Jacobs

4121 Carmichael Road
Suite 400
Montgomery, AL 36106
O +1 (334) 271-1444

www.jacobs.com

Subject	Twin Pines Minerals, LLC Saunders Demonstration Mine Monitoring Plan Recommendations
Attention	Lewis Jones/Jones Fortuna LP
From	Lynn Sisk
Date	DRAFT: November 5, 2020 FINAL: September 29, 2023

1. Background

Twin Pines Minerals, LLC (TPM) has submitted applications to the Georgia Department of Natural Resources Environmental Protection Division (GAEPD) for environmental permits associated with a proposed mineral sands mine and beneficiation facility along Trail Ridge located in Charlton County in southeast Georgia. The permit applications include a surface mining permit to be issued by the Surface Mining Unit within the Land Protection Branch, a groundwater use and industrial stormwater permits to be issued by the Watershed Protection Branch, and an air quality construction permit to be issued by the Air Protection Branch . To support these applications, TPM's consultant, TTL, Inc. (TTL), began extensive site characterization activities in 2019, including groundwater and surface water monitoring of water levels and water quality. The information collected to date has been used to establish baseline conditions on and near the proposed mining site.

This memo presents recommendations for future monitoring activities that may be conducted on and near the area in which the mining will occur. The recommendations are based on a review of available groundwater and surface water quality data and with the understanding that future monitoring activities should accomplish the following general goals:

- Characterize pre-mining groundwater quality and levels at locations near the mining area;
- Characterize pre-mining surface water quality conditions in nearby streams which may receive stormwater runoff from the mining area, and;
- Document post-mining groundwater quality and levels at locations on or near the mining area and document water quality in nearby streams following the mining activity, to assess if impacts have occurred as a result of the proposed mining activities.

The mining and beneficiation facilities will not use nor add contaminants which could then impact area groundwater and surface waters. Also, the site will not be subject to any of the traditional/typical contaminant monitoring programs such as the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), etc.; thus, the list of applicable constituents for monitoring is oriented around those constituents reasonably present based on existing groundwater and surface data so that post-mining changes can be identified. The rationale for selecting the constituents to be monitored is outlined in the sections below and supports the general goals above.

These recommendations do not include transient or temporary monitoring locations or constituents within the area to be mined whose purposes may be different from the longer-term monitoring locations or constituents.

2. Groundwater Monitoring Locations

Strategic locations for future groundwater monitoring that will achieve the general goals listed above will be determined using available information about the site such as groundwater flow direction and pre-mining depth. It is recommended that sufficient monitoring locations be established to assess potential impacts of the proposed mine to shallow (0 – 15 feet below ground surface) and deep (~50 feet below ground surface) groundwater quality.

2.1 Groundwater Constituents of Potential Concern

Jacobs reviewed the available pre-mining data to develop a list of constituents of potential concern (COPC) in the site's monitoring program.

This analysis used a two-step evaluation of the data:

- First, the list of COPCs was narrowed to contaminants with established Maximum Contaminant Levels (MCLs) for drinking water for comparison. Primary MCLs address contaminants that can have an adverse effect on human health if the MCL is exceeded in finished drinking water. Secondary MCLs pertain to contaminants that may impart objectionable properties (i.e., taste or odor) to finished drinking water but are not health threatening. While MCLs are developed for finished drinking water, they provide useful guidelines for assessing the quality of groundwater and are used as guideline values in Georgia's Groundwater Monitoring Network. Primary and Secondary MCLs are listed in GAEPD regulations at Rule 391-3-5-.18 (Primary MCLs) and Rule 391-3-5-.19 (Secondary MCLs).

- Second, for the MCL constituents, a statistical analysis was performed of the existing groundwater data. To provide for early detection of trends in constituent concentrations and to be consistent with GAEPD's groundwater assessment practices, constituents that were detected in more than 50% of the groundwater samples and had a maximum detected concentration exceeding 50 percent of its MCL value were selected for analysis in samples collected quarterly at the groundwater monitoring locations.

