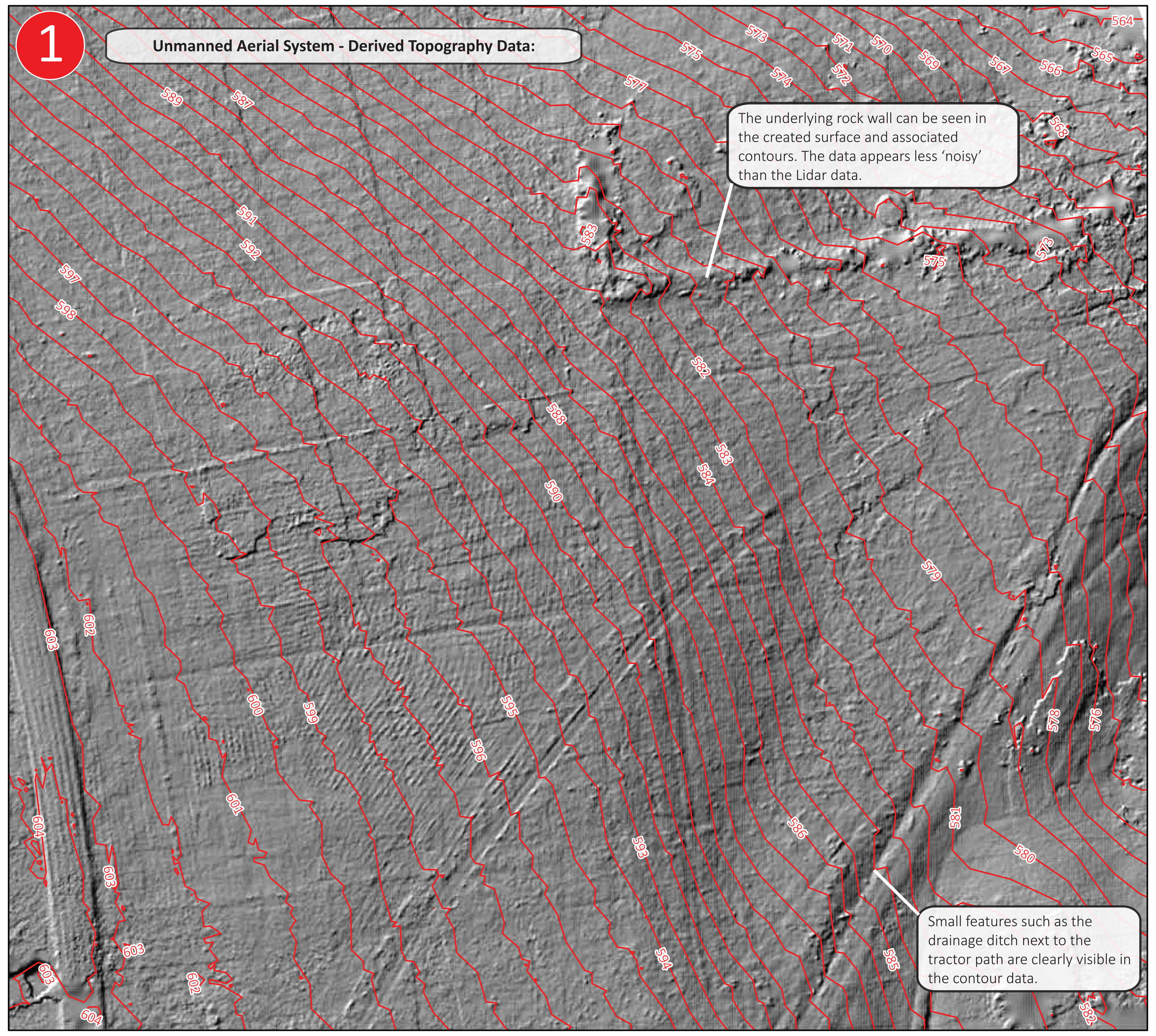


1 Unmanned Aerial System - Derived Topography Data:

The 1' contours and associated hillshade surface model were derived using FluidState Consulting's UAS (drone) from a flight on March 12, 2020. The UAS flew at a height of approximately 200' above ground level over an area of ~21 acres. The flight took approximately 15 minutes. The data was uploaded to the mission control and imagery stitching software service. The resulting data was downloaded as a 'bare earth' digital terrain model (DTM) where larger trees and buildings were removed from the surface. DTM resolution was 3.22" / pixel. Contours were created using QGIS, as was the hillshade. Contour interval was set to 1' (set to break on whole number elevation values in feet above sea level).
Note that many small features in the field are well captured (tractor path ditch for example) and the remnants of an old stone fence can be seen. The impact of vegetation in the field during this time is minimal (and rows can actually be seen on the hillshade).

