Memorandum

From: Wei Zeng, Water Supply Program

To: File, Feng Jiang, Bill Frechette, Christine Voudy, John Ariail, Edward Rooks, Jamie Lancaster, William Cook, and Rhett Schley

Re: Summary of October 26, 2022 meeting with representatives of Twin Pines Mineral

Date: November 9, 2022

Introduction

The Water Supply Program regulates water withdrawal activities and its Groundwater Withdrawal Permitting Unit has the authority to review Twin Pines Mineral groundwater withdrawal application. The program is also home to the Hydrology Unit, which conducts EPD's water quantity modeling and technical analyses.

The Hydrology Unit has conducted three types of modeling analyses in support of the program's review of water quantity-related issues in the TP project in Charlton County. The first is an overall impact analysis on the Okefenokee Swamp assuming that the entire 1.44 mgd of water withdrawal from the Floridan Aquifer is placed directly on the swamp itself instead. Because the impact from the Floridan Aquifer withdrawal is indirect and through hundreds of feet of an aquitard, the impact identified in this model is almost certainly an overestimate of its true magnitude. This modeling indicates trivial impact on the swamp itself and its receiving water body – the St. Marys River.

The second type of modeling is on water management at the mining site utilizing TP's water management pond system. With two extreme assumptions on how much runoff generated on mining property goes through the water management pond system, Hydrology Unit was able to bookend the possibilities of water management. At one end of the assumptions, only precipitation falling on free water surface of the water management ponds would be handled by the system. Under this scenario, water level within the system would fluctuate but well within the capacity of the system. There would be no discharge from the system. The long-term average need for groundwater withdrawal is only 0.21 mgd.

The third type of modeling is on whether the groundwater withdrawal would have a detectable impact on saltwater encroachment in coastal Georgia and South Carolina. Modeling results indicate the level of impact as non-detectable.

The above has been documented in an earlier Technical Memorandum I prepared for File (20220929-tech-memo-TP-modeling-WeiZeng_Feng.doc last modified October 6, 2022).

After the completion of the above work, I realized that the Water Supply Program may need to shoulder some of the responsibilities that was placed in Dr. James Kennedy, the former State Geologist, who retired a few months earlier. In particular, the geologists and modelers in the Water Supply Program

possess the capability to assess impacts on surface water and groundwater bodies resulting from TP's proposed mining operations.

After the Water Supply team reviewed key documents on lithology, monitoring network, and groundwater modeling, I asked Jamie Lancaster of EPD's Land Protection Branch, who has been the coordinator between EPD teams and TP, to arrange a meeting with TP's technical experts. A list of questions for TP from both modeling and documents review has been developed for this purpose.

Meeting with Representatives of TP

On October 26, 2022, EPD associates from the Land Protection Branch (William Cook, Jamie Lancaster, and Rhett Schley) and the Watershed Protection Branch (Bill Frechette, Christine Voudy, John Ariail, Edward Rooks, Feng Jiang, and Wei Zeng) met with representatives of Twin Pines Mineral (Dr. Sorab Panday, Jim Smith, Mark Tanner, and Cindy House-Pearson) to discuss questions raised in review of TP submissions by Watershed Protection Branch's geologists.

These questions can be placed into the following major categories:

(1) What is TP's estimate of the rate of seepage into the mining pit during normal mining operation? The answer to this question also indicates whether mining will be conducted under wet or dry conditions.

(2) What is TP's estimate of consumptive water loss during normal mining operation? EPD modeling team encountered different assumptions in TP's various submissions and will need a clarified answer to fine tune its modeling.

(3) Will the mining process and dewatering of mining pit happen simultaneously? EPD modeling team assumed that the two processes do not take place simultaneously. However, a clarification is needed from TP. If and when there is the need to dewater the mining pit, water pumped from the pit would be stored in the water management pond system. This water is considered industrial process water. Therefore, once a dewatering event takes place, water stored in the water management pond system is considered comingled industrial process water and stormwater. How does TP show that there would not be the need to discharge from the water management pond system even during heavy precipitation events? A detailed modeling is probably needed.

(4) What is the proper sequence of rain events to test the capability of the water management pond system under heavy precipitation circumstances? TP did provide a NOAA website, but this can not constitute an adequate answer or a detailed technical analysis.

(5) EPD's modeling team identified a USGS gage to the west of TP's groundwater model domain. This gage recorded a wide range of gage heights. EPD would like to see that a sensitivity analysis be conducted by TP's modeling expert (Dr. Panday) on boundary conditions reflecting the gage height changes.

(6) A substantial number of the core samples used in determining hydraulic conductivities seemed to have been contaminated with drilling mud. Did the contamination undermine the hydraulic properties determined by these samples?