In addition to constituents selected based on the evaluation noted above, several water quality parameters will be measured in-situ at the time water samples are collected. These additional parameters will assist with the evaluation of results over time.

Table 1 lists the water quality parameters and COPCs to be monitored quarterly at each monitoring well, along with the rationale for monitoring.

Table 1. Water Quality Parameters and COPCs to be Measured at Groundwater Monitoring Wells

Parameter / COPC	Rationale for Monitoring
Arsenic, Total and Dissolved	While total arsenic only had a 27% detection frequency (8 of 30 samples), dissolved arsenic was detected in 67% (14 of 21 samples) of groundwater samples and had a maximum detected concentration of 5.74 ug/L or 57.4% of the MCL.
Lead, Total and Dissolved	Lead had a detection frequency of 58% and a maximum detected concentration of 63.7 ug/L, which exceeds the MCL value of 15 ug/L..
Gross Alpha	Gross alpha activity was detected in 83% of the groundwater samples and had a maximum detected concentration of 26.8 pCi/L, well in excess of the MCL value of 5 pCi/L.
Radium-226 + Radium 228	Radium-226 had a detection frequency of 92% and radium-228 had a detection frequency of 54%. Radium-228 had a maximum detected concentration of 6.84 pCi/L, which exceeds the 5 pCi/L MCL for the combined concentration of radium-226 and radium-228.
Aluminum, Total and Dissolved	Aluminum had a detection frequency of 100% and a maximum detected concentration of 17.6 mg/L, which exceeds the secondary MCL concentration range of 0.05 to 0.2 mg/L.
Iron, Total and Dissolved	Iron had a detection frequency of 100% and a maximum detected concentration of 8.8 mg/L. The MCL concentration for iron is 0.3 mg/L.
Manganese, Total and Dissolved	Manganese had a detection frequency of 97% and a maximum detected concentration of 12.0 mg/L. The secondary MCL concentration for manganese is 0.05 mg/L.
Total Dissolved Solids (TDS)	Total dissolved solids had a detection frequency of 100% and a maximum detected concentration of 1080 mg/L. The secondary MCL concentration for total dissolved solids is 500 mg/L.
Zinc, Total and Dissolved	Zinc had a detection frequency of 77% and maximum detected concentration of 2.66 mg/L. The MCL concentration for zinc is 5.0 mg/L.
pH	In-situ measurements of pH in the surficial aquifer can detect seasonal variations in the acidity of the aquifer.
Specific Conductivity	In-situ measurements of specific conductivity in the surficial aquifer can detect trends in dissolved constituents.
Water Temperature	In-situ measurements of temperature provide contextual information and may indicate areas of significant surface water influence or recharge.
Oxidation-Reduction Potential (ORP)	In-situ measurements of ORP can indicate the presence of dissolved pollutants, especially metals and can be useful for detecting the movement of pollutant plumes in the surficial aquifer over time.
Turbidity	Measurements of turbidity indicate the presence of suspended colloidal clays which can have a significant influence on the concentration of metals from natural sources.

3. Surface Water Monitoring Locations

Stormwater runoff may be collected and reused in material processing. Stormwater will be permitted to be discharged under a general industrial stormwater permit. Three existing monitoring locations, listed in Table 2 below and shown on Figure 1 , are proposed to monitor water quality in surface waters near the site.

Table 2. Surface Water Monitoring Locations

Surface Water Station ID	Location Description	Latitude	Longitude	Rationale / Comments
MSW-BG04	Location coincides with current surface water monitoring station MSW-BG04. This location is at the TPM property line.	30.523710	-82.090130	This monitoring location on an unnamed tributary to Boone Creek will receive runoff from the southeastern portion of the mining area.
MSW-BG05	Location coincides with current surface water monitoring station MSW-BG05. Located at an unpaved road.	30.534290	-82.088410	This monitoring location on Boone Creek will receive runoff from the northeastern portion of the mining area.
MSW-BG06	Location coincides with current surface water monitoring station MSW-BG06. Located at an unpaved road.	30.542916	-82.085060	This monitoring location on a tributary to Boone Creek that is outside of the area that will receive runoff from the mining area and associated disturbed areas will serve as a background water quality station.

