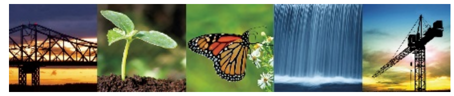

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M E M O R A N D U M

Date: January 6, 2023

To: Josh Whitney, Mine Planner, Vulcan Materials Company

From: Joshua Simpson, GZA GeoEnvironmental, Inc.
Mark Krumenacher, P.G., GZA GeoEnvironmental, Inc.
Peter Foster, P.G., GZA GeoEnvironmental, Inc.

File No.: 20.0157528.00

Re: Numerical Groundwater Flow Model Update
Vulcan Orangeburg Quarry
Orangeburg County, South Carolina ("Site")

In accordance with Contract Addendum No. 2, dated October 7, 2022, GZA GeoEnvironmental, Inc. (GZA) updated and recalibrated a three-dimensional (3D) numerical groundwater flow model that was previously developed to simulate groundwater flow conditions when dewatering a potential limestone quarry at the above-referenced Site. As part of this work, recent field observations/measurements and Site testing results were utilized to refine the numerical model. Following model refinement and recalibration, GZA simulated the approximate maximum allowable quarry acreage when dewatering between 57- and 67-foot elevations within the proposed pit area while maintaining at least 3 feet of saturated overburden at the property boundary. This work and technical memorandum are subject to the Limitations provided in **Attachment 1**.

BACKGROUND

In early 2022, GZA developed a groundwater flow model for the Site area using the United States Department of Defense Groundwater Modeling System (GMS) software, which incorporates the United States Geological Survey (USGS) modular, finite difference groundwater flow solution known as MODFLOW. Within the model, the equations governing groundwater flow are numerically solved for a point located at the center of each grid block within a 3D numerical grid. The following surficial and subsurface information was utilized to develop the model:

- LiDAR datasets to estimate ground surface elevation;
- Borings performed at the Site by others;
- Borings performed off-Site by others within the active model domain. These borings/well logs are saved in the South Carolina Department of Natural Resources (DNR) Coastal Plain Well Inventory database;
- Geologic and hydrogeologic information and data sets documented in reports for the Site; and
- Geologic and hydrogeologic information included in published USGS, South Carolina Department of Health and Environmental Control (DHEC), and DNR documents.

The model development and original calibration are discussed in further detail in GZA's Memorandum dated April 14, 2022 ("April 2022 Memo").[1] As presented in the April 2022 Memo, limited information was available regarding the hydraulic properties of the overburden due to lack of testing. In addition, the modeled bedrock surface elevations were interpolated from widely spaced coreholes. Given that these two parameters noticeably influence the simulated approximate allowable quarry acreage and dewatering rates, GZA recommended a field-testing program to gather additional information for subsequent model refinements.

In August 2022, GZA and the drilling subcontractor, Elite Techniques, performed a field investigation to evaluate the bedrock surface elevations in two areas along the property boundary and assess the hydraulic properties of the overburden. The August 2022 field observations/measurements and testing results indicated that the actual bedrock surface elevations at both areas along the property boundary were lower than the previously interpolated surface. In addition, the Site hydraulic conductivity testing results for the overburden were approximately one order of magnitude lower than the estimated value previously incorporated in the numerical model, which were based on general literature values. As a result, GZA refined model input parameters to update simulated approximate allowable areal extents of the potential quarry, injection rates for surface trenches, and simulated dewatering pumping rates.

NUMERICAL MODEL REFINEMENTS

The following numerical model input parameters were refined based on the August 2022 field investigation results:

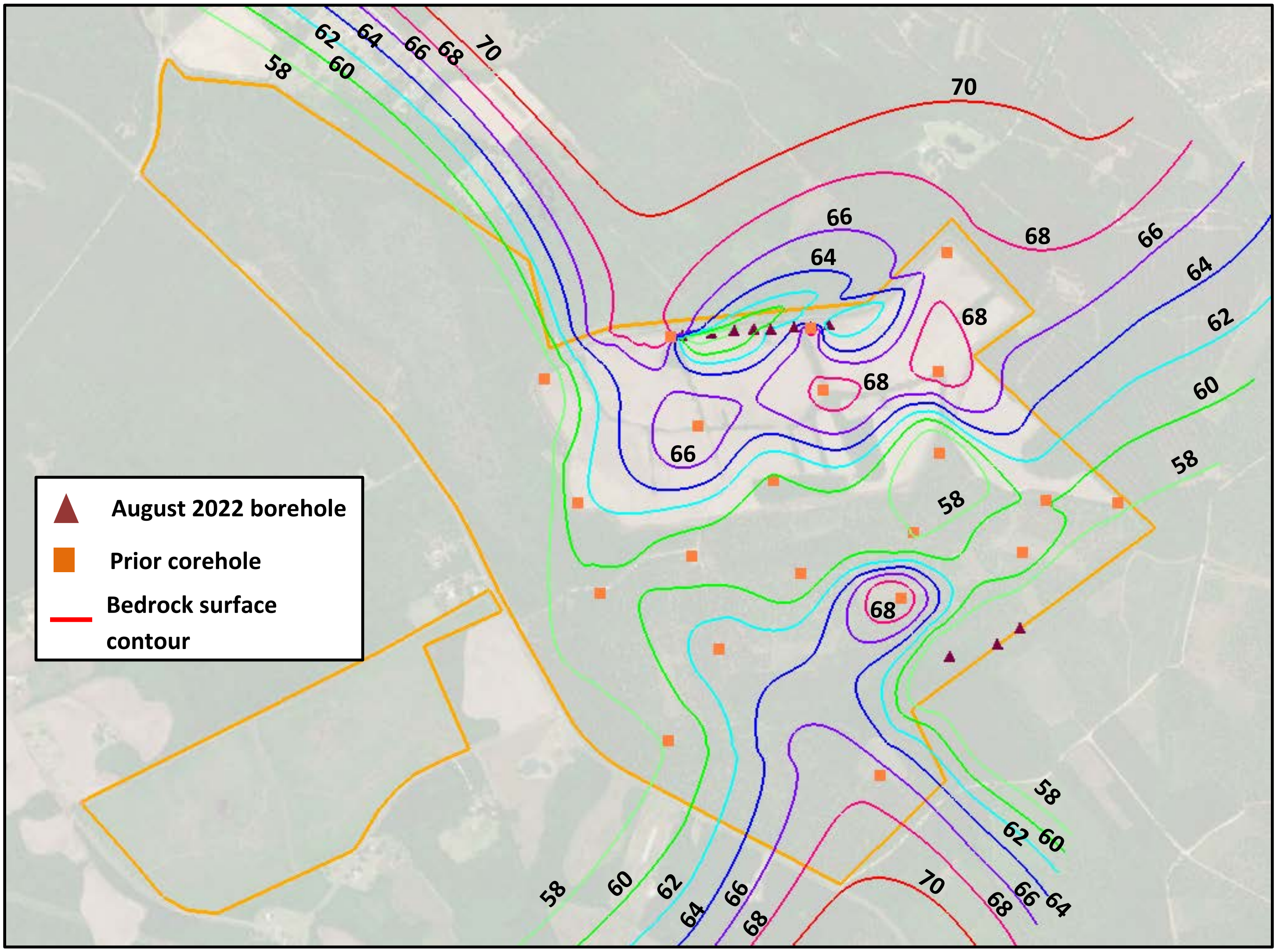
- Hydraulic Conductivity of Overburden: Based on general literature values for a silty sand soil, a hydraulic conductivity (K) of 3 feet/day was previously assigned to the overburden within the numerical model. The August 2022 Site K testing results ranged between 0.1 and 1.8 feet/day, with an average horizontal K near 0.5 feet/day.[2] As a result, the simulated horizontal K of the overburden was lowered to 0.5 feet/day within the numerical model.

