Memorandum

From: Wei Zeng (Water Supply Program)

To: Jamie Lancaster, William Cook (Land Protection Branch)

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Date: December 7, 2022

Re: Additional hydrologic analysis in response to Dr. Rhett Jackson's 11/22/2022 comment

The purpose of this technical memorandum is to supplement my prior draft memorandum dated September 29, 2022 on potential impacts from Twin Pines Minerals (TP) mining project in Charlton County. It also serves as a response to one of the comments received from Dr. Rhett Jackson of the University of Georgia on November 22, 2022.

In Dr. Rhett Jackson's November 22, 2022 comment letter, he used USGS gage 02228500 (North Prong St. Marys River at Moniac, GA) in assessing the potential impact from the mining pit seepage and associated dewatering. This gage controls 160 square miles of drainage area, has 28,351 days of daily record, and has a more or less continuous record since the early 1950's (with a gap of about two years from October 2004 to October 2006). Dr. Jackson concludes that the occurrence of extreme events at the very low end of the flow spectrum would be tripled had the St. Marys River been impacted by TP's dewatering of the mine pit.

Before presenting the Water Supply Program's assessment on this issue, I will provide a brief description of relevant hydrologic analysis that has been documented in the September 29, 2022 draft memorandum. In that draft memorandum, the hydrologic impact of a 1.44 mgd of water withdrawal from the Floridan Aquifer has been analyzed in a rather conservative way, i.e. our unrealistically placing the entire amount directly on the Okefenokee Swamp as if this was a direct surface water withdrawal from the swamp itself. We have modeled the impact of this loss of water and concluded that water level in the swamp will have an impact of roughly 5 mm at the worst time.

We also conducted a study on the potential impact of this withdrawal on the receiving St. Marys River using USGS Gage 02231000 (St. Marys River near MacClenny, FL). The magnitude of this unrealistic withdrawal (1.44 mgd or 2.23 cfs) is very low in comparison to the median flow of 212 cfs or the average flow of 629.4 cfs. When compared to the absolute minimum flow historically recorded, the quantity of the whole withdrawal is significant at 23.26%. However, this is certainly the result of the overly conservative approach. In reality, the effect of 1.44 mgd of withdrawal from the Floridan Aquifer on either the swamp or the St. Marys River would be greatly attenuated through the aquitard (with a thickness of several hundred feet).

TP has since provided more updated information on seepage rate from its mining pit, at 783 gallons per minute. This indicates the need for dewatering from the mining pit when the mining operation is underway. Since the industrial process will be associated with a water loss of 300 gallons per minute, what will be pumped into the Water Management Pond System is around 483 gallons per minute.

Even though these quantities are less than the 1.44 mgd withdrawn from the Floridan Aquifer, dewatering from the mining pit may have a higher level of connection with the surficial aquifer or the swamp than the Floridan Aquifer withdrawal. It is worth noting that mining pit dewatering and pumping from the Floridan Aquifer will not likely take place simultaneously because the seepage already provides more water than water lost in the industrial process (or make up water).

We updated our hydrologic analysis to reflect this new information and as a way of responding to Dr. Jackson's point on hydrologic impact to the St. Marys River. As we did in the prior study, we choose USGS 02231000 (St. Marys River near MacClenny, FL). This gage controls a drainage area of 700 square miles, has 35,129 days of daily record, and has a continuous record since October 1, 1926. We chose this gage because of its long and continuous record (a better basis for developing an exceedance curve and statistics), as well as the quality of field measurements in prolonged drought periods, which tend to be associated with low flows.

In order to make our point and maintain conservative, we continue to use the 1.44 mgd (2.23 cfs) as if it is entirely removed from the St. Marys River. Flow exceedance curves have been developed for the original gage record and an altered flow sequence as if 2.23 cfs has been removed from the original flow sequence. The two curves are very close for the upper 80% of the flow spectrum (Figure 1). We developed Figure 2 to zoom in to the lowest 30% of the flow exceedance. Here, we see the separation of the two curves, but the difference remains small. At the very low end of the flow exceedance curves, there may be an increase in the occurrence of such low flows (e.g. around 10 cfs). However, that is true when analyzing any magnitude of a flow reduction and on any stream.

