Technical Memorandum

To: Reuben Maxbauer (Edw. C. Levy Co.)
From: Ryan Conway and Katy Lindstrom, PE (Barr Engineering Co.)
Subject: Hydrogeologic Evaluation of Potential Sand and Gravel Mine – Springfield, Township, MI
Date: May 17, 2025
Project: 22631250.00
c: Tom Green (Edw. C. Levy Co.)

The Edw. C. Levy Co. (Levy) D.B.A. Burroughs Materials Corp. (BMC) has an interest in developing a sand and gravel mine on an approximate 480-acre property in Oakland County, Michigan located on the west side of Ormond Road beginning approximately 1.1 miles south of Davisburg Road. A portion of this property is part of Springfield Township's Eagle Road resource protection overlay district. Refer to Figure 1 for the site location relative to the resource protection overlay area. The topography is rolling, with flat to gently rolling agricultural land to the east along Ormond Road, sloping more steeply to the west on the western portion of the property down to lower-laying upland woods, wetlands, and a man-made lake.

BMC intends to mine portions of the property that are not in the protection overlay district for sand and gravel, including removing and stockpiling topsoil and overburden, excavating above and below the water table, thereby creating a lake, and processing aggregate for commercial sale. No groundwater dewatering is planned. A groundwater supply well will be constructed on the northeastern portion of the property near Ormond Road and used for a sand and gravel wash plant and firefighting water supply for Springfield Township. At mine closure, the mining area will be reclaimed, graded, and seeded as appropriate for future use of the property. See Figure 2 for the approximate 240-acre mining area proposed on the eastern half of the property.

BMC retained Barr Engineering Co. (Barr) to characterize and assess hydrogeologic (i.e., groundwater) conditions under current and proposed (i.e., full mine development) conditions.

1 Existing Hydrogeologic Conditions

A hydrogeologic evaluation of existing conditions (before mine development) was completed to assess the potential for impacts to resources on and adjacent to the property. The hydrogeologic understanding was prepared using topographic data, aerial imagery, property-specific observations, regional hydrogeologic resources, publicly available information regarding water supply wells, and groundwater monitoring wells on the property. The following sub-sections describe hydrogeology on regional and site scales.

1.1 Regional Hydrogeology

The property is located within the Michigan Basin, a regional-scale sequence of unconsolidated deposits and sedimentary rocks that underlie the Lower Peninsula of Michigan and beyond. The geology of the Michigan Basin informs the regional understanding of the hydrogeology. The regional geologic units are generally divided into the following three hydrostratigraphic units, or units of rock or soil with a reasonably distinct hydrologic system (reference (1)):

- Unconsolidated deposits;

- Bedrock aquifer (Marshall Sandstone); and
- Bedrock confining unit (Coldwater Shale).

Most water supply wells in Oakland County are completed in unconfined, unconsolidated deposits, and the groundwater flow direction is likely influenced by surface water features and topographic relief. Higher water levels were recorded along the northern edge of an outwash plain, which corresponds to the highest topographic elevations in Oakland County and creates a groundwater-flow divide running southwest to northeast east of the property (reference (2)). Groundwater flow north of this divide is expected to be to the northwest and groundwater flow south of this divide is expected to be to the southeast.

Except for the northwestern portion of Oakland County, the primary bedrock surface in the county is the Coldwater Shale, a regional confining unit that ranges in thickness from 500 feet in western Michigan to more than 1,300 feet in eastern Michigan (reference (3)). This confining unit forms the base of the Michigan regional aquifer system and covers the majority of Michigan's lower peninsula (reference (3)).

Throughout the central portion of the Lower Peninsula, Marshall Sandstone overlays the Coldwater Shale, and in northwestern Oakland County, the Marshall Sandstone is the bedrock surface (reference (3)). In Oakland County, the Marshall aquifer produces adequate water supplies for northwestern communities, including Holly, Groveland, Brandon, and Rose Townships (reference (4)), but wells completed in the unconsolidated deposits are still the main source of water (references (2); (4)).