- Newly Installed Monitoring Wells, Including Groundwater Elevation Data: In August 2022, Elite Techniques installed seven overburden monitoring wells at the Site. Four wells were installed near the property boundary north of the proposed quarry and three wells were installed at the property boundary south of the proposed quarry. The well completion information was imported into the numerical model, including the field-measured groundwater elevations. The field-measured groundwater elevation data were utilized during the model recalibration process, as discussed in the following section.

- Bedrock Surface Elevation: In August 2022, Elite Techniques advanced 10 boreholes to bedrock. Seven boreholes were completed near the property boundary north of the proposed quarry and three were completed at the property boundary south of the proposed quarry. GZA's field scientist recorded the depth to bedrock at each borehole location. These measurements were added to the existing Site corehole data set to generate a refined, interpolated bedrock surface elevation map. The refined bedrock surface elevation contours are presented in the following figure. The refined bedrock surface elevations were imported as the top of Layer 2 within the numerical model, which represents the boundary between the overburden and bedrock at the Site.

[1] *Memorandum – Numerical Groundwater Flow Model, Vulcan Orangeburg Quarry, Orangeburg County, South Carolina*, dated April 14, 2022, GZA File No. 20.0157528.00.

[2] Note that heterogeneous soil conditions were observed during the August 2022 drilling program, including zones of sandy soils (fewer fines). These zones of sandy soil are anticipated to have a somewhat higher hydraulic conductivity than the average value used to conservatively simulate the overburden within the updated model.



Updated bedrock surface elevation contours.

GROUNDWATER FLOW MODEL RECALIBRATION

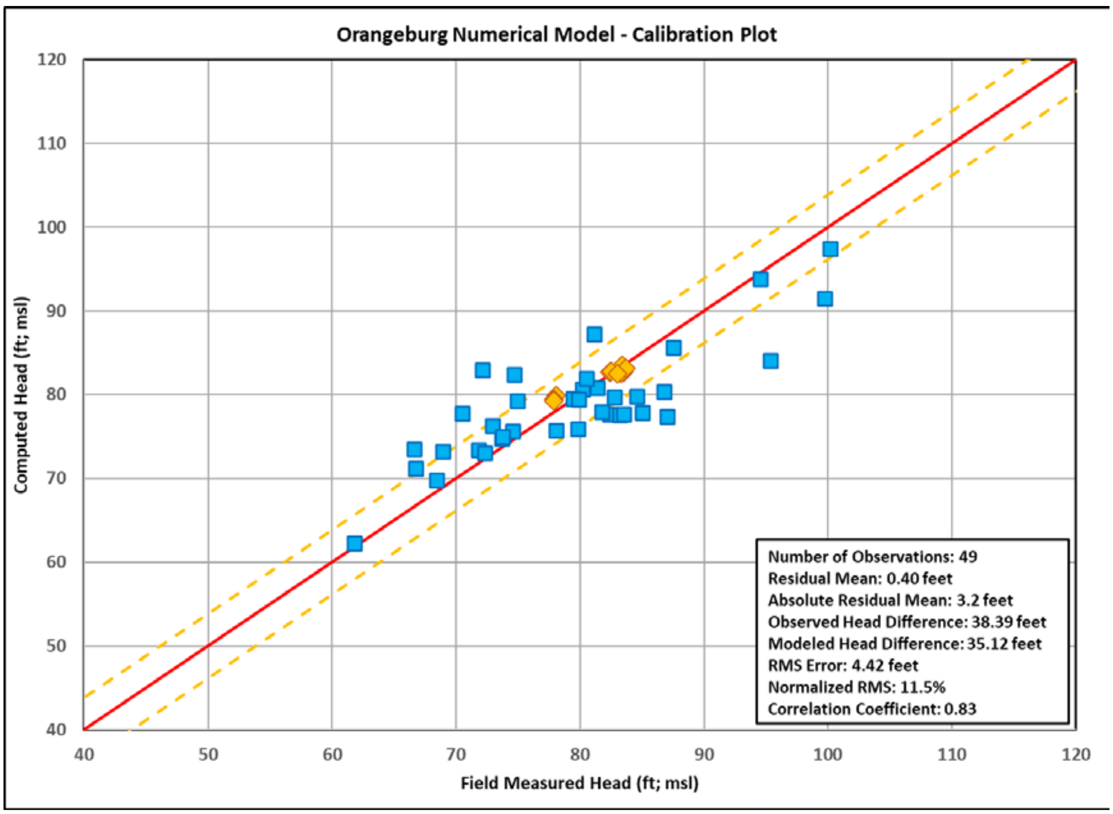
Simulated groundwater elevations were computed based on the model's input and boundary conditions (e.g., hydraulic conductivity, groundwater recharge, river boundaries, drain boundaries). To recalibrate the model, the simulated results were compared to groundwater elevation measurements collected during prior investigation programs (i.e., water level measurements collected by others), available water level information for off-Site wells contained in the DNR's Coastal Plain Well Inventory database,[3] and groundwater elevation measurements from the August 2022 field investigation. A total of 37 off-Site and 12 on-Site observation points were used for the model recalibration.