Other than the longer record of USGS 02231000 and its record being continuous, we also have reasons to believe that its data during multi-year droughts are of higher quality when compared with USGS 02228500 (the gage used by Dr. Jackson). This is based on the USGS field measurement record during the historical multi-year droughts when flows tend to be at or near the lower end of the flow spectrum. USGS routinely sends its field crew to conduct field measurements to update its gage rating curves and to make sure the gages work properly. These field measurements are documented as part of the gage records. When these measurements are done, there is an assessment of the quality of such measurements. The assessment classifies each field measurement as Excellent, Good, Fair, Poor, or Not specified. Per USGS Code Description, an Excellent rating means that the data is within 2% of the actual flow; a Good rating means that the data is within 5% of the actual flow; a Fair rating means that the data is within 8% of the actual flow; and a Poor rating means that the data is beyond 8% of the actual flow.

We developed Figures 3 through 7 to show the comparison of field measurement quality between the two gages. Figure 3 shows the comparison for the drought period of 1954-1955. Bars in the chart show the percentage of field measurement in each classification. The blue bars represent USGS 02231000, and the orange bars represent USGS 02228500. The percentage values associated with the bars of the same color add up to 100%. The higher the bars toward the left of the chart, the better the field measurement quality. The higher the bars toward the right of the chart, the poorer the quality of the field measurements. For example, during the 1954-1955 drought, USGS 02231000 has 82% of the field measurements classified as Good, while USGS 02228500 has 36% of its measurements classified as such. At the right side of the chart, USGS 02231000 has only 6% of the field measurements classified as Poor, while USGS 02228500 has 27% of the field measurements in that category.

Figure 4 shows a similar comparison for the drought period of 1986-1988. Figures 5, 6, and 7 are for the drought periods of 1999-2002, 2006-2008, and 2011-2012, respectively. It is almost universally true that USGS 02231000 provides higher bars on the left side of the charts, meaning higher quality field measurements, than USGS 02228500 does. The only exception in these figures is probably in Figure 7 showing the 2011-2012 drought, where USGS 02228500 has 12.5% of the field measurements assessed to be Excellent and USGS 02231000 does not have field measurements assessed in that category. But even for this multi-year drought, USGS 02231000 still has a lower percentage of Poor rating (at roughly 6%) than USGS 02228500 does (at 25%).

When the focus of a hydrologic analysis is on the lower end of the flow spectrum, especially when it is mostly about the extremely low flows, it is important to rely on gage data of better quality. We believe USGS 02231000 provides a longer period of record, a more complete record, and a record of higher quality in the historically critical drought years. We believe the use of this USGS gage is appropriate. Based on this data set and with very conservative assumptions, we believe the hydrologic impact on the St. Marys River from dewatering of the mining pit would be very low.