2 VCGI - Light Detection and Ranging (Lidar) - Derived Topography Data:

This data was obtained from VCGI's online Lidar data service. The data is from 2014. While Lidar sensors can penetrate below tree canopy and other vegetation, and the effects of buildings can be manually edited out, Lidar data for large areas is captured only occasionally as it requires a fixed-wing aircraft (typically). Additionally, the need to interpolate the data for a large area can mean that some topographic features can be 'smoothed out'. This can be seen in portions of this site. While Lidar does appear to do a good job of capturing most majors features in the open area, there are some smaller features that are not characterized as well (drainage ditches in particular). The hillshade is also much coarser. This is primarily due to the resolution of the raster used to create this data which is 0.7m (30") / pixel - approximately 10x that of the drone data.

3 Comparison of the Two Contour Datasets:

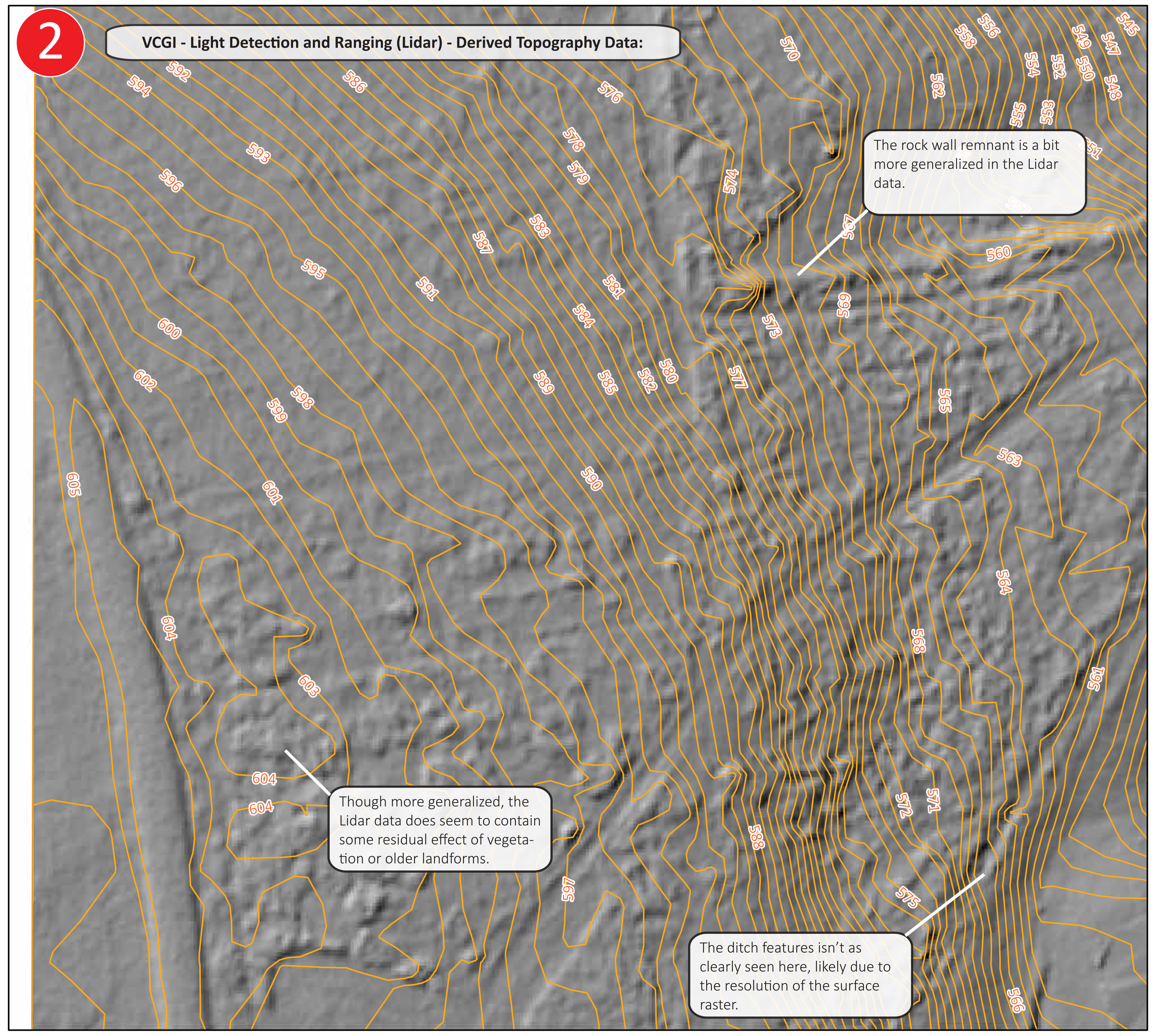
Adding Ground Control Points (GCPs) to drone-captured data can greatly enhance the absolute accuracy of the data by tying the information to a known datum. Using an accuracte GPS unit is key. GCPs for this project were captured by Spencer Harris of Vermont Contours with a sub-centimeter accurate GPS unit with Real Time Kinematic (RTK) processing using the NAD83 Vermont State Plane system (EPSG32145).
As a result, the contour elevations as created by the UAS line up nearly perfectly with the VCGI Lidar contours, though there are some areas of disagreement.