For recalibration, GZA iteratively adjusted the recharge rate within ranges constrained by published values until the simulated groundwater elevations were again comparable to the field measurements. In fact, the comparison statistics

[3] Note that long-term groundwater elevation data sets were not available in this database, so the groundwater elevation data for these off-Site observation points typically reflect the estimated depth to groundwater when each well was drilled. Therefore, the field data were collected at different times/years and could represent varying conditions. In addition, estimates from well driller logs are typically less accurate than groundwater elevation measurements collected during site investigations.

for the recalibrated model are improved when compared to the original calibration. Note that the recalibrated model does not necessarily provide a unique solution. Furthermore, numerical models and the resulting simulations of groundwater flow are dependent, in part, on the scale of the geologic features modeled, the amount of data collected, and the solution methods. These limitations were addressed in our original calibration and recalibration process to the extent practical, as model input parameters were derived from Site-specific and published data.

A calibration plot, which directly compares the simulated and field-measured groundwater elevations and, thus, illustrates the overall accuracy of the numerical model, is shown below. The red line indicates the 1:1 match line. If a data point falls on this line, the simulated groundwater elevation matches the field measurement for that observation point. For calibrated models, the simulated heads at individual wells should generally be within 10% of the observed range from the field-measured groundwater elevations, denoted by the area within the dashed orange lines on the calibration plot. The Site observation points (orange diamond symbols on the plot) are within this range. Even considering the limitations of the off-Site observation points and the simplified nature of the homogeneous model discussed above, the off-Site points (blue square symbols) also generally fall within, or close to, 10% of the observed range.



Model calibration plot.

Both a residual mean near zero and the grouping around the red match line indicate that the calibrated model does not provide an overall bias (high or low) to the simulated groundwater flow conditions at the Site. The statistical results of the calibrated model indicate the general accuracy of the model (correlation coefficient of 0.83, normalized RMS of 11.5%), especially considering the off-Site field measurements were collected at several snapshots in time and obtained from driller's logs. Finally, an absolute residual mean divided by the observed head difference should be less than 10% for a well-calibrated model. That test statistic was 8.4% for the calibrated model, which is within the generally accepted range.

The simulated hydraulic head contours within the recalibrated groundwater flow model are consistent with regional potentiometric maps produced by the USGS and DNR (DNR, 2017; DNR, 2019); groundwater generally flows east/southeast within the model domain. Convergent flow conditions are observed in the vicinity of the existing Martin Marietta (MM) quarry, due to their groundwater dewatering. The simulated hydraulic gradient (i.e., slope of the water table) at the Site ranges between approximately 0.0001 and 0.0003 and is generally steeper to the east, due to groundwater dewatering by MM.

Based on the numerical modeling results presented above, the recalibrated, steady-state simulation provides a reasonable match to the observed groundwater elevation data at the Site for current hydrogeologic conditions, as well as the overall groundwater flow conditions within the model domain. Therefore, in our opinion, the recalibrated model results adequately represent current groundwater flow conditions and are in agreement with the currently available data. The recalibrated input parameters for the model are presented in **Table 1**, including the rationale for each selected value. As shown in **Table 1**, the input parameters were selected based on: 1) Site-specific testing results; 2) published ranges; 3) LiDAR data; or 4) commonly selected hydrogeologic values.

STEADY-STATE (QUARRY DEWATERING) FORECAST SIMULATIONS

After recalibration, GZA performed forecast simulations (i.e., modeling of potential future conditions) to evaluate the approximate maximum allowable quarry acreage when dewatering between 57- and 67-foot elevations within the proposed pit area while maintaining at least 3 feet of saturated overburden at the property boundary. Forecast simulations were performed for the following three potential future conditions:

1. Dewatering to 57 feet elevation, which represents 3 feet below the top of weathered limestone in the central portion of the potential quarry.
2. Dewatering to 67 feet elevation, which represents 3 feet below a 10-foot-thick dragline pad in the central portion of the potential quarry.
3. Dewatering to 72 feet elevation, which represents 3 feet below a 15-foot-thick dragline pad in the central portion of the potential quarry.

The potential future quarry dewatering was simulated with a drain boundary within MODFLOW, where the drain elevation was set to the selected dewatering elevation. As a result of the drain boundary, the hydraulic head within the simulated extents of the quarry equaled the simulated drain elevation. This approach simulates long-term, steady-state dewatering from either one large pump or several pumps across the quarry area because the water level would essentially be the same across the entire quarry.

In addition, perimeter re-infiltration/groundwater recharge into a trench was simulated as a 30-foot-wide constant head boundary at the property boundary. Based on this modeling approach, the perimeter recharge is limited by the simulated hydraulic conductivity of the overburden. This approach assumes infiltration efficiency does not deteriorate over time.

The results of these forecast, quarry dewatering simulations are summarized in the following table.

Forecast Simulation	Dewatering Scenario	Groundwater Dewatered Elevation within the Quarry Area	Perimeter Recharge	Max Simulated Allowable Quarry Size (acre)	Quarry Dewatering Rate (gpm)	River/ Wetland Losses (gpm)	Perimeter Recharge Rate (gpm)
1	3 Ft Below Rock	**57'** (evaluate maximum rectangular area that maintains a suitable simulated GW elev. at property boundary)	Yes	100	4,000	180	1,900
2	5-ft Pad; 3 Ft Below Pad	**62'** (evaluate maximum rectangular area that maintains a suitable simulated GW elev. at property boundary)	Yes	180	3,600	170	1,800
3	10-ft Pad; 3 Ft Below Pad	**67'** (evaluate maximum rectangular area that maintains a suitable simulated GW elev. at property boundary)	Yes	260	3,200	160	1,700

As shown, the model results indicate that a quarry of approximately 100 acres could be mined while dewatering to 57 feet elevation and maintaining at least 3 feet of saturated overburden at the property boundary. The simulated extents of this quarry are illustrated on **Figure 1**, along with the simulated saturated thickness of overburden at several locations along the property boundary. As shown, the quarry area that could be dewatered to 57 feet elevation is located in the southern portion of the overall potential quarry area. The simulated quarry boundary maintains a distance from the northern and northeastern property boundaries where the highest interpolated bedrock surface elevations occur. Along those two boundaries, the minimum simulated saturated thickness of the overburden is 3.1 feet.