(7) Related to Point (6) above, TP seemed to have drilled a total of 385 boreholes in YEAR(S). There is insufficient information indicating the entity (entities) or person(s) who conducted that drilling or whether it was supervised by a Georgia-licensed Professional Engineer or Professional Geologist. TP does not have a bond posted with Georgia or a license issued by Georgia for drilling, thus EPD presumes that the drilling was conducted without proper licensing or bonding from the relevant State of Georgia regulatory authority. EPD notes this as a compliance issue to be resolved, and requests further information from TP regarding this drilling as further described below.

(8) Dr. Panday's modeling report reflects the extent of change between pre-project and post-project groundwater conditions. However, it does not address the transition or the mining process. For example, the assumption of bentonite treated layer being placed at the vertical location of the black sand layer and at the thickness of the original black sand layer is only appropriate if there is successful implementation of the intended configuration. EPD asks for a backfill plan that ensures the proper emplacement of the bentonite treated layer.

<u>Discussions and Understanding</u>

Rate of Seepage

TP representatives expressed that the rate of seepage into the mining pit has yet to be determined and is still being studied. TP will share with EPD when this determination is made. TP's understanding or assumption at this point is that when mining is conducted properly, the rate of the pit's advancement will prevent the mining pit from being filled with water, making a semi-dry mining operation the norm. This understanding (assumption) and the seepage rate will be critical in determining whether there will be the need for more than occasional pit dewatering, which then has implications to the water management pond system's capacity to handle dewatering needs. At this point, this appears to be a critical piece of information that is missing. A water management assessment on the need for pit dewatering, the capacity of the water management pond system, and the operation of such system cannot be completed without this information.

Consumptive Loss

TP representatives confirmed that a 10% loss (300 GPM on page 4 of water management plan, May 2022 by TP) is assumed in the normal mining process. EPD will fine tune its model to reflect this. No substantial changes are expected from this updated modeling.

Mining and Dewatering the Mining Pit Simultaneously

Contrary to EPD modeling team's understanding, TP representatives expressed that mining and pit dewatering may take place simultaneously. As Mark Tanner stated, the more water there is in the mining pit, the more difficult it is to mine. TP mining operation would be normal if there is a depth of 4 to 5 feet of water from the bottom of the mining pit. However, it would be problematic if the mining pit is full of water. EPD associates asked the question on whether water pumped into the water

management pond system can be used for the mining process instead of water pumped from the Floridan Aquifer. TP representatives stated that this is their understanding, which means that there likely is not the need to pump simultaneously from the mining pit and the Floridan Aquifer.

This understanding, when combined with the lack of a reliable estimate of a seepage rate into the mining pit, further highlights the need for a comprehensive assessment on water management under various circumstances beyond normal mining operation. For example, how does the water management pond system handle water pumped from the mining pit when the pond system is at different levels of fullness? For example, would the assumption of no discharge still hold if an adverse sequence of precipitation events takes place after a dewatering event or two? A detailed modeling of water management operations (of the pond system) is needed to address various challenges that arise from both dewatering of the mining pit and adverse meteorological conditions.

Sequence of Precipitation Events

TP needs to respond to this point. It is necessary to identify a set of precipitation events that could be used to test if capacity of the water management pond system is enough. Detailed modeling is needed to ensure that the system is capable of managing these events under various assumed states and preceding conditions. See subsections *Rate of Seepage* and *Mining and Dewatering the Mining Pit Simultaneously* as well.

Groundwater Modeling

One focal point of the Water Supply Program's review is groundwater modeling conducted by Dr. Sorab Panday. Geologists and modelers participated in this review. There is a consensus that the overall framework of the groundwater modeling makes sense. Groundwater conditions on and around the Trail Ridge have been modeled and analyzed under pre-project and post-project soil structures. Existing lithology has been identified with extensive field work, and it seems that this lithology will be confirmed again as part of the mining process (Sheet 9 Soil Amendment Plan Section 1.2.2.). Assumed hydrologic input seems to make sense. Boundary conditions seem consistent with trade conventions.

Calibration of the model seems reasonable with general agreement between simulated values and observations. See Figure 21 and Table 2 in Dr. Panday's September 14, 2021 modeling report. The model's sensitivity analysis is very informative and strengthens our confidence in the modeling process and results. For example, Dr. Panday categorized all modeling parameters into four different types. Type I sensitivity is defined for parameters that cause insignificant changes to the calibration residuals as well as to model conclusions/predictions of interest. Type II sensitivity is defined for parameters that cause significant changes to the calibration residuals but insignificant changes to model conclusions/predictions of interest. Type III sensitivity is defined for parameters that cause significant changes to the calibration residuals as well as to the model conclusions/predictions. Type IV sensitivity is defined for parameters that cause insignificant changes to model calibration residuals but significant changes to the model predictions. Of all parameters involved in the TP model, recharge and hydraulic conductivity of the consolidated black sands have a Type I sensitivity, while hydraulic conductivity of the unconsolidated and semi consolidated sand units (hydrogeologic units 1 and 3) have a Type III

sensitivity. None belong to Type IV. This means that slight change of parameter values tested in sensitivity analysis will not substantially alter the model results and conclusions.

