



**Hydrogeologic Assessment
Chester Greenfield Site
Chester, Chester County, South Carolina
S&ME Project No. 4261-19-029**

PREPARED FOR:

**Luck Companies
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September 19, 2019



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Attention: Mr. Bruce Smith via email: brucesmith@luckcompanies.com


Reference: **Hydrogeologic Assessment
Chester Greenfield Site**
Chester, Chester County South Carolina
S&ME Project No. 4261-19-029

Dear Mr. Smith:

S&ME, Inc. has completed a Hydrogeologic Assessment for the referenced property (i.e. the subject property). The attached report presents the findings of the Hydrogeologic Assessment, which was performed in general accordance with S&ME Proposal No. 43-1900069 Rev 1, dated January 29, 2019.

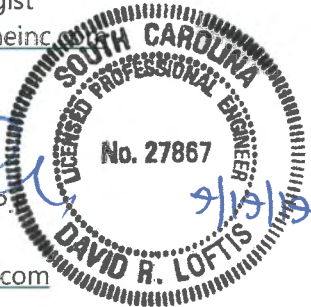
S&ME appreciates the opportunity to provide this Hydrogeologic Assessment for this project. Please contact us at your convenience if there are questions regarding the information contained in this report.

Sincerely,
S&ME, Inc.


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1.0 INTRODUCTION

S&ME, Inc. (S&ME) conducted a Hydrogeologic Assessment of the subject property located north of S.C. Highway 9 (Lancaster Highway) near Chester in Chester County, South Carolina. A site vicinity is shown on **Figure 1, Appendix I**. The Hydrogeologic Assessment was conducted in general accordance with S&ME, Inc. Proposal No. 42-1900069 Rev 1, dated January 29, 2019.

1.1 Purpose

S&ME understands that Luck is considering the purchase of the subject property for the purpose of developing the property as a construction aggregate mine. The mining operations will use dry mining techniques; therefore, the proposed mining area will need to be dewatered via groundwater extraction points/sumps. The purpose of the hydrogeologic assessment requested by Luck was to provide information on groundwater flow into the pit area during dewatering, and understand potential impacts within the dewatering cone of influence, on neighboring wells, bodies of water, streams, and nearby wetlands. An additional purpose was to estimate the potential impacts of make-up water supply wells Luck may use during quarry operation.

1.2 Methodology

This hydrogeology assessment relied on a process that began with the development of a preliminary site conceptual model. The preliminary model was based on known or expected main features of geology, hydrogeology, mine pit location and development, and site-specific relationships between geologic structures and groundwater flow. The preliminary site conceptual model was utilized to develop field data collection needs for this assessment. The collected data included geologic, geophysical, and hydrogeologic information. Site specific data was then collected to further characterize the hydrogeologic system and the resultant data analyzed to refine the site conceptual model. A computer aided mathematical model was then employed to provide predictive simulations of effects of future mine dewatering scenarios.

2.0 Site Setting

The subject site is located near the town of Chester, Chester County, South Carolina. The approximate 287-acre site is located north of S.C. Highway 9, a four-lane divided highway, and bound to the north by railroad tracks. The tax parcels comprising the site include 089-00-00-025-000 (74 acres), 089-00-00-002-000 (202 acres), and 089-00-00-001-000 (11 acres). The site consists of forestland, pastureland, two residential structures, and associated farming structures (barns, outbuildings, and sheds). Properties surrounding the subject site consist of forestland, single-family residences, a railroad, Orr's Baptist Church, Chester Wood Products, and a former landfill that was part of Chester Wood Products.

The subject site is identified on the United States Geological Survey (USGS) 7.5-minute series Topographic Maps titled Chester, South Carolina Quadrangle dated 1969. The original map has a scale of one inch equals 2,000 feet. A USGS Topographic Map of the site vicinity is included as **Figure 2, Appendix I**.

The subject site includes forestland and cleared land with three structures evident on the southern portion of the site, just north of Lancaster Highway. The subject site is generally undulating with a slope towards the onsite



Rocky Creek and tributaries located on the central and eastern portions of the site. Surface elevations on the subject site range from approximately 480-580 feet above Mean Sea Level.

2.1 Planned Quarry Operations

The planned mining operations will take place in the central portion of the subject property with the land west and south of the pit used for overburden storage. The primary infrastructure (i.e., settling ponds, clean water pond, pumps, etc.) for the facility will be north of the proposed mine pit and may (at a later date) include a spur line to facilitate the transporting of mined aggregate via the adjacent rail line bordering the subject property to the north. The entrance to the mine facility will be off Lancaster Highway and will extend northward along the eastern property boundary to the primary infrastructure area north of the proposed mine pit.

The planned mining operations will begin with the excavation and removal of overburden and rock from the Phase I pit (45 acres) located east and adjacent to Rocky Creek. The Phase I pit will be mined to an approximate depth of 300 feet below grade, which, for the purpose of this evaluation, is assumed to occur 37 years after mining operations begin. At that point, the pit will begin to be expanded to form the Phase II pit (82 acres), at which time the entire pit area will be excavated to an approximate depth of 400 to 450 feet below grade. The life of the aggregate mine is estimated to be 55 to 60 years.

Please reference **Figure 3, Appendix I** regarding the planned operations.

2.2 Geology and Lineament Mapping

2.2.1 Geology

According to the *Geology of the Carolinas*, (Horton, Jr. J. Wright and Zulu A. Victor, University of Tennessee Press, 1991), the Property lies in the Piedmont Physiographic Province. The Piedmont is characterized by rolling relief drained by numerous creeks. Generally, soils in the Piedmont formed by the weathering of the underlying rock. Parent material is felsic/mafic residuum weathered from metamorphic and igneous rocks. In general vicinity of the subject site, the soils are gently sloping or sloping sandy loams or loamy sands with red, brown, or yellow subsoil.

Figure 4, Appendix I represents a portion of the *Geologic Map of Chester County South Carolina* (1988) with mapped local geologic units in the vicinity of the subject site shown. According to this map and accompanying text, the subject site and vicinity are likely underlain by one or more of the following rock types:

- Mafic to intermediate plutonic complexes, of Upper Proterozoic to Cambrian Age. This unit is described as "mainly amphibolite and hornblende gneiss with metagabbro, metadiorite and related mafic rocks derived from a wider range of plutonic mafic to intermediate precursors"
- Felsic to intermediate plutonic complexes of Upper Proterozoic to Cambrian Age. This unit is described as "dominantly metamorphosed granite, granodiorite, and tonalite, with lesser amounts of biotite and hornblende gneiss and various mafic rocks."
- Lowrys Granitic Pluton, a granitic intrusion composed of two mapped phases; the unmetamorphosed and undeformed, relative uniform biotite granite phase and the porphyritic phase with feldspar phenocrysts.
- Probable Jurassic age Diabase dikes have been mapped in the area. The dikes generally trending N 40 degrees W to N 5 degrees east.



A review of core drilling data provided by Luck indicated that the site is underlain by bedrock primarily described as metadiorite, with lesser zones of metagabbro, felsic pegmatite, and diabase; consistent with geologic units previously mapped for this area. High angle vertical fractures were encountered at some core locations and depth intervals. Significant quantities of groundwater were not noted, although rock coring focused primarily on the proposed open pit mine site area.

The thickness of the soil/saprolite overburden is highly variable throughout the subject site ranging from a depth of 5 feet to 97 feet below grade (BG). The soil saprolite overburden thickness in the planned mine pit area ranges from 10 feet to 40 feet.

2.2.2 *Lineament Study*

Fractures are often the primary sources of permeability in crystalline bedrock aquifers. When these features cannot be observed directly, they can often be inferred by examining topographic maps, aerial and satellite images. As an ancillary tool for predicting the location of possible geologic structures in the study area, a lineament (or fracture trace) study was prepared. The lineament study entailed a qualitative and subjective visual analysis of the topographic map features in the study area and surrounding vicinity, searching for apparent linear features (i.e. lineaments) embedded in the map data. For example, straight stream segments or draws arranged in somewhat parallel patterns or aligned at roughly 90-degree angles to main streams may indicate that the drainage features would be controlled by high-angle fractures. Other non-man-made linear features may also provide indications of the structural fabric and compositional variations in the underlying bedrock.

As depicted in **Figure 5, Appendix I**, the recognized lineaments are generally oriented north 5-10 degrees east and north 25-30 degrees west. The lineaments identified may be indicative of geologic structures or zones of contrasting strength due to differences in the composition of adjoining rock types. Lineaments and lineament intersections can represent possible targets for water well drilling, and/or identify areas warranting further examination during hydrogeologic studies. Considering the map scale used for this lineament study, fractures inferred by this method may or may not directly underlie the lines shown. Because a lineament study is a qualitative analysis, the actual presence and dip of features cannot be determined without additional investigations.

2.3 Hydrogeology

The hydrogeology of the Piedmont is typically characterized by surficial soils underlain by a weather rock zone referred to as saprolite, which can range from a few feet to tens of feet thick. The saprolite transitions into bedrock with increased depth. In places the lowermost portion of saprolite transition zone, just above bedrock, can be more permeable. Groundwater within the Piedmont generally moves from topographically high areas (recharge zones) to topographically low areas within and along stream valleys (discharge areas). Rocky Creek and its unnamed tributaries that bisect portions of the site, are the expected discharge zones for the shallow saprolite aquifer beneath the site.

The site conceptual model presented below provides further discussion of local hydrogeology.

2.4 Site Conceptual Model

The generally accepted model for the Piedmont aquifers is a two layered system, built on the premise of an unconsolidated layer of soil and saprolite containing an unconfined aquifer that has a relatively high storage

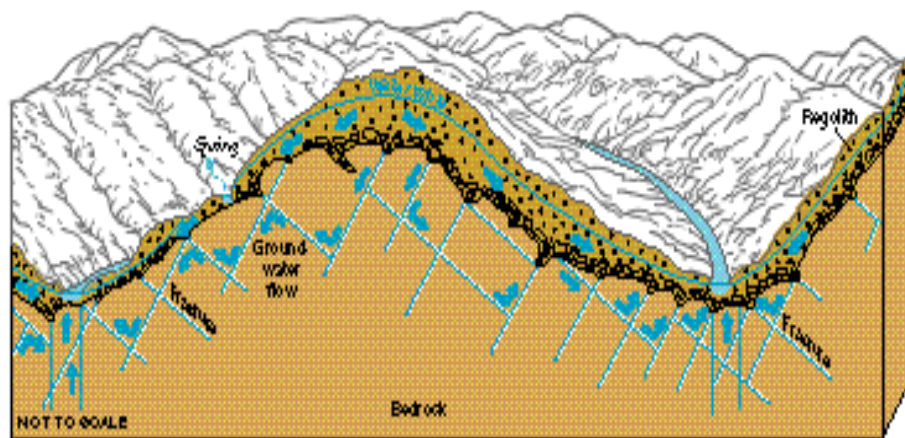
capacity supplying water to an underlying variably fractured crystalline bedrock aquifer that has low overall porosity and storage (Heath 1989). The low overall porosity and storage are due to the dense, somewhat impermeable bedrock that yields water primarily from secondary porosity and permeability provided by fractures, faults, joints, and foliations. The saprolite aquifer and bedrock fractures zone are common targets for residential, industrial, and irrigation water wells. It is important to emphasize that crystalline bedrock aquifers are irregular and heterogeneous in distribution, often highly localized, and exhibit discontinuous water bearing zones.

Although far more complex, the local aquifer system can be conceptually simplified and viewed as a two-layered system consisting of a shallow, unconsolidated, unconfined, porous regolith water aquifer that can supply water to surface water features and to the second layer, the underlying fractured bedrock aquifer.

Aquifer recharge in the Piedmont region is provided by precipitation which occurs in the form of rainfall and snow melt. Depending on factors such as ground saturation, ground cover, and slope, a portion of the precipitation forms runoff. This runoff flows to areas of lower elevation where some of the runoff water infiltrates in the unconsolidated material (i.e. soil) and some flows into local surface waters. The precipitation that does not form runoff infiltrates through the unsaturated zone where it can merge with underlying aquifers.

Most of the recharge in this region takes place in inter-stream areas. In general, recharge from precipitation enters the aquifer system through the saprolite zone. It is believed that much of the recharge water moves laterally through the saprolite zone and discharges to nearby streams. Under some conditions shallow groundwater can discharge at the ground surface down slope as seeps or permanent springs above these surface water bodies. Some of these seeps may occur on a seasonal basis or as short-term temporal responses to precipitation. This unconfined saprolite aquifer is generally expected to act as a storage reservoir for the underlying fractured bedrock aquifer.

Figure 2-1 Simplified Illustration of Groundwater Movement



Heath 1980

Some of the water moves vertically downward through the saprolite until it reaches bedrock where it enters fractures in the crystalline rock. Groundwater within the consolidated fractured bedrock aquifer flows in accordance with hydraulic (i.e. pressure) gradients in the fracture network. Because of this, the groundwater does not necessarily flow in the direction of topographic gradients. Based on the site geology and Very Low Frequency



(VLF) imaged fractures, flow likely occurs along rock fabric and fracture zones. Significant fracture zones have the potential to substantially influence groundwater flow and velocities.

Published geologic data, lineament study findings, site geologic data, and the VLF survey findings were reviewed for the selection of test well and observation well locations.

3.0 Water Well Inventory

3.1 Freedom of Information Request

On February 6, 2019, S&ME requested to review available environmental regulatory files pertaining to water supply wells located within one mile of the site from the South Carolina Department of Health and Environmental Control (SCDHEC) through its Freedom of Information (FOI) office. The Freedom of Information Request Form is included in **Appendix II**.

On February 15, 2019, S&ME received two spreadsheets (Chester-1.csv and Chester-2.csv) containing information regarding registered water supply wells in Chester County, South Carolina. In an electronic mail message from Mr. Greg Withycombe, with the SCDHEC Bureau of Water Private Well Program, to our David R. Loftis, P.E., Mr. Withycombe indicated that the older of the two database files (Chester-1.csv) contains wells supposedly installed from 1985 to 2006. SCDHEC did not start permitting wells until 2000. Because of this, older non-permitted wells installed between 1985 and 1999 were given a log number only. Wells noted in the old database that were installed from 2000 to 2006 were permitted and given both a log number and a permit number.

The newer database (Chester-2.csv) has been in use since 2006. When data was being migrated from the old database to the new, the wells with permit numbers (those installed from 2000 to 2006) were included in this new database. This makes for some duplication in the database of wells permitted between 2000 to 2006. Mr. Withycombe also noted that wells included in the database are only the wells that were reported and should not be considered a complete inventory of all wells in Chester County.

Email correspondence between Mr. Loftis and Mr. Withycombe is included in **Appendix II**. Due the volume of information provided by SCDHEC via S&ME's FOI request, the data was not included in this report but can be submitted electronically upon request by S&ME.

A review of database information showed that there are 76 wells present in the database that are within a one-mile radius of the site. The majority of these wells are residential water supply wells and are located to the north and west of the site in a residential area that spans from the railroad tracks just north of the site northward to Saluda Road (Route 72). These wells ranged in depth from 85 to 850 feet BG, with most of the wells being 300 feet BG or less. Wells seem to be located at each residence and are generally 150 to 200 feet apart.

One private irrigation well is present approximately 0.75 miles east of the site on Highway 9 and is operated by PPG Industries. No information regarding the depth or date of installation of this well was contained in the SCDHEC database. An additional private irrigation well is present at least 0.5 miles southeast of the site and is owned and operated by Chester Golf Club. This well is 8-inch diameter, 850-feet BG, and was installed in 1999.



3.2 Local Water Supply Well Registration Data

On June 11, 2019, Mr. Loftis contacted Chester County and spoke to Ms. Katie Jordan, Permit/Zoning Specialists with the Building and Zoning department via telephone regarding the availability of water supply well registration records for Chester County. According to Ms. Jordan, well permits and registrations are not handled at the local level and are done by SCDHEC. Based on the information from Ms. Jordan, Chester County does not have water supply well registration information.

3.3 Site Reconnaissance and Public Meeting

During a site reconnaissance on February 13, 2019 by our Ed Henriques, no evidence of municipal water lines such as fire hydrants were observed on roads north of the railroad track that adjoins the proposed mine site. Fire hydrants were observed along the following roads and are suspected to indicate the presence of a municipal water line:

- Along McCandles Road from the railroad to Lancaster Street
- Along Lancaster Street from the intersection of Old Richburg Road and to the east beyond the limits of the 1-mile area of concern
- Along Meador Road from Lancaster Street south beyond the limits of the 1-mile area of concern.

An unnamed pond is located on the property directly east of the site on SC Highway 9, approximately 250 feet from the southeastern corner of the Luck property. This pond is approximately 11 acres in surface area. An unnamed pond is located on the PPG Industries property, approximately 0.5 miles east of the northeast corner of the Luck property. This pond is approximately 2 acres in surface area.

On May 8, 2019, S&ME participated in a Chester community meeting to provide information regarding the proposed mine project. During the meeting, S&ME was notified by property owner that a 50-foot deep, drilled well located at 1051 Craighbrow Circle – approximately 1,900 feet north-northeast. S&ME was further notified during a meeting by a property owner that a spring used for drinking water supply is located at 1417 Meador Road – approximately 4,500 feet northeast of the subject property.

3.4 Municipal Water Accounts

On June 21, 2019, Mr. Andy Litten, P.E., District Engineer with Chester County Metropolitan District (CMD), provided Luck with a list of properties in the area of the proposed mine that are currently connected to municipal water system. The list is provided below and the email correspondence is included in **Appendix II**:

- Parcel #089-00-00-037-000: 1039 Lancaster Hwy
- Parcel #089-00-00-033-000: 1147 Lancaster Hwy
- Parcel #089-00-00-005-000: 1207 Lancaster Hwy
- Parcel #089-00-00-021-000: 1266 Lancaster Hwy
- Parcel #098-00-00-001-000: 1444 Lancaster Hwy
- Parcel #098-00-00-046-000: 1445 Lancaster Hwy
- Parcel #098-00-00-076-000: 1497 Lancaster Hwy
- Parcel #098-00-00-105-000: 1577 Lancaster Hwy
- Parcel #098-00-00-125-000: 1588 Lancaster Hwy



- Parcel #098-00-00-171-000: 1856 Beltline Road
- Parcel #098-00-00-005-000: 750 Old Richburg Road
- Parcel #098-00-00-004-000: 756 Old Richburg Road
- Parcel #098-00-00-006-000: 770 Old Richburg Road
- Parcel #098-00-00-128-000: 869 Old Richburg Road
- All lots on Putter Place, Wedgeway Drive, Sand Iron Circle, and Birdie Haven Drive

3.5 Data Summary

The findings of our receptor survey, including the parcels with water supply wells within a 1-mile radius of the site and parcels with active water accounts with the CMD water system, are summarized on **Figure 6, Appendix I**. It should be noted that the well information discussed in Section 3.1 was mapped using addresses provided by the databases and their georeferenced locations provided by Google Earth®. As such, the well symbols are shown on the parcels of interest to indicate that a well is present on the parcel, but do not indicate the location of the wells.

4.0 Field Methods

4.1 Geophysical Survey

The site conceptual model assumed that bedrock fractures would provide primary control over groundwater movement in the bedrock aquifer. Characterization of fractured bedrock aquifers can be aided by the utilization of certain non-invasive geophysical survey tools. For this project a VLF survey was employed for imaging steeply dipping fractures in the immediate vicinity of the proposed mine site.

S&ME subcontract THG Geophysics for the collection of VLF profile data across select portions of the site. The VLF survey utilizes very low frequency military radio signals to measure electrical properties of near surface soil and shallow bedrock. Electrically conductive features include fault zones and fractures, which tend to be more conductive than the surrounding bedrock. VLF is used to collect conductivity data, which is analyzed for contrasting electrical conductivities among underlying geologic units. The results of the analysis allow identification of more conductive zones (e.g. suspect fracture zones) in the underlying bedrock. The data is collected by walking a series of lines (e.g. profiles) with a backpack VLF receiver and stopping to collect data at points roughly every 10 meters along each line. The location of each data point along the profile is determined and recorded using a non-survey grade GPS. The VLF method is sensitive to cultural interference from items such as pipelines, utilities, fences, and other conductive objects. If observed, cultural features were noted at the time of data collection.

On February 13, 2019, THG Geophysics collected data along five profiles covering approximately 9,200 feet, as depicted in **Figure 7, Appendix I**. The profile locations and orientations were selected based on regional and local geologic information, as well as inferences made from the lineament study.

Following field data collection, the VLF data was post-processed. **Appendix III** contains the THG Geophysics report which includes figures illustrating the VLF profiles and the points along each profile where fractures were imaged. The post-processed VLF data was presented in both plan and cross-sectional view to illustrate the interpreted dip of the imaged fractures. The VLF data was examined and utilized to make interpretations of the subsurface fracture patterns within the study area. The red lines depicted on **Figure 7, Appendix I** illustrate the



interpreted location and orientation of the imaged fractures, with arrows depicting the dip of these features. Although the lines shown are straight and continuous, actual fracture patterns are not always linear and/or as laterally continuous as shown.

4.2 Well Installations

Site-specific field data collection needs were influenced by the conceptual site model. Well drilling locations were selected based on the VLF geophysical survey findings, with the goals of installing wells that intersect dominant fractures and development of an observation well network to be used during pump tests for monitoring aquifer responses and estimating aquifer parameters. In selecting drilling locations, consideration was given to anticipated mining infrastructure placement and the to the option of using one or more of the drilled wells as production wells for mining operations.

The well network provided for a primary pumping well and three observation wells. Well drilling targeted installation of a pumping well in a primary fracture zone and installation of a second well (observation well) intersecting the same apparent fracture zone, but at some distance from the pumping well. Two additional observation wells would be installed to examine the influences of pumping in the aquifer system away from the fracture zone intersected by the pumping well. Given the dipping orientation of the fractures, this arrangement allowed for the possibility of a single fracture being intersected by two wells located along a line perpendicular to the trace of the fracture. This approach would provide an opportunity to measure hydraulic conductivity along the same fracture, the degree of hydraulic connection between parallel fractures, and test the conceptual site model

On behalf of Luck, S&ME obtained a well installation permit (Permit) from the SCDHEC Mining and Reclamation Program, a copy is contained in **Appendix IV**. S&ME notified SCDHEC of the schedule for these field activities, as required by the Permit.

Faulkner Well Drilling (Faulkner), a South Carolina Licensed Well Driller, installed four 6-inch diameter groundwater monitoring wells, each to a depth of approximately 450 feet below ground surface. The wells are identified as RW-1, RW-2, RW-3 and RW-4. Each well was installed using 6.25-inch diameter air hammer/rotary drilling. Depth to bedrock varied from 17 feet below ground surface at well RW-2 to 42 feet below ground surface at well RW-1. Based on the drill cuttings, bedrock encountered consisted primarily of a mafic, intermediate grade metamorphic rock and a mica schist. Veins of pink and white quartz were noted at varying depths throughout the bedrock as noted on the well logs. Well locations are depicted in **Figure 8, Appendix I**. **Table 4-1** summarizes the dominant water bearing fracture zones recognized during drilling of monitoring wells.

Table 4-1 Dominant Fracture Zones Encountered

| Well ID | Depth to Dominant Water Bearing Fractures or Fracture Zones (feet below grade) | Driller Estimate of Well Yield At Time of Drilling |
|---------|--|--|
| RW-1 | 35'-40', 124'-145', 185', and 200' | 100 GPM |
| RW-2 | 45', 62', and 390' | 40 GPM |
| RW-3 | 80', 100', 200' and 380' | 25 GPM |
| RW-4 | 430'-450' | 23 GPM |



After drilling was completed, each well was constructed using 6-inch diameter galvanized steel surface casing that extended from less than 3 feet above grade to the top of bedrock. An inner well casing was not installed into bedrock; the borehole was left open. After installation of the surface casing, each well was secured with a lockable, stick-up well protector.

S&ME documented the installation and development of the groundwater extraction wells, prepared a geologist's log, and developed a well completion report for each well installed. These logs are included in **Appendix IV**. A Water Well Record (SCDHEC Form 1903) was also completed and submitted to the SCDHEC within 30 days of completion of each well. These well records are included in **Appendix IV**.

4.3 Aquifer Pump Testing

4.3.1 Variable Rate (Step) Test

On July 1, 2019, to determine the target flow rate for the constant rate aquifer pumping test, S&ME conducted a variable flow rate pump test (step test) on the pumping well (RW-2). A 4-inch diameter, 10-horsepower submersible electric pump rated at a maximum flow rate of 95 gallons per minute (gpm) was installed on a 1.5-inch diameter galvanized pipe and positioned at a depth of approximately 400 feet BG. A flow control device was installed on the discharge line to maintain a controlled flow rate. A digital flow meter capable of providing instantaneous flow rate data and flow totalizer data was installed to document flow rates and the total volume of water pumped. After the pump and discharge were configured, S&ME installed a Level Troll 500® pressure transducer/datalogger into the pumping well to collect height of water column data during the step test, from which drawdown levels were calculated.