Figure 2 presents the areal extents of the simulated quarry that could be dewatered to elevation 62 feet while maintaining at least 3 feet of saturated overburden at the property boundary. The simulated quarry area was expanded by an additional 80 acres for this simulation, bringing the total simulated area to approximately 180 acres. As expected, the same two areas of the property boundary limit the areal extents for a quarry that can be dewatered to 62 feet elevation while maintaining at least 3 feet of saturated overburden.

The model results for the 67-foot elevation dewatering scenario are presented on **Figure 3**. The modeling results indicate that a quarry of approximately 260 acres could be mined while dewatering to 67 feet elevation and maintaining at least 3 feet of saturated overburden at the property boundary. Therefore, the simulated quarry area was expanded by an additional 80 acres for this dewatering scenario. This simulated quarry boundary is approximately 5 acres less than the quarry design provided by Vulcan at the initiation of the modeling efforts. The simulated saturated thickness along the northeastern property boundary limits the simulated allowable quarry area in this portion of the property.

In summary, the approximate allowable simulated quarry extents for each dewatered elevation are presented on **Figure 4**. These simulated areal extents for the potential quarry are less than the previous modeling results due to the lower hydraulic conductivity of the overburden within the updated model. These forecast simulations assume that extracted groundwater is reintroduced via recharge trenches along the property boundary. Approximately 50% of the simulated dewatering rates (i.e., around 1,500 to 2,000 gallons per minute [gpm]) was not reinfiltrated along the property perimeter via the surface trench, which is a higher percentage than the previous modeling results. These results again reflect the refined hydraulic conductivity of the overburden with the model (K decreased from 3 feet/day to 0.5 feet/day). Based on these results, alternative water management methods may need to be considered, such as subsurface re-injection or off-Site discharge.

REFERENCES

DNR SC Coastal Plain Well Inventory database:
https://www.arcgis.com/apps/webappviewer/index.html?id=5052e9310cb242eaa5b07340b406ab5a.

State of South Carolina Department of Natural Resources (DNR) (2019). Potentiometric surface maps of the upper and middle Floridan and Gordon Aquifers in South Carolina; November-December 2018.

State of South Carolina Department of Natural Resources (DNR) (2017). Potentiometric surface maps of the upper and middle Floridan and Gordon Aquifers in South Carolina; November-December 2016.

ATTACHMENTS

Table 1 - Calibrated Numerical Model Input Parameters
Figure 1 – Groundwater Modeling Results (Forecast Conditions: Dewater to 57' Elevation)
Figure 2 – Groundwater Modeling Results (Forecast Conditions: Dewater to 62' Elevation)
Figure 3 – Groundwater Modeling Results (Forecast Conditions: Dewater to 67' Elevation)
Figure 4 – Groundwater Modeling Results (Forecast Conditions: Maximum Simulated Dewatering Areas)
Attachment 1 – Limitations

TABLES

TABLE 1
CALIBRATED NUMERICAL MODEL INPUT PARAMETERS
Potential Vulcan Materials Company Quarry
Orangeburg, South Carolina

Boundary Condition	Parameter	Calibrated Value	Basis/Rationale
Hydraulic Conductivity	Overburden	Horizontal: 0.5 ft/day Anisotropy (Kh/Kv): 5	Horizontal hydraulic conductivities are consistent with Site-specific testing results and published ranges presented in USGS, 2010. Standard anisotropies were assigned to each hydrogeologic unit. Primary bedrock fracture orientations were unavailable for bedrock.
	Floridan Aquifer	Horizontal: 70 ft/day Anisotropy: 10	
	Lakebed Sediments	Horizontal: 0.5 ft/day Anisotropy: 10	
	Gordon Confining Unit	Horizontal: 0.1 ft/day Anisotropy: 10	
	Weathered Limestone	Horizontal: 75 ft/day Anisotropy: 5	
	Gordon Aquifer	Horizontal: 50 ft/day Anisotropy: 10	
Recharge Rate	N/A	3 in/yr	Published ranges for recharge rates in the region are 3 to 15 inches (USGS, 1996; USGS, 2010; DHEC, 2017). USGS simulated recharge rates for this area ranged between 3 and 5 in/yr (USGS, 2010).
River Boundaries	Stage (feet)	Equals LiDAR dataset	Stream depths were estimated based on size of streams. Survey information was not available so LiDAR data was the most accurate dataset to estimate stream stage. Conductance was calculated assuming fine-grained streambed sediments.
	Bottom Elevation (feet)	3 feet below LiDAR elevation	
	Conductance ((ft^2/day)/ft)	0.05	
Drain Boundaries	Elevation (feet)	Equals LiDAR dataset	Survey information was not available so LiDAR data was the most accurate dataset to estimate the wetland surface water elevations. Conductance was calculated assuming fine-grained streambed sediments.
	Conductance ((ft^2/day)/ft^2)	0.1	
General Head	Elevation (feet)	DNR Maps	General head boundary was selected to be approximately parallel to drawn DNR potentiometric surface contours, and GHB elevations equaled the contour values. Conductance was selected based on estimated transmissivities of the Gordon aquifer.
	Conductance ((ft^2/day)/ft)	1	
Constant Head	Elevation	Equals LiDAR dataset (Lakes)	Lake Marion and Lake Moultrie - survey information was not available so LiDAR data was the most accurate dataset.
		65 feet - MM Quarry	Martin Marietta Existing Quarry - LiDAR used to estimate dewatered elevation.
Public Water Supply Wells	Pumping Rate	5 to 100 gpm	Pumping rates were estimated from boring log information and information regarding number of people served. This rate represents continuous (steady state) groundwater extraction.

