Supporting Documentation for Response to Comments 7(b) and 7(c)

Twin Pines Minerals, LLC (TPM) has conducted an analysis to evaluate the potential impacts to the Surficial Aquifer at the boundary of the Okefenokee National Wildlife Refuge due to the pumping of process water from the Upper Floridan Aquifer. This document specifically provides responses to the Georgia Environmental Protection Division's (EPD's) Permit Coordination review comments 7b and 7c.

Comment 7 b:

In Section 6 – page 14 of the application and Table 2 – page 9 of attachment B ("An evaluation of drawdown from Floridan wells") lists three scenarios for the total drawdown of the Floridan aquifer at the edge of the Okefenokee National Wildlife Refuge (ONWR), based on pumping two wells at 500 gpm for 4 years. "The maximum drawdown of the Floridan Aquifer at the edge of the ONWR is 3.8 ft in the Base Case Scenario, 13.2 ft for the Maximum-Drawdown Scenario, and 1.3 feet for the Minimum-Drawdown Scenario."

The application does not quantify the impact to the Surficial aquifer at the edge of the ONWR, as a result of the Floridan aquifer "Maximum-Drawdown Scenario" listed above. Please provide further analysis / detailed modeling to quantify the surficial aquifer drawdown at the edge of the ONWR, based on the Floridan aquifer drawdown numbers provided in the application. This may require a more detailed modeling of the drawdown in the Floridan aquifer, and its associated impact to the Surficial aquifer.

Response to Comment 7 b:

Dr. James Kennedy, in a meeting on April 29 2021, directed TPM to use an approach developed by Hantush (1967) to evaluate drawdown in the surficial aquifer caused by leakage through the Hawthorn Group due to TPM's proposed pumping in the Floridan Aquifer. Dr. Kennedy supplied TPM with a spreadsheet for these calculations. The spreadsheet implements Equation 26 of Hantush (1967), which is a pseudo steady-state solution for the drawdown in an upper aquifer separated by an aquitard from a lower aquifer that is pumped. Unfortunately, the Equation 26 of Hantush (1967) is an approximation which produces negative drawdowns (water-level increases) in the Surficial Aquifer using the parameters appropriate to hydraulic conditions found at the TPM site. To complete the analysis directed by Dr. Kennedy, we modified his spreadsheet to solve the steady-state form of Equations 45 and 46 of Hantush (1967) (Attachment 1). These equations solve for the steady-state drawdown in an un-pumped upper and a pumped lower aquifer separated by an aquitard. These solutions assume that the aquifer is circular with no drawdown at the boundary, and that the well is pumped at a fixed pumping rate for an infinite period of time.

The hydraulic properties used for the Floridan Aquifer are those used by Holt and Tanner (2020) for their Minimum, Base Case, and Maximum Drawdown Scenarios. The hydraulic conductivity of the Hawthorn Group was assumed to be 10^{-4} ft/day (e.g., Williams and Kuniansky, 2015) and the specific storage for the Hawthorn was assumed to be 10^{-4} 1/ft, which is typical for clay units. Instead of pumping 500 gpm from two wells, we assumed that all pumping was occurring in a single well that is closest to the ONWR with a pumping rate of 1,000 gpm. This represents a conservative case.

Initially, we determined the effective radius defined by Hantush (1967) and used in the spreadsheet provided by Dr. Kennedy. This effective radius ranged from 5,728 ft to 5,731 ft. It should be noted that the distance from the nearest TPM well to the edge of the ONWR is 22,304 ft. So, this model cannot be used to predict the drawdown at the edge of the ONWR, as the drawdown is 0 ft at the effective radius.