1.2 Site Hydrogeology

Information used to characterize site hydrogeology includes boring logs, water level measurements from groundwater monitoring wells, and sieve analyses. Twenty-five monitoring wells (i.e., Well #1 through Well #25) were installed across the property with the bottom of the screened intervals at elevations ranging from 965 feet to 1012 feet, with an average elevation of 996 feet. Monitoring wells are screened within the unconsolidated deposits, which include layers of well to poorly sorted, fine- to coarse-grained sands with varying amounts of clays and silts, frequent gravel, and occasional boulders. The sandy layers range in thickness from 30 feet to 80 feet. Discontinuous clay, sandy clay, silty clay, and silt lenses are commonly found within the sand and gravel layers. Unconsolidated deposits in Oakland County range from 20 feet to 350 feet thick (reference (4)); however, the total thickness of the unconsolidated deposits at the site has not been characterized (i.e., borings have not been drilled to the top of the bedrock).

A groundwater contour map developed using groundwater elevations calculated from static water level measurements collected April 2023 is shown on Figure 3. Groundwater flow is toward the west to northwest and influenced by local topography, surface water features, and heterogeneity in local lithology, consistent with regional groundwater flow in Oakland County. A 9.15-acre, man-made lake is present in the west central portion of the property. The surface elevation is approximately 1010 feet, consistent with groundwater elevations in shallow monitoring wells in the area, indicating the lake is at least partially groundwater-fed and its surface likely reflects the water table in this area.

Hydraulic conductivity was estimated using sieve analysis results from site samples and the spreadsheet tool HydrogeoSieveXL. The geometric mean hydraulic conductivity from 36 samples is approximately 70.5 feet per day. This value is a representative hydraulic conductivity estimate for the unconsolidated deposits at the mine.

2 Proposed Hydrogeologic Conditions

Barr conducted a hydrogeologic evaluation based on proposed mining operations and updated groundwater supply well information provided by Levy in May 2025. Four potential factors impacting groundwater elevations were evaluated: 1) excavation of the unconsolidated deposits from below the water table, 2) evaporation from the proposed lake, 3) the post-excavation steady-state water table, and 4) groundwater withdrawal for aggregate processing.

2.1 Excavation of Unconsolidated Deposits from Below the Water Table

When solid material is removed from below the water table in the excavation, there will be a temporary water level decline before water flows into the excavation and fills the space previously occupied by the material excavated. A decline of approximately 3 inches at the boundary of the waterbody was conservatively estimated by assuming instantaneous removal of one week's worth of excavated material. This decline represents a conservative estimate. In reality, the assumed weekly excavation volume is unlikely to be realized due to production downtime and actual production rates less than the maximum possible rate. In addition, mining is not instantaneous, and water would fill the excavated space continuously as mining progresses throughout the week. Therefore, the decline in groundwater elevations from excavation of unconsolidated deposits is expected to have a negligible impact on surrounding wetlands, water bodies, and groundwater.

2.2 Evaporation from the Proposed Lake

Evaporation from an open water surface at the location of the mine for the growing season of May to October is estimated to be 25 inches based on the National Weather Service (reference (5)). For the growing season of 184 days, the evaporation rate is 0.135 inches per day. For conservative evaluation, the groundwater elevation decline was estimated for instantaneous removal of a week of evaporation at a rate of 0.135 inches per day, or 0.951 inches per week. That is, the hypothetical instantaneous decline due to evaporation is estimated to be 0.951 inches. This decline represents a conservative estimate. In reality, a week's worth of evaporation would not occur instantaneously, evaporation would likely be offset by precipitation, and groundwater would continuously refill the excavation as evaporation is occurring. Therefore, the decline in groundwater elevations from evaporation is expected to have a negligible impact on surrounding wetlands, water bodies, and groundwater.