Based on field observations during well installation, the flow rates chosen for the step test were 40, 50, 60, and 70 gpm. The pump test began with an initial flow rate of 40 gpm, which was maintained using the flow control valves. The pump was operated at 40 gpm for one hour, during which the change in drawdown in the pumping well became asymptotic. Approximately one hour after starting the test, the flow rate was increased to 50 gpm and maintained at this rate for one hour, during which the change in drawdown in the pumping well became asymptotic. After one hour of pumping at 50 gpm, the flow rate was increased to 60 gpm and maintained at this rate for approximately one hour. During this step, changes to the pumping well drawdown once again became asymptotic. After one hour of pumping at 60 gpm, the flow rate was further increased to 70 gpm. After approximately 10 minutes, drawdown increase significantly producing a total head condition that reduced the pumping rate. After approximately 20 minutes, the changes in drawdown had leveled out, however, the flow rate declined to 59 gpm due to pump capacity limitations. The test was performed for an additional 30 minutes at the reduced flow rate, prior to shutting down the pump and terminating the step test. Note that no rainfall events occurred at the site at least 48-hours prior to the step test nor during the step test.

The drawdown data collected and recorded by the transducers was analyzed following the test. Based on an analysis of the flow rate employed and drawdown data obtained, a target flow rate of 55 gallons per minute was selected for the constant rate pumping test.

A chart depicting the pressure transducer data collected at pumping well RW-2 during the step test is included in **Appendix V**.

4.3.2 Constant Rate Pumping Test

From July 2 through July 3, 2019, a constant rate pumping test was performed using well RW-2 as the pumping well and wells RW-1, RW-3, and RW-4 as observation wells. This test was configured and conducted in a similar manner to the step test, though the pumping rate would be constant at 55 gpm. The same four-inch diameter, 10-horsepower submersible electric pump installed on a 1.5-inch diameter galvanized pipe and positioned at a depth of approximately 400 feet BG was used for the constant rate pump test. The flow control device and electronic flow meter utilized during the step test were employed during the constant rate test. **Figure 8, Appendix I** depicts the well locations.



Prior to starting the pump test, S&ME installed Level Troll 500® pressure transducers in the pumping well (RW-2) and the three observation wells (RW-1, RW-3, RW-4). These transducers were set to record height of water column data during the pump test, from which drawdown levels were calculated. In addition to transducer data, manual water level readings were collected from each of the three observation wells during the test. **Table 4-2** provides a summary of the transducer types, locations deployed, and logging intervals utilized.



Table 4-2 Transducers, Device Type, and Logging Intervals

| Well ID | Device Type | Logging Interval (minutes) |
|---|-----------------|----------------------------|
| Well #2 (Pumping Well) | LevelTROLL 500® | 30 second |
| Well #2, Well #3 Well #4 (Observation Wells) | LevelTROLL 500® | 5 minutes |

Maximum drawdown observed in each of the wells is summarized in **Table 4-3** below:

Table 4-3 Summary of Maximum Drawdown

| Well ID | Maximum Drawdown During Pump Test (feet) |
|-------------------------|--|
| RW-1 (Observation Well) | 0.27 |
| RW-2 (Pumping Well) | 252.17 |
| RW-3 (Observation Well) | 0.41 |
| RW-4 (Observation Well) | 15.10 |

The pumping phase for the constant rate test was run for approximately 32 hours. The pump rate was held generally constant throughout the test at 55 gpm, with a total of 104,795 gallons pumped from the well during the test.

After the test was completed and the pump was deactivated, the transducers in each of the wells continued to record data during the aquifer recovery phase, to monitor post-pumping water levels responses at the pumping and observation wells. On July 8, 2019, the transducer logging was terminated and the transducers were removed from the wells. No rainfall events occurred a minimum 48-hours prior to the pumping phase of the test or during the constant rate pump test. Charts depicting pump test drawdown data collected are included in **Appendix V**.

Drawdown data obtained for each of the four wells utilized for the constant rate pump test was subsequently analyzed as part of the groundwater modeling task.

5.0 Pump Test Analysis and Model Construction and Calibration

The analysis of pumping tests and development of projections for the dewatering operations were performed utilizing groundwater flow simulation models. Groundwater simulations were performed using MODFLOW-2000 or MODFLOW-2005 through the graphical user interface Groundwater Vistas, version 7.22. Groundwater Vistas is a reliable and commonly used graphical user interface for MODFLOW and the MODFLOW family of groundwater modeling codes. It aids in the construction of model input files and is particularly helpful for data organization for three-dimensional models with multiple hydrogeologic zones. It also facilitates model calibration and the rapid visualization of simulation results.

In preparation for development of a regional model for the simulation of site and regional effects of the proposed mine dewatering, a three-dimensional groundwater flow model was constructed and calibrated to the site-specific aquifer pumping test data. Use of a discretized model to evaluate site-specific variables was essential where



specific fracture zones and pit configurations will be mapped. The pumping test calibration model simulated specific fractures over a domain limited to the area of the VLF profiles and pumping test well locations. The purpose of the pumping test calibration model was to derive input parameters for the regional model simulations.

Following pump test calibration, an equivalent porous media (EPM) model was developed for the purpose of simulating specific phases of the proposed mining operations, over time. The EPM model applied aquifer parameters derived from the pumping test to a larger, more regional domain that included residential wells in the vicinity of the planned mining area.

5.1 Pumping Test Calibration

5.1.1 Model Construction

Figure 9, Appendix I is a map of the pumping test model domain and grid, placed on a site map. The model has 160 rows and 140 columns. The model was rotated 5 degrees east of north (clockwise) to better align model columns with fracture traces. It is rotated so that the y-direction is parallel to the fractures in general, and specifically to the fracture intersected by the pumping well (RW-2).

The model has 24 layers. The top layer represents the surficial aquifer, consisting of partially weathered rock (PWR). Model cells are perfect 25-foot square cubes, which allows creation of fracture zones dipping at a 45-degree angle. Each fracture zone is four cells wide, with an overlap of three cells between layers. An overlap of three cells is 75 feet wide in plan view. Since the fractures dip is approximated to be 45-degrees, the effective width of the fracture zones is approximately 53 feet (75 times the cosine of 45 degrees).

5.1.2 Aquifer Storage Properties

The pumping test calibration effort yielded four unique storage coefficient zones (see **Table 5.1.2, Appendix VI**):

1. Matrix rock: $S_s = 6 \times 10^{-7} \text{ ft}^{-1}$; $S_y = 0.0001$; effective porosity = 0.01
2. Surficial aquifer (PWR): $S_s = 0.00005 \text{ ft}^{-1}$; $S_y = 0.1$; effective porosity = 0.01
3. Stream: $S_s = 0.00005 \text{ ft}^{-1}$; $S_y = 0.0001$; effective porosity = 0.01
4. Fracture zones: $S_s = 1 \times 10^{-7} \text{ ft}^{-1}$; $S_y = 0.0001$; effective porosity = 0.001

S_s is the specific storage of the aquifer, and S_y is the specific yield. The S_s used in zone 1 (matrix rock) and zone 4 (fracture zones) corresponds to published values for rock and fractured rock. Unique storage properties for individual fracture zones were explored but eliminated in the calibration process.

The calibration was particularly sensitive to S_s . Calibration yielded low S_s values in matrix rock and fracture zones, typical of published values for rock and fractured rock. The S_y value of the streams limited the amount of drawdown simulated in well RW-4.

5.1.3 Hydraulic Conductivity Zones

Six zones with unique hydraulic conductivity values in the three principal directions comprise the pumping test model:

1. Matrix rock (between fractures): $K_x = K_y = K_z = 0.002 \text{ feet/day (ft/day)}$



2. Surficial aquifer (PWR): $K_x = K_y = K_z = 0.1$ ft/day
3. Stream: $K_x = K_y = K_z = 0.1$ ft/day
4. Fracture zones: $K_x = K_y = 0.8$ ft/day; $K_z = 10$ ft/day

K_x and K_y are horizontal hydraulic conductivities (K_h), oriented normal and parallel to the fractures, respectively. K_z represents the vertical hydraulic conductivity (K_v). The highest K value in the model is K_z in the fracture zones, reflecting the strong groundwater drawdown response in RW-4. K_x and K_y in the fracture zones primarily control regional projections. A two order-of-magnitude difference between horizontal K values in fracture zones compared to matrix rock reflects the expected contrast in fractured and non-fractured rock properties. The following additional hydraulic conductivity zones were explored, but eliminated in the calibration process:

- Fracture zone extensions into the surficial aquifer
- Individual fractures
- Different stream zones

While the streams were not a major factor in the calibration, they contributed by limiting drawdown, particularly in observation well RW-4.

5.1.4 Calibration Charts

Chart 5.4.1-A, Appendix VI, shows plots of observed and modeled drawdown over time for the four test wells (RW-1, RW-2, RW-3 and RW-4) during the pumping and recovery phases of the pumping test. **Chart 5.4.1-B, Appendix VI** shows observed and modeled drawdown plots for the observation wells. While a closer fit for RW-4 was achieved during the calibration process, the final calibration shown allows good calibration of RW-3 (**Chart 5.4.1-C, Appendix VI**); therefore, representing a better balance across the model. **Chart 5.4.1-D, Appendix VI** shows observed and modeled drawdown plots on a log scale for all four test wells.

Aquifer properties of the fracture zones and the intervening matrix rock were the primary focus of the calibration effort. Contrasting K_h and K_v values were critical in the fracture zones (**Table 5.1.2, Appendix VI**), Matrix rock remained isotropic, with $K_h = K_v$. Calibration yielded similar but distinct S_s values for fracture zones and matrix rock. Compared to the rock zones, the model calibration showed lower sensitivity to the surficial aquifer, which also remained isotropic ($K_h = K_v$). Calibration revealed S_y to be the most important aspect of the surficial aquifer.

5.1.5 Fracture Adjustment

Chart 5.1.6, Appendix VI shows a cross section through RW-2, and a cross section at the depth where RW-2 intersects a neighboring fracture. Model calibration indicated that RW-2 is receiving significant water from the deeper fracture. The fracture zone is widened locally to allow sufficient flow.

6.0 Regional Model Development and Predictive Simulations

6.1 Regional Model Construction and Aquifer Parameters

Figure 10, Appendix I shows the regional model domain and grid. The regional model domain covers an area 35,000 feet wide in the east-west direction and 30,000 feet wide in the north-south direction. The model grid is



rotated 5 degrees clockwise from north to align it with the fracture orientation and thus with the principal direction of hydraulic conductivity.

A 200-foot x 200-foot grid was used over a roughly 18,000-foot x 18,000-ft area that encompasses the project site and all mapped receptor wells. The grid expands gradually to a 1000-foot x 1000-foot spacing toward the edges of the model.

The model has two layers. Layer 1 is 25 feet thick and represents the saturated portion of the PWR zone. Rocky Creek was represented (with conservative assumptions about its leakage) in Layer 1. Layer 2 is 575 feet thick and represents the fractured rock zone. The most relevant Layer 1 properties are $K_x = K_y = 0.1$ ft/day and $S_y = 0.10$. The most relevant Layer 2 properties are $K_y = 0.081$ ft/day, $K_x = 0.0031$ ft/day, and $S_y = 0.001$, as well as $S_s = 5 \times 10^{-7}$ ft⁻¹. The K_y to K_x ratio of 26 reasonably reflects the preferential flow effect of the fracture zones. These values were obtained by determining the bulk or macroscale equivalent porous media (EPM) properties of the pumping test model domain (through additional simulations) after completing the calibration of the pumping-test model to the pumping test drawdown observations. **Table 1 Appendix VI** summarizes the input parameters for both the Regional Model and the Pumping Test Calibration Model.

6.1.1 *Boundary Conditions*

Figure 6.1.1, Appendix VI shows creek boundary condition cells in the model grid. Grid resolution is sufficient for distant effects. Although the cell width of streams is fairly large, the impact of the creeks in the model is controlled by the conductance term of the creek, not cell width. The conductance term represents a limited width, length, and streambed hydraulic conductivity.

The thickness of the fractured rock aquifer (Layer 2), 600 feet (Table 5.1.2, Appendix VI), was selected based on extrapolation of the VLF profiles and the need to minimize boundary effects in the depth interval of the mining operation (400 to 500 feet).

6.1.2 *Transient Model Simulation*

Model runs are transient in order to realistically represent gradual increases in mine depth over time. Steady state runs risk over-predicting drawdown, unless there is a well-connected source of water within the model that is known to create equilibrium in a certain number of years. The depth of pumping at the mine site and low hydraulic conductivity values in the rock and fractured rock limit the influence of streams, making steady-state predictions unrealistic.

Chart 6.1.2, Appendix VI shows the progression of mine dewatering simulated by the transient model. The East Pit is dewatered gradually to 200 feet after 24 years (Phase I pit), and to 300 feet after 37 years. Dewatering in the West Pit (Phase II) begins in year 37 and catches up to the East Pit (300 feet) in year 47. Both the East and West Pits continue to dewater gradually to 400 feet after 60 years (full mine pit dewatering scenario) from the beginning of mining operations.

6.1.3 *Regional Model Calibration*

Consistent with the results of the pumping test model calibration, quantifying the vertical and horizontal anisotropy of the fractured aquifer was one of two main objectives of the regional model calibration, which yielded order-of-magnitude contrasts among K_x , K_y and K_z . Quantifying specific storage of the fractured rock



aquifer was the second main objective of the regional model calibration. A conservative safety factor was applied to the K values. The S_y of the fractured rock aquifer was calibrated and adjusted for EPM properties. In the surficial aquifer, both K and S_y values derived in the pumping test calibration remained unchanged in the regional model, where sensitivity to these parameters was relatively low. Standard conductance values were applied to boundary cells representing streams, and adjusted for grid resolution.

6.2 Phase I Pit Drawdown Predictions

Figure 11, Appendix I shows contours of 5 feet and 50 feet drawdown for the Phase I pit scenario after 10 years. **Figure 12, Appendix I** shows contours of 5 feet, 50 feet and 100 feet drawdown for the Phase I pit scenario after 24 years. **Chart 6.2, Appendix VI** shows the gradual increase in the dewatering rate (in gpm) over time for this scenario. The small increase in the dewatering rate after 3 years of operation is a model artifact caused by desaturation of cells in Layer 1 (surficial aquifer). Smaller node spacing (higher grid resolution) would create a smoother dewatering curve at the point in time when flow in Layer 2 (fractured rock) begins to dominate over flow in Layer 1.

6.3 Full Mine Pit Drawdown Predictions

Figure 13, Appendix I shows contours of 5 feet, 50 feet and 100 feet drawdown for the Full Mine Pit scenario after 60 years of gradual dewatering as depicted in **Chart 6.1.2, Appendix VI**. **Chart 6.2, Appendix I** shows the total dewatering rates for both the Phase I Pit and Phase II Pit over time. The abrupt change in flow rate between 37 and 38 years reflects the onset of dewatering the Phase II Pit. After 47 years the rate of change in flow rate decreases because the rate of excavation slows down in the model once the Phase II Pit catches up with the Phase I Pit at 300 feet.

The model also does not include ponds and lakes because they are assumed to have silty bottoms and their effect is therefore insignificant.

6.4 Stream Impacts

Potential impacts to surface waters and wetlands are predicted to vary depending on type and for some, distance from the proposed mine pit. Potential impacts to ponds are estimated to be insignificant given that natural siltation of pond bottoms over time typically limits vertical leakage (water loss) into the surficial aquifer and sequent bedrock aquifer during mine dewatering. Ponds will continue to receive recharge directly from precipitation and indirectly as precipitation runoff, consistent with existing conditions. Similarly, upland wetland features are typically present due to poorly draining soils, and are typically supported by precipitation rather than groundwater flow. Accordingly, it is predicted that groundwater dewatering would have limited or no impact on upland wetland features.

With regards to streams, stream flows will continue to vary seasonally due to natural variations in precipitation, which provides water directly and indirectly into the stream in the vicinity of the site as well as stream segments near the proposed mine pit. In addition, precipitation will continue to provide water to recharge the surficial aquifer. Mine dewatering is expected to reduce the discharge of groundwater directly into the stream segments in the immediate vicinity of the proposed mine pit. The streams will continue to receive natural water flows from the relatively unaffected upstream areas.



The stream segments in the areas of greatest predicted drawdown are predicted to experience an increase in the fraction of water lost to the underlying aquifer. Given the limited length of the stream segments encompassed by the area of greatest predicted groundwater drawdown, the overall impact to natural stream flow rates is estimated to be minimal. If stream flow impacts are minimal, impacts to bed and bank wetland should also be limited. S&ME understands that future mine operations will likely include reintroducing a portion of the groundwater extracted by dewatering into on-site stream segments, to lessen the predicted stream flow impacts.

6.5 Anticipated Dewatering Effort and Makeup Water Needs

Information provided by Luck suggests the water requirements for the mining operation will be 100,000 gallons per day during each work day. Projected over an entire week and during a 24-hour period, the water requirement is roughly 50 gpm. Based on the information provided in **Chart 6.2, Appendix VI**, the groundwater modeling simulation suggests that the dewatering rate after approximately 12.5 years should be sufficient to produce the water needed for mining operations. Therefore, during initial start of mining operations until around year 12.5, additional water will need to be supplemented by an onsite water supply well.

6.6 Significant Assumptions

- The assessment assumes that the proposed mine pit and operations would be configured as provide by Luck and outlined in this report.

6.7 Limitations and Exceptions of Assessment

- Information obtained regarding off-site water supply wells was limited to that provided by SCDHEC through its FOI office and the Chester County Metropolitan District.
- This evaluation is based on data available at this time. The estimates and opinions contained herein may need to be revised if significant additional information becomes available. Nevertheless, the opinions are well-founded and consistent with observed conditions at the site.
- S&ME used generally accepted industry practices to characterize site conditions.
- The techniques used in preparing the modeling evaluation were based upon generally-accepted industry standards, the current understanding of site conditions, and literature values for some model parameters. Subsurface data is always limited in its spatial coverage and subsurface hydraulic testing produces only approximate results. Furthermore, numerical models are simplified approximations of a complex subsurface. Estimates and projections about groundwater and subsurface behavior have inherent and unavoidable uncertainties. This is particularly true for potential local-scale variations in bedrock depth, fracture distribution, and subsurface permeability. By using good, industry standard, generally-accepted methods and best practices, we believe this assessment provides useful and reasonable guidance concerning expected site behavior. Model simulation data outputs should be viewed as predictions. Contour lines shown depicting future groundwater drawdowns scenarios should be viewed as reasonably anticipated conditions, not actual. Results for actual mine operations may be different from model simulated results.
- This report does not warrant against future operations or conditions, nor does it warrant against operations or conditions of a type or at a specific location not evaluated.
- This evaluation was prepared by S&ME specifically for use by the Client and SCDHEC. Use of or reliance upon this information by any other party without express written permission granted by S&ME and the Client is not authorized and is completely at the risk of the user.



7.0 CONCLUSIONS

S&ME has completed a hydrogeologic assessment at the approximate 287-acre site near Chester, in Chester County, South Carolina. The purpose of the assessment requested by Luck was to provide information on groundwater flow into the pit area during dewatering, and to help understand potential impacts within the dewatering cone of influence, on neighboring wells, bodies of water, streams, and nearby wetlands.

This hydrogeologic assessment relied on a process of that began with the development of a preliminary site conceptual model. The preliminary model was based on known or expected main features of geology, hydrogeology, mine pit location and development, and site-specific relationships between geologic structures and groundwater flow. The preliminary site conceptual model was utilized to develop field data collections needs for this assessment. Site specific data was collected for the purpose of further characterizing the hydrogeologic system and refining the site conceptual model. A standard computer aided three-dimensional mathematical model was then employed to provide predictive simulations of effects of future mine dewatering scenarios. The model used conservative assumptions about aquifer properties and is consistent with standard best practice in numerical finite-difference modeling of flow in porous and fractured media.

S&ME modeled three future mine pit development scenarios. The Phase I pit scenarios involved the expansion and gradual dewatering of the Phase I pit down 85 feet after 10 years (scenario #1) and down to 200 feet after 24 years (scenario #2), from the beginning of mining operations. The Phase I pit continues expansion down to 300 feet in year 37. Mining and dewatering of the Phase II pit begins in year 37 and catches up to the Phase I Pit (300 feet) in year 47. For the Full Mine Pit dewatering scenario (scenario #3), both the Phase I and Phase II Pits continue to expand and are gradually dewatered down to 400 feet after 60 years, from the beginning of mining operations.

The model predicts a drawdown cone elongate in the north-south direction, consistent with the orientation of dominant fractures imaged on the subject site using geophysical tools. After 10 years of operation of the Phase I pit, the regional model simulations predict a 5-foot drawdown cone of influence that is predominantly confined to the proposed mine property. The regional model simulations predict 5 feet of drawdown 2,700 to 3,000 feet north and south of the Phase I mine pit, and 600 to 350 feet east and west of the mine pit after 24 years of operation of the Phase I pit. All simulation results are approximate. After 60 years of operation, including 23 years of both the Phase I and Phase II pits operating, model simulations predict 5 feet of drawdown 3,600 to 5,200 feet south and north, respectively, and 0 to 950 feet west and east of the mine pits, respectively. After 24 years of Phase I mine operations, the 50-foot drawdown cone is predicted to be contained within the mine site property boundaries. After 60 years Phase I and II mining operations, the 50-foot estimated drawdown contour extends 2,700 feet north and 1,800 feet south of the mine pit.

The area south of the proposed mine is predominantly rural and properties with structures that occur within the estimated 50-foot drawdown contour line associated with the 60-year simulation are reportedly served by municipal water. With regards to the area north of the mine and within the estimated 50-foot drawdown contour for the 60-year simulation, the area is dominantly rural with homes not visible from recent aerial photographs.

Potential impacts to surface waters and wetlands are predicted to vary depending on type and for some, distance from the proposed mine pit. The stream segments in the areas of greatest predicted drawdown are forecast to experience an increase in the fraction of water lost to the underlying aquifer. Given the limited length of the stream segments encompassed by the area of greatest predicted groundwater drawdown, the overall impact to



natural stream flow rates is estimated to be minimal. If steam flow impacts are minimal, impacts to bed and bank wetland should also be limited. Potential impacts to ponds and upland wetlands are estimated to be insignificant.

S&ME understands that future mine operations will likely include reintroducing a portion of the groundwater extracted by dewatering into on-site stream segments, to lessen the predicted stream flow impacts.

8.0 REFERENCES

Geologic Map of Chester County, South Carolina (1988), South Carolina Geologic Survey Open-File Report 63

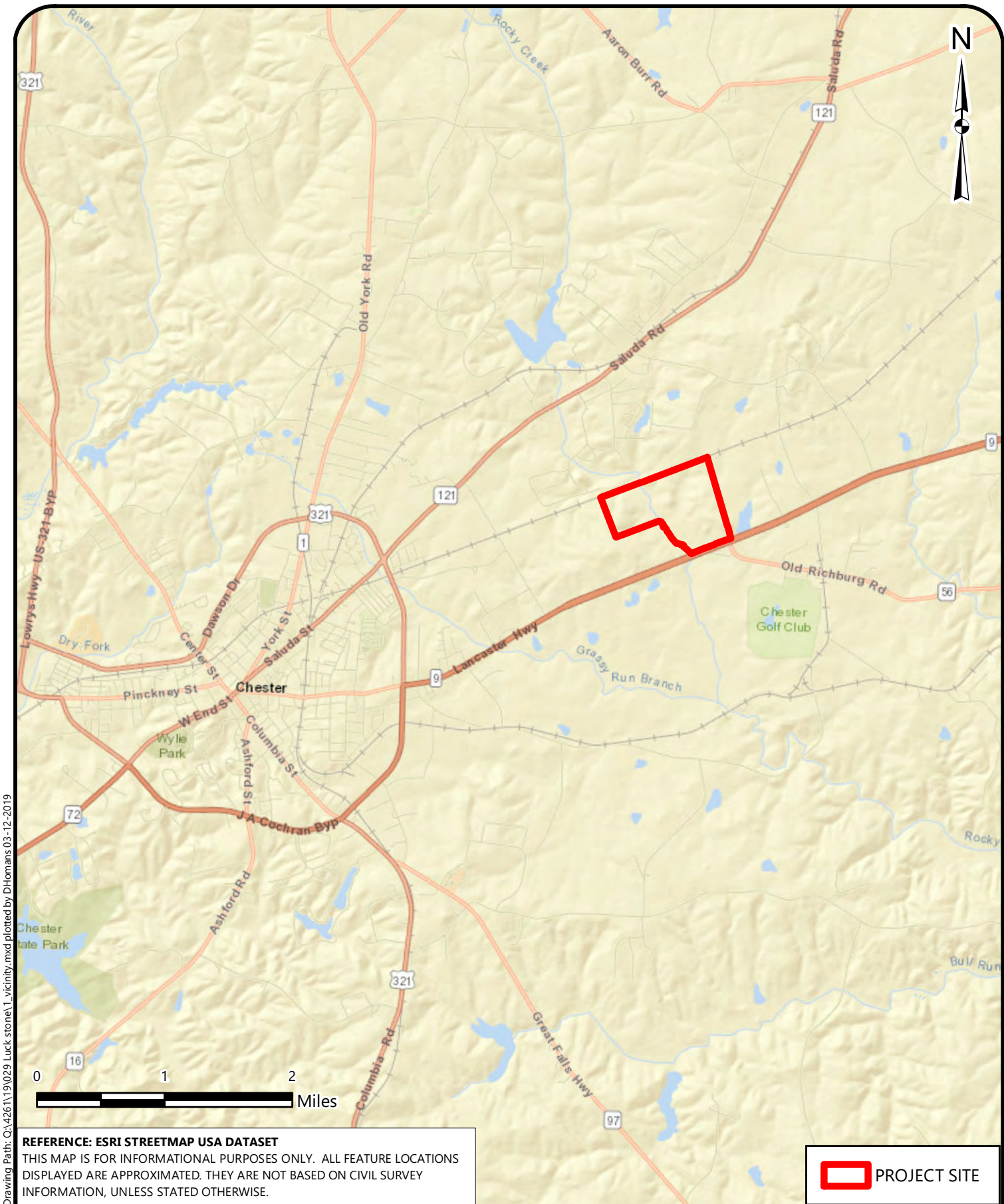
Geology of the Carolinas (1991), Horton, Jr. J. Wright, and Zulu A. Victor, University of Tennessee Press

Heath, R.C. (1989), Ground Water in the Piedmont: Proceedings of a conference on ground water in the Piedmont of the eastern United States: Clemson University, October 16-18, 1989: Clemson, South Carolina.

