

How Cold does a Water Tank Get?

Greg Moore

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Introduction

Hatchet Ranch in Pueblo County Colorado houses several above-ground water tanks that are maintained by the Rye Fire Protection District. Since this area occasionally receives bouts of extreme cold, there is some concern for whether these tanks will freeze. While local opinion is that they will not, there is no data to back up this belief.

As a sanity check, we monitored the water temperature on a large uninsulated above-ground tank on the ranch during a portion of winter of 2014-2015. This beige-colored fiberglass tank is located at the intersection of Railroad Spring Drive and Lady Katherine Lane. (37 degrees, 58 minutes, 42.75 seconds N and 104 degrees, 38 minutes, and 42.31 seconds W). It holds approximately 13,000 gallons of water.

Measurement Procedure

Easy Log (Lascar Electronics) makes a compact USB temperature logger that is suitable for long-term measurements. One of these devices is shown in Figure 1.



Figure 1. EasyLog Temperature Logger (EL-USB-1)

The loggers are capable of taking and storing up to 16,382 measurements (to a precision of 0.1 degree F) at programmable sampling intervals of 10 seconds to 12 hours. Their range of operation is -31 to +176 degrees F.

Two of these loggers were programmed to acquire data every hour for this experiment. One was encased in a weighted sealed PVC container (shown in Figure2) and suspended in the tank at a depth of

5 feet (as measured from the top; the tank is approximately 10 feet high). The point of suspension was approximately 1 foot inside of the tank wall on the East side. The remaining logger was sealed in an aluminum container and suspended 4 feet off of the ground in the shade of a juniper tree. The tree was located within 200 meters of the tank.



Figure 2. Temperature Sensor Housings during Construction and after Recovery

The sensors were deployed on February 5, 2015 and recovered on March 15, 2015.

Results

Figure 3 shows the air temperature as recorded by one of the sensors in the juniper tree. The data up to February 5, 2015 (shown on the graph as 5/2/2015) should be ignored since the loggers were activated several days before they were deployed. Of most interest is the 1 ½ weeks of relatively cold weather at the end of February and the beginning of March when the lowest night temperatures reached 0 F.