2.3 Post-excavation Steady-state Water Table

Groundwater tables generally slope from the highest elevations located in recharge areas to the lowest elevations located in discharge areas. For a waterbody that is not perched above the water table, the water table is flat across the waterbody. If a waterbody is constructed in an area with a sloped water table, the elevation of the water across the waterbody will theoretically be equal to the average elevation of the groundwater elevation in the area prior to the waterbody being formed (i.e., the average of the groundwater elevation at the upgradient boundary of the waterbody and the groundwater elevation at the downgradient boundary of the waterbody). This will generally lower the groundwater elevation on the upgradient side of the waterbody and raise the groundwater elevation on the downgradient side.

To estimate the average water table in the area of the proposed lake, Barr reviewed groundwater elevation data provided by Levy from four monitoring events (August and November, 2022 and February and April, 2023). The average of the pre-mining water table (i.e., the predicted lake water elevation after construction) was calculated to be 1015.9 feet. This estimates a maximum increase in the water table of 2.72 feet downgradient of the lake and maximum decrease in water table of 1.06 feet upgradient of the

lake. The existing 9.15-acre, man-made lake and wetlands are not upgradient of the proposed lake where reductions in the water table are likely to occur and therefore are not expected to have a reduction in hydrology due to mining below the water table.

2.4 Groundwater withdrawal and drawdown

The proposed mine plan includes construction of a water supply well in the northeast portion of the property near Ormond Road to provide water for a wash plant, dust control, and firefighting by Springfield Township. Construction details for the well are not known at this time; however, it is assumed the well will be screened in the deep, unconsolidated aquifer.

The processing plant will feature a closed-loop water recycling system, ensuring the absence of wastewater discharge into the environment. The plant has a water containment capacity of approximately 135,000 gallons, which will be filled once (annually) at each start-up. This once-annual groundwater withdrawal is not expected to have a significant impact on groundwater resources due to the temporary nature of the withdrawal.

During operation, the processing plant will require approximately 30 gallons per minute of make-up water to compensate for water lost through evaporation and entrainment within the aggregate products from approximately from April 1 to November 30, 12 hours per day, six days per week. A desktop evaluation of the potential impacts to groundwater resources from this withdrawal was completed. The withdrawal is not expected to adversely impact groundwater or surface water resources for the following reasons:

- The well will be located on the eastern portion of the property, more than 2,000 feet from the groundwater-fed man-made lake and wetlands on the western portion of the property. The horizontal separation of the water supply well and the man-made lake and wetlands west of the mining area is expected to limit any reductions in groundwater discharge to these surface water features.

- Based on review of publicly available well logs (reference (6)), wells in this area are typically screened in unconsolidated deposits over 100 feet deep. Many are over 200 feet deep. A thick (approximately 50- to 150 feet-thick) clay/sandy clay layer is observed above the deep interval where groundwater is extracted from these wells. The water supply well to be installed is likely to be deep and may have low-permeability clay layers between the pumped interval and shallower groundwater. The vertical separation of and the likely presence of low-permeability clay layers between the likely interval to be pumped by Levy and shallower groundwater is expected to limit any reductions in groundwater discharge to the man-made lake and wetlands west of the mining area.

- A screening-level estimate of drawdown of 3 feet at the water supply well was calculated using the Theis equation, an analytical solution for confined aquifers. The estimated drawdown at the nearest wells neighboring Levy's property was 1.25 feet. Based on review of the publicly available well logs, drawdown on the order of 1.25 feet is not expected to affect neighboring wells.

- Levy has an existing groundwater monitoring well network that can be used to collect site-specific data after the water supply well is installed and pumped. Site-specific estimates of drawdown can be updated based on this information, and the monitoring well network can be used to implement

contingency measures (e.g., decreased pumping rates) if adverse impacts to groundwater resources are anticipated based on the site-specific data.