Heath, R.C. (1990), Basic Elements of Ground-Water Hydrology with reference to conditions in North Carolina: USGS Water-Resources Investigations Open File Report 80-44, page 86.

Appendices


Appendix I – Figures

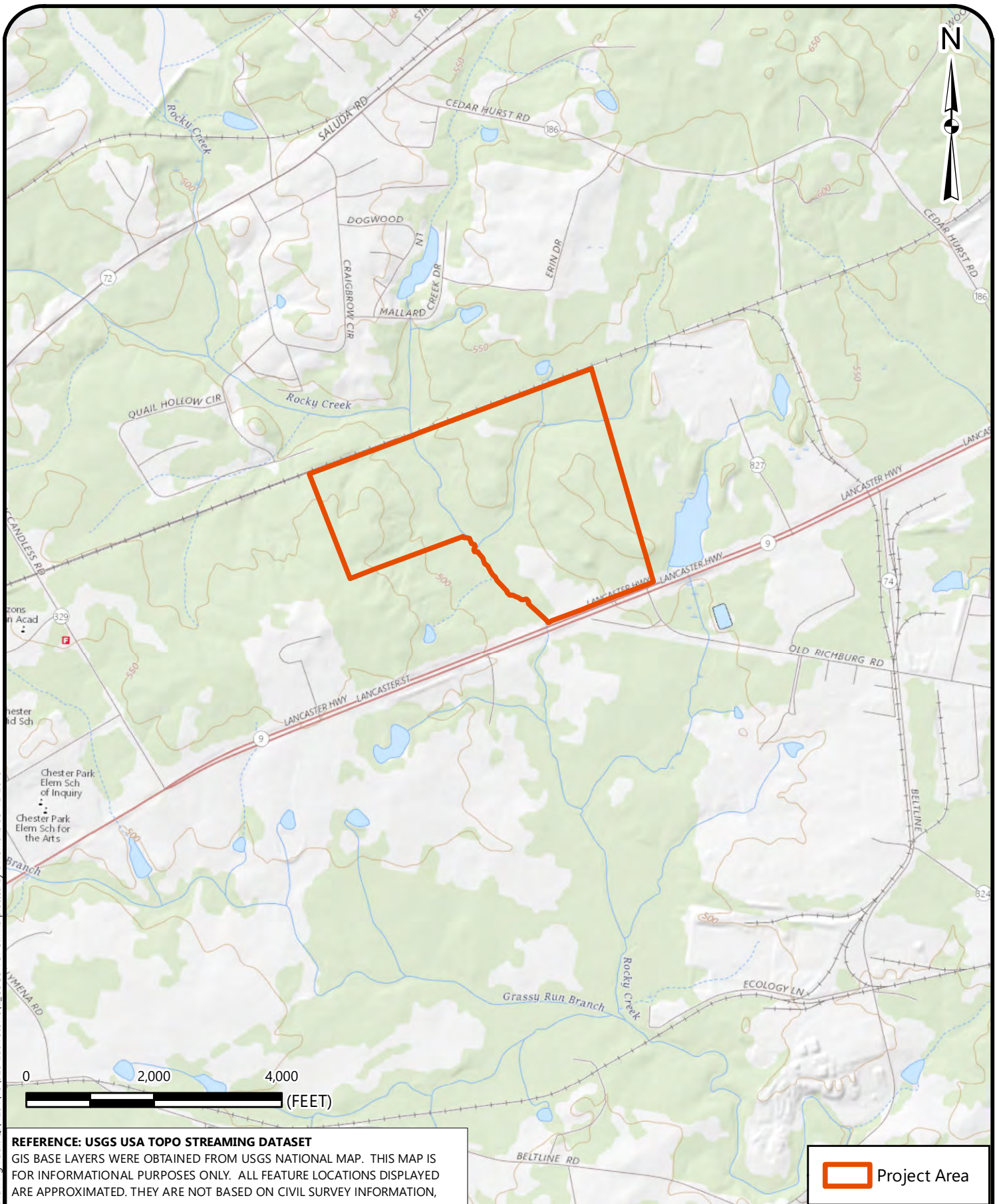


Drawing Path: Q:\4261\19\029 Luck stone\1_vicinity.mxd plotted by:DHomans 03-12-2019

REFERENCE: ESRI STREETMAP USA DATASET
 THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

 PROJECT SITE


| | | | |
|---|--|---|------------|
|  | VICINITY MAP | SCALE: 1" = 1.0 miles | FIGURE NO. |
| | LUCK STONE CHESTER COUNTY, SOUTH CAROLINA | DATE: 3-12-19 PROJECT NUMBER 4261-19-029 | 1 |



Drawing Path: Q:\4261\19\029 Luck stone\2_USGS TOPO.mxd plotted by DHomans 03-12-2019

REFERENCE: USGS USA TOPO STREAMING DATASET
 GIS BASE LAYERS WERE OBTAINED FROM USGS NATIONAL MAP. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION.

 Project Area

| | | | |
|---|--|---|----------------------------|
|  | USGS TOPOGRAPHIC MAP | SCALE: 1" = 2,000' | FIGURE NO. 2 |
| | LUCK STONE CHESTER COUNTY, SOUTH CAROLINA | DATE: 3-12-19 PROJECT NUMBER 4261-19-029 | |



PROPOSED MINE OPERATION AREAS

LUCK STONE
CHESTER COUNTY, SOUTH CAROLINA

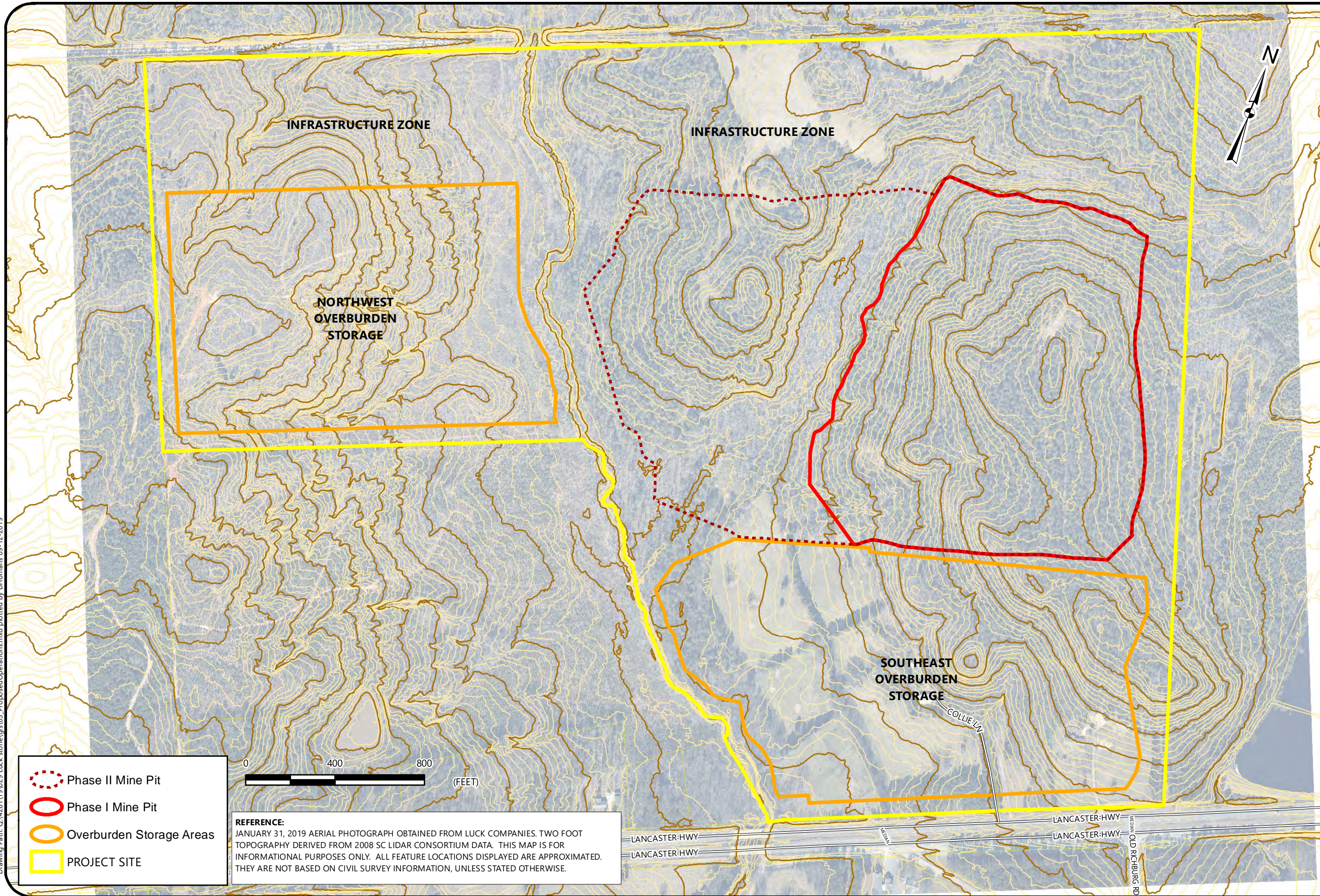
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DATE:
9-12-19

PROJECT NUMBER
4261-19-029

FIGURE NO.

3

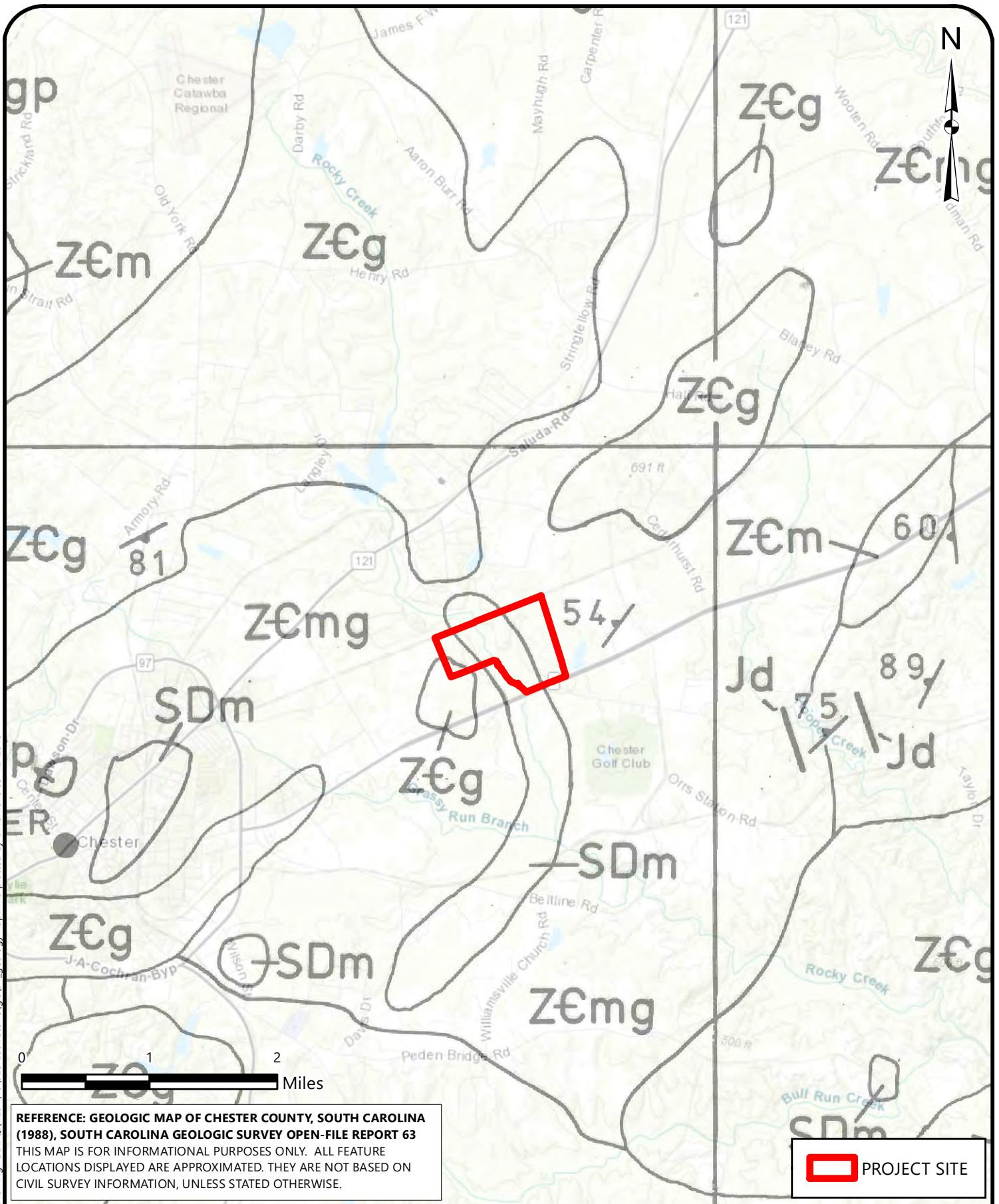


-  Phase II Mine Pit
-  Phase I Mine Pit
-  Overburden Storage Areas
-  PROJECT SITE

0 400 800
(FEET)


REFERENCE:
JANUARY 31, 2019 AERIAL PHOTOGRAPH OBTAINED FROM LUCK COMPANIES. TWO FOOT TOPOGRAPHY DERIVED FROM 2008 SC LIDAR CONSORTIUM DATA. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

Drawing Path: C:\4261\19\029 Luck stone\gis\04_gelogymap.mxd plotted by DHomans 09-12-2019



REFERENCE: GEOLOGIC MAP OF CHESTER COUNTY, SOUTH CAROLINA (1988), SOUTH CAROLINA GEOLOGIC SURVEY OPEN-FILE REPORT 63
 THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

 PROJECT SITE

| | | | |
|---|--|-------------------------------|------------|
|  | COUNTY GEOLOGY MAP | SCALE: 1" = 1 mile | FIGURE NO. |
| | | DATE: 9-12-19 | 4 |
| | LUCK STONE CHESTER COUNTY, SOUTH CAROLINA | PROJECT NUMBER 4261-19-029 | |

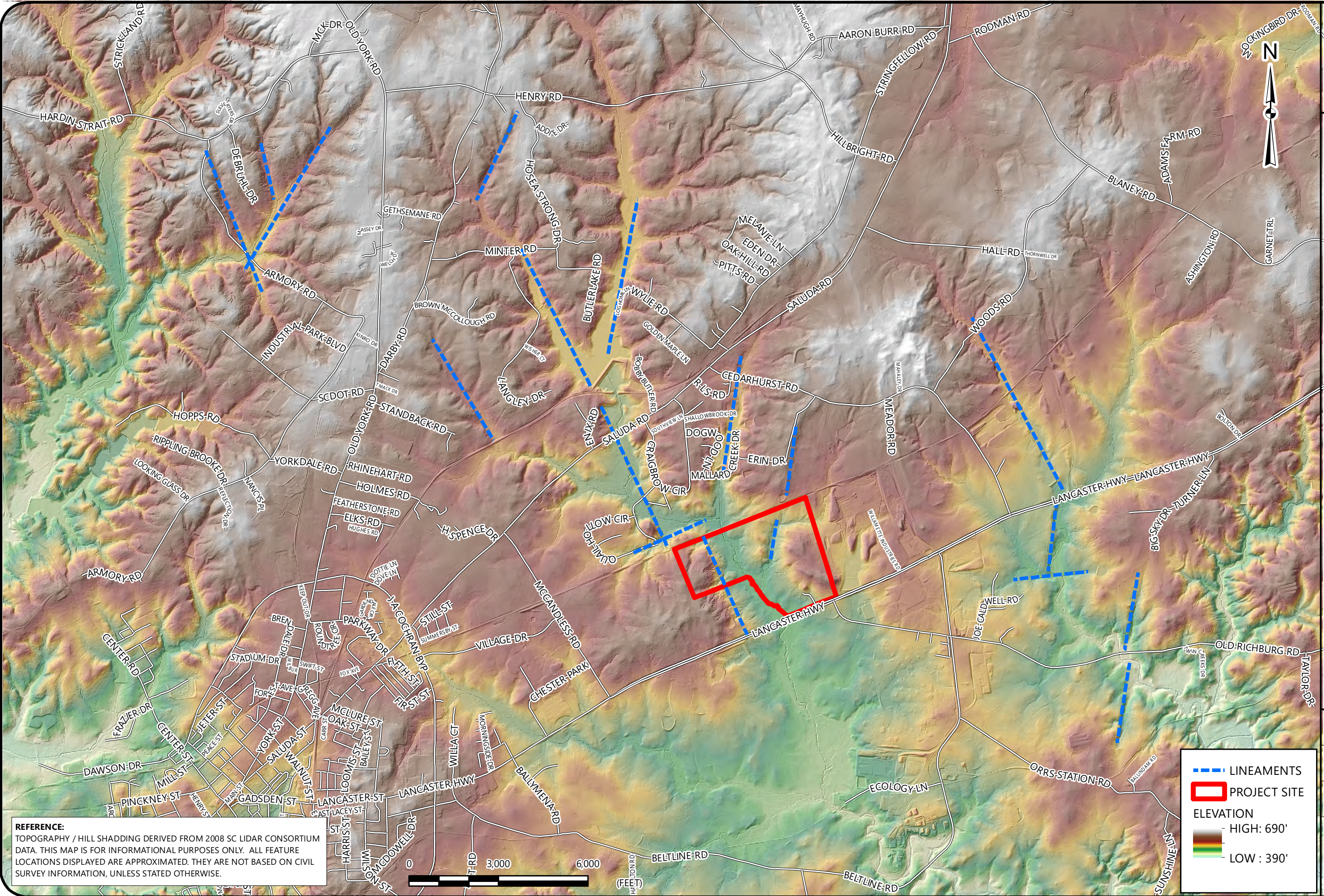


LINEAMENT STUDY MAP

LUCK STONE
CHESTER COUNTY, SOUTH CAROLINA

SCALE:
1" = 3,000'
DATE:
8-27-19
PROJECT NUMBER
4261-19-029
FIGURE NO.

5



- LINEAMENTS
- PROJECT SITE
- ELEVATION
- HIGH: 690'
- LOW: 390'

REFERENCE:
TOPOGRAPHY / HILL SHADING DERIVED FROM 2008 SC LIDAR CONSORTIUM DATA. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

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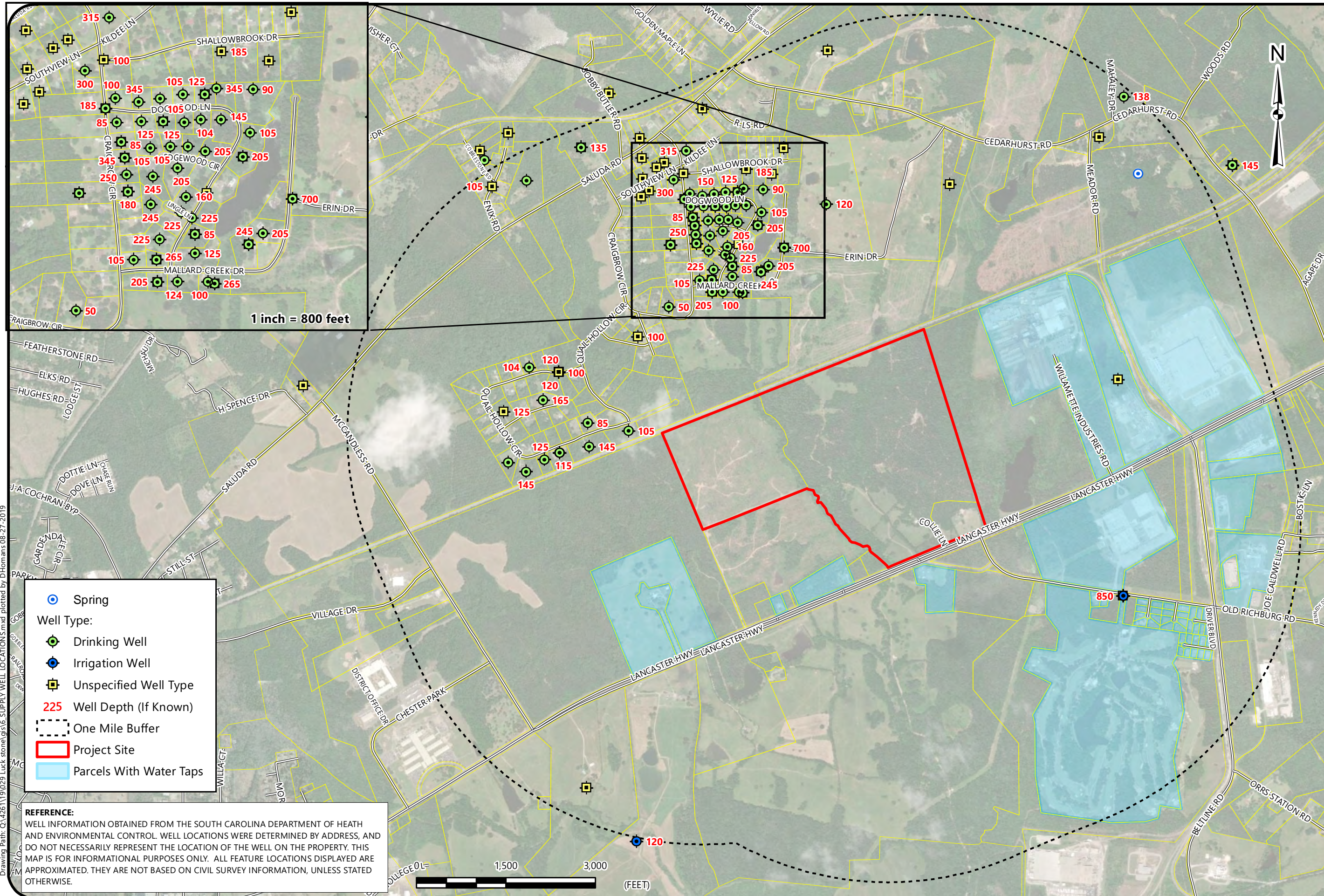


SUPPLY WELL LOCATION MAP

LUCK STONE
CHESTER COUNTY, SOUTH CAROLINA

SCALE:
1" = 1,500'
DATE:
8-27-19
PROJECT NUMBER
4261-19-029
FIGURE NO.