The Water Supply Program geologists and modelers did have a few questions and suggestions on the groundwater model. For example, the team asked that flux into the Okefenokee Swamp be quantified and compared between the pre-project and post-project scenarios. The team also identified a USGS gage to the west of the model domain which recorded a wide range of gage heights. The team asked for additional sensitivity analysis so that the groundwater model's boundary condition close to the gage be varied consistent with the recorded gage height. The team also asked that summary table be slightly revised to include not only percentage numbers but also the absolute values of the flux. Dr. Panday agreed to conduct these analyses.

Contaminated Core Samples

As TP stated in its submission (Modeling the Groundwater Flow System at the Proposed Twin Pines Mine on Trail Ridge, by Dr. Sorab Panday, Ph.D., July 20, 2021), there is a substantial portion of the core samples contaminated with drilling mud. There is the question of how reliable the hydraulic conductivities are based on these core samples. The concern is mitigated to some extent by the sensitivity analysis referenced above though.

Drilling Boreholes without a Georgia License or Bond and without supervision by a Georgia-licensed PE or PG

In the Water Supply Program team's review of TP submissions, it was noted that 385 boreholes have been drilled by TP before TTL was retained as a consultant. TP does not hold a valid Georgia Water Well Contractor's license nor proper bonding for this type of drilling. This appears to be a compliance issue needing resolution. We let TP representatives know of this discovery.

In an internal follow up meeting, it was determined that several actions need to take place. First, TP needs to identify to EPD the Professional Geologist (or Professional Engineer) who supervised the drilling process. Second, TP needs to identify the person(s) or entity(ies) who conducted the drilling. If TP conducted the drilling, it must now seek and obtain bonding from the State of Georgia. Third, TP needs to update EPD with status of these boreholes (i.e., have they been properly closed in accordance with applicable law) and any other potential issues with drilling under regulations. Fourth, depending on the answers to the above, the State may decide to take proper compliance actions to bring TP under compliance.

Backfill Plan

The Water Supply team noticed a statement made in Dr. Panday's modeling report that the modeling only analyzes the comparison between the pre-project and the post-project soil structures and not on how the post-project soil structure would come into existence. This prompted the EPD team to ask in

the meeting that a backfill plan be developed, something whose compliance can be checked. TP representatives referred the EPD team to submitted Soil Amendment Plan Sheet 9.

After review of the Soil Amendment Plan, we believe the procedures and process outlined in the plan make sense. However, we recommend to the Land Protection Branch that an ongoing review and periodic (e.g. quarterly) certification of compliance by a registered Professional Geologist or Professional Engineer be required as part of the Mining Land Use Plan.

Conclusions

To summarize the above, the following action items are to be taken by TP (with the last one recommended for EPD's Surface Mining Unit):

1. TP needs to provide EPD with an estimate of seepage rate into the mining pit, and this estimate needs to be supported by sound evidence.
2. With this seepage rate (or a set of seepage rates under different conditions), TP needs to develop a set of dewatering scenarios covering a reasonable range of dewatering needs, including the rates of dewatering and the durations of such dewatering events.
3. TP needs to review historical precipitation records and develop a set of adverse sequences of high precipitation events.
4. TP needs to use information from 2 and 3 above to model, analyze, and show how prescribed operations of its Water Management Pond System will be able to handle combinations of various states (starting condition of the Water Management Pond System) and inflow conditions (including precipitation, water pumped from the mining pit, and any other types of inflow). TP needs to show that its prescribed operations of the Water Management Pond System can avoid the need to discharge even under the most adverse hydrologic conditions.
5. TP needs to run its groundwater model for a set of sensitivity runs covering a range of constant head boundary conditions on the western side of the model domain consistent with gage heights observed at USGS gage 02228500.
6. From its groundwater model, TP needs to compare the magnitude of flux from the model's boundary into the Okefenokee Swamp between the pre-project and post-project scenarios. TP will also revise its water balance tables to include not only percentage values but also absolute values of modeled fluxes.
7. TP needs to explain why any data (e.g. hydraulic conductivities) developed from samples contaminated with drilling mud should be considered reliable.
8. TP needs to work with EPD to resolve compliance issues with drilling (boring) without a license or bonding. Action items include: (1) TP must identify to EPD the Professional Geologist (or Professional Engineer) who supervised the drilling process, and identify the person(s) or entity(ies) who conducted the drilling; (2) If TP conducted the drilling, it must now seek and obtain bonding from the State of Georgia; (3) TP needs to update EPD with status of these boreholes (i.e., have they been properly closed in accordance with applicable law) and any other potential issues with drilling under State regulations; (4) Depending on the answers to the above, TP needs to work with EPD on appropriate action(s) to come under compliance.
9. The Water Supply Program recommends to the Land Protection Branch that a condition be made part of the Surface Mining Land Use Plan requiring an ongoing review and periodic (e.g.

quarterly) certification of compliance with TP's Soil Amendment Plan by a registered Professional Geologist or Professional Engineer.