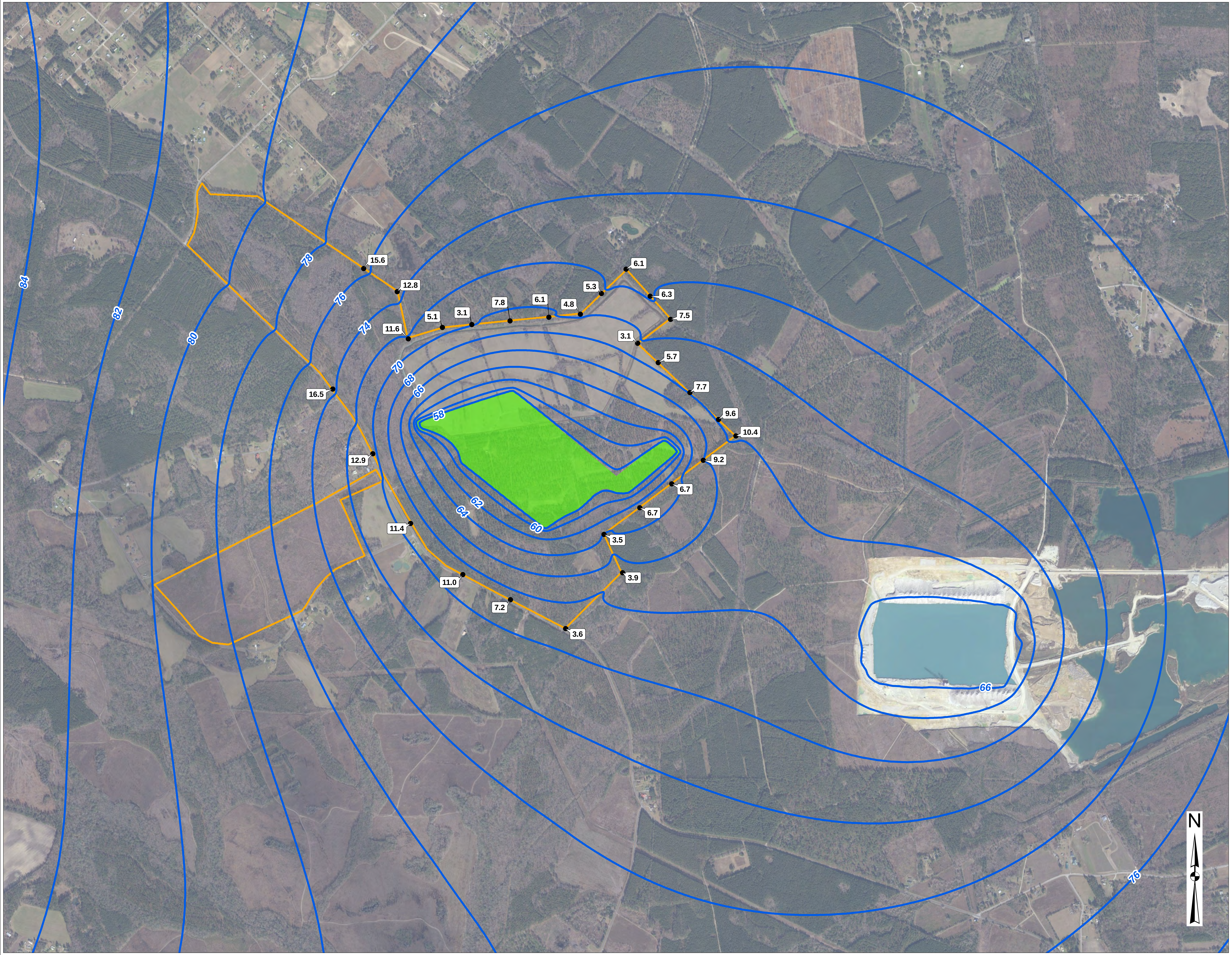
References

USGS (2010). Groundwater Availability in the Atlantic Coastal Plain of North and South Carolina. Professional Paper 1773.

USGS (1996). Hydrology of the southeastern coastal plain aquifer system in South Carolina and parts of Georgia and North Carolina. USGS Professional Paper 1410-E.

DHEC (May 2017). A preliminary assessment of the groundwater conditions in Aiken, Allendale, Bamberg, Barnwell, Calhoun, Lexington, and Orangeburg Counties, South Carolina.

FIGURES



LEGEND

- 10.4 — SIMULATED SATURATION THICKNESS OF THE OVERBURDEN DURING DEWATERING TO 57'
- 70 — GROUNDWATER ELEVATION CONTOUR (FEET). MODELING RESULTS FOR QUARRY DEWATERING TO 57' ELEVATION.
- MODELED MAXIMUM ALLOWABLE EXTENTS OF QUARRY WHEN DEWATERING TO 57' ELEVATION
- SITE BOUNDARY

SOURCE

1) THE SOUTH CAROLINA STATEWIDE AERIAL IMAGERY MAP SERVICE WAS CAPTURED BETWEEN JANUARY AND MARCH 2020 DURING LEAF-OFF AND CLOUD FREE CONDITIIONS BY KUCERA INTERNATIONAL. THE SERVICE IS MANAGED BY THE SOUTH CAROLINA STATE GIS COORDINATOR AND WAS DISTRIBUTED BY ESRI ON JULY 21, 2021.
2) SIMULATED GROUNDWATER ELEVATION CONTOURS ARE BASED ON NUMERICAL GROUNDWATER FLOW MODEL SIMULATIONS AND MAY NOT REFLECT ACTUAL WATER SURFACE CONDITIONS.
3) NUMERICAL GROUNDWATER DEWATERING SIMULATION PERFORMED AS STATED IN THE TEXT.
4) SIMULATED GROUNDWATER DEWATERING ELEVATION CONTOURS ARE SHOWN IN UNITS OF FEET (NAVD88).