6



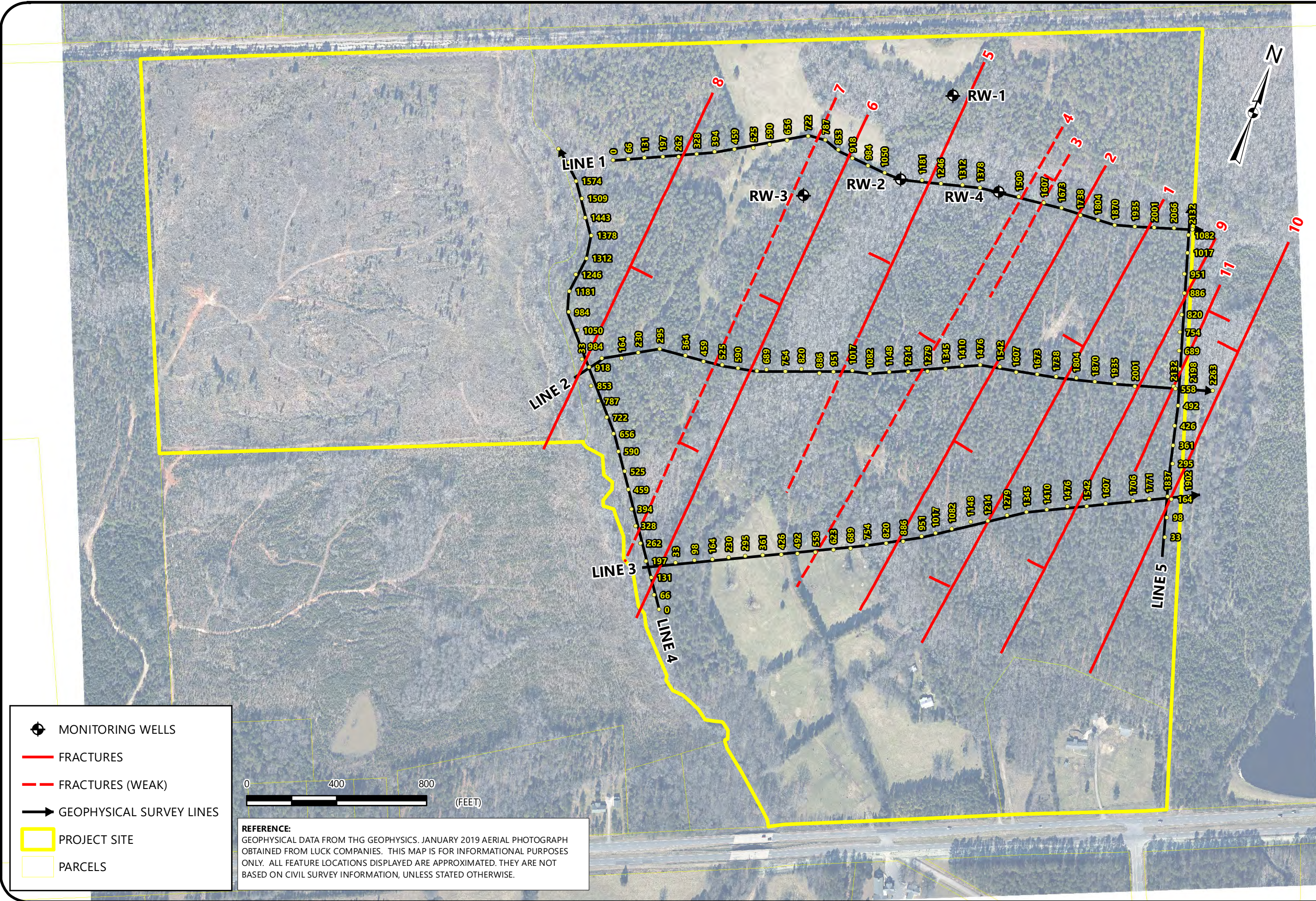
1 inch = 800 feet

- Spring
- Well Type:
- Drinking Well
- Irrigation Well
- Unspecified Well Type
- Well Depth (If Known)
- One Mile Buffer
- Project Site
- Parcels With Water Taps

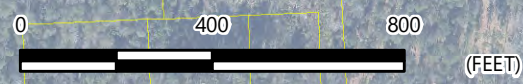
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Drawing Path: Q:\4261\19\029 Luck stone\gis\07_BEDROCK FRACTURE MAP.mxd plotted by D:\Homans 09-12-2019



- MONITORING WELLS
- FRACTURES
- FRACTURES (WEAK)
- GEOPHYSICAL SURVEY LINES
- PROJECT SITE
- PARCELS



REFERENCE:
 GEOPHYSICAL DATA FROM THG GEOPHYSICS. JANUARY 2019 AERIAL PHOTOGRAPH OBTAINED FROM LUCK COMPANIES. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.



VLF SURVEY-
 BEDROCK FRACTURE MAP

LUCK STONE
 CHESTER COUNTY, SOUTH CAROLINA

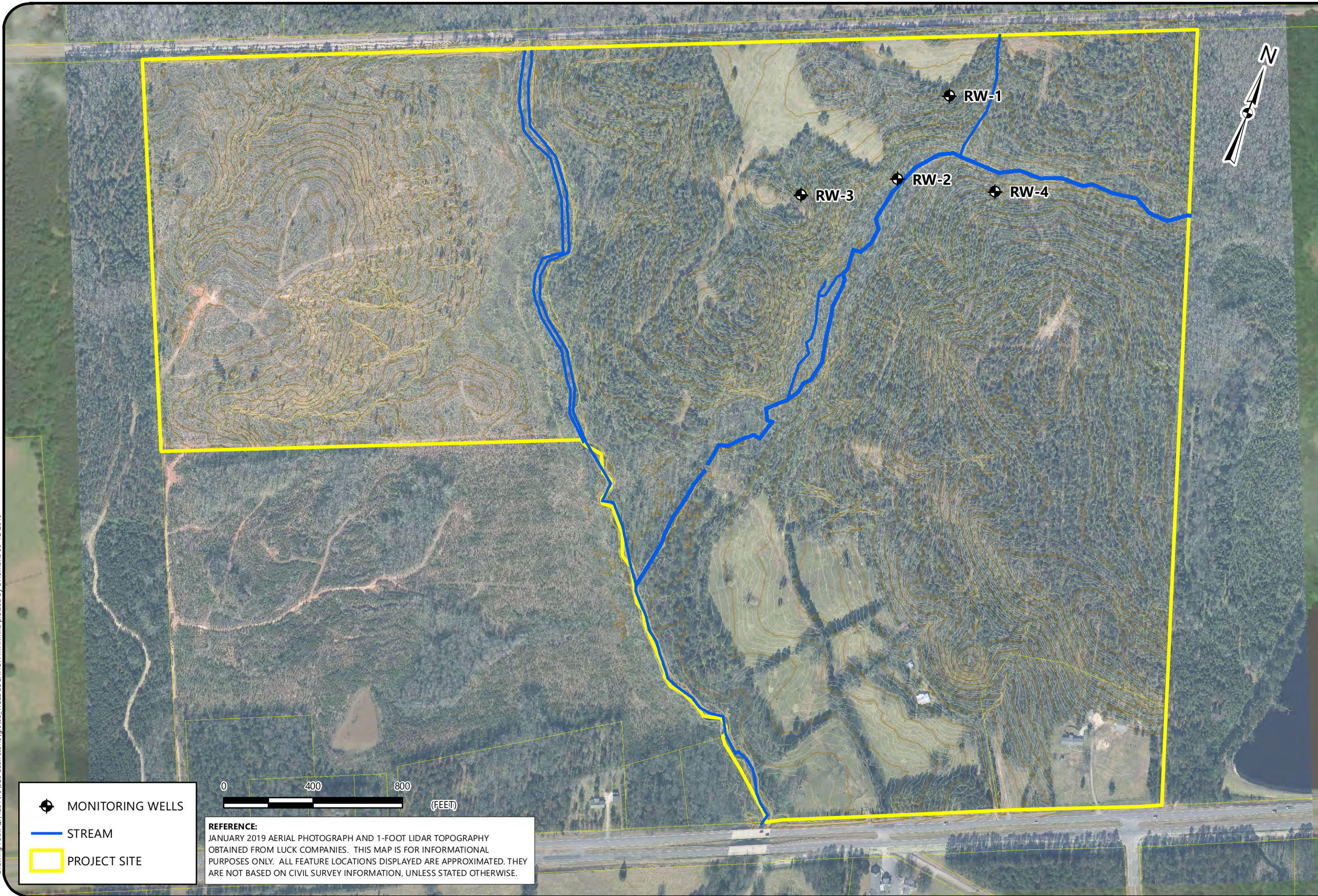
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DATE:
 9-12-19

PROJECT NUMBER
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FIGURE NO.

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WELL LOCATION MAP

LUCK STONE
CHESTER COUNTY, SOUTH CAROLINA




SCALE:
1" = 400'

DATE:
9-12-19

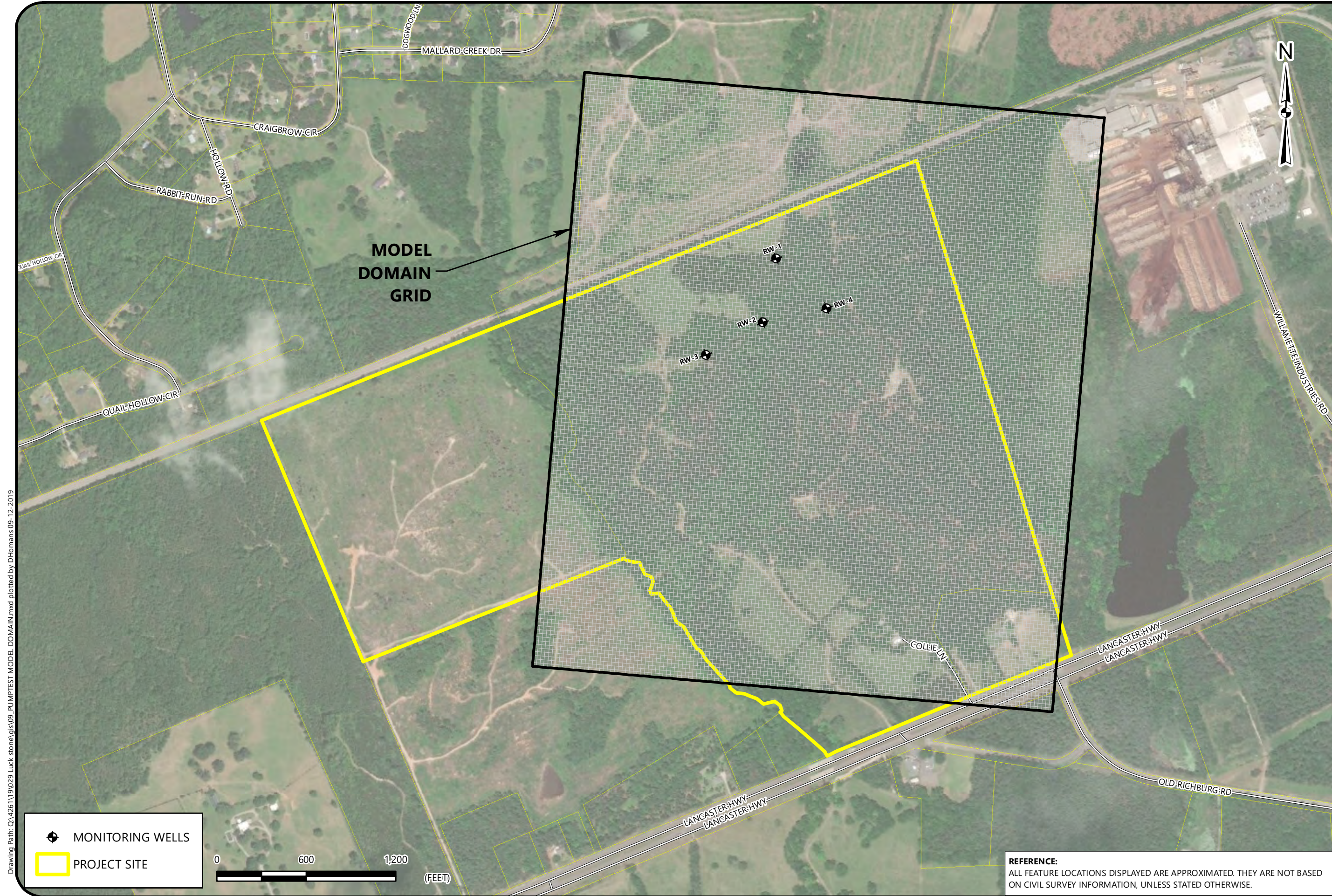
PROJECT NUMBER
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FIGURE NO.



8

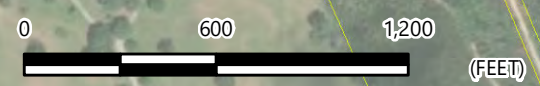
-  MONITORING WELLS
-  STREAM
-  PROJECT SITE

REFERENCE:
JANUARY 2019 AERIAL PHOTOGRAPH AND 1-FOOT LIDAR TOPOGRAPHY OBTAINED FROM LUCK COMPANIES. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.



Drawing Path: Q:\4261\19\029 Luck stone\gis\09_PUMPTEST MODEL DOMAIN.mxd plotted by D.Homans 09-12-2019

-  MONITORING WELLS
-  PROJECT SITE



REFERENCE:
ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

**MODEL DOMAIN:
PUMP TEST CALIBRATION**

LUCK STONE
CHESTER COUNTY, SOUTH CAROLINA

SCALE:
1" = 600'

DATE:
9-12-19

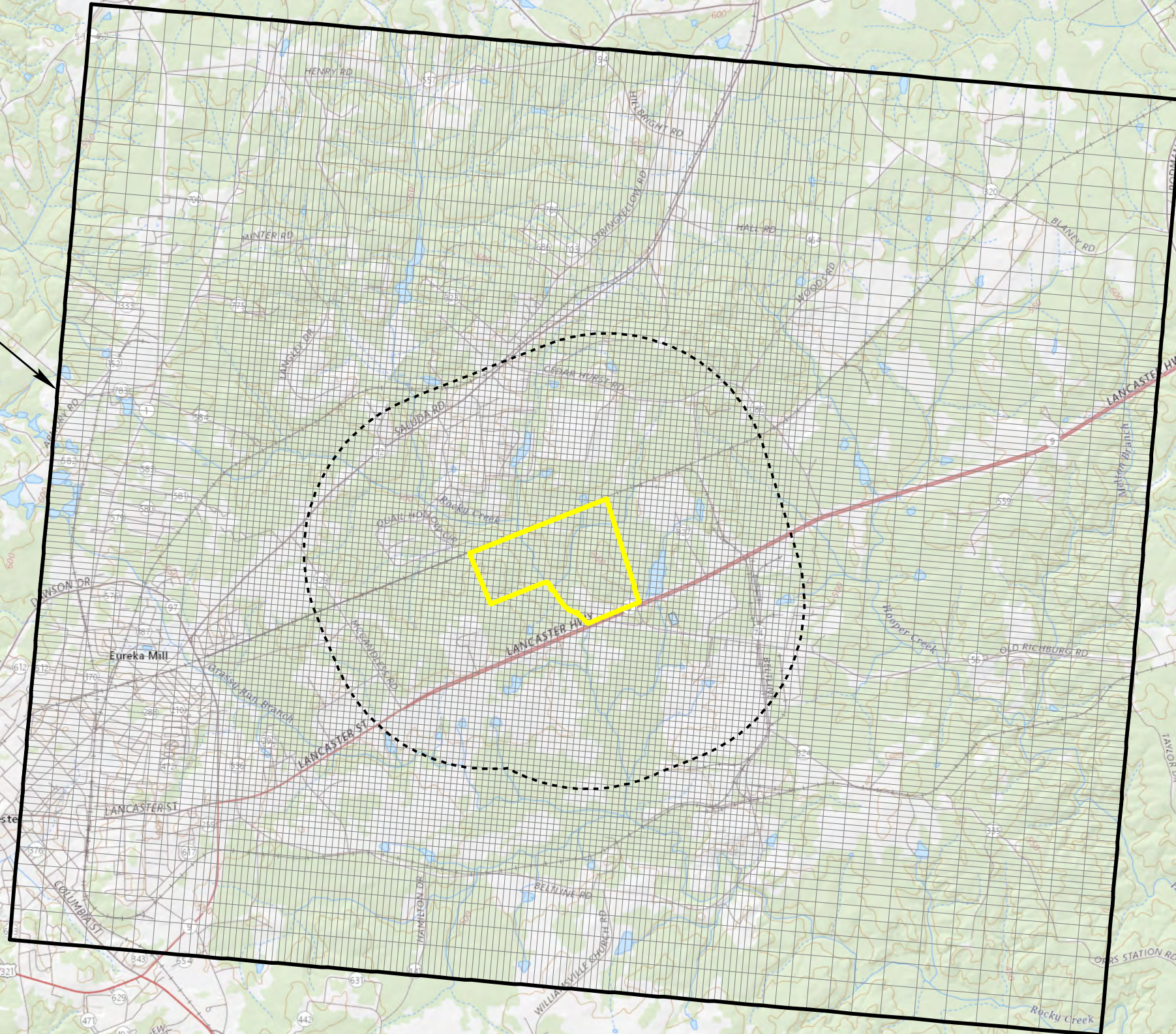
PROJECT NUMBER
4261-19-029



FIGURE NO.

9



**MODEL
DOMAIN
GRID**



-  PROJECT SITE
-  One Mile Buffer



REFERENCE:
THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS
DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY
INFORMATION, UNLESS STATED OTHERWISE.

Drawing Path: Q:\4261\19\029 Luck Stone\gis\10_REGIONAL_MODEL_DOMAIN.mxd, plotted by D\Homan on 09-12-2019

REGIONAL MODEL GRID MAP

LUCK STONE
CHESTER COUNTY, SOUTH CAROLINA

SCALE:
1" = 4,000'
DATE:
9-12-19
PROJECT NUMBER
4261-19-029
FIGURE NO.

10

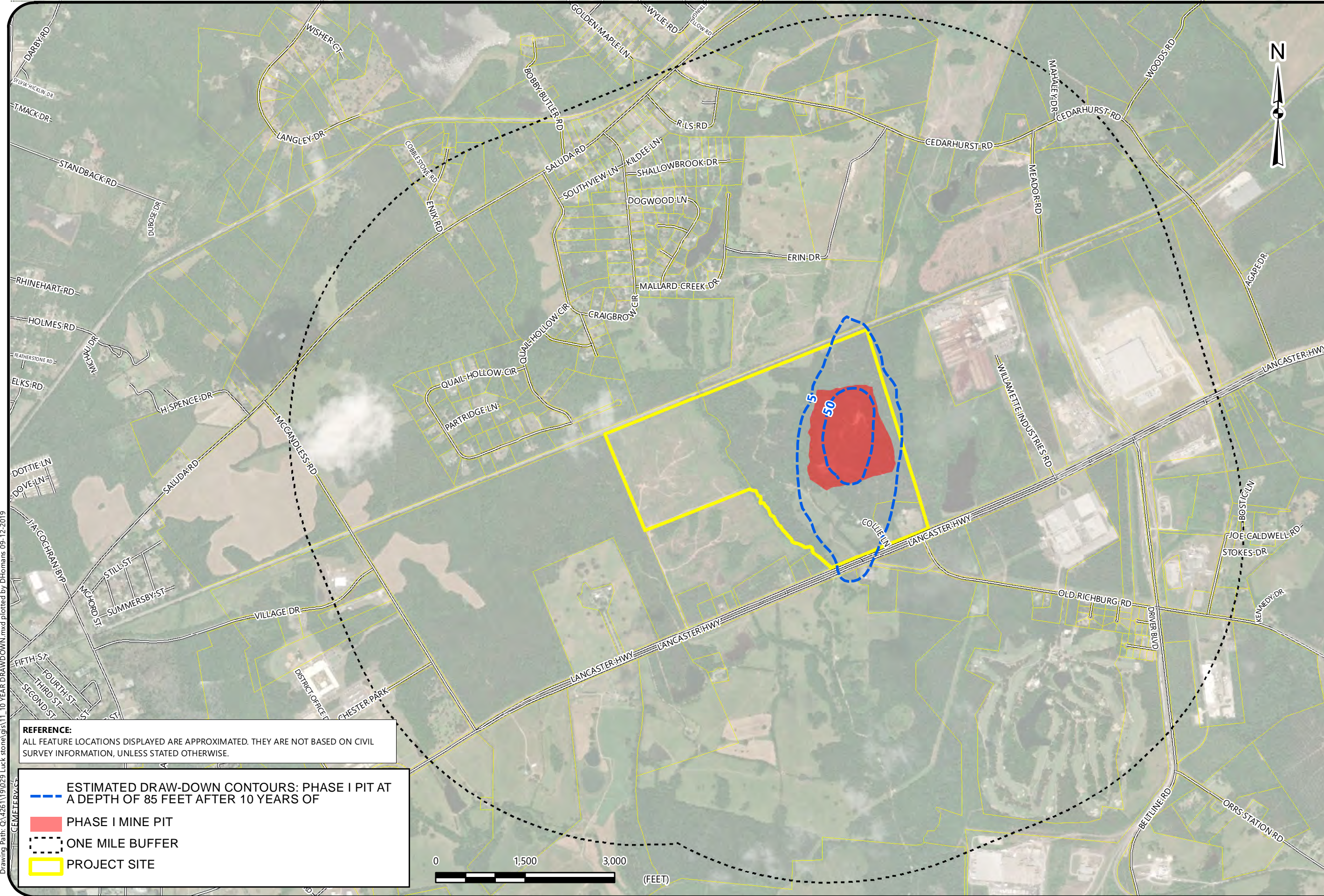


**REGIONAL MODEL DRAWDOWN
AFTER 10 YEARS**





LUCK STONE
CHESTER COUNTY, SOUTH CAROLINA

SCALE:
1" = 1,500'
DATE:
9-12-19
PROJECT NUMBER
4261-19-029
FIGURE NO.

11



REFERENCE:
ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

-  ESTIMATED DRAWDOWN CONTOURS: PHASE I PIT AT A DEPTH OF 85 FEET AFTER 10 YEARS OF
-  PHASE I MINE PIT
-  ONE MILE BUFFER
-  PROJECT SITE

Drawing Path: Q:\4261\19\029 Luck stone\gis\11_10 YEAR DRAWDOWN.mxd plotted by DThomans 09-12-2019

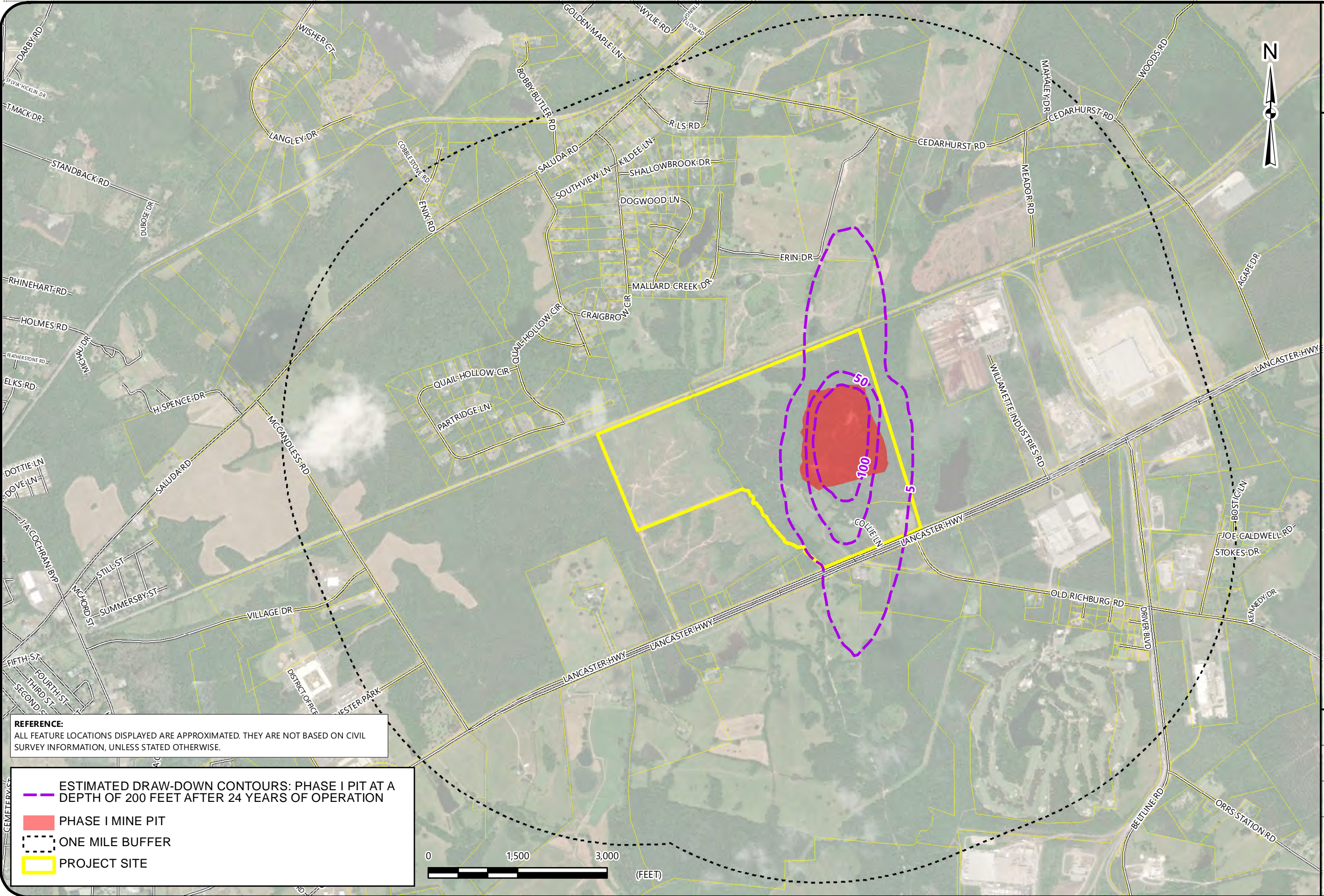


**REGIONAL MODEL DRAWDOWN
AFTER 24 YEARS**





LUCK STONE
CHESTER COUNTY, SOUTH CAROLINA

SCALE:
1" = 1,500'
DATE:
9-12-19
PROJECT NUMBER
4261-19-029
FIGURE NO.