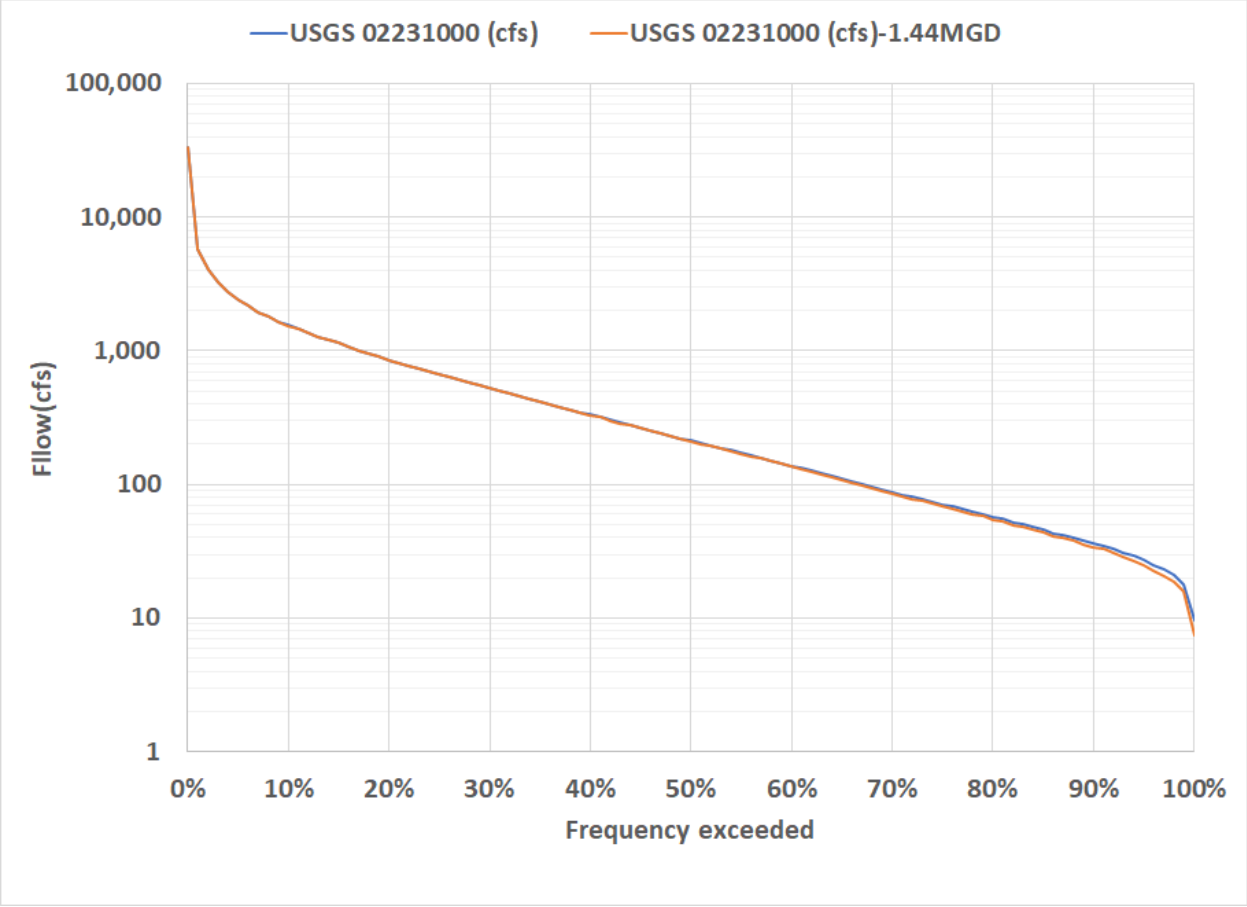

Figure 1. Flow exceedance at USGS 02231000