Additional water will be needed for dust control at the mine and for Springfield Township firefighting. These water supply needs will be intermittent and dependent on site-specific conditions. Groundwater withdrawal for dust control and firefighting is not expected to have a significant impact on groundwater or surface water resources due to the intermittent nature of the withdrawals and can be evaluated in the future with site-specific data collection at the time of pumping.

3 Summary

Groundwater elevation changes due to excavation of unconsolidated deposits from below the water table, evaporation from the proposed lake, the post-expansion steady-state water table, and groundwater withdrawals from an onsite well were evaluated. The potential changes to groundwater levels are not expected to result in changes to hydrology of wetlands or other water bodies or adverse impacts to neighboring wells based on the available information. Site-specific information on lithology, pumping well construction, and aquifer properties would be needed to more accurately estimate drawdown from the water supply well. Levy has an existing groundwater monitoring well network that can be used to collect site-specific data after the water supply well is installed and pumped. Site-specific estimates of drawdown can be updated based on this information, and the monitoring well network can be used to implement contingency measures (e.g., decreased pumping rates) if adverse impacts to groundwater resources are anticipated based on the site-specific data.

4 References

1. **Seaber, Paul R.** Hydrostratigraphic units. [book auth.] William Back, Joseph S. Rosenshein and Paul R. Seaber. *Hydrogeology: The Geology of North America.* s.l. : Geological Society of of America, Inc., 1988, Vol. 2.

2. **U.S. Geological Survey.** Ground-Water Quality Atlas of Oakland County, Michigan. August 2000. Water-Resources Investigation Report 00-4120.

3. —. Hydrogeologic Framework of the Michigan Basin Regional Aquifer System. 1998. Professional Paper 1418. ISBN 0-607-88068-6.

4. **Apple, Beth A. and Reeves, Howard W.** Summary of Hydrogeologic Conditions by County for the State of Michigan. 2007. p. 78. U.S. Geological Survey Open-File Report 2007-1236.

5. **Farnsworth, R K, Peck, E L and Thompson, E S.** Evaporation Atlas for the Contiguous 48 United States, NOAA Technical Report NWS 33. s.l. : U.S. Dept. of Commerce, Washington, D.C., 1982. p. 26.