12



REFERENCE:
ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

-  ESTIMATED DRAWDOWN CONTOURS: PHASE I PIT AT A DEPTH OF 200 FEET AFTER 24 YEARS OF OPERATION
-  PHASE I MINE PIT
-  ONE MILE BUFFER
-  PROJECT SITE

Drawing Path: Q:\4261\19\029 Luck stone\gis\12_24 YEAR DRAWDOWN.mxd plotted by DThomans 09-12-2019

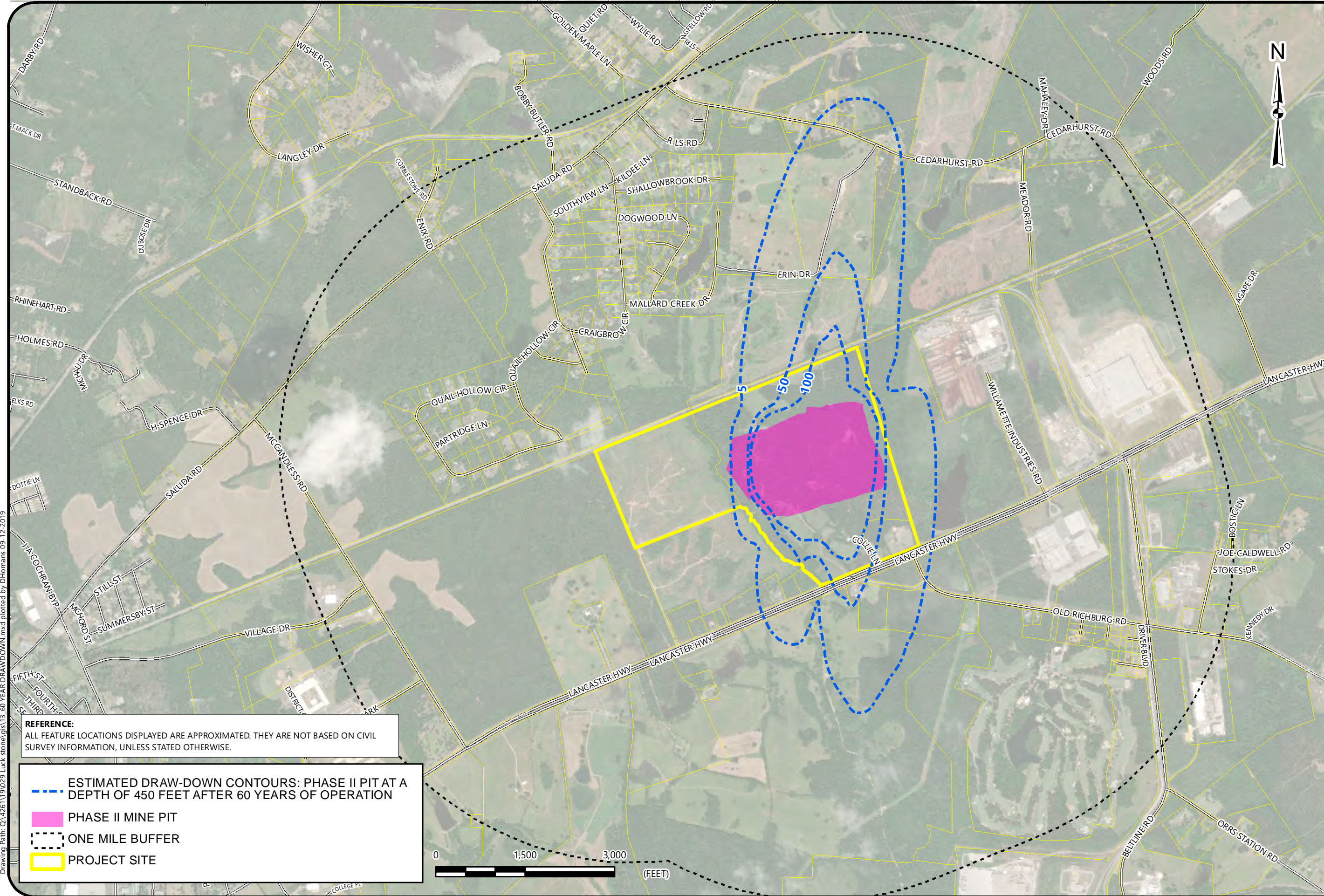


**REGIONAL MODEL DRAWDOWN
AFTER 60 YEARS**





LUCK STONE
CHESTER COUNTY, SOUTH CAROLINA

SCALE:
1" = 1,500'
DATE:
9-12-19
PROJECT NUMBER
4261-19-029
FIGURE NO.

13



REFERENCE:
ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

-  ESTIMATED DRAWDOWN CONTOURS: PHASE II PIT AT A DEPTH OF 450 FEET AFTER 60 YEARS OF OPERATION
-  PHASE II MINE PIT
-  ONE MILE BUFFER
-  PROJECT SITE



Drawing Path: C:\4261\19\029 Luck stone\gis\13_60 YEAR DRAWDOWN.mxd plotted by DHomans 09-12-2019

Appendix II – Receptor Survey



Freedom of Information Request Form
Customer Service: (803) 898-3882

Date: February 6, 2019

Internal request number: _____

Contact information

Name: John Whitehead Company/Organization: S&ME, Inc.
Street address: 301 Zima Park Road City: Spartanburg State: SC Zip Code: 29301
Phone number: 864.208.9398 (direct dial) Email address: jwhitehead@smeinc.com

Request information

I'm requesting: **Specific documents** **File review**

Facility or project name: Chester County Water Well Records

Facility address: _____

County: Chester

DHEC file custodian/staff contact if known: _____

Description of documents or files requested:

Please send me the excel database reports for water wells in Chester County, South Carolina.

Family Privacy Protection Act statement

The Family Privacy Protection Act, SC Code Section 30-2-50, prohibits any person or private entity from knowingly obtaining or using any personal information obtained from our agency for commercial solicitation directed to any person in the State. Violation of this law is a crime.

I have read and understand this statement. I am not requesting personal information for the purposes of commercial solicitation or in violation of law.

Signed: John Whitehead

Submit requests: Email: foi@dhec.sc.gov • Fax: (803) 898-3816 • Mail: FOI Office, 2600 Bull St., Columbia, S.C. 29201

Office Use Only: Date completed: _____

Billing info: Research: Time: _____ Cost: _____

Description: _____

Services: Scan #: _____ WebX documents #: _____ Hard copies #: _____ CD duplication #: _____

Other: _____

Delivery options: Pick up Emailed Mailed Other: _____ **Total charge:** _____

Archived: Friday, February 15, 2019 4:01:02 PM

From: John W Whitehead

Sent: Friday, February 15, 2019 1:09:55 PM

To: David Loftis

Subject: FW: FOI 808104

Response requested: No

Sensitivity: Normal

Attachments:

[chester-1.csv](#) [chester-2.xlsx](#)

Here are the database spreadsheets for Chester County. let me know if you need additional help. Enjoy your weekend.

John Whitehead, PG

Senior Geologist



S&ME
301 Zima Park Road
Spartanburg, SC 29301 [map](#)
O: 864.574.2360
M: 864.580.1429
D: 864.208.9398
jwhitehead@smeinc.com
www.smeinc.com
[LinkedIn](#) | [Twitter](#) | [Facebook](#)

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From: Keller, Kristen M. [<mailto:KellerKM@dhec.sc.gov>]

Sent: Friday, February 15, 2019 12:17 PM

To: John W Whitehead <JWhitehead@smeinc.com>

Subject: FOI 808104

Good Afternoon,

Attached is the excel reports for all water wells in Chester, SC. Please let me know if you need anything else. This request is now considered closed.

Thanks,

Kristen Keller, Assistant Director

Freedom of Information Office

S.C. Dept. of Health & Environmental Control

Office: (803)898-3881

Fax: (803)898-3816

Connect: www.scdhec.gov [Facebook](#) [Twitter](#)

5,241 Requests Opened July 2017-July 2018

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David Loftis

From: Withycombe, Greg <WITHYCGS@dhec.sc.gov>
Sent: Tuesday, June 11, 2019 2:26 PM
To: David Loftis
Subject: Re: FOI 808104

David,

Kinda interesting, but I'll try to explain.

The Chester-1 is from an old database. It contains wells from supposedly 1985 till 2006. We started permitting wells in 2000.

The log # was assigned to wells that did not have a permit (1985 to 1999). The wells listed with a permit number and log number (2000 to 2006) were issued a permit in the old database.

Chester -2 is from a new database that has been in use since 2006. During the data migration in 2006, the wells with permit numbers got picked up. That does make for some duplication of wells permitted between 2000 and 2006.

In Chester-1 the D is for drinking, I is irrigation and E is existing (no permit #)

I will add the disclosure that these are only the wells reported and should not be considered a complete inventory of all wells in Chester County.

Hope this clears up some of the confusion.

Greg Withycombe
Private Well Program
Bureau of Water
S.C. Dept. of Health & Environmental Control
Office: (803) 898-3232
Connect: www.scdhec.gov [Facebook](#) [Twitter](#)



From: David Loftis <DLoftis@smeinc.com>
Sent: Tuesday, June 11, 2019 9:44:28 AM
To: Withycombe, Greg
Cc: Edmund Q B Henriques
Subject: RE: FOI 808104

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Good morning Greg,

S&ME received the attached data files related to the above-referenced FOI request. The received data was stated to be excel reports for all water wells in Chester, SC. I have a few questions regarding the information:

- 1) What is the difference in the two databases? Do they contain the same data?
- 2) Can you explain the different well types? I am assuming that "D" stands for dwelling. What do the "I" and "E" designations mean?

Thank you,

David R. Loftis, P.E.

Senior Engineer



S&ME
44 Buck Shoals Road, Suite C-3
Arden, NC 28704 [map](#)
O: 828.483.3012
M: 828.337.1923
www.smeinc.com
[LinkedIn](#) | [Twitter](#) | [Facebook](#)

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From: Keller, Kristen M. [mailto:KellerKM@dhec.sc.gov]
Sent: Tuesday, May 28, 2019 10:52 AM
To: David Loftis <DLoftis@smeinc.com>
Subject: Re: FOI 808104

David,

Greg Withycombe is the private well contact in the department of water.

Kristen Keller, Assistant Director
Freedom of Information Office
S.C. Dept. of Health & Environmental Control
Office: (803)898-3796
Fax: (803)898-3816
Connect: www.scdhec.gov [Facebook](#) [Twitter](#)



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From: David Loftis <DLoftis@smeinc.com>
Sent: Friday, May 24, 2019 4:27:44 PM
To: Keller, Kristen M.
Subject: RE: FOI 808104

*** Caution. This is an EXTERNAL email. DO NOT open attachments or click links from unknown senders or unexpected email. ***

Kristen,

If I have questions regarding the attached data that was provided to John Whitehead with S&ME on February 15, 2019, who should I talk to?

Thanks,

David R. Loftis, P.E.

Senior Engineer



S&ME
44 Buck Shoals Road, Suite C-3
Arden, NC 28704 [map](#)
O: 828.483.3012
M: 828.337.1923
www.smeinc.com
[LinkedIn](#) | [Twitter](#) | [Facebook](#)

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From: John W Whitehead

Sent: Friday, February 15, 2019 1:10 PM

To: David Loftis <DLoftis@smeinc.com>

Subject: FW: FOI 808104

Here are the database spreadsheets for Chester County. let me know if you need additional help. Enjoy your weekend.

John Whitehead, PG

Senior Geologist



S&ME
301 Zima Park Road
Spartanburg, SC 29301 [map](#)
O: 864.574.2360
M: 864.580.1429
D: 864.208.9398
jwhitehead@smeinc.com
www.smeinc.com
[LinkedIn](#) | [Twitter](#) | [Facebook](#)

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From: Keller, Kristen M. [<mailto:KellerKM@dhec.sc.gov>]
Sent: Friday, February 15, 2019 12:17 PM
To: John W Whitehead <JWhitehead@smeinc.com>
Subject: FOI 808104

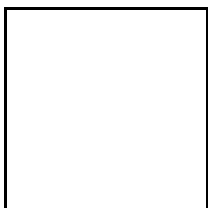
Good Afternoon,

Attached is the excel reports for all water wells in Chester, SC. Please let me know if you need anything else. This request is now considered closed.

Thanks,

Kristen Keller, Assistant Director
Freedom of Information Office
S.C. Dept. of Health & Environmental Control
Office: (803)898-3881
Fax: (803)898-3816
Connect: www.scdhec.gov [Facebook](#) [Twitter](#)

5,241 Requests Opened July 2017-July 2018



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David Loftis

From: Bruce Smith <BruceSmith@luckcompanies.com>
Sent: Friday, June 21, 2019 12:32 PM
To: David Loftis
Subject: FW: Chester Development Project 1730

David,

Here you go.

From: Andy Litten <alitten@cmdcsd.com>
Sent: Friday, June 21, 2019 11:50 AM
To: Bruce Smith <BruceSmith@luckcompanies.com>
Cc: Karlisa Parker Dean <kpdean@choosesechester.com>
Subject: RE: Chester Development Project 1730

CAUTION: EXTERNAL EMAIL

Bruce,

The following locations have public water:

Parcel #089-00-00-037-000: 1039 Lancaster Hwy
Parcel #089-00-00-033-000: 1147 Lancaster Hwy
Parcel #089-00-00-005-000: 1207 Lancaster Hwy
Parcel #089-00-00-021-000: 1266 Lancaster Hwy
Parcel #098-00-00-001-000: 1444 Lancaster Hwy
Parcel #098-00-00-046-000: 1445 Lancaster Hwy
Parcel #098-00-00-076-000: 1497 Lancaster Hwy
Parcel #098-00-00-105-000: 1577 Lancaster Hwy
Parcel #098-00-00-125-000: 1588 Lancaster Hwy
Parcel #098-00-00-171-000: 1856 Beltline Road
Parcel #098-00-00-005-000: 750 Old Richburg Road
Parcel #098-00-00-004-000: 756 Old Richburg Road
Parcel #098-00-00-006-000: 770 Old Richburg Road
Parcel #098-00-00-128-000: 869 Old Richburg Road
All lots on Putter Place, Wedgeway Drive, Sand Iron Circle, and Birdie Haven Drive

Please let me know if you need anything else.

Thanks,

Andy Litten, PE
District Engineer
(T) 803-385-5123

From: Bruce Smith <BruceSmith@luckcompanies.com>
Sent: Wednesday, June 19, 2019 4:49 PM
To: Andy Litten <alitten@cmdcsd.com>

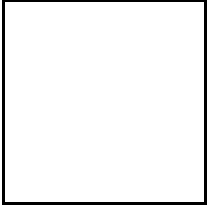
Cc: Karlisa Parker Dean <kpdean@chooschester.com>

Subject: Chester Development Project 1730

Good afternoon Andy, I hope you are doing well.

I wanted to get some information on water connections in the area of our project if possible. I was wondering if it would be possible to get a list of properties around us that have taps into the County water supply. We are beginning to think about which properties we will need to approach when we begin our well analysis and hydro modeling. Is that possible to provide or is it something I can research at the County offices?

Thanks so much, let me know of any questions.



Bruce Smith

Construction Engineer II

+1 (804) 476-6406 Direct

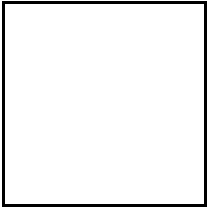
+1 (804) 641-9458 Mobile

BruceSmith@luckcompanies.com

P.O. Box 29682

Richmond, VA 23242

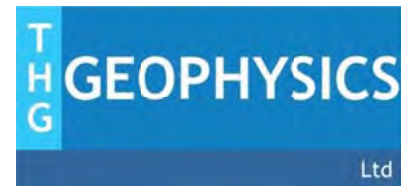
www.luckcompanies.com



Appendix III – Geophysical Survey Report

January 18, 2019

Edmund Henriques, PG
S&ME, Inc.
8646 W. Market Street, Suite 105
Greensboro, NC 27409
(336) 288-7180



**Re: Proposed Geophysical Survey
Luck Stone Corporation
Chester, South Carolina
THG Project No. 459-10107rev**

Mr. Henriques:

THG Geophysics, Ltd. (THG) conducted a Very Low Frequency (VLF) fracture investigation at the Proposed Lucky Stone Quarry, Chester, South Carolina February 13, 2019 (**Figure 1**). The scope of work was to identify well-developed subsurface fractures for groundwater production. The study consisted of collecting VLF records to determine the presence and orientation of subsurface fractures (**Figure 2**).

VLF SURVEY

A VLF bedrock fracture survey was conducted using an ABEM WADI instrument to collect multiple profiles in the target area (**Figures 3 and 4**). The VLF method can be used to find steeply dipping structures that differ from their surroundings with regard to electrical resistance. VLF transmitters, the strongest located in Cutler, Maine, send out low frequency military radio signals (15-30 kHz). When the field emitted by one of the transmitters strikes an anomaly, secondary currents are created that can be read and recorded by the WADI VLF meter.

Cables, metal pipes, and electrical fences can also cause very strong anomalies because they are grounded, which permits a large ground-return current loop to form, showing a similar signature to that of fractured bedrock (ABEM Geophysics, 1989). The power plant is an extreme case for using this tool as it was difficult to find areas free of utilities, power lines and rail tracks.

When a field emitted by a transmitter strikes a body having low electrical resistance, secondary circuits are created in the body. Fraser filtering, a numeric algorithm is performed on the real part of the VLF data to enhance the anomaly. Fraser filtering is based upon the work of Karous and Hjelt (1983):

$$F_o = - 0.102 H_{-3} + 0.059 H_{-2} - 0.561 H_{-1} + H_o + 0.561 H_1 - 0.059 H_2 + 0.102 H_3$$

Where; F_o is the filtered result and H_{-3} to H_3 are the original VLF data.

Approximately 9,200 feet (2,800 meters) of VLF data were collected in 5 profile lines (**Figures 3 and 4**). The composite VLF profiles are generated through the Fraser-filtering algorithm. These profiles show a rough estimate of the presence and dip of fractures, where the portion of the image (in red or darker colors) is considered to be the profile of a fracture (however power lines and fences can create noise within this image).

ANALYSIS

The study area is an upland pine and deciduous forest with shallow topographic relief. Seventeen borings have been drilled in this area and all borings show the presence of fractures in the subsurface (**Appendix A**). Bedrock consists of hard and brittle metavolcanic rocks of Late Proterozoic age (Butler, 1989). Horton and Dicken (2001) considered these rocks to be Middle Paleozoic to Neoproterozoic in age and called them metagabbro. Exposures of loose rocks, since there were no exposures of bedrock, indicated that the subsurface consisted of gneiss and quartz-bearing rocks.

Two 100-foot long parallel lineaments of Jurassic-aged (?) diabase dikes are exposed along the eastern portion of the property (**Figure 2**). These dikes, presumably emplaced through a fracture, trend N6°E; however, no dip direction was noted. VLF mapping paralleled the fracture trend of the diabase dikes with the dip directions determined by the VLF survey.

The VLF profiles show that this area is quite fractured (**Figure 2**). Eleven fracture sets are interpreted to exist in this area. These fractures have been modeled to trend up to 6° east of north and dip up to 70°, or subparallel to parallel of the diabase dikes.

A large anomaly that may represent an ore body or a very thick magnetic diabase dike occurs at the beginning of VLF Line 1 and the end of VLF Line 4 (**Figure 2**). No additional information is available concerning the anomaly except that it trends parallel to the fracture traces.

Should you have any questions or require additional information, please contact our office at (724) 325-3996 or via e-mail pjh@geo-image.com.

Sincerely,
THG Geophysics, Ltd.

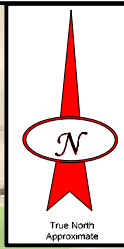
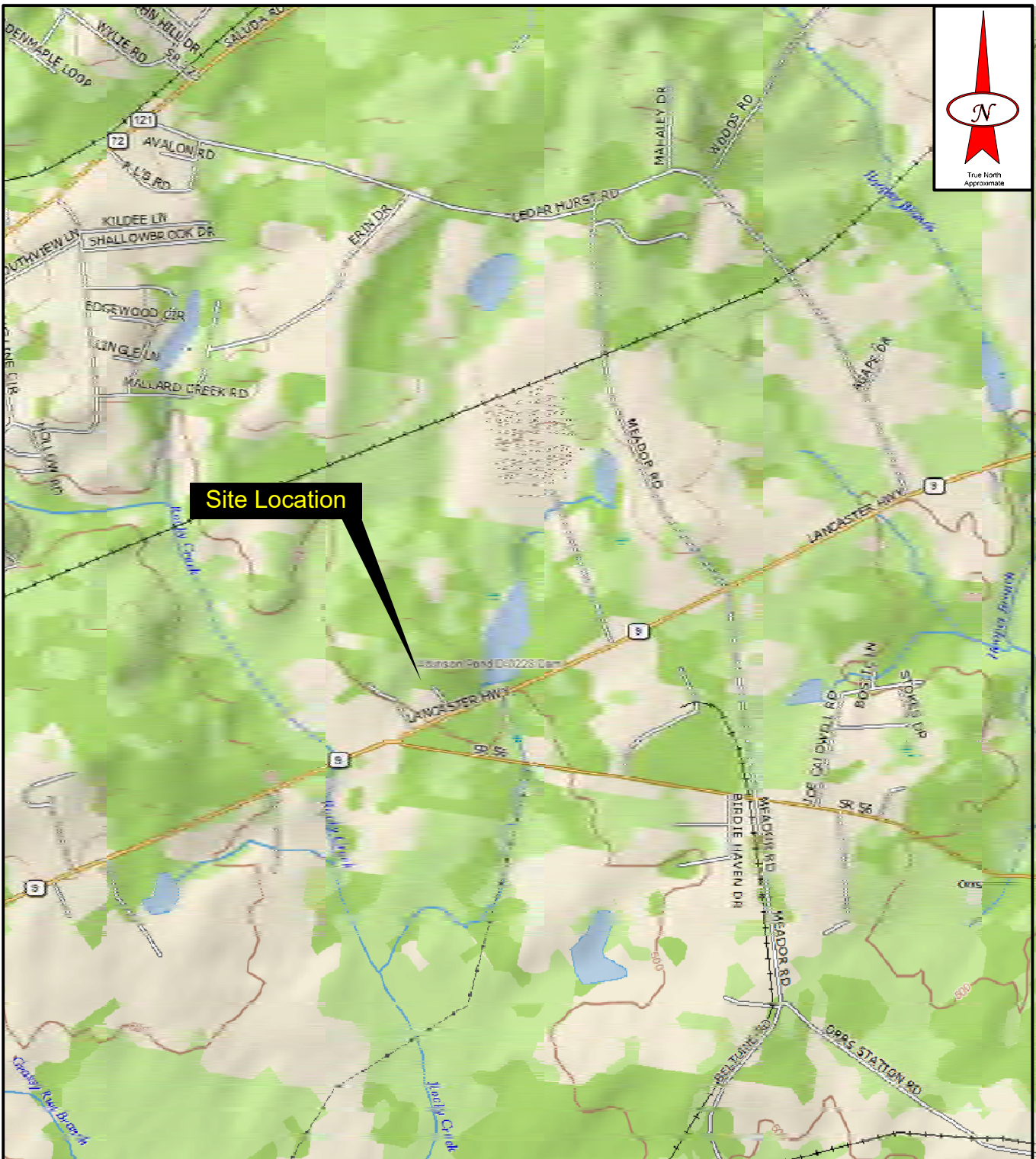
Peter J. Hutchinson

Peter J. Hutchinson, PhD, PG

References

- Butler, J. R. (1989). Geologic map of Chester County, S.C. (1:125,000); South Carolina Geological Survey Open-File Report 63.
- deGroot-Hedlin, C. and Constable, S., 1990, Occam's inversion to generate smooth, two-dimensional models from magnetotelluric data. *Geophysics*, V. 55, 1613-1624.
- Horton, J. W., and C. L. Dicken. (2001). Preliminary Geologic Map of the Appalachian Piedmont and Blue Ridge, South Carolina Segment: US Geological Survey Open File Report 01-298.
- Karous and Hjelt (1983) Linear filtering of VLF dip-angle measurements: *Geophysical Prospecting*, v. 31, p. 782-794.
- Loke, M. N., and Barker, R. D., 1996, Rapid least-squares inversion of apparent resistivity pseudosection by quasi-Newton method. *Geophysical Prospecting*, V. 44, 131-152.
- Reynolds, J. M. (1997). An Introduction to Applied and Environmental Geophysics. New York, NY, Wiley.