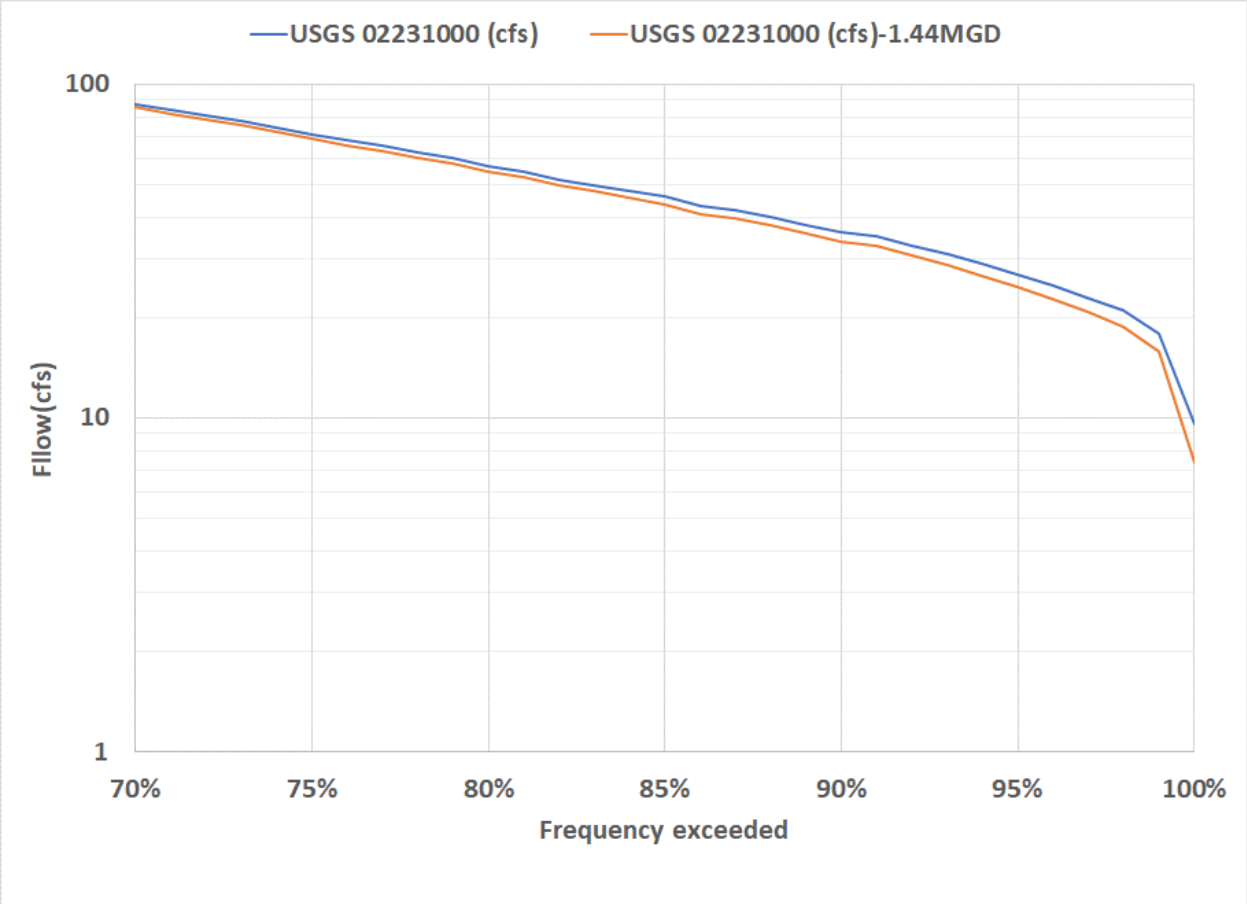

Figure 2. Flow exceedance at USGS 02231000 (lower 30% of the flow spectrum)