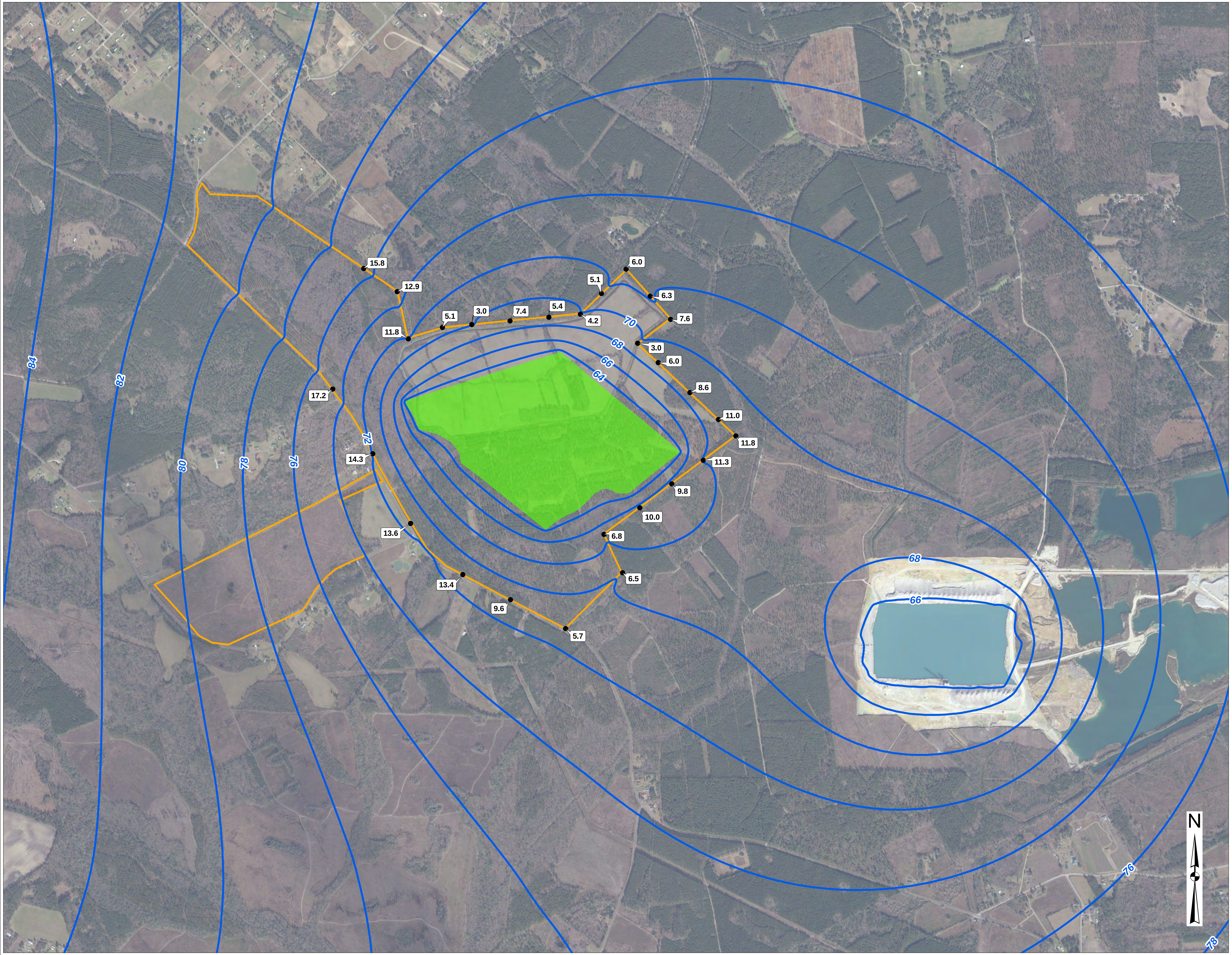
0 400 800 1,600 2,400

SCALE IN FEET

VULCAN ORANGEBURG QUARRY
ORANGEBURG COUNTY, SOUTH CAROLINA

GROUNDWATER MODELING RESULTS (FORECAST CONDITIONS: DEWATER TO 57' ELEVATION)

PREPARED BY:		PREPARED FOR:	
GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		VULCAN MATERIALS COMPANY	
PROJ MGR: MJK	REVIEWED BY: MJK	CHECKED BY: JAS	FIGURE 1
DESIGNED BY: JAS	DRAWN BY: EMD	SCALE: 1 IN. = 800 FT	
DATE: 11-30-2022	PROJECT NO. 20.0157528.00	REVISION NO.	



LEGEND

11.8	SIMULATED SATURATION THICKNESS OF THE OVERBURDEN DURING DEWATERING TO 62'
70	GROUNDWATER ELEVATION CONTOUR (FEET). MODELING RESULTS FOR QUARRY DEWATERING TO 62' ELEVATION.
	MODELED MAXIMUM ALLOWABLE EXTENTS OF QUARRY WHEN DEWATERING TO 62' ELEVATION
	SITE BOUNDARY

SOURCE

1) THE SOUTH CAROLINA STATEWIDE AERIAL IMAGERY MAP SERVICE WAS CAPTURED BETWEEN JANUARY AND MARCH 2020 DURING LEAF-OFF AND CLOUD FREE CONDITIIONS BY KUCERA INTERNATIONAL. THE SERVICE IS MANAGED BY THE SOUTH CAROLINA STATE GIS COORDINATOR AND WAS DISTRIBUTED BY ESRI ON JULY 21, 2021.
2) SIMULATED GROUNDWATER ELEVATION CONTOURS ARE BASED ON NUMERICAL GROUNDWATER FLOW MODEL SIMULATIONS AND MAY NOT REFLECT ACTUAL WATER SURFACE CONDITIONS.
3) NUMERICAL GROUNDWATER DEWATERING SIMULATION PERFORMED AS STATED IN THE TEXT.
4) SIMULATED GROUNDWATER DEWATERING ELEVATION CONTOURS ARE SHOWN IN UNITS OF FEET (NAVD88).