3.1 Surface Water Constituents of Potential Concern

As with the groundwater data, surface water COPCs were selected based on their presence in Georgia's surface water quality criteria listed in Rule 391-3-6-.03, and their presence in the available pre-mining data. For the statistical analysis, a threshold detection frequency of 50% was selected to account for the small sample size at individual monitoring locations and is considered a conservative approach to ensure that all contaminants likely to be present in surface waters at the site are included. The resulting list of COPCs is shown in Table 3.

Table 3 lists the water quality parameters and COPCs to be monitored quarterly at each of the surface water monitoring locations listed in Table 2. In addition to constituents that passed the tests noted above, several water quality parameters will also be measured in-situ at the time water samples are collected. These additional parameters will assist with the evaluation of results over time.

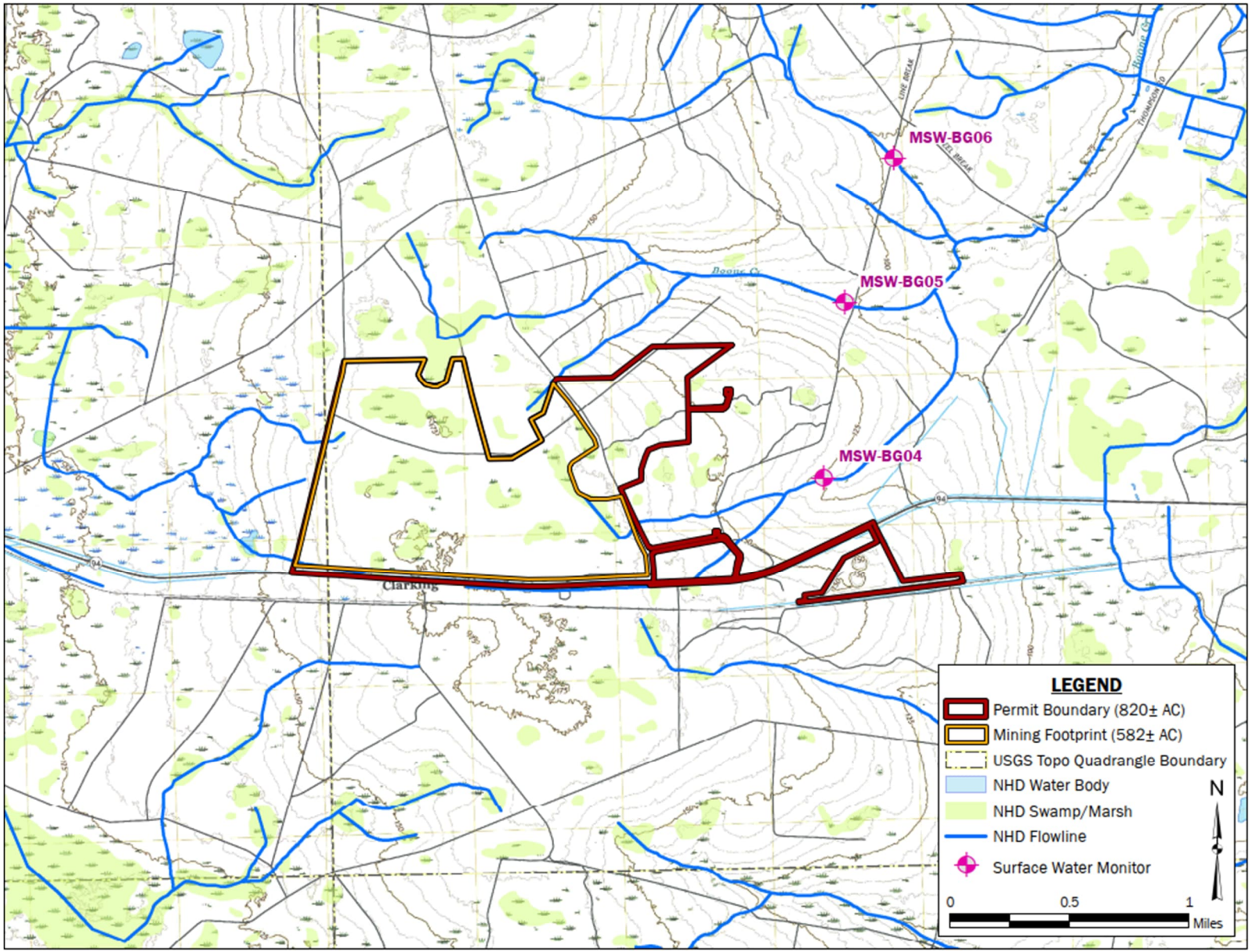
Table 3. Water Quality Parameters and COPCs to be Measured at Surface Water Monitoring Locations