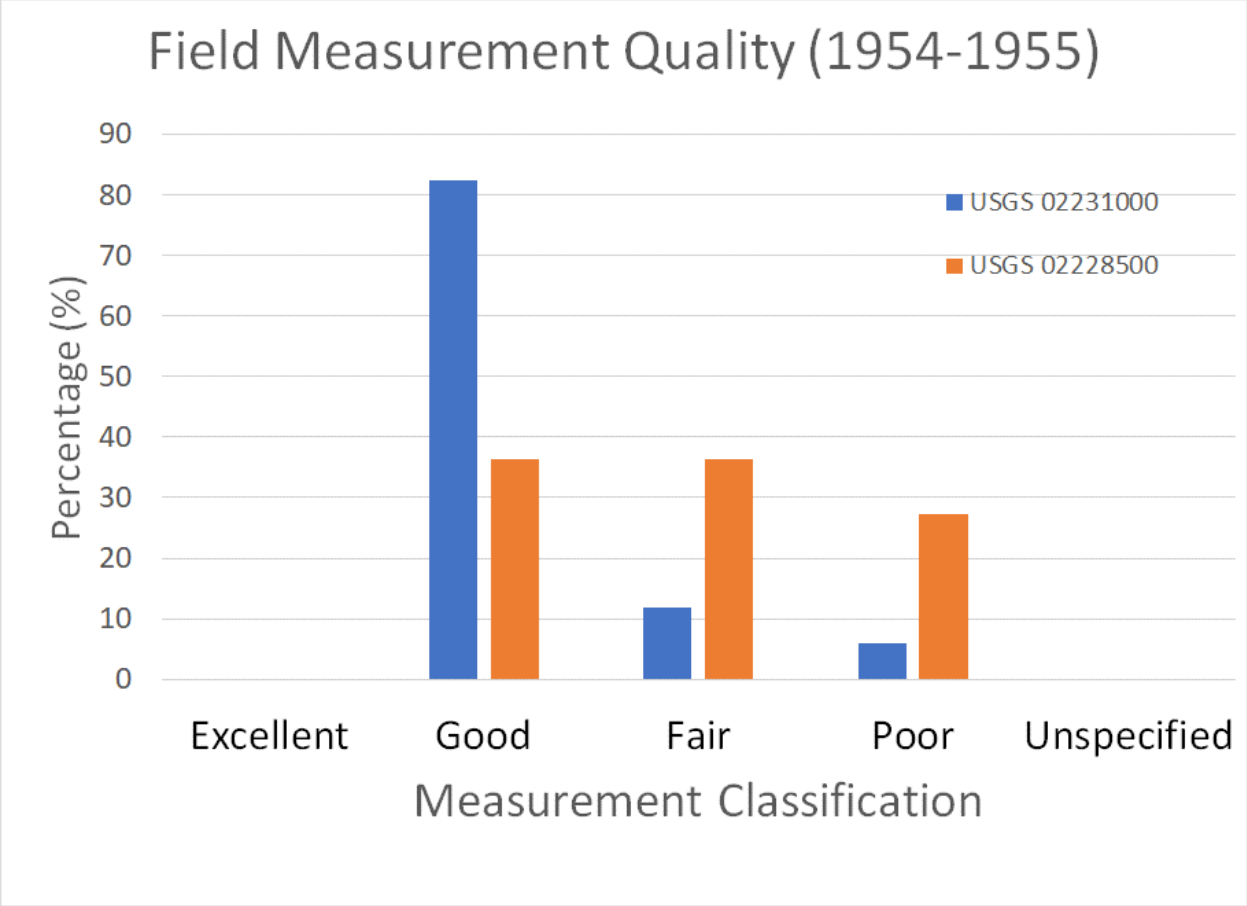

Figure 3. Comparison of quality of USGS field measurements, 1954-1955

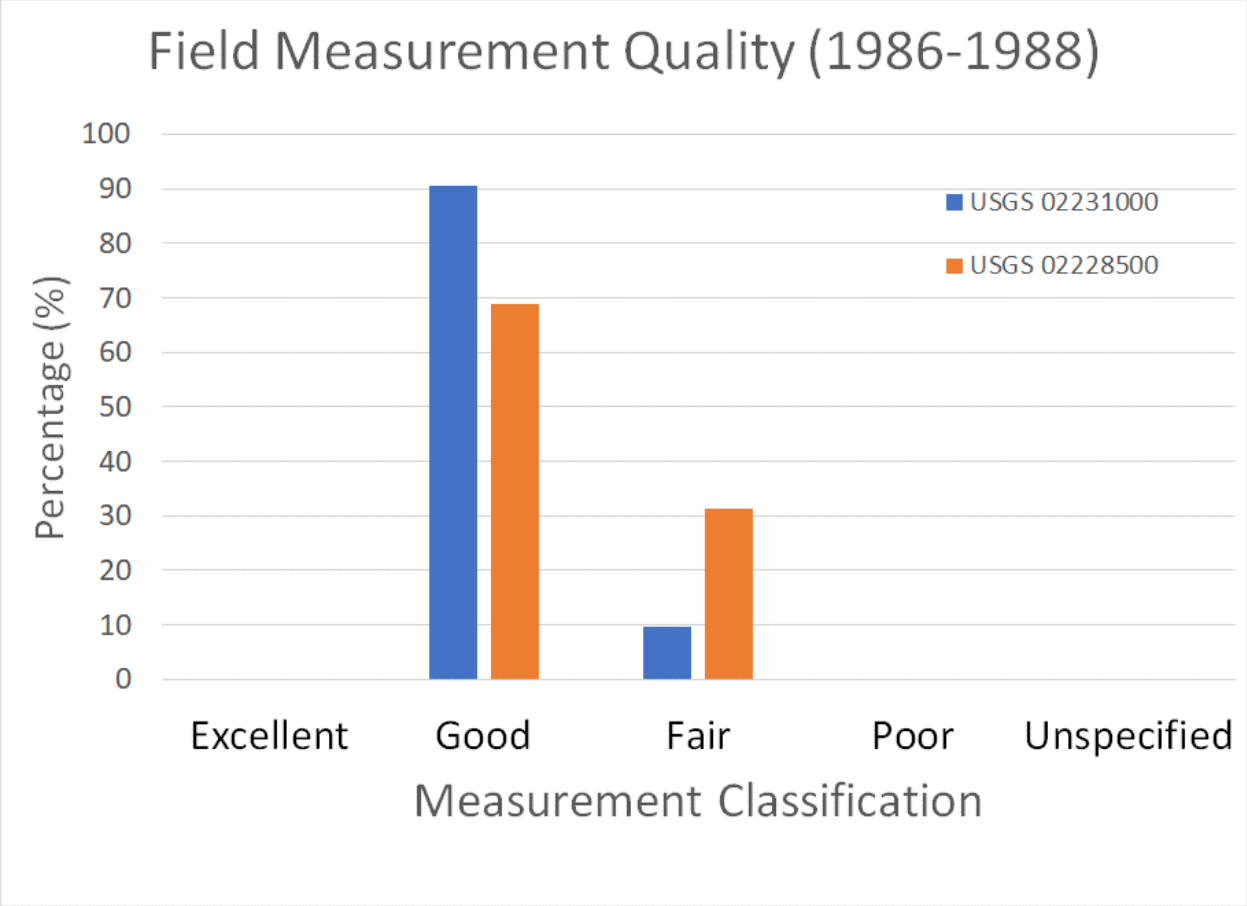