0 400 800 1,600 2,400

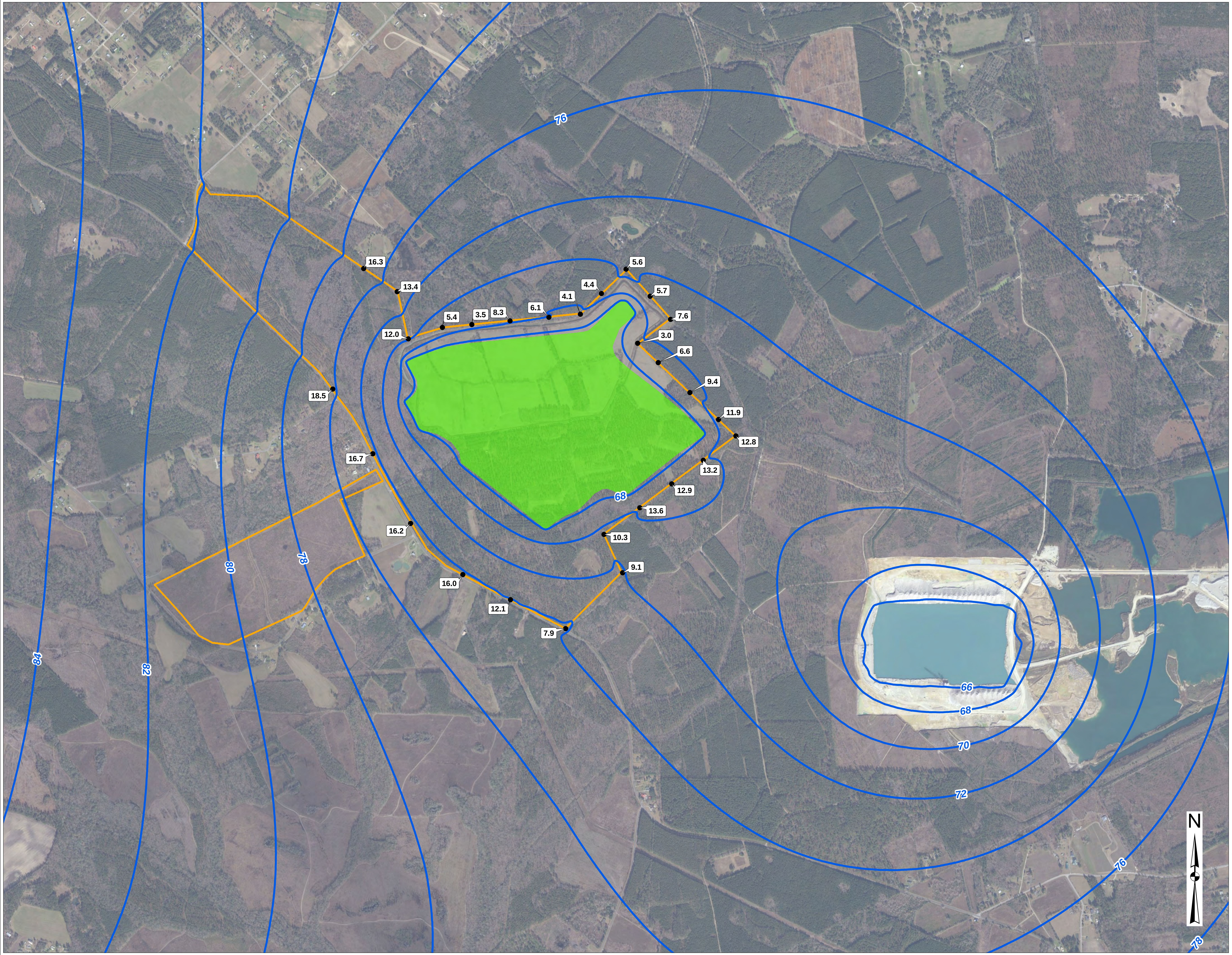
SCALE IN FEET

VULCAN ORANGEBURG QUARRY

ORANGEBURG COUNTY, SOUTH CAROLINA

GROUNDWATER MODELING RESULTS (FORECAST CONDITIONS: DEWATER TO 62' ELEVATION)

PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		PREPARED FOR: VULCAN MATERIALS COMPANY	
PROJ MGR: MJK	REVIEWED BY: MJK	CHECKED BY: JAS	FIGURE 2
DESIGNED BY: JAS	DRAWN BY: EMD	SCALE: 1 IN. = 800 FT	
DATE: 11-30-2022	PROJECT NO. 20.0157528.00	REVISION NO.	



LEGEND

12.8 SIMULATED SATURATION THICKNESS OF THE OVERBURDEN DURING DEWATERING TO 67'

70 GROUNDWATER ELEVATION CONTOUR (FEET). MODELING RESULTS FOR QUARRY DEWATERING TO 67' ELEVATION.

MODELED MAXIMUM ALLOWABLE EXTENTS OF QUARRY WHEN DEWATERING TO 67' ELEVATION

SITE BOUNDARY

SOURCE

1) THE SOUTH CAROLINA STATEWIDE AERIAL IMAGERY MAP SERVICE WAS CAPTURED BETWEEN JANUARY AND MARCH 2020 DURING LEAF-OFF AND CLOUD FREE CONDITIIONS BY KUCERA INTERNATIONAL. THE SERVICE IS MANAGED BY THE SOUTH CAROLINA STATE GIS COORDINATOR AND WAS DISTRIBUTED BY ESRI ON JULY 21, 2021.

2) SIMULATED GROUNDWATER ELEVATION CONTOURS ARE BASED ON NUMERICAL GROUNDWATER FLOW MODEL SIMULATIONS AND MAY NOT REFLECT ACTUAL WATER SURFACE CONDITIONS.

3) NUMERICAL GROUNDWATER DEWATERING SIMULATION PERFORMED AS STATED IN THE TEXT.

4) SIMULATED GROUNDWATER DEWATERING ELEVATION CONTOURS ARE SHOWN IN UNITS OF FEET (NAVD88).

