

Using the CEE-USV™ and Hydromagic Software for an Ongoing Tailings Facility Monitoring Program.

The CEE HydroSystems CEE-USV™ allows accurate bathymetry mapping of tailings storage facilities, with navigation through manually-operated or robotic line-following modes. Survey data acquired in Eye4Software Hydromagic may be easily evaluated and edited for quality control. Time-series plots of TSF evolution may be generated, and volume estimates with predictive elevation versus water volume relationships are easy to produce. Data are exported as XYZ points or TIN-modeled surfaces in world, national, state or local “mine grid” co-ordinates.

The georeferenced echo sounder data generated by the CEE-USV™ survey drone may be processed in two frameworks: **depth** and **elevation**. The “raw” data is always a **depth** dataset, which is the transducer measured depth to the mudline added to the USV draft (typically 0.25ft). For tailings monitoring absolute Z elevations and XY coordinates in the site coordinate system, which may be a local grid, are usually required. To generate the elevation dataset, Hydromagic simply needs the water height, which may be measured in two ways:

- An RTK enabled GNSS receiver is used on the CEE-USV to continuously record accurate elevations in addition to accurate depths, using the real time “RTK tides” configuration with the site geoid model.
- The water surface elevation is simply measured on the survey day, with a single point GNSS shot at the water surface. This elevation offset is added to all measured depths as a “tide correction” during processing.

Once the soundings are edited, the “tide” correction is added, and then final product data may be exported in several ways. XYZ color-filled and contour plots of mudline elevations or depth may be generated, which will fit exactly with co-located land survey or aerial drone data. Hydromagic’s built-in volume tools allow generation of a stage-volume relationship, so a bathymetric survey at a high water level may be used to show available water storage as the level subsequently decreases, as shown in Figure 1.



Figure 1, Tailings pool bottom elevations and water volume versus stage – extrapolated to the beach.

Survey data may be stored and compared to provide a time series of the pool water volume, as shown in Figure 2, which shows a 200% increase in water volume from low to high stage. As the USV cannot safely reach the beach, the entire area is impossible to survey. However, surveying to about a 1ft contour allows a simple gradient extrapolation to the expected beach position to maximize the water volume estimate accuracy. Of course, if available, UAV data may be able to show the exact location of the beach, allowing the exact shoreline position to be used.

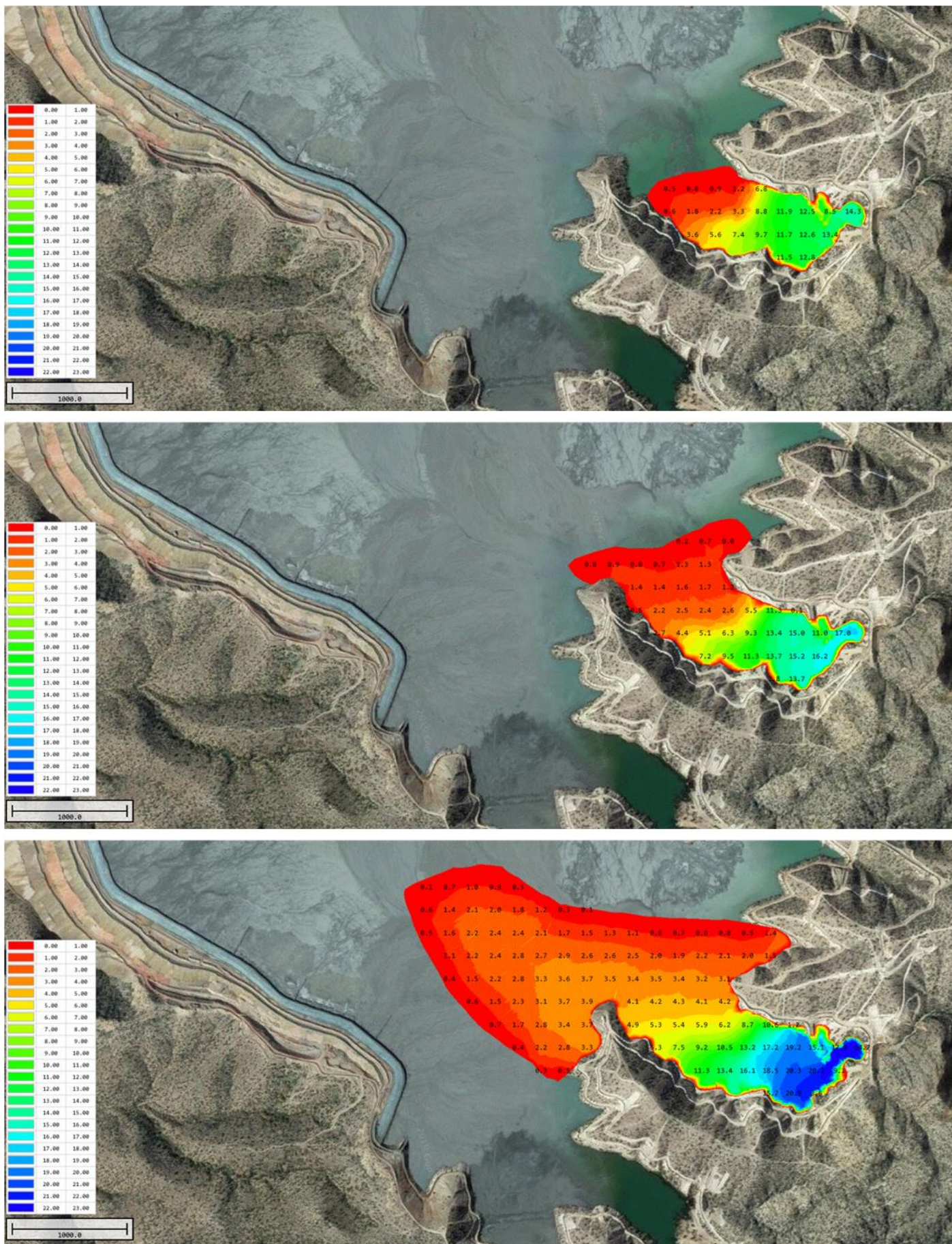


Figure 2. Tailings pool seasonal volume changes as measured by the CEE-USV™.