Figure 4. Comparison of quality of USGS field measurements, 1986-1988

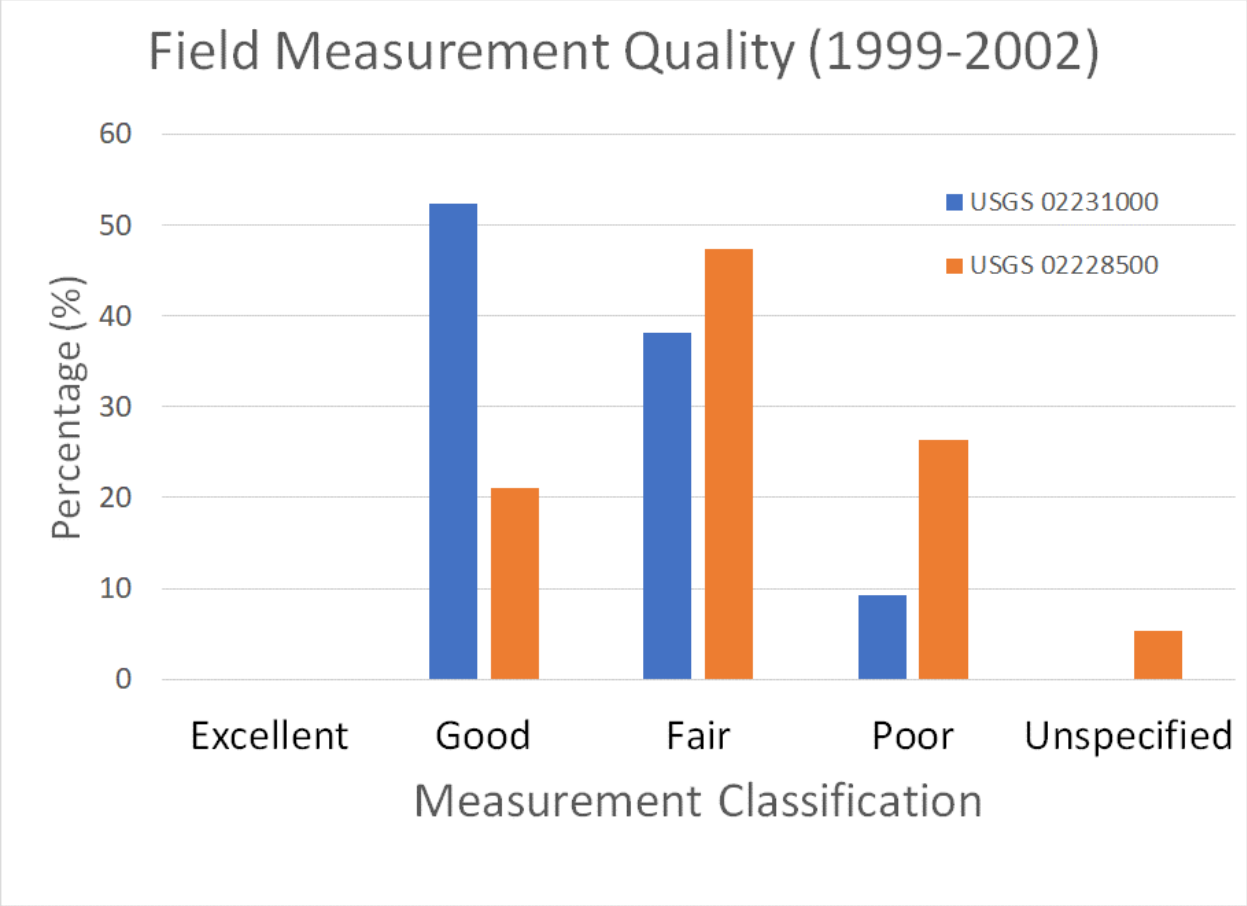