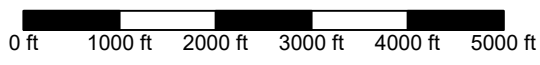
Geophysical investigations are a non-invasive method of interpreting physical properties of the shallow earth using electrical, electromagnetic, or mechanical energy. This document contains geophysical interpretations of responses to induced or real-world phenomena. As such, the measured phenomenon may be impacted by variables not readily identified in the field that can result in a false-positive and/or false-negative interpretation. THG makes no representations or warranties as to the accuracy of these interpretations.



Site Location



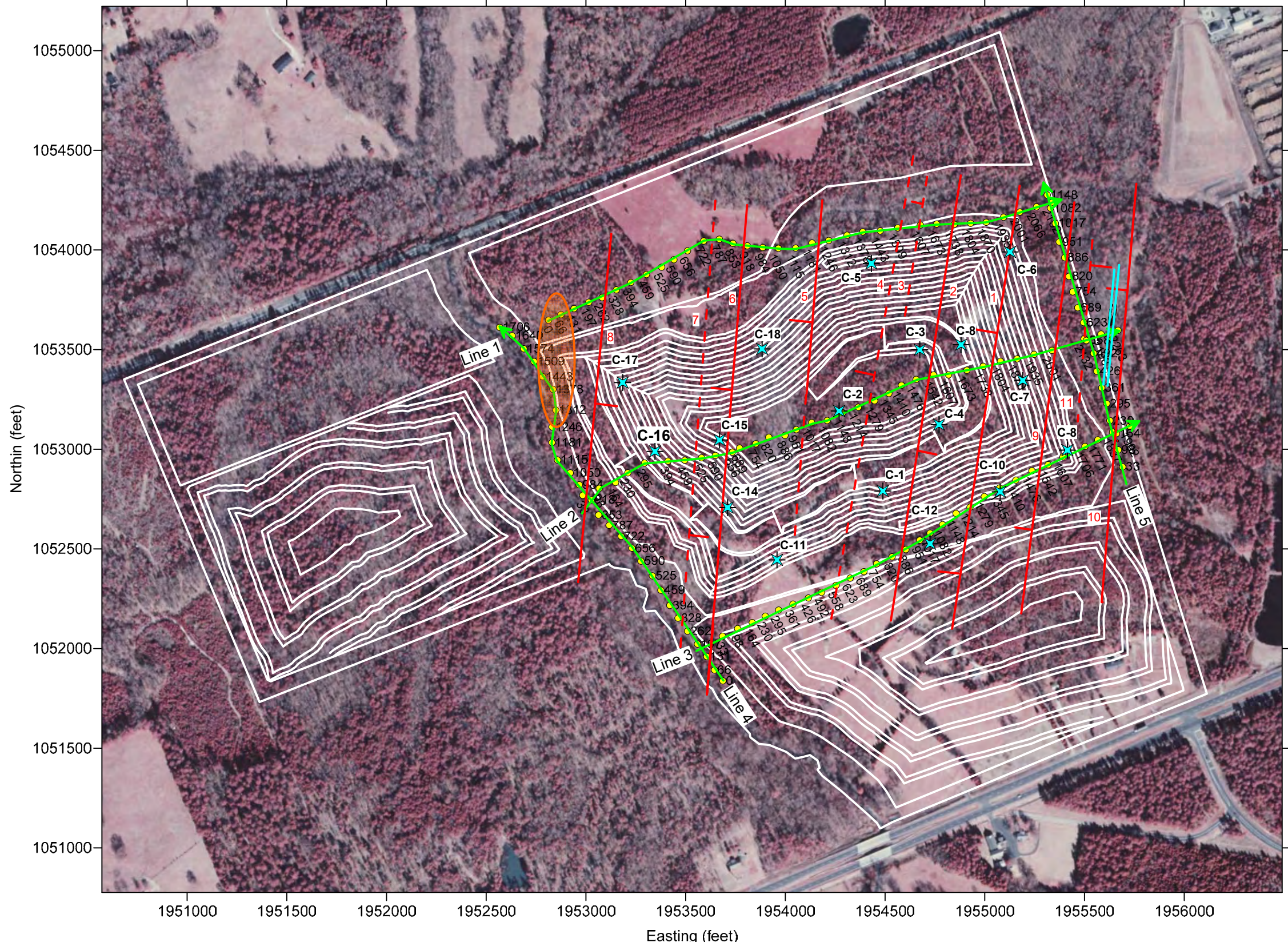
4280 Old William Penn Hwy
 Murrysville, Pennsylvania 15668
 (724) 325-3996 Fax: (724) 733-7901
 www.thggeophysics.com



**Figure 1
 Site Location Map**

**Geophysical Investigation
 Proposed Lucky Stone Quarry
 Chester, South Carolina**

| | | |
|-----------------|--|-------------------------|
| SCALE: 1:24,000 | PROJECT NO.: 459-10107 | DRAWING NO.: DWG10107F1 |
| DATE: 1/31/2019 | | |
| DRAWN BY: DJH | SOURCE: 1983 Chester (SC) USGS 7.5 Minute Topographic Quadrangle | |
| CHECKED BY: PJH | | |



Legend

- Line 1 VLF Profile
Showing collection direction and distance along profile
- Jurassic-aged(?) Diabase Dike
- Numbered Fracture
Showing dip direction
Dashed where poorly developed
- Interpreted Ore Body
- Existing boring

Notes

Geophysical survey conducted February 13, 2019 using ABEM Wadi Very Low Frequency (VLF) meter.

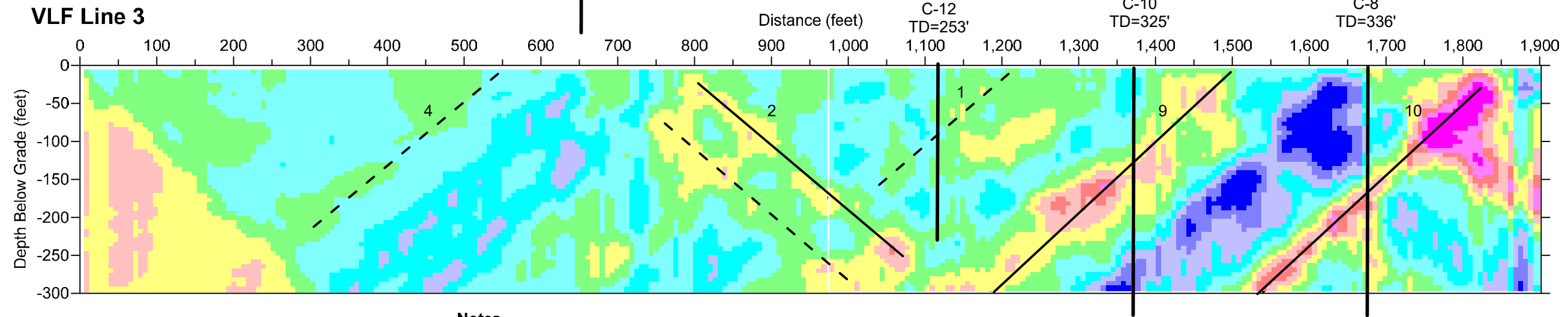
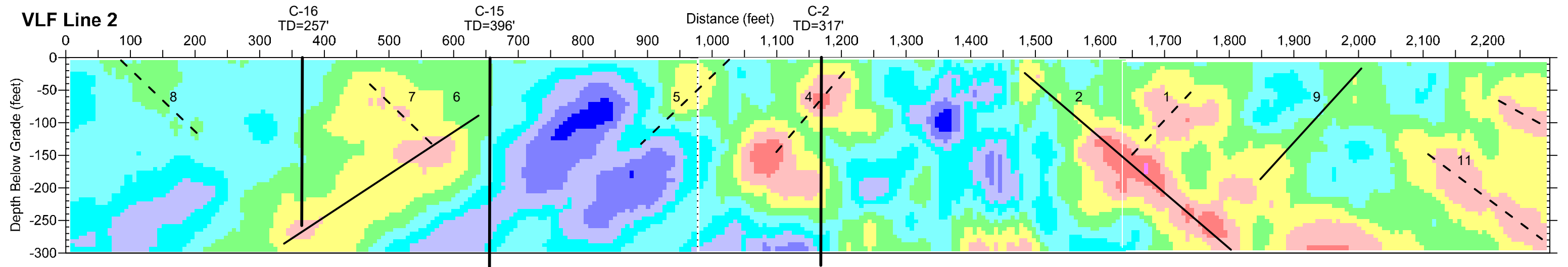
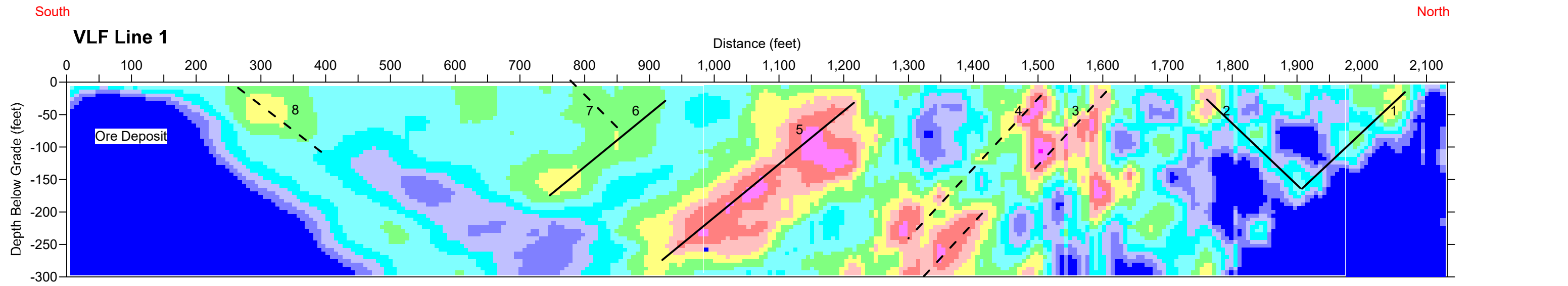
Real-time positioning of data using fully integrated Trimble Geo7X global positioning system set to NAD 1983 US State Plane (South Carolina) coordinate system in US Survey feet.

The numbers on each profile line are in feet.

Locations are approximate.

GEOPHYSICS 4280 Old William Penn Hwy
Murrysville, Pennsylvania 15668
(724) 325-3996 Fax: (724) 733-7901
www.thgeophysics.com

| | | | | | |
|------------|-----|---------|---------------|---|--|
| DRN | PJH | 2/19/19 | PROJECT: | Geophysical Investigation Proposed Lucky Stone Quarry Chester, South Carolina | |
| DES | PJH | 2/19/19 | DRAWING NO.: | Figure 2 Location Map Showing VLF Profile locations | |
| CHK | PJH | 2/19/19 | SCALE: | 1 in = 550 ft | |
| REV | | | SOURCE: | SCDNR | |
| PROJ. MGR. | PJH | 2/19/19 | PREPARED FOR: | S&ME | |
| | | | PROJECT NO.: | 459-10107 | |
| | | | SHEET TITLE: | DWG10107F2 | |



Legend

- Major Fracture
- Minor Fracture
- Fracture No. (see Fig. 2)

Notes

Geophysical survey conducted February 13, 2019 using ABEM Wadi Very Low Frequency (VLF) meter.

Real-time positioning of data using fully integrated Trimble Geo7X global positioning system set to NAD 1983 US State Plane (South Carolina) coordinate system in US Survey feet.

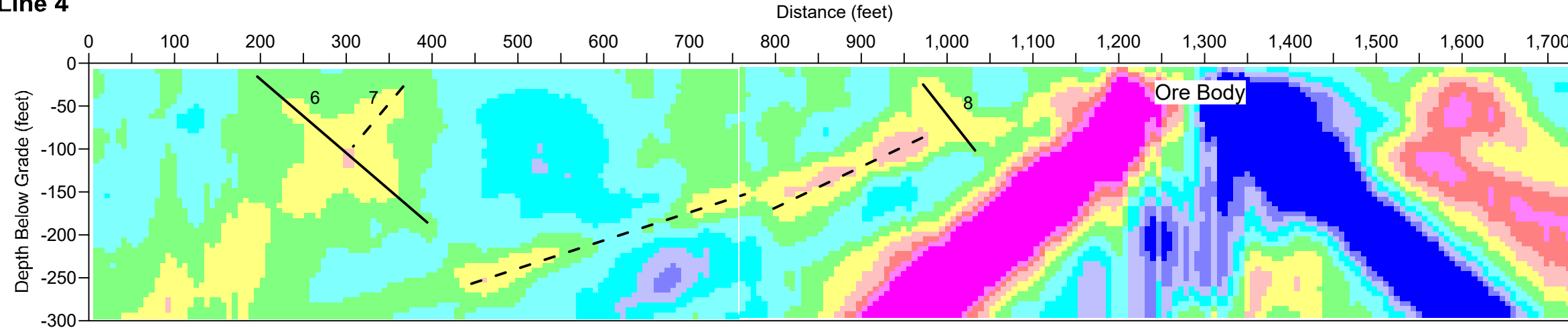
No vertical Exaggeration
 Vertical 1" = 150'
 Horizontal 1" = 150'

| | | |
|---|--|--|
| 4280 Old William Penn Hwy Murrysville, Pennsylvania 15668 (724) 325-3996 Fax: (724) 733-7901 www.thggeophysics.com | | |
| DRN: PJH 2/14/2019 DES: PJH 2/14/2019 CHK: PJH 2/18/2019 REV: PROJ. MGR.: PJH 2/18/2019 | PROJECT: Geophysical Investigation Proposed Lucky Stone Quarry Chester, South Carolina | |
| SCALE: 1 in = 150 ft SOURCE: | DRAWING NO.: Figure 3 VLF Profiles 1, 2, and 3 | |
| PREPARED FOR: | PROJECT NO.: 459-10107 SHEET TITLE: DWG10107F3 | |

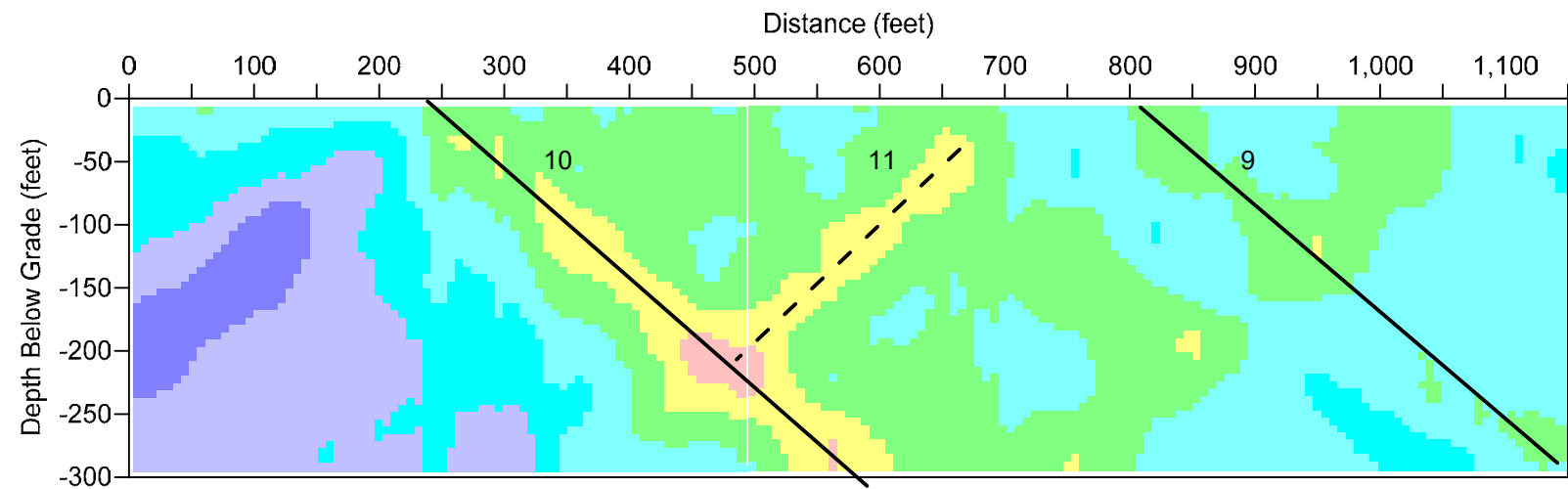
Southeast

Northwest




VLF Line 4



VLF Line 5



Legend



-  Major Fracture
-  Minor Fracture
-  Fracture No. (see Fig. 2)

Notes

Geophysical survey conducted February 13, 2019 using ABEM Wadi Very Low Frequency (VLF) meter.

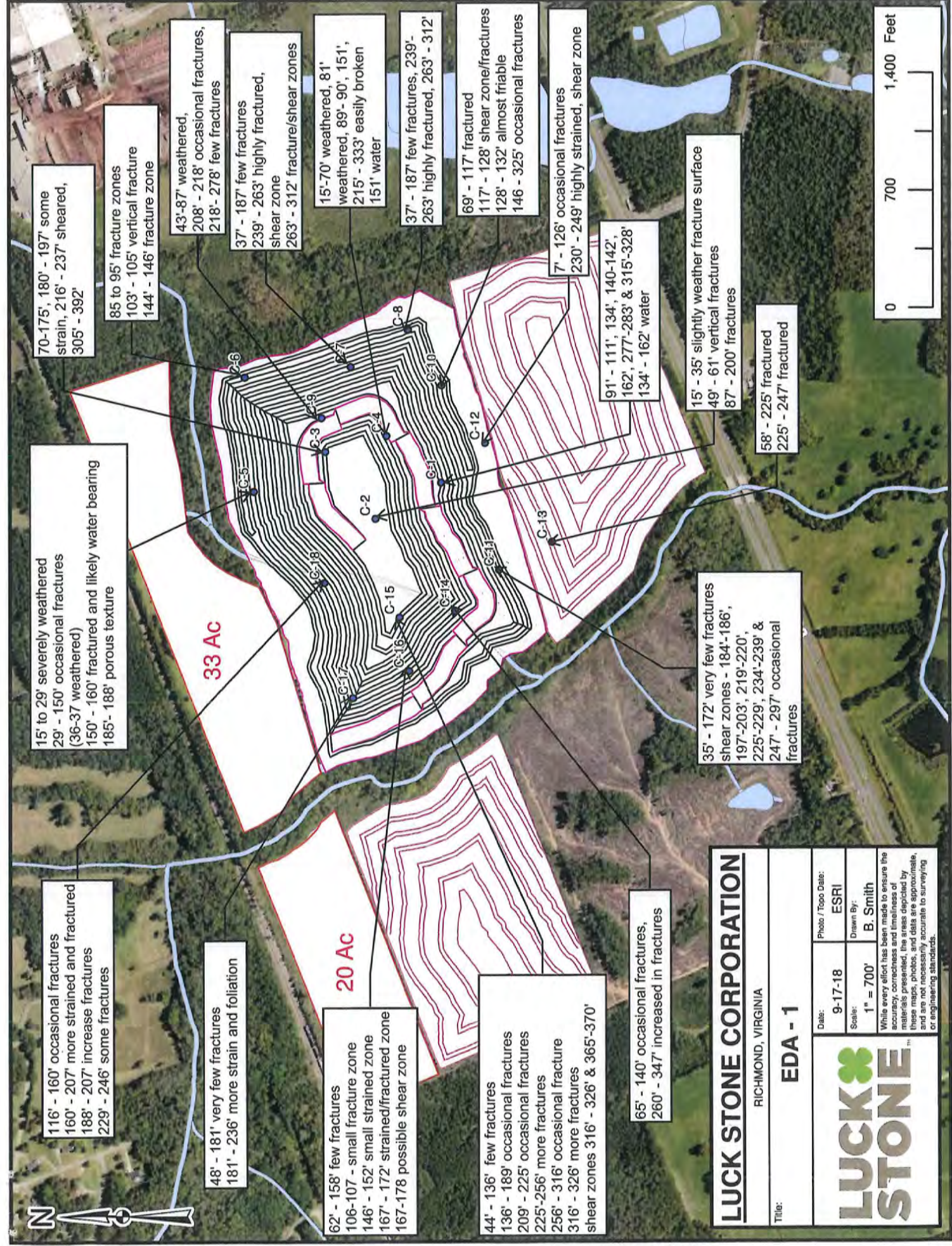
Real-time positioning of data using fully integrated Trimble Geo7X global positioning system set to NAD 1983 US State Plane (South Carolina) coordinate system in US Survey feet.

No vertical Exaggeration
Vertical 1" = 150'
Horizontal 1" = 150'

| | | | |
|---|-----|-----------|---|
|  4280 Old William Penn Hwy Murrysville, Pennsylvania 15668 (724) 325-3996 Fax: (724) 733-7901 www.thsgeophysics.com | | | |
| DRN | PJH | 2/14/2019 | PROJECT: Geophysical Investigation Proposed Lucky Stone Quarry Chester, South Carolina |
| DES | PJH | 2/14/2019 | |
| CHK | PJH | 2/18/2019 | |
| REV | | | |
| PROJ. MGR. | PJH | 2/18/2019 | |
| SCALE: 1 in = 150 ft | | | DRAWING NO.: Figure 3 VLF Profiles 4 and 5 |
| PREPARED FOR:  | | | PROJECT NO.: 459-10107 SHEET TITLE: DWG10107F3 |

APPENDIX A

Lucky Stone Boring Map
And
Boring Description



116' - 160' occasional fractures
 160' - 207' more strained and fractured
 188' - 207' increase fractures
 229' - 246' some fractures

15' to 29' severely weathered
 29' - 150' occasional fractures
 (36-37 weathered)
 150' - 160' fractured and likely water bearing
 185' - 188' porous texture

70-175', 180' - 197' some strain, 216' - 237' sheared, 305' - 392'

85 to 95' fracture zones
 103' - 105' vertical fracture
 144' - 146' fracture zone

43'-87' weathered,
 208' - 218' occasional fractures,
 218' - 278' few fractures

37' - 187' few fractures
 239' - 263' highly fractured,
 shear zone
 263' - 312' fracture/shear zones

15'-70' weathered, 81'
 weathered, 89'- 90', 151',
 215' - 333' easily broken
 151' water

37' - 187' few fractures, 239'-
 263' highly fractured, 263' - 312'

69' - 117' fractured
 117' - 128' shear zone/fractures
 128' - 132' almost friable
 146 - 325' occasional fractures

7' - 126' occasional fractures
 230' - 249' highly strained, shear zone

91' - 111', 134', 140-142',
 162', 277'-283' & 315'-328'
 134' - 162' water

15' - 35' slightly weather fracture surface
 49' - 61' vertical fractures
 87' - 200' fractures

58' - 225' fractured
 225' - 247' fractured

35' - 172' very few fractures
 shear zones - 184'-186',
 197'-203', 219'-220',
 225'-229', 234'-239' &
 247' - 297' occasional
 fractures

65' - 140' occasional fractures,
 260' - 347' increased in fractures

48' - 181' very few fractures
 181' - 236' more strain and foliation

62' - 158' few fractures
 106-107 - small fracture zone
 146' - 152' small strained zone
 167' - 172' strained/fractured zone
 167-178 possible shear zone

44' - 136' few fractures
 136' - 189' occasional fractures
 209' - 225' occasional fractures
 225'-256' more fractures
 256' - 316' occasional fracture
 316' - 326' more fractures
 shear zones 316' - 326' & 365'-370'

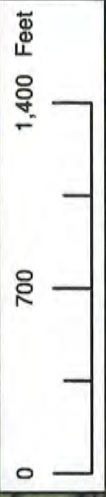
LUCK STONE CORPORATION
 RICHMOND, VIRGINIA

Title: **EDA - 1**

| | | | |
|--------|-----------|--------------------|----------|
| Date: | 9-17-18 | Photo / Topo Date: | ESRI |
| Scale: | 1" = 700' | Drawn By: | B. Smith |

While every effort has been made to ensure the accuracy, correctness and timeliness of materials presented, the areas depicted by these maps, photos, and data are approximate, and are not necessarily accurate to surveying or engineering standards.