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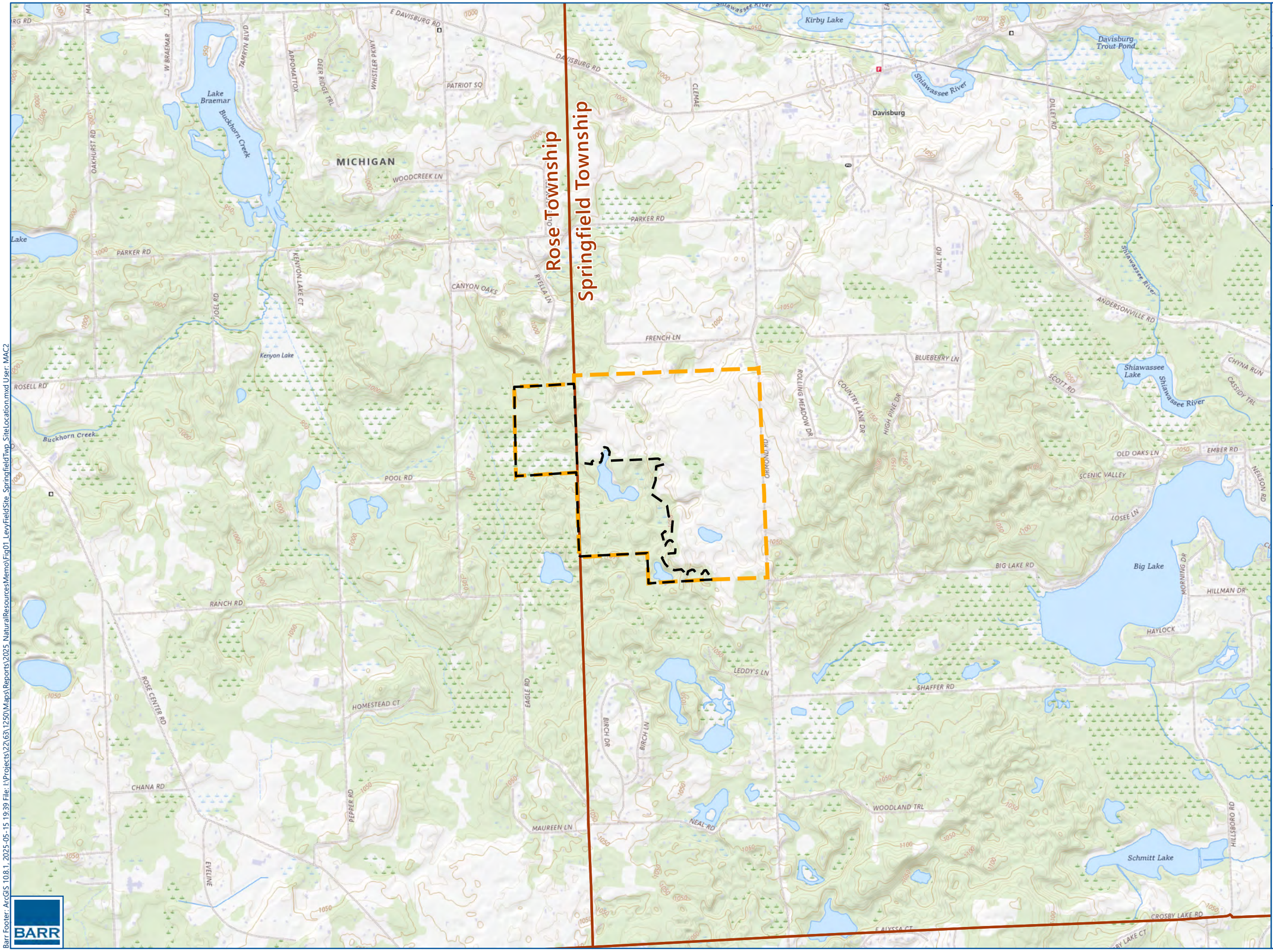

Property Boundary

Township Boundary

Estimated Protection Overlay District Area within Property Boundary

Notes:

- Property boundary shown on this figure based on data from the Oakland County Property Gateway and should be considered approximate. Available online at: *https://gis.oakgov.com/PropertyGateway/Home.mvc*