Figure 5. Comparison of quality of USGS field measurements, 1999-2002

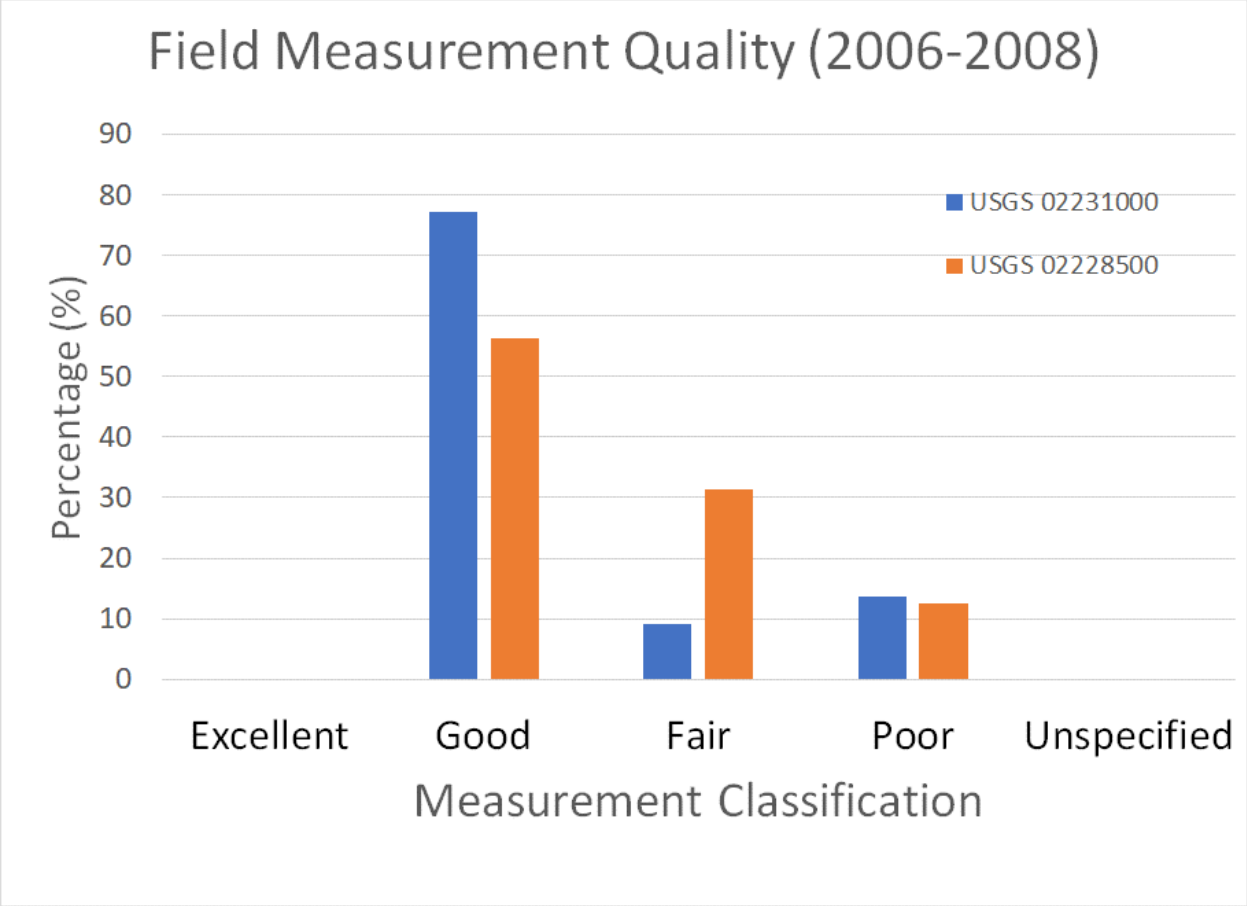

Figure 6. Comparison of quality of USGS