LUCK STONE



| Sample ID | Total depth | Top of PWR | Top of Hard Rock | Water bearing | Notes: |
|-----------|-------------|------------|---------------------------|---|--|
| EDA-C-1 | 337' | 35' | 45' | fractures 134 - 162 may be water bearing | 35'-91' - weathered zones and low Recovery 91'-111' Fractured with some staining Fractured zones 134', 140' - 142', 162' shear zone 277'-283' & 315' - 328' |
| EDA-C-2 | 317' | 15' | 35' | | 15' - 35' slightly weather/staining on fracture surface 49' - 61' vertical fractures 87' - 200' some white mineralization filling fractures 70' - 175' occasional fractures with green/white coating 180' - 197' some strained zones 216' - 237' some sheared/gneissic texture 350' - 392 fractured and altered with some red/pink mineralization. |
| EDA-C-3 | 429' | 35' | 70' | | 15' - 70' highly weathered, weathered streak at 81' & 89' - 90' with occasional high angle fracture with green-white mineralization. 151' water bearing fracture 215' - 333' relatively easily broken 215' - 262' highly broken by drilling 15' to 29' severely weathered |
| EDA-C-4 | 416' | 15' - 70' | 70' some hard rock at 15' | 151' water bearing fracture | 29' - 150' occasional fractures with 36-37 slight weathered zones 150' - 160' fractured and likely water bearing, some vertical fractures 185' - 188' porous texture 85 to 95' fracture zones 103' - 105' vertical fracture 144' - 146' fracture zone |
| EDA-C-5 | 217' | 15' | 29' | 150' - 160' Fractured, likely water bearing | 25' - 37' slightly to moderately weathered 37' - 187' few fractures 239' - 263' highly fractured, shear zone 263' - 312' fracture/shear zones |
| EDA-C-6 | 307' | 15' | 20' | | 40' - 66' moderately to severely weathered 66' - 73' red powderly mineralization on fracture surfaces 82' - 99' weathered, low recovery 99' - 130' shear zone, soft rock easily broken 161' - 179' increase in fractures with green white mineralization 43' - 53' some weathering 66' - 80' some weathered |
| EDA-C-7 | 312' | 25' | 37' | | 208' - 218' occasional fractures with green-white mineralization 218' - 278' few fractures |
| EDA-C-8 | 336' | 40' - 66' | 40' | 220' - 230' minor water bearing fracture zone | 20' - 39' moderately to high weathered 69' - 117' fractured with pink mineralized surfaces 117' - 128' shear zone/fractures 128' - 132' almost friable, pink mineralized 146 - 325' occasional green-white mineral filling fractures |
| EDA-C-9 | 307' | 10' - 101' | 10' | | |
| EDA-C-10 | 325' | 20' | 39' | | |

| | | | | |
|----------|------|-----|-----|--|
| EDA-C-11 | 297' | 30' | 35' | 35' - 172' very few fractures shear zones 184'-186', 197'-203', 219'-220', 225'-229', 234'-239' 247' - 297' occasional fractures with green-white filling 37' - 47' very soft saproilite 47' - 126' occasional high angle fractures 230' - 249' highly strained, shear zone, mineralized 58' - 225' fractured, mostly high angle fractures, white-green mineralization in fractures 225' - 247' fractured |
| EDA-C-12 | 253' | 37' | 37' | 36' - 45' few fractures 65' - 130' occasional fractures 130' - 140' occasional green mineral filled fractures 260' - 347' increase in fractures and green filling 7' - 44' weathered rock |
| EDA-C-13 | 247' | ? | 58' | 44' - 136' few fractures 136' - 189' occasional green mineralization fractures 209' - 225' occasional green mineralization fractures 225' - 256' more green mineralization fractures 256' - 316' occasional green mineralization fractures 316' - 326' more green mineralization fractures shear zones 316' - 326' & 365'-370' 62' - 158' few fractures |
| EDA-C-14 | 347' | ? | 35' | 106-107 - small fracture zone 146' - 152' small strained zone 167' - 172' strained/fractured zone 167-178 possible shear zone 40' - 48' slight to moderately weathered 48' - 181' very few fractures 181' - 236' more strain and foliation |
| EDA-C-15 | 396' | 7' | 44' | 45' - 87' moderately weathered, weathering associated with fractures 116' - 160' occasional fractures 160' - 207' more strained and fractured 188' - 207' increase in green-white mineralization in fractures 229' - 246' some green mineralized fractures |
| EDA-C-16 | 257' | ? | 63' | |
| EDA-C-17 | 256' | ? | 40' | |
| EDA-C-18 | 146' | ? | 46' | |

Appendix IV – Well Permit and Well Records



Monitoring Well Approval

Approval is hereby granted to: S&ME, Inc.
Attention: David R. Loftis, P.E.

Facility: S&ME, Inc. – TMS#: 089-00-00-002-000
Chester County

This approval is for the installation of a monitoring well, identified and located as specified and in accordance with the construction plans and specifications described in the monitoring well application (enclosed). This well is to be used for water quality monitoring prior to a quarry construction and operation.

Conditions:

1. The well shall be drilled, constructed, and abandoned by a South Carolina certified well driller per R.61-71.D.1.
2. The well shall be properly developed per R.61-71.H.2.d. A Water Well Record Form (DHEC 1903) and drillers/geologists logs shall be completed and submitted within 30 days after well completion or abandonment unless another schedule has been approved by DHEC. The form should contain the "as-built" construction details and all other information required by R.61-71.H.1.f.
3. All analytical data and water levels obtained from the monitoring well shall be submitted to the author of the approval within 30 days of receipt of laboratory results unless another schedule has been approved by DHEC as required by R.61-71.H.1.d.
4. The monitoring well shall be labeled, as required by R.61-71.H.2.c.

This approval is pursuant to the provisions of Section 44-55-40 of the 1976 South Carolina Code of Laws and R.61-71 of the South Carolina Well Standards and Regulations, effective May 27, 2016.

Date of Issuance: May 16, 2019

Joe Koon, Manager
Mining & Reclamation Program
Division of Mining and Solid Waste Management
Bureau of Land & Waste Management



May 13, 2019

South Carolina Department of Health and Environmental Control
Mining Reclamation
2600 Bull Street
Columbia, South Carolina 29201

Attention: Mr. Joe Koon
Mining Section Manager

koonjm@dhec.sc.gov

Reference: **Well Permit Submittal**
Chester Mine Site
Chester, Chester County, North Carolina
S&ME Project No. 4341-18-019

Dear Mr. Koon:

S&ME, Inc. (S&ME) is currently assisting Luck Stone with site evaluation services associated with a proposed aggregate mine in Chester County, North Carolina. Included in our evaluation services will be the completion of an aquifer pump test and development of a numerical groundwater model to evaluate the potential impacts of dewatering and groundwater extraction activities at the site.

Prior to performing the pump test, S&ME will install four groundwater extraction/observation wells to a depth on the order of 500 feet below grade. The wells will be constructed with a 6-inch diameter galvanized steel surface casing (to rock) and the remaining portion of the well will be comprised of 6-inch open borehole within the competent rock formation. Groundwater pump testing will be performed to gather pertinent aquifer data. Drilling activities are tentatively scheduled to begin on June 3, 2019.

Per your request, I have attached the completed D-3736 form and supporting figures to aid in your review of the application. S&ME appreciates your assistance with this project. Please do not hesitate to contact David Loftis at (828) 483-3012 with any questions.

Sincerely,

S&ME, Inc.

A blue ink signature of David R. Loftis, P.E.

David R. Loftis, P.E.
Senior Engineer (SC #27867)

A blue ink signature of Edmund Q.B. Henriques.

Edmund Q.B. Henriques
Principal Geologist (NC)

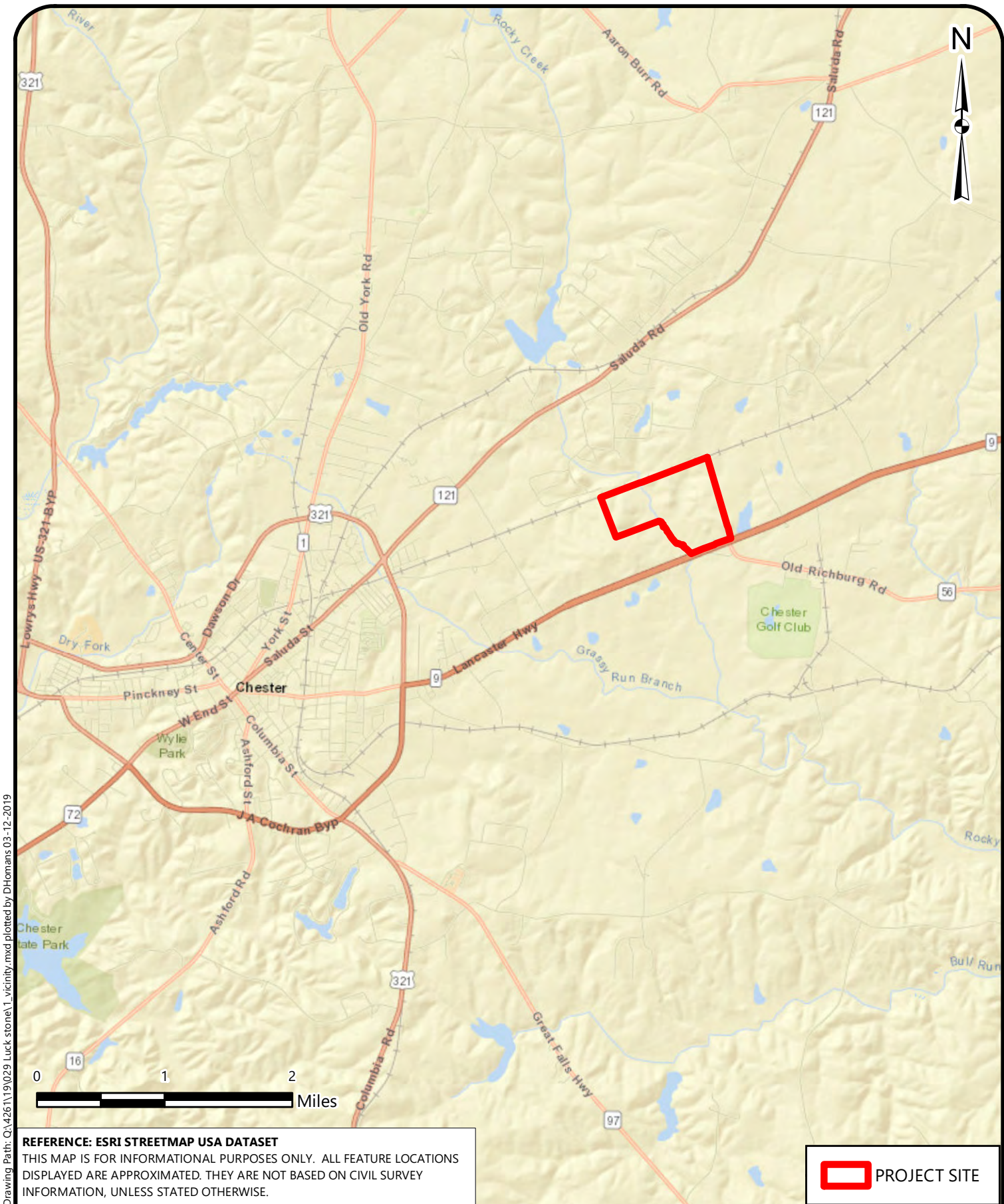
Attachments: D-3736
Supporting Figures (4)

cc: Mr. Bruce Smith, Luck Companies



Monitoring Well Application


| | | | |
|--|--|---|--|
| 1. Proposed Location of Monitoring Well(s): Street Address: City (including Zip): County: Please attach Scaled Map or Plat | | 5. Intended Purpose of Well(s): Pre-Purchase Investigation Program Area: Project or Site ID #: | NOTE: If this request is for an existing DHEC project, please enter the Program area and ID number below. |
| 2. Well Owner's Information: Name (Last then First): Company: Complete Address: Telephone Number: | | 6. Proposed number of monitoring wells: | |
| 3. Property Owner's Information: Check if same as Well Owner Name (Last then First): Company: Address: Telephone Number: | | 7. Proposed parameters to be analyzed (check all that apply), please specify analytical method beside check box: VOCs BTEX MtBE Naphthalene PAHs Metals Nitrates Base, Neutral & Acid Ex. Pesticides/Herbicides Phenols Radionuclides PCBs Other (<u>specify below</u>) | |
| 4. Proposed Drilling Date: | | 8. Proposed construction details (complete and attach proposed monitoring well schematics): | |

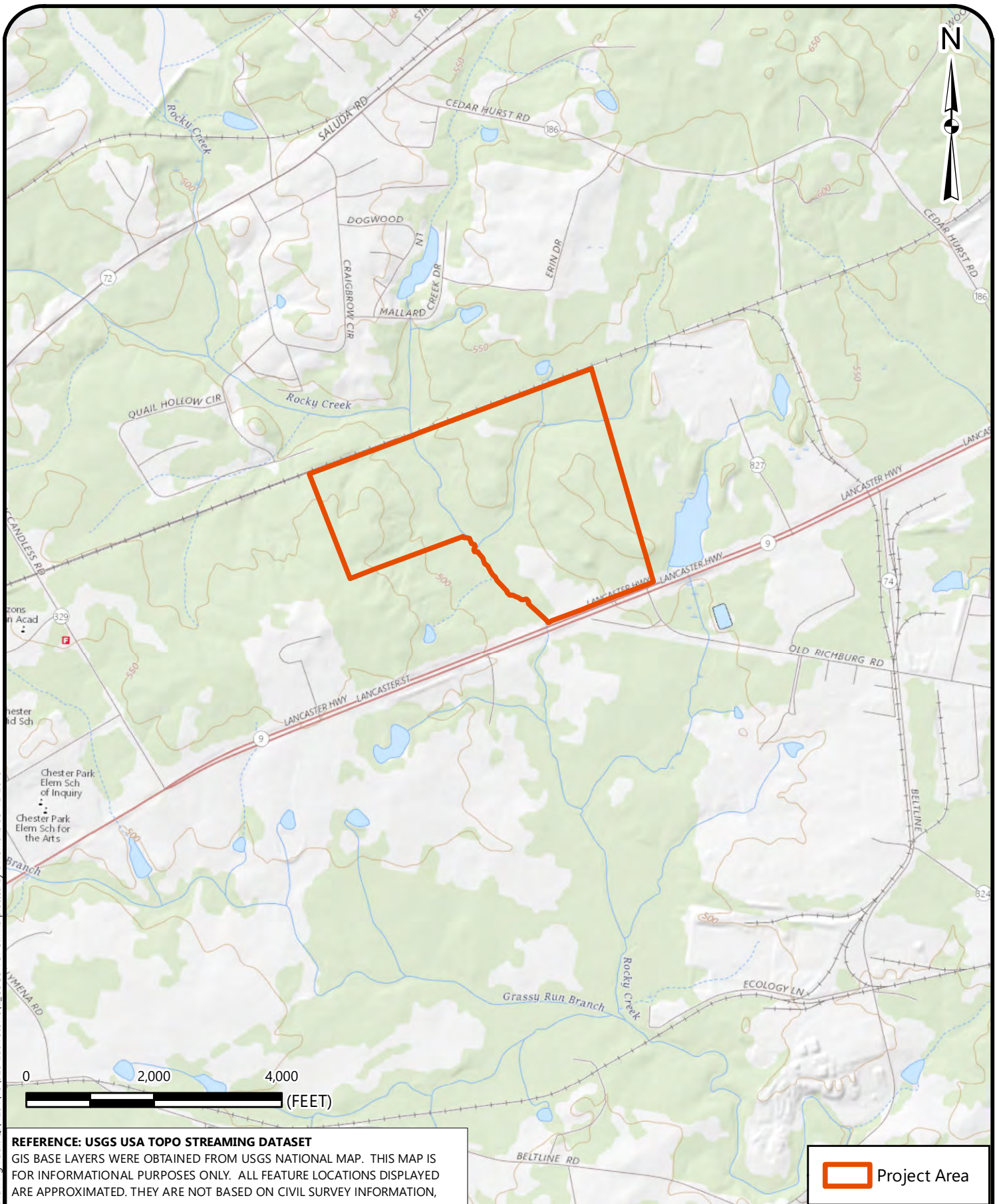


Drawing Path: Q:\4261\19\029 Luck stone\1_vicinity.mxd plotted by:DHomans 03-12-2019

REFERENCE: ESRI STREETMAP USA DATASET
 THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

 PROJECT SITE


| | | | |
|---|--|---|------------|
|  | VICINITY MAP | SCALE: 1" = 1.0 miles | FIGURE NO. |
| | LUCK STONE CHESTER COUNTY, SOUTH CAROLINA | DATE: 3-12-19 PROJECT NUMBER 4261-19-029 | 1 |



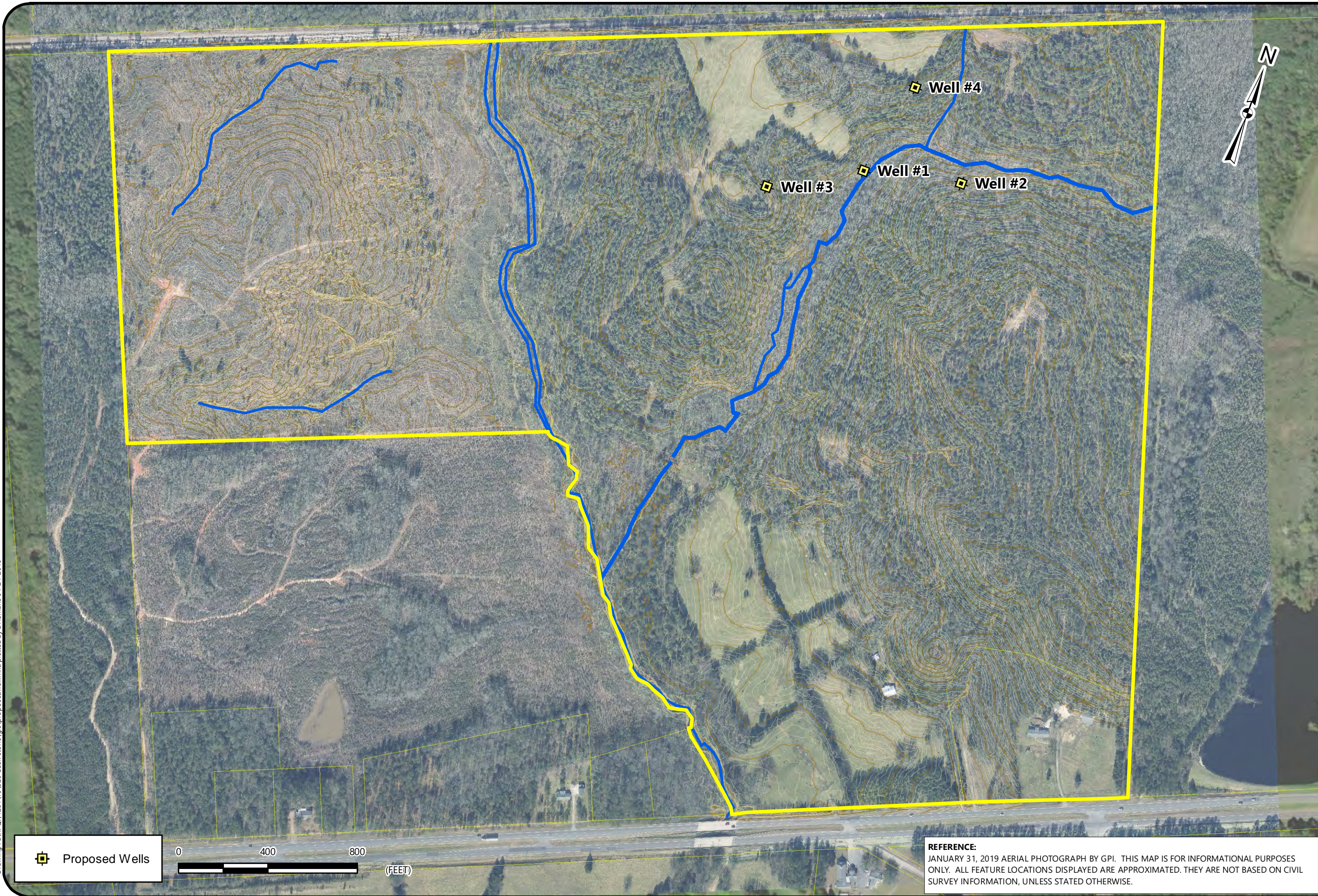
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REFERENCE: USGS USA TOPO STREAMING DATASET
 GIS BASE LAYERS WERE OBTAINED FROM USGS NATIONAL MAP. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION.

 Project Area

| | | | |
|---|--|---|----------------------------|
|  | USGS TOPOGRAPHIC MAP | SCALE: 1" = 2,000' | FIGURE NO. 2 |
| | LUCK STONE CHESTER COUNTY, SOUTH CAROLINA | DATE: 3-12-19 PROJECT NUMBER 4261-19-029 | |

Drawing Path: Q:\4261\19\029 Luck stone\gis\proposedwell.mxd plotted by Dhlomans 04-24-2019



PROPOSED WELL LOCATION MAP

LUCK STONE
CHESTER COUNTY, SOUTH CAROLINA

SCALE:
1" = 400'

DATE:
4-24-19

PROJECT NUMBER
4261-19-029

FIGURE NO.

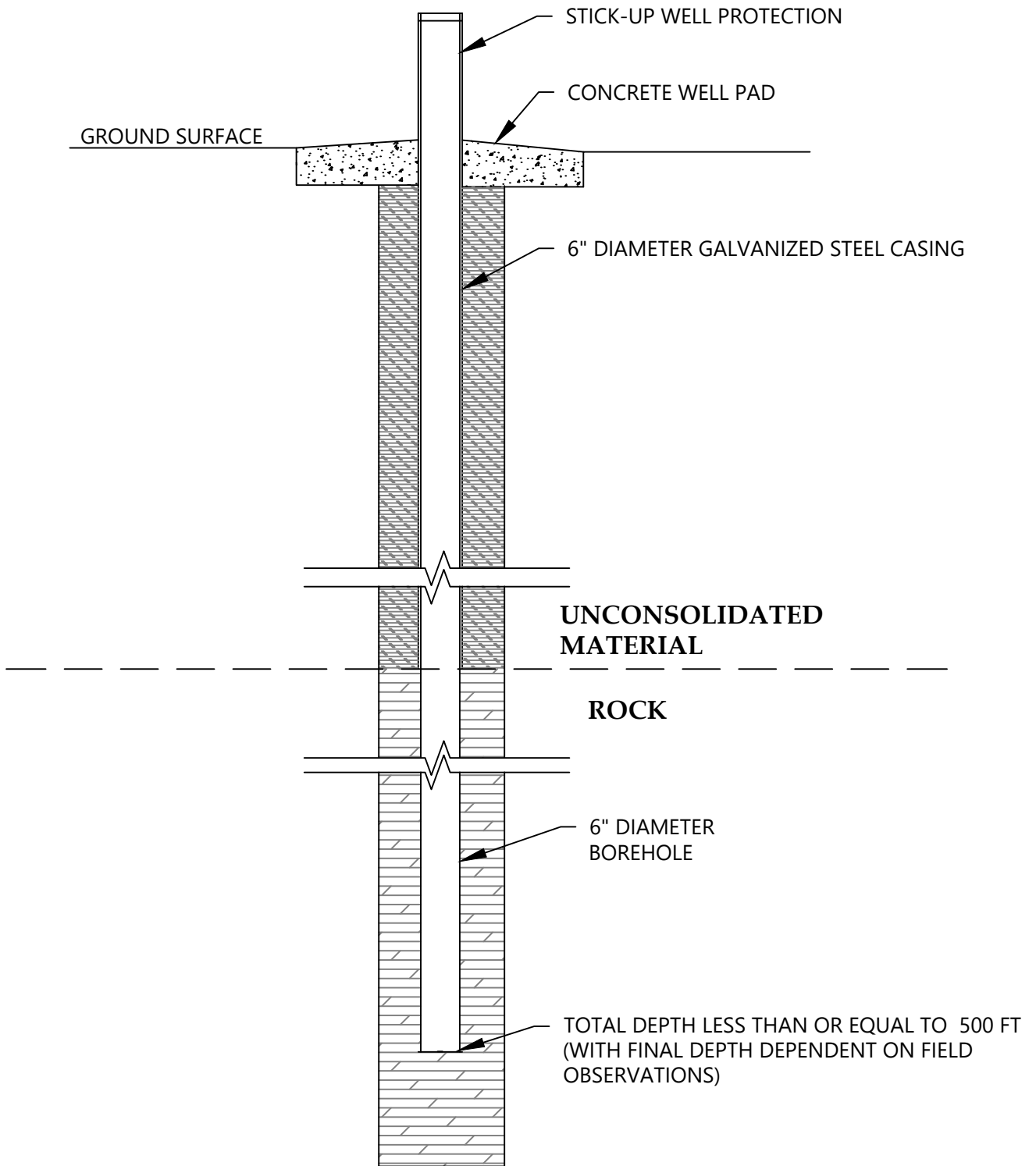
3

 Proposed Wells



REFERENCE:
JANUARY 31, 2019 AERIAL PHOTOGRAPH BY GPI. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

Drawing Path: Q:\4261\19\029 Luck stone\DWG\PROPOSED WELL SCHEMATIC.dwg



PROPOSED WELL SCHEMATIC

LUCK MINE
CHESTER, SOUTH CAROLINA

SCALE:

NTS

DATE:

MAY 2019

PROJECT NUMBER

4261-19-029

FIGURE NO.

4



Water Well Record
Bureau of Water

2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

1. WELL OWNER INFORMATION:

Name: Smith (last) Bruce (first)
Address: Luck Companies
PO Box 29682
City: Richmond VA Zip: 23242
Telephone: Work: 804-476-6406 Home:

2. LOCATION OF WELL:

COUNTY: Chester
Name: Floyd, William C
Street Address: Tm# 089-00-00-002-000
City: 1295 Lancaster Hwy
Chester SC 29706
Latitude: Longitude:

3. PUBLIC SYSTEM NAME:

PUBLIC SYSTEM NUMBER:

4. ABANDONMENT: Yes No

Give Details Below

Grouted Depth: from ft. to ft.