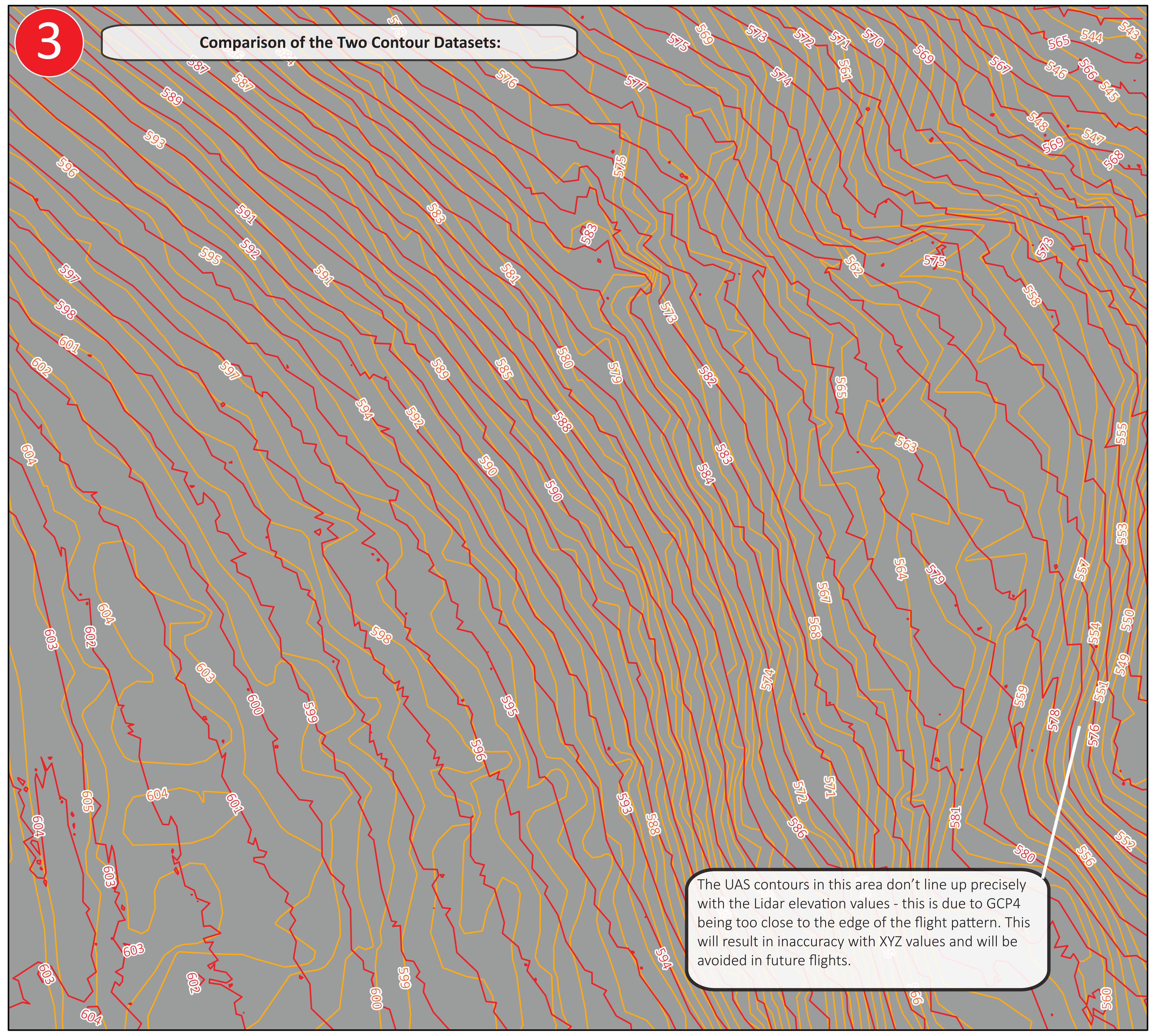
4 UAS-Derived Orthomosaic:

The UAS was also used to create a high-resolution orthomosaic of the site. Approximately 284 nadir (straight-down) images were captures from a height of 200' to generate an image with a resolution of 0.81" / pixel. The resolution of this imagery shows features as small as the individual rows of vegetation in the farm field.
While useful on its own, capturing imagery at this resolution could be powerful in illustrating change over time on a site. This imagery is also ortho-rectified (flattened with respect to terrain and camera distortion) and georeferenced (in this case using the GCPs). It can therefore be used to accurately measure visible features using a known datum.

5 VCGI Imagery:

This imagery was captured using a fixed-wing aircraft in 2017 for a portion of the state of Vermont for the Vermont Center for Geographic Information. The resolution is 0.3m (30cm or approximatley 12" / pixel). While suitable for planning purposes and, in many cases, for site planning and plan development, the much higher resolution imagery derived from the UAS flight would be helpful in picking out smaller features not necessarily clearly visible on the VCGI imagery. Additionally, the UAS imagery can show up-to-date features or changes on the site whereas the VCGI imagery is typically scheduled for 5-year intervals.





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Willowell Foundation
Monkton, VT
Topography & Imagery Comparison

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