Parameter / COPC	Rationale for Monitoring
Lead, Total and Dissolved	Lead was detected in 100% of the surface water samples. Georgia's surface water quality criteria for the protection of freshwater aquatic life are expressed as dissolved lead and are calculated using site-specific hardness concentrations. Dissolved lead exceeded the applicable water quality criterion in 31 of the 32 samples due to low water hardness values.
Mercury, Total	Mercury was detected in 97% of the surface water samples. Georgia's surface water quality criterion for the protection of freshwater aquatic life is 0.012 ug/L. This criterion was exceeded in 7.8% of the surface water samples. In addition, Georgia has established a Total Maximum Daily Load for total mercury for the Boone Creek watershed to limit the discharge of mercury from new and existing sources.
Zinc, Total and Dissolved	Dissolved zinc was detected in 100% of the surface water samples. Georgia's surface water quality criteria for the protection of freshwater aquatic life are expressed as dissolved zinc and are calculated using site-specific hardness concentrations. Dissolved zinc exceeded the applicable water quality criterion in 7 of the 32 samples due to extremely low water hardness values.
Total Hardness	Water quality criteria for the protection of aquatic life are calculated using site-specific total hardness concentration.
pH	Georgia's surface water quality criterion for the protection of freshwater aquatic life requires that pH be maintained within a range of 6.0 – 8.5 standard units. pH values outside this range occurred in 48 of the 55 measurements.
Dissolved Oxygen (DO)	Georgia's surface water quality criteria for waters supporting warmwater fish species require a daily average DO concentration of at least 5.0 mg/L and a daily minimum concentration of at least 4.0 mg/L. 49% of the DO concentrations measured at surface monitoring locations were less than 4.0 mg/L.

Table 3. Water Quality Parameters and COPCs to be Measured at Surface Water Monitoring Locations

Parameter / COPC	Rationale for Monitoring
Specific Conductivity	In-situ measurements of specific conductivity of surface waters can detect trends in dissolved constituents.
Water Temperature	In-situ measurements of temperature provide contextual information and affect dissolved oxygen saturation concentrations.
Turbidity	Measurements of turbidity indicate the presence of suspended colloidal clays which can have a significant influence on the concentration of metals from natural sources.
Total Organic Carbon (TOC)	Measurements of TOC indicate the presence of organic materials.
Total Phosphorus	Total phosphorus is a primary nutrient necessary for algal growth in surface waters and is an indicator of nutrient enrichment.
Total Nitrogen	Nitrogen is a nutrient necessary for algal growth in surface waters and is an indicator of nutrient enrichment.
Total Suspended Solids (TSS)	Measurements of TSS indicate the presence of suspended soil particles, include sand, silt, clay, and organic matter which can account for differences in the concentration of other contaminants.

Figure 1. Surface Water Monitoring Locations



4. Conclusion

Quarterly monitoring at the locations described will provide data and information characterizing conditions in groundwater and surface waters which may be influenced by TPM's mining activities. The recommendations in this memo are based on available data from previous monitoring conducted at the site and are subject to change as new monitoring data becomes available and pending requirements that may be established in the TPM surface mining permit. Monitoring plans must be adaptable to account for changing site conditions and monitoring results should be reviewed after three years of data are available to evaluate if the information being collected is relevant and meets the plan's stated purpose.