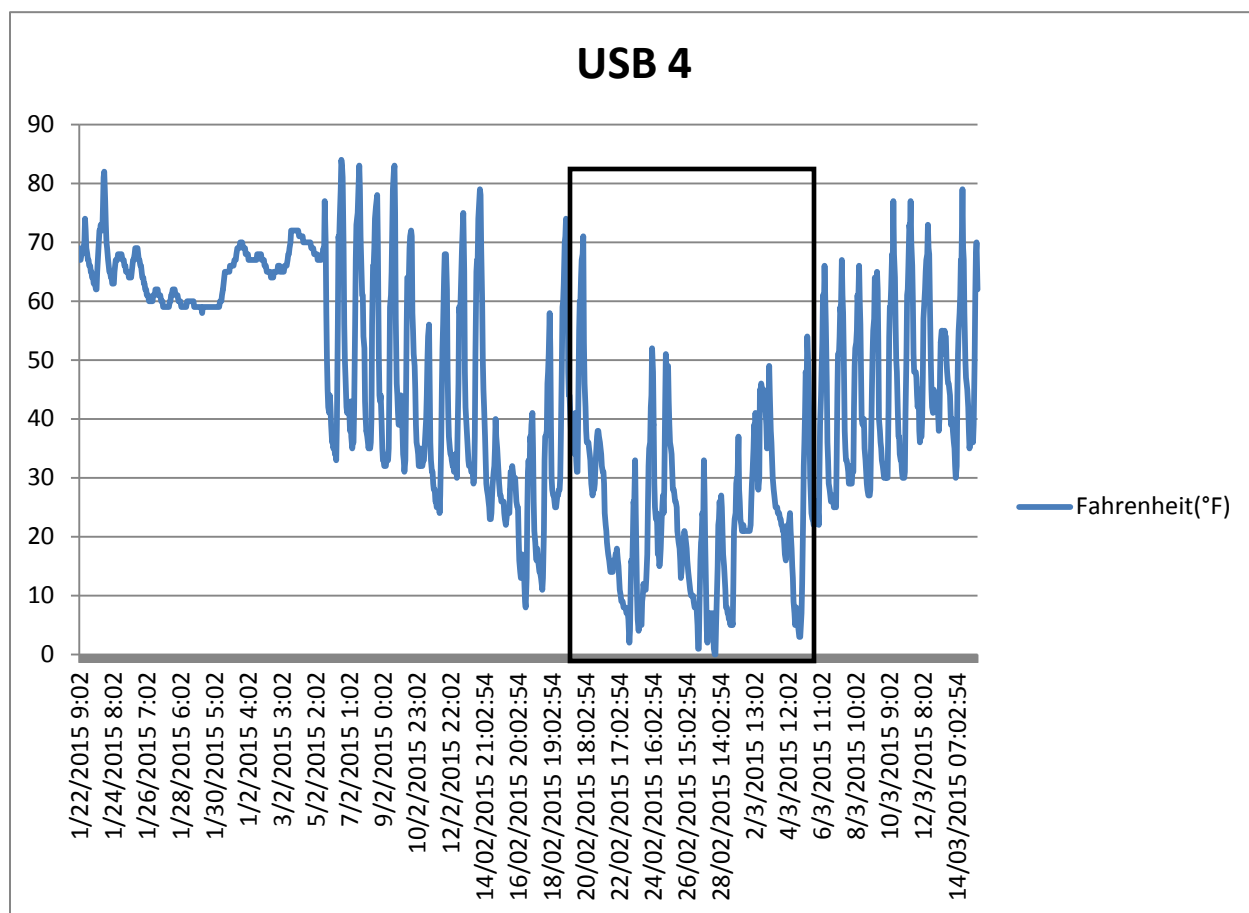


Figure 3. Outdoor Air Temperature

Figure 4 shows the corresponding tank temperature at the 5-foot depth. The thermal buffering of the water is fairly dramatic – taking out most of the swing in daily temperature. One can also see a broad cycle of heating and cooling that correspond to general swings in the weather over time. During the coldest weather, the temperature at this depth reached 36 degrees.

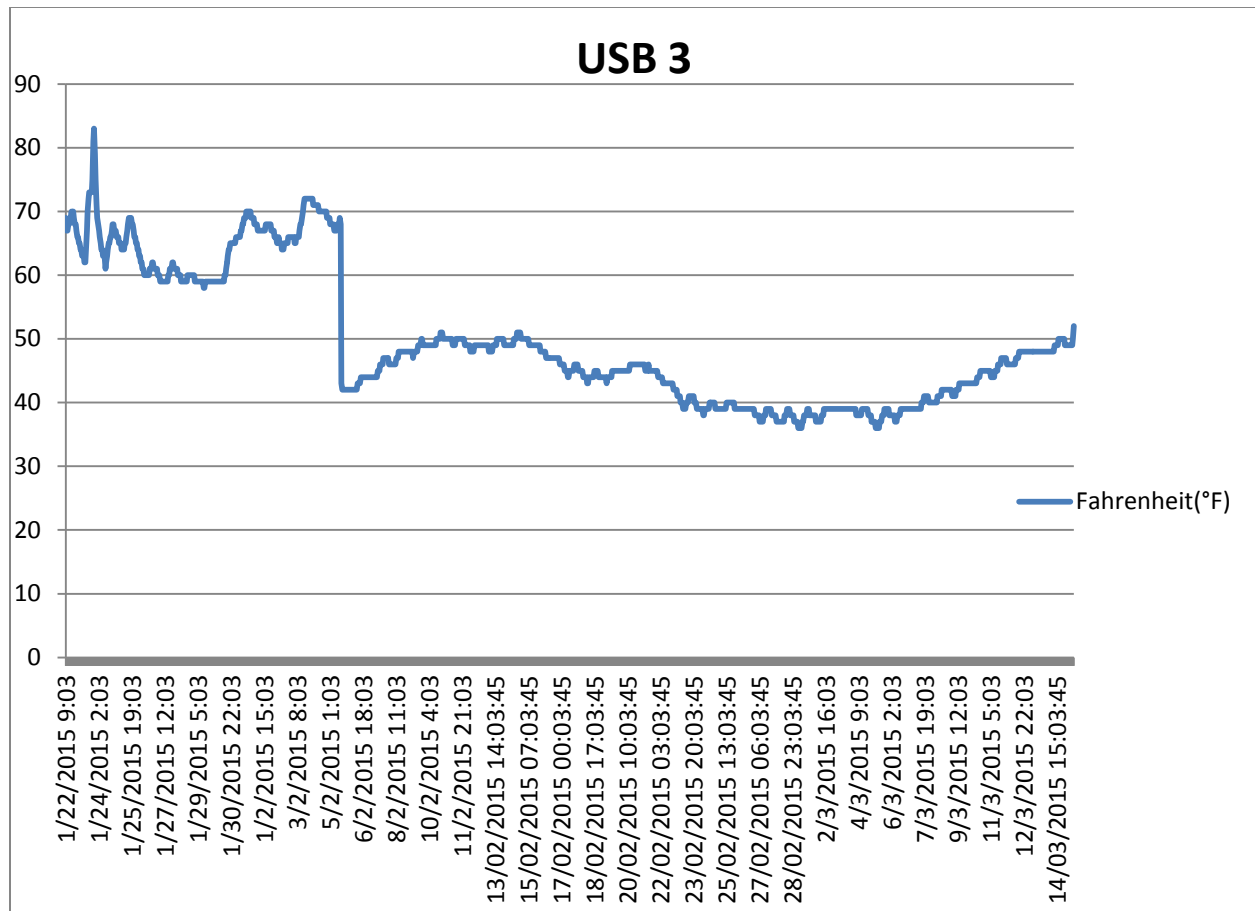


Figure 4. Tank Temperature at 5 Foot Depth

Conclusion

The temperature buffering effect of the water in the tank is considerable and –under the conditions we observed- freezing should not be a problem. Nonetheless, winters are highly variable, and it seems prudent to: (1) use frost-free valves, (2) continue to insulate the metal portions of the valves that can act as a radiator, and (3) be prepared to puncture any ice layer that might form at the top of the tank.