field measurements, 2006-2008

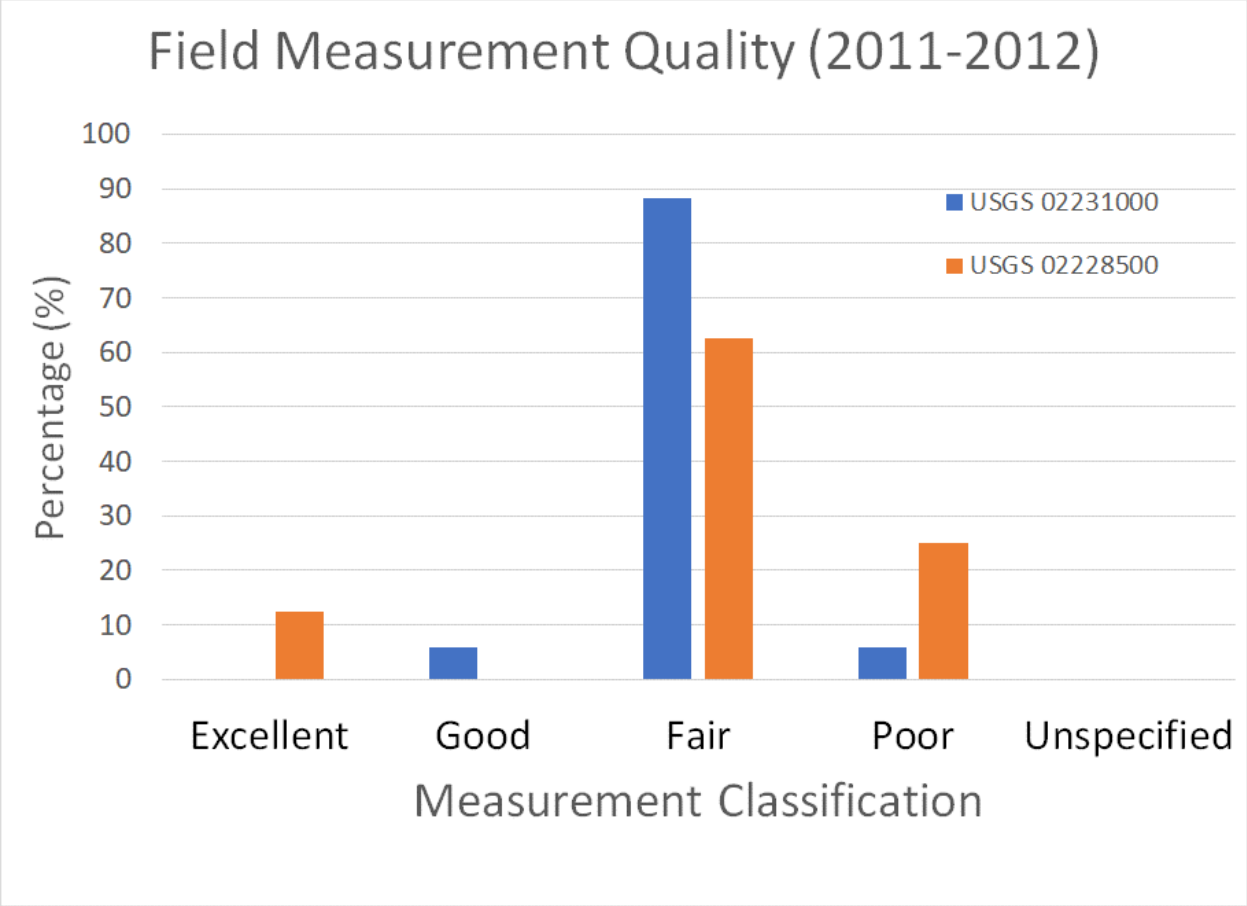

Figure 7. Comparison of quality of USGS field measurements, 2011-2012