0 2,000 4,000

Feet

Background: USGS National Map

SITE LOCATION
LEVY FIELD SITE
Springfield Township, Michigan

FIGURE 1

BARR

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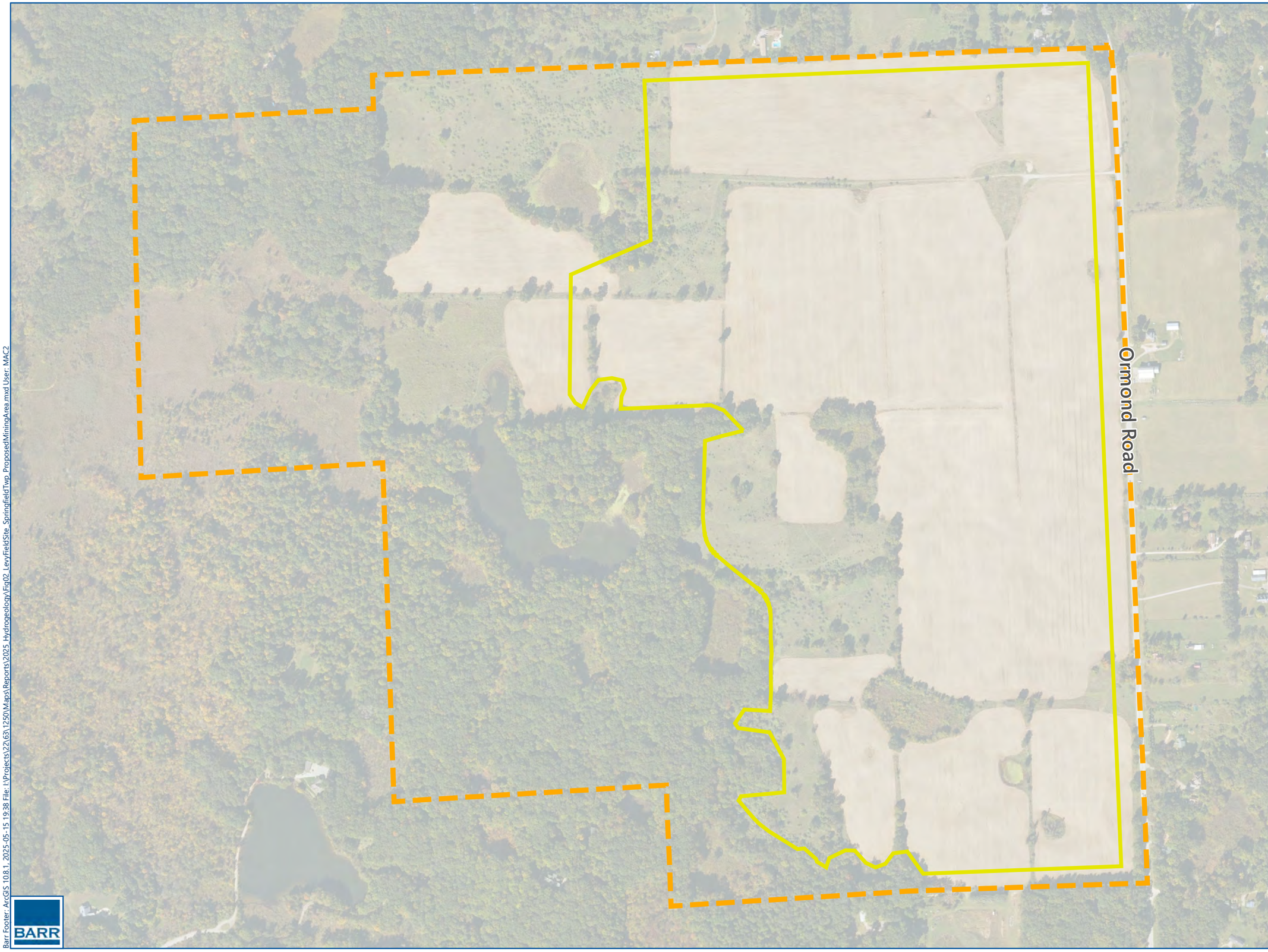

Property Boundary

Approximate Mining Boundary

Notes:

- Property boundary shown on this figure based on data from the Oakland County Property Gateway and should be considered approximate. Available online at: *https://gis.oakgov.com/PropertyGateway/Home.mvc*

