while a transient approach solves for the groundwater flow at different times, as flow conditions and water levels change through time due to changing recharge or discharge conditions. Modeling objectives, and the behavior of the hydrogeologic system determine how a numerical groundwater model is discretized in space and whether steady-state or transient simulations are necessary.

4.1 Model Discretization

The model domain was discretized for the current study as shown on Figure 23. The study area was divided into 64 columns and 62 rows of cells. The grid block size is a uniform 500 feet in the x- and y- coordinate directions. The grid block thickness is variable, to enable the grid to conform to hydrogeologic units and to post-mining backfill conditions.

The stratigraphic layer elevations and thicknesses of the numerical model honor the hydrogeologic conceptual model depicted on Figures 6 through 14, though additional numerical layers have been added so as to allow post-mining conditions to be accurately represented – mining is anticipated to occur up to different depths from stratigraphic contacts between the hydrogeologic units and therefore additional numerical layers were included in the model to accommodate those post-mining conditions. Figure 24 shows the model layering in relation to the hydrostratigraphic layers. If a hydrostratigraphic layer is divided into more than one numerical layer, the sub-discretization is performed with equal thickness allocated to the numerical layers that represent a hydrostratigraphic layer, except where it is specifically allocated to represent the bottom of post-mining back-fill materials. Figure 25 shows N-S and E-W cross-sections of the numerical model grid (cross-section locations are also depicted on Figure 23).

The numerical model was run using a steady-state approach. Though fluctuations were noted in the water level hydrographs, they were seasonal and did not exhibit long-term trends. GA EPD has further examined the State Water Plan model which showed little change in hydraulic heads between high and low recharge periods and noted that steady-state simulation conditions could be used to evaluate conditions at the mine (Kennedy, 2020b).

4.2 Model Parametrization

The numerical model cells are all assigned with initial horizontal and vertical hydraulic conductivity values for the associated hydrogeologic units. Figures 15 through 18 show initial estimates of hydraulic conductivity at wellbore locations from various aquifer and laboratory tests, which were then interpolated across the site to provide values for the entire domain. The anisotropy (horizontal to vertical hydraulic conductivity ratio) of the units was taken as 1:1 for the consolidated black sands and 10:1 for the other hydrogeologic units. Layers containing the consolidated black sand were zoned into regions where the consolidated black sands did and did not exist, and a transition zone as depicted on Figure 4. Initial hydraulic conductivity values in the transition zone were in between those of the unconsolidated sand and the consolidated black sand. The initial hydraulic conductivity distributions were then changed during the model calibration process.

4.3 Model Boundary Conditions

Model boundary conditions applied on the top surface of the model included recharge of precipitation and discharge to stream channels and wetlands within the model domain. Model boundary conditions also include prescribed water levels along the east and west lateral boundaries in all layers of the model to allow water to migrate out of the domain laterally. Since the groundwater flow system is mainly in the east-west direction with Trail Ridge acting as a