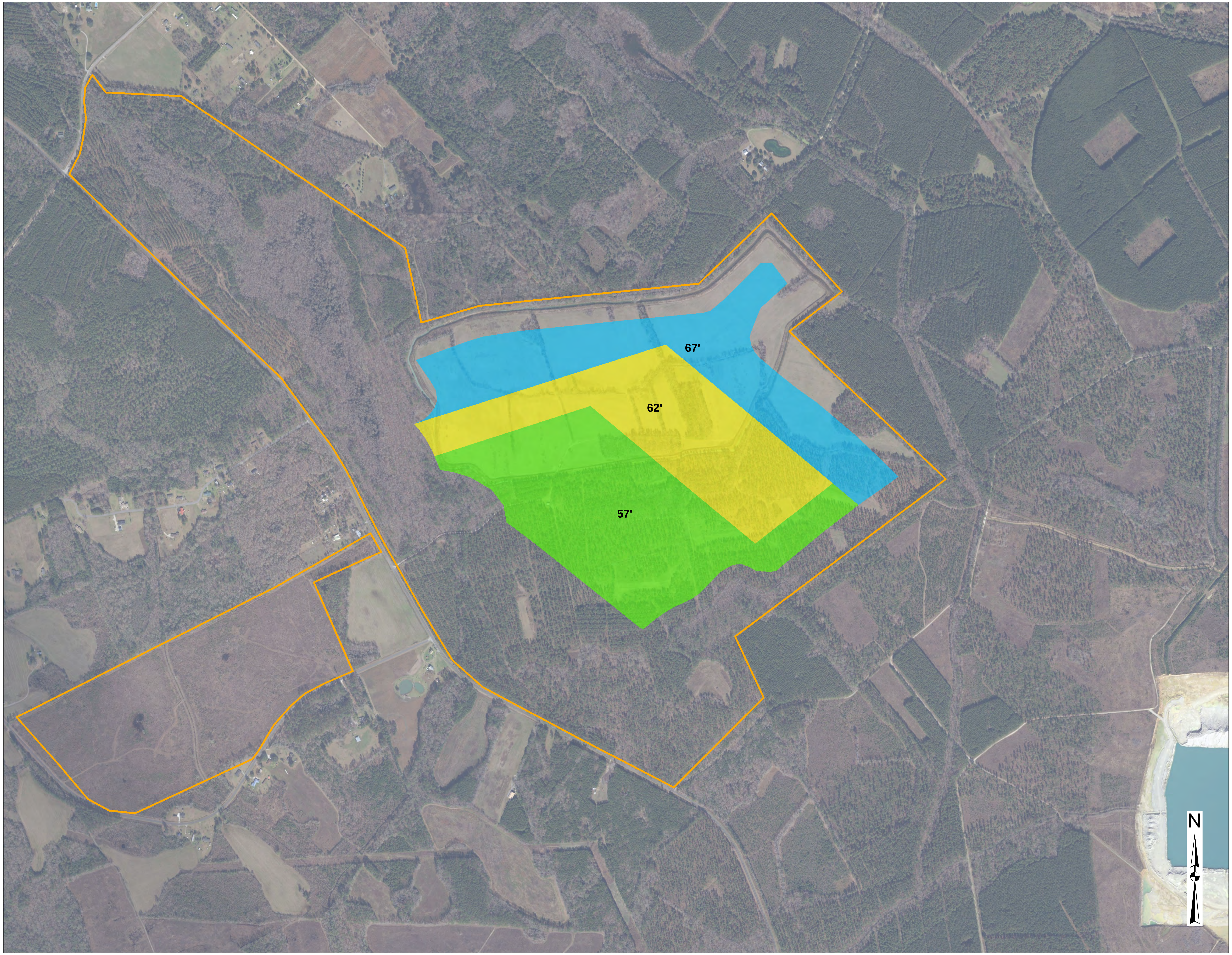
0 400 800 1,600 2,400

SCALE IN FEET

VULCAN ORANGEBURG QUARRY
ORANGEBURG COUNTY, SOUTH CAROLINA

GROUNDWATER MODELING RESULTS (FORECAST CONDITIONS: DEWATER TO 67' ELEVATION)

PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		PREPARED FOR: VULCAN MATERIALS COMPANY	
PROJ MGR: MJK	REVIEWED BY: MJK	CHECKED BY: JAS	FIGURE 3
DESIGNED BY: JAS	DRAWN BY: EMD	SCALE: 1 IN. = 800 FT	
DATE: 11-30-2022	PROJECT NO. 20.0157528.00	REVISION NO.	



LEGEND

- MAXIMUM SIMULATED AREA WHEN DEWATERING TO ELEVATION 57'
- MAXIMUM SIMULATED AREA WHEN DEWATERING TO ELEVATION 62'
- MAXIMUM SIMULATED AREA WHEN DEWATERING TO ELEVATION 67'
- SITE BOUNDARY

SOURCE

1) THE SOUTH CAROLINA STATEWIDE AERIAL IMAGERY MAP SERVICE WAS CAPTURED BETWEEN JANUARY AND MARCH 2020 DURING LEAF-OFF AND CLOUD FREE CONDITIIONS BY KUCERA INTERNATIONAL. THE SERVICE IS MANAGED BY THE SOUTH CAROLINA STATE GIS COORDINATOR AND WAS DISTRIBUTED BY ESRI ON JULY 21, 2021.
2) THE NUMBERS (E.G. 57') IN EACH POLYGON REPRESENT THE LOWEST SIMULATED GROUNDWATER DEWATERING ELEVATION, WHERE THE CORRESPONDING SIMULATED GROUNDWATER LEVELS AT THE PROPERTY BOUNDARY REMAINED AT LEAST 3-FEET HIGHER THAN THE BEDROCK SURFACE ELEVATIONS.
3) NUMERICAL GROUNDWATER DEWATERING SIMULATION PERFORMED AS STATED IN THE TEXT.
4) SIMULATED GROUNDWATER DEWATERING ELEVATIONS ARE SHOWN IN UNITS OF FEET (NAVD88).

0 250 500 1,000 1,500

SCALE IN FEET

VULCAN ORANGEBURG QUARRY

ORANGEBURG COUNTY, SOUTH CAROLINA

GROUNDWATER MODELING RESULTS (FORECAST CONDITIONS: MAXIMUM SIMULATED DEWATERING AREAS)

PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com	PREPARED FOR: VULCAN MATERIALS COMPANY

PROJ MGR: MJK	REVIEWED BY: MJK	CHECKED BY: JAS	FIGURE 4
DESIGNED BY: JAS	DRAWN BY: EMD	SCALE: 1 IN. = 500 FT	
DATE: 11-30-2022	PROJECT NO. 20.0157528.00	REVISION NO.	

ATTACHMENT 1

Limitations

LIMITATIONS

1. The conclusions presented in this Memorandum are based upon the hydrogeologic and physical data obtained by others from specific sampling and gauging locations at specific times. The full nature and extent of variations in the data between these specific locations and times are not known. The conditions existing between these specific locations and times have only been inferred using interpolation and extrapolation based on judgment.
2. The subsurface profiles described in the Memorandum are intended to convey anticipated trends in subsurface conditions. The conditions modeled are approximate and generalized and were developed, in part, based on judgment and professional interpretation. For specific information at specific locations, refer to the individual boring investigation logs.
3. Water level readings (piezometric pressures) have been made by others in the specific monitoring points at times and under conditions stated. These data have been reviewed and interpretations have been made in the text and on the figures of this memorandum. However, it must be noted that temporal and spatial fluctuations in the level of the groundwater may occur due to variations in rainfall and other factors different from those prevailing at the time and location measurements were made.
4. Actual subsurface conditions are likely more complex than indicated in this Memorandum. Our mathematical model is, by its very nature, a simplification of actual conditions. Except as noted in the Memorandum, we did not validate the code used in the model. In constructing the model, point-specific data were generalized and extrapolated across the study area. In addition, in areas where field data were not available, we used professional judgment, based on experience and regional information, to construct the model. Model assumptions are provided within the Memorandum. Actual flow patterns and/or groundwater discharges may be other than simulated. As additional field data becomes available our numerical model can be modified to better reflect conditions of possible interest.
5. Variations in the flow paths may occur due to seasonal water table fluctuations, past and current operational practices (i.e., groundwater extraction), climate change, the passage of time, and other factors. Should additional data (water analyses, water elevations, subsurface deposits, construction and operation, etc.) become available in the future, these data should be reviewed by GZA, and the conclusions and recommendations presented herein modified accordingly.
6. Our results are based on the work conducted as part of the primary modeling objective presented in the Memorandum and reflect our professional judgment. These results must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data provided during the course of our work. Conditions other than described in this memorandum may be found at the subject location(s).
7. Our services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made.