0 500 1,000

Feet

Aerial Image: USDA NAIP 2024

PROPOSED MINING AREA
LEVY FIELD SITE
Springfield Township, Michigan

FIGURE 2

BARR

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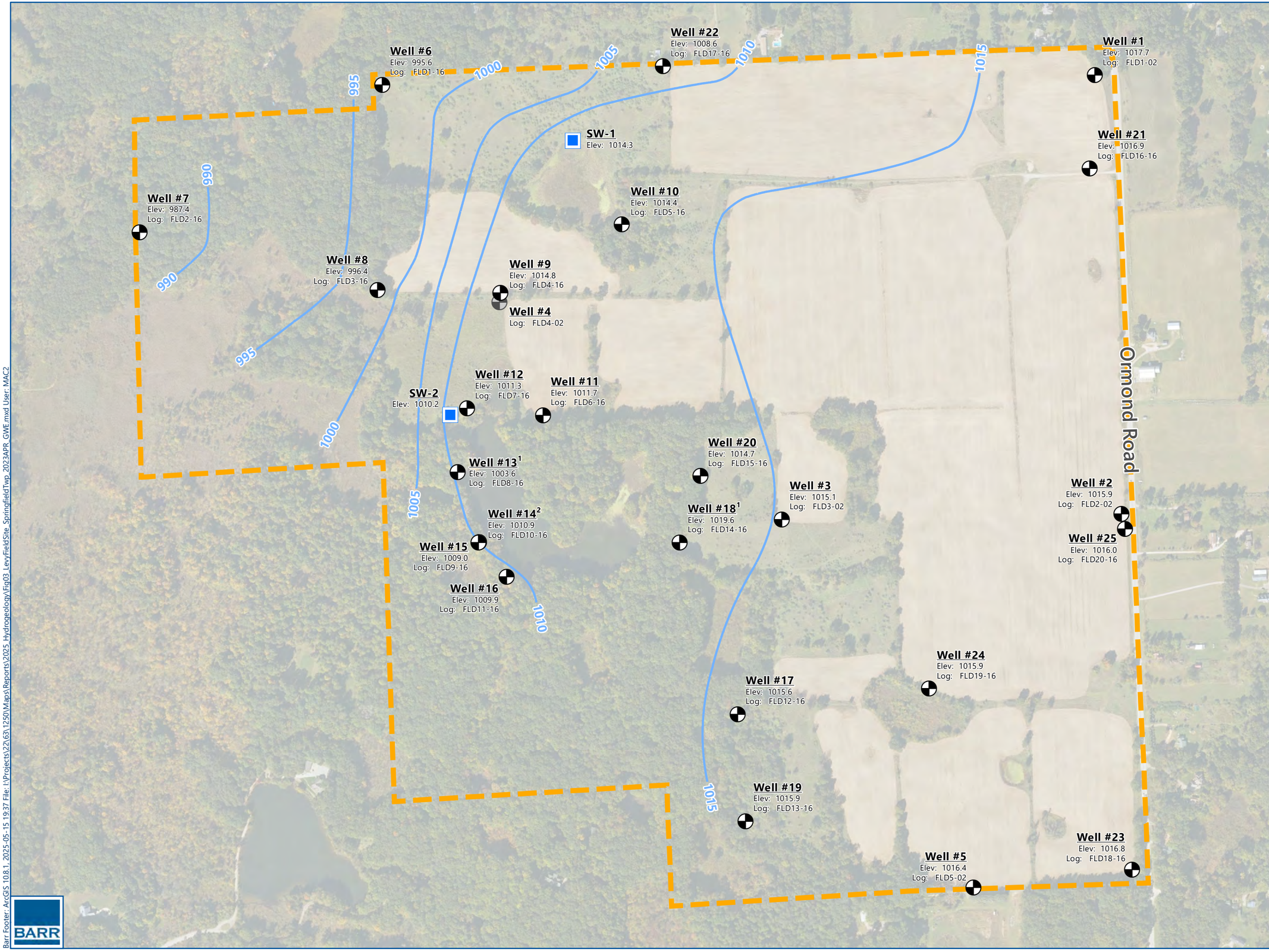

Property Boundary

Groundwater Contour (Feet)

Surface Water Measurement

Monitoring Well

Abandoned Well

Well #1	Well ID
Elev: 1017.7	Groundwater Elevation
Log: FLD1-02	Well Log

Notes:

- Property boundary shown on this figure based on data from the Oakland County Property Gateway and should be considered approximate. Available online at: *https://gis.oakgov.com/PropertyGateway/Home.mvc*
- Water levels measured on 4/11/2023.
- [1]Not used for contouring due to perched groundwater or anomalous elevation.
- [2]Not used for contouring due to anomalous elevation.

0 500 1,000

Feet

Aerial Image: USDA NAIP 2024

GROUNDWATER ELEVATIONS APRIL 2023 LEVY FIELD SITE

Springfield Township, Michigan

FIGURE 3

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