Table with 3 columns: Formation Description, Thickness of Stratum, Depth to Bottom of Stratum. Rows include Sandy Silt, Brown; Brown Sand; Pea Gravel; Blue Granite; and Water Bearing Zones (35-40, 100-105).

5. REMARKS:

- 6. TYPE: Mud Rotary, Dug, Cable tool, Jetted, Air Rotary, Other, Bored, Driven

7. PERMIT NUMBER:

Monitor Well = Drilling RW-1

8. USE:

- Residential, Irrigation, Test Well, Public Supply, Air Conditioning, Monitor Well, Process, Emergency, Replacement

9. WELL DEPTH (completed)

450 ft.

Date Started: 6-4-19

Date Completed: 6-10-19

10. CASING: Threaded Welded

Diam.: 6
Type: PVC Galvanized, Steel Other
0 in. to 38 ft. depth

Height: Above/Below
Surface 1 ft.
Weight lb./ft.
Drive Shoe? Yes No

11. SCREEN:

Type: NA Diam.:
Slot/Gauge: Length:
Set Between: ft. and ft.
Sieve Analysis Yes (please enclose) No

NOTE: MULTIPLE SCREENS USE SECOND SHEET

12. STATIC WATER LEVEL

5 ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface:

ft. after hrs. Pumping G.P.M.
Pumping Test: Yes (please enclose) No
Yield: 100 GPM

14. WATER QUALITY

Chemical Analysis Yes No Bacterial Analysis Yes No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) Yes No

Installed from ft. to ft.
Effective size Uniformity Coefficient

16. WELL GROUTED? Yes No

Neat Cement Bentonite Bentonite/Cement Other
Depth: From 0 ft. to 38 ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 75+ ft. direction

Type:
Well Disinfected Yes No Type: bleach Amount: 1qt

18. PUMP: Date installed:

Not installed
Mr. Name: Model No.:
H.P. Volts Length of drop pipe ft. Capacity gpm
TYPE: Submersible Jet (shallow) Turbine
Jet (deep) Reciprocating Centrifugal

19. WELL DRILLER: William M. Faulkner

CERT. NO.: 510
Level: A B C D (circle one)

Address; (Print)
1000 MAIN STREET
SMYRNA, SC 29743
Telephone No.: 803-925-2221

Fax No.: 803-925-4024

20. WATER WELL DRILLER'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

Signed: William M. Faulkner III Date: 7/10/19
Well Driller

If D Level Driller, provide supervising driller's name:



Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

1. WELL OWNER INFORMATION:
Name: (last) (first)
Address:
City: State: Zip:
Telephone: Work: Home:

7. PERMIT NUMBER: monitor well = Drilling RW-1
8. USE:
Residential, Irrigation, Test Well, Public Supply, Air Conditioning, Monitor Well, Process, Emergency, Replacement

2. LOCATION OF WELL:
Name:
Street Address:
City: Zip:
Latitude: Longitude:

9. WELL DEPTH (completed) 450 ft. Date Started: 6-4-19 Date Completed: 6-10-19
10. CASING: Threaded, Welded, Diam.: 6, Type: PVC, Galvanized, Steel, Other, Height: Above/Below Surface, Weight, Drive Shoe?

3. PUBLIC SYSTEM NAME: PUBLIC SYSTEM NUMBER:

11. SCREEN: Type: NA, Diam., Slot/Gauge, Length, Set Between, Sieve Analysis, NOTE: MULTIPLE SCREENS USE SECOND SHEET

4. ABANDONMENT: Yes No, Give Details Below, Grouted Depth: from ft. to ft.

Table with 3 columns: Formation Description, *Thickness of Stratum, Depth to Bottom of Stratum

12. STATIC WATER LEVEL ft. below land surface after 24 hours
13. PUMPING LEVEL Below Land Surface, ft. after hrs. Pumping G.P.M., Pumping Test, Yield: GPM

14. WATER QUALITY: Chemical Analysis, Bacterial Analysis, Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) Yes No, Installed from ft. to ft., Effective size, Uniformity Coefficient

16. WELL GROUTED? Yes No, Neat Cement, Bentonite, Bentonite/Cement, Other, Depth: From ft. to ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 75+ ft. direction, Type, Well Disinfected Yes No, Type, Amount

18. PUMP: Date installed, Not installed, Mfr. Name, Model No., H.P., Voits, Length of drop pipe, Capacity, TYPE: Submersible, Jet (shallow), Turbine, Jet (deep), Reciprocating, Centrifugal

19. WELL DRILLER: William M. Faulkner, CERT. NO.: 510, Address: (Print) 1000 MAIN STREET, SMYRNA, SC 29743, Telephone No.: 803-925-2221, Fax No.: 803-925-4024, Level: A B C D (circle one)

*Indicate Water Bearing Zones (Use a 2nd sheet if needed) 125, 180, 200, 145, 185, 205

20. WATER WELL DRILLER'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

5. REMARKS:

Signed: Well Driller, Date:

6. TYPE: Mud Rotary, Dug, Cable tool, Jetted, Air Rotary, Other, Bored, Driven

If D Level Driller, provide supervising driller's name:



Water Well Record Bureau of Water

2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

1. WELL OWNER INFORMATION:
Name: **Luck Companies/Bruce Smith**
(last) (first)
Address: **PO Box 29682**
City: **Richmond** State: **VA** Zip: **23242**
Telephone: **804 476-6406** Home:

7. PERMIT NUMBER:
Monitor Well - RW-3

8. USE:
 Residential Public Supply Process
 Irrigation Air Conditioning Emergency
 Test Well Monitor Well Replacement

2. LOCATION OF WELL: COUNTY: **Chester**
Name: **Floyd, William C**
Street Address: **1295 Lancaster Hwy**
City: **TM# 089-00-00-002-000**
Chester SC 29706
Latitude: Longitude:

9. WELL DEPTH (completed) Date Started: **6-6-19**
450 ft. Date Completed: **6-10-19**

10. CASING: Threaded Welded
Diam.: _____ Height: Above/Below _____
Type: PVC Galvanized Surface _____ ft.
 Steel Other Weight _____ lb./ft.
0 in. to **52** ft. depth Drive Shoe? Yes No
_____ in. to _____ ft. depth

3. PUBLIC SYSTEM NAME: PUBLIC SYSTEM NUMBER:

11. SCREEN:
Type: **NA** Diam.: _____
Slot/Gauge: _____ Length: _____
Set Between: _____ ft. and _____ ft. NOTE: MULTIPLE SCREENS
USE SECOND SHEET
Sieve Analysis Yes (please enclose) No

4. ABANDONMENT: Yes No
Give Details Below
Grouted Depth: from _____ ft. to _____ ft.

12. STATIC WATER LEVEL **25** ft. below land surface after 24 hours

| Formation Description | *Thickness of Stratum | Depth to Bottom of Stratum |
|-----------------------|-----------------------|----------------------------|
| Brown Sandy Soil | 0 | 3 |
| Brown Sand | 3 | 17 |
| Brown/Gray Sand | 17 | 25 |
| Pea Gravel | 25 | 30 |
| Blue Granite | 30 | 450 |

13. PUMPING LEVEL Below Land Surface.
_____ ft. after _____ hrs. Pumping _____ G.P.M.
Pumping Test: Yes (please enclose) No
Yield: **25** GPM

14. WATER QUALITY
Chemical Analysis Yes No Bacterial Analysis Yes No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) Yes No
Installed from _____ ft. to _____ ft.
Effective size _____ Uniformity Coefficient _____

16. WELL GROUTED? Yes No
 Neat Cement Bentonite Bentonite/Cement Other _____
Depth: From _____ **0** ft. to _____ **52** ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: **75+** ft. direction _____
Type _____
Well Disinfected Yes No Type: **Bleach** Amount: **10+**

18. PUMP: Date installed: _____ Not installed
Mfr. Name: _____ Model No.: _____
H.P. _____ Volts _____ Length of drop pipe _____ ft. Capacity _____ gpm
TYPE: Submersible Jet (shallow) Turbine
 Jet (deep) Reciprocating Centrifugal

19. WELL DRILLER: **William M. Faulkner** CERT. NO.: **510**
Address: (Print) _____ Level: A B C D (circle one) _____
1000 MAIN STREET
SMYRNA, SC 29743
Telephone No.: **803-925-2221** Fax No.: **803-925-4024**

*Indicate Water Bearing Zones
(Use a 2nd sheet if needed)
17 25
70 85
95 105

20. WATER WELL DRILLER'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

5. REMARKS:

Signed: _____ Date: _____
Well Driller

6. TYPE: Mud Rotary Jetted Bored
 Dug Air Rotary Driven
 Cable tool Other

If D Level Driller, provide supervising driller's name:



Water Well Record
Bureau of Water
2600 Bull Street, Columbia, SC 29201-1708; (803) 898-4300

1. WELL OWNER INFORMATION:
Name: (last) (first)
Address:
City: State: Zip:
Telephone: Work: Home:

7. PERMIT NUMBER: RW-3
8. USE:
Residential Public Supply Process
Irrigation Air Conditioning Emergency
Test Well Monitor Well Replacement

2. LOCATION OF WELL: COUNTY:
Name:
Street Address:
City: Zip:
Latitude: Longitude:

9. WELL DEPTH (completed) Date Started: 6-6-19
450 ft. Date Completed: 6-10-19

10. CASING: Threaded Welded
Diam.:
Type: PVC Galvanized Steel Other
0 in. to 52 ft. depth
Height: Above/Below Surface 1 ft.
Weight lb./ft.
Drive Shoe? Yes No

3. PUBLIC SYSTEM NAME: PUBLIC SYSTEM NUMBER:

11. SCREEN:
Type: NA Diam.:
Slot/Gauge: Length:
Set Between: ft. and ft. NOTE: MULTIPLE SCREENS USE SECOND SHEET
Sieve Analysis Yes (please enclose) No

4. ABANDONMENT: Yes No
Give Details Below
Grouted Depth: from ft. to ft.

Table with 3 columns: Formation Description, Thickness of Stratum, Depth to Bottom of Stratum

12. STATIC WATER LEVEL ft. below land surface after 24 hours

13. PUMPING LEVEL Below Land Surface.
ft. after hrs. Pumping G.P.M.
Pumping Test: Yes (please enclose) No
Yield: GPM

14. WATER QUALITY
Chemical Analysis Yes No Bacterial Analysis Yes No
Please enclose lab results.

15. ARTIFICIAL FILTER (filter pack) Yes No
Installed from ft. to ft.
Effective size Uniformity Coefficient

16. WELL GROUTED? Yes No
Neat Cement Bentonite Bentonite/Cement Other
Depth: From ft. to ft.

17. NEAREST SOURCE OF POSSIBLE CONTAMINATION: 75+ ft. direction
Type
Well Disinfected Yes No Type: Amount:

18. PUMP: Date installed: Not installed
Mfr. Name: Model No.:
H.P. Volts Length of drop pipe ft. Capacity gpm
TYPE: Submersible Jet (shallow) Turbine
Jet (deep) Reciprocating Centrifugal

19. WELL DRILLER: William M. Faulkner CERT. NO.: 510
Address: (Print) Level: A B C D (circle one)
1000 MAIN STREET
SMYRNA, SC 29743
Telephone No.: 803-925-2221 Fax No.: 803-925-4024

*Indicate Water Bearing Zones
(Use a 2nd sheet if needed)
195 205
375 385

20. WATER WELL DRILLER'S CERTIFICATION: This well was drilled under my direction and this report is true to the best of my knowledge and belief.

5. REMARKS:

Signed: Date:
Well Driller

6. TYPE: Mud Rotary Jetted Bored
Dug Air Rotary Driven
Cable tool Other

If D Level Driller, provide supervising driller's name:

COMPLETION REPORT OF WELL No. RW-1

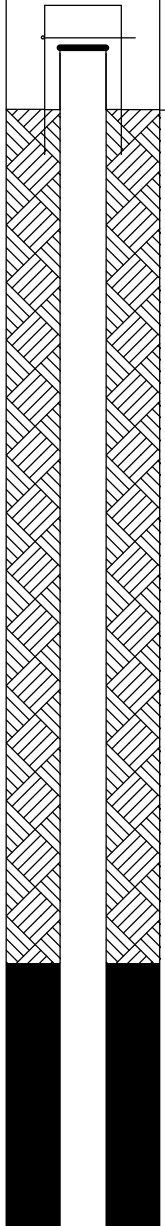
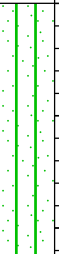

































PROJECT: **Luck Stone**
 PROJECT NO: **4261-19-029**
 PROJECT LOCATION: **Chester, South Carolina**

WATER LEVEL: **Water at 12.18 Ft-BTOC**

DRILLING CONTRACTOR: **Faulkner Well Drilling**
 DRILLING METHOD: **Air Rotary**
 DATE COMPLETED: **6/4/19**

LATITUDE:
 LONGITUDE:
 TOP OF CASING ELEVATION:
 DATUM:

LOGGED BY: **J. Peele**

| STRATA | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|--|---|---------|---|---|---|---|---|---|--|---|---------------|---|---------------------|---|--------------------|--|----------------------|---------------|---------------|----------------|------------------|----------------|-------------|----------------------|--------------|---------------|-----|------------------|----|-------------|----|--------------|
| DESCRIPTION | SYMBOL DEPTH (ft.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | |  | 0.00 | GS | | PROTECTIVE CASING Diameter: Type: Interval: | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 0.00 | CG | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 0 5 10 15 20 25 30 35 40 45 | | | | | RISER CASING Diameter: 6" Type: SCH 40 PVC Interval: -2.5 - 38 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SANDY SILT (ML) brown, dry |  | | | | | GROUT Type: #2 Grout Interval: 0 - 38 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SAND (SP) brown, gray, fine to coarse, wet/saturated, ~2 GPM |  | | | | | SEAL Type: Interval: | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PARTIALLY WEATHERED ROCK hard, gray, black, dark brown, gravelly sand size rock fragments |  | | | | | FILTERPACK Type: Interval: | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mafic Intermediate Metamorphic Rock Medium grained; black, gray, and white/tan; appears to be schist/mica schist. Fracture Zone (35 - 40 ft) ~5 GPM |  | | | | | SCREEN Diameter: Type: Interval: | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | 38.00 | BOC | | LEGEND | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> <table border="0"> <tr><td></td><td>FILTER PACK</td></tr> <tr><td></td><td>BEDROCK</td></tr> <tr><td></td><td>CEMENT GROUT</td></tr> <tr><td></td><td>CUTTINGS / BACKFILL</td></tr> <tr><td></td><td>STATIC WATER LEVEL</td></tr> </table> </td> <td style="width: 50%; vertical-align: top;"> <table border="0"> <tr><td>TOC</td><td>TOP OF CASING</td></tr> <tr><td>GS</td><td>GROUND SURFACE</td></tr> <tr><td>BS</td><td>BENTONITE SEAL</td></tr> <tr><td>BOC</td><td>BASE OF OUTER CASING</td></tr> <tr><td>TSC</td><td>TOP OF SCREEN</td></tr> <tr><td>BSC</td><td>BOTTOM OF SCREEN</td></tr> <tr><td>TD</td><td>TOTAL DEPTH</td></tr> <tr><td>CG</td><td>CEMENT GROUT</td></tr> </table> </td> </tr> </table> | <table border="0"> <tr><td></td><td>FILTER PACK</td></tr> <tr><td></td><td>BEDROCK</td></tr> <tr><td></td><td>CEMENT GROUT</td></tr> <tr><td></td><td>CUTTINGS / BACKFILL</td></tr> <tr><td></td><td>STATIC WATER LEVEL</td></tr> </table> |  | FILTER PACK |  | BEDROCK |  | CEMENT GROUT |  | CUTTINGS / BACKFILL |  | STATIC WATER LEVEL | <table border="0"> <tr><td>TOC</td><td>TOP OF CASING</td></tr> <tr><td>GS</td><td>GROUND SURFACE</td></tr> <tr><td>BS</td><td>BENTONITE SEAL</td></tr> <tr><td>BOC</td><td>BASE OF OUTER CASING</td></tr> <tr><td>TSC</td><td>TOP OF SCREEN</td></tr> <tr><td>BSC</td><td>BOTTOM OF SCREEN</td></tr> <tr><td>TD</td><td>TOTAL DEPTH</td></tr> <tr><td>CG</td><td>CEMENT GROUT</td></tr> </table> | TOC | TOP OF CASING | GS | GROUND SURFACE | BS | BENTONITE SEAL | BOC | BASE OF OUTER CASING | TSC | TOP OF SCREEN | BSC | BOTTOM OF SCREEN | TD | TOTAL DEPTH | CG | CEMENT GROUT |
| <table border="0"> <tr><td></td><td>FILTER PACK</td></tr> <tr><td></td><td>BEDROCK</td></tr> <tr><td></td><td>CEMENT GROUT</td></tr> <tr><td></td><td>CUTTINGS / BACKFILL</td></tr> <tr><td></td><td>STATIC WATER LEVEL</td></tr> </table> |  | FILTER PACK |  | BEDROCK |  | CEMENT GROUT |  | CUTTINGS / BACKFILL |  | STATIC WATER LEVEL | <table border="0"> <tr><td>TOC</td><td>TOP OF CASING</td></tr> <tr><td>GS</td><td>GROUND SURFACE</td></tr> <tr><td>BS</td><td>BENTONITE SEAL</td></tr> <tr><td>BOC</td><td>BASE OF OUTER CASING</td></tr> <tr><td>TSC</td><td>TOP OF SCREEN</td></tr> <tr><td>BSC</td><td>BOTTOM OF SCREEN</td></tr> <tr><td>TD</td><td>TOTAL DEPTH</td></tr> <tr><td>CG</td><td>CEMENT GROUT</td></tr> </table> | TOC | TOP OF CASING | GS | GROUND SURFACE | BS | BENTONITE SEAL | BOC | BASE OF OUTER CASING | TSC | TOP OF SCREEN | BSC | BOTTOM OF SCREEN | TD | TOTAL DEPTH | CG | CEMENT GROUT | | | | | | | |
|  | FILTER PACK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  | BEDROCK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  | CEMENT GROUT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  | CUTTINGS / BACKFILL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  | STATIC WATER LEVEL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOC | TOP OF CASING | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GS | GROUND SURFACE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BS | BENTONITE SEAL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BOC | BASE OF OUTER CASING | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TSC | TOP OF SCREEN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BSC | BOTTOM OF SCREEN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TD | TOTAL DEPTH | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CG | CEMENT GROUT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

MONITORING WELL - 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



COMPLETION REPORT OF WELL No. RW-1

| STRATA | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|--------|-----------------|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | | | | | |
| | | | | | | (See Page 1) |
| Softer/Fracture Zone (50 - 52 ft) No flow rate increase | | | 50 | | | |
| | | | 55 | | | |
| Slight Color Change (60 - 65 ft) Rock flour in water has a greenish gray hue No flow rate increase | | | 60 | | | |
| | | | 65 | | | |
| | | | 70 | | | |
| | | | 75 | | | |
| | | | 80 | | | |
| | | | 85 | | | |
| | | | 90 | | | |
| | | | 95 | | | |
| Fracture Zone (100 - 105 ft) Softer, brown discoloration Flow ~6 GPM | | | 100 | | | |
| | | | 105 | | | |
| | | | 110 | | | |

- LEGEND**
- FILTER PACK
 - BEDROCK
 - CEMENT GROUT
 - CUTTINGS / BACKFILL
 - STATIC WATER LEVEL
 - TOC TOP OF CASING
 - GS GROUND SURFACE
 - BS BENTONITE SEAL
 - BOC BASE OF OUTER CASING
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




MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-1**

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|---|--------|----------------|-----------------|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| | | | | | | | (See Page 1) |
| | | 115 | | | | | |
| | | 120 | | | | | |
| | | 125 | | | | | |
| (125 - 145 ft) Softer, increase in flow rate to 35 - 50 GPM | | 130 | | | | | |
| | | 135 | | | | | |
| | | 140 | | | | | |
| | | 145 | | | | | |
| | | 150 | | | | | |
| | | 155 | | | | | |
| | | 160 | | | | | |
| | | 165 | | | | | |
| | | 170 | | | | | |
| | | 175 | | | | | |


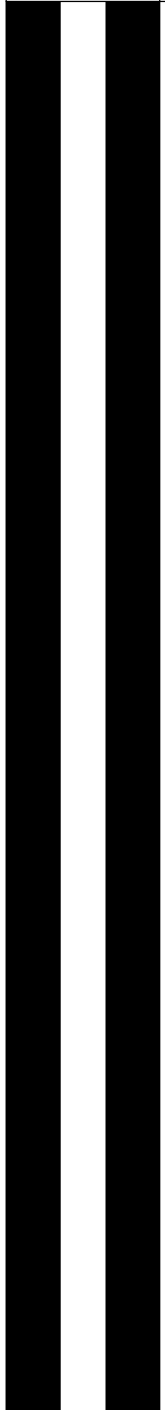











LEGEND

-  FILTER PACK
-  BEDROCK
-  CEMENT GROUT
-  CUTTINGS / BACKFILL
-  STATIC WATER LEVEL
- TOC TOP OF CASING
- GS GROUND SURFACE
- BS BENTONITE SEAL
- BOC BASE OF OUTER CASING
- TSC TOP OF SCREEN
- BSC BOTTOM OF SCREEN
- TD TOTAL DEPTH
- CG CEMENT GROUT






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-1**

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|---|---|----------------|--|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| (See Page 1) | | | | | | | |
| (175 - 177 ft) Brown discoloration in cuttings No noted increase in flow rate (<i>continued</i>) |  | 180 |  | | | | |
| Fracture Zone (180 - 185 ft) Softer, no discoloration noted Flow rate ~60 GPM |  | 185 | | | | | |
| |  | 190 | | | | | |
| |  | 195 | | | | | |
| |  | 200 | | | | | |
| Soft Zone (200 - 205 ft) Brown discoloration in water Flow rate has increased above 60 GPM; estimated: 80 GPM |  | 205 | | | | | |
| |  | 210 | | | | | |
| |  | 215 | | | | | |
| Softer Zone (215 - 225 ft) No noted discoloration or increase in flow |  | 220 | | | | | |
| |  | 225 | | | | | |
| |  | 230 | | | | | |
| Multiple Quartz Veins (235 - 260 ft) |  | 235 | | | | | |

LEGEND

| | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |

MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-1**





| STRATA | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|---|--------------------------|-----------------|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL DEPTH (ft.) | | | | | |
| | | | | | | (See Page 1) |
| Multiple Quartz Veins (235 - 260 ft) <i>(continued)</i> | 240 | | | | | |
| | 245 | | | | | |
| | 250 | | | | | |
| | 255 | | | | | |
| | 260 | | | | | |
| | 265 | | | | | |
| | 270 | | | | | |
| | 275 | | | | | |
| | 280 | | | | | |
| | 285 | | | | | |
| | 290 | | | | | |
| | 295 | | | | | |
| | 300 | | | | | |

- LEGEND**
- FILTER PACK
 - BEDROCK
 - CEMENT GROUT
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MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-1**

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|---|---------------------------------|-----------------|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| | | | | | | | (See Page 1) |
| |  | 305 310 315 320 325 | | | | | |
| Softer Zone (325 - 330 ft) Possible fractures No discoloration |  | 330 | | | | | |
| (330 - 345 ft) Increase in Quartz Content |  | 335 340 | | | | | |
| (345 - 450 ft) Mica schist with some pink quartz No soft zones or fractures noted Boring terminated at 450 ft Final flow rate is estimated to be 100 GPM |  | 345 350 355 360 | | | | | |















LEGEND

| | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-1**

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|---|---|----------------|--|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| | | | | | | | (See Page 1) |
| (345 - 450 ft) Mica schist with some pink quartz No soft zones or fractures noted Boring terminated at 450 ft Final flow rate is estimated to be 100 GPM (continued) |  | 365 |  | | | | |
| |  | 370 | | | | | |
| |  | 375 | | | | | |
| |  | 380 | | | | | |
| |  | 385 | | | | | |
| |  | 390 | | | | | |
| |  | 395 | | | | | |
| |  | 400 | | | | | |
| |  | 405 | | | | | |
| |  | 410 | | | | | |
|  | 415 | | | | | | |
|  | 420 | | | | | | |
|  | 425 | | | | | | |


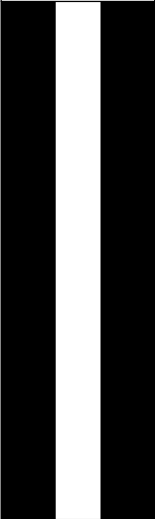
LEGEND

- | | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
 WELL No. RW-1**

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|---|---|---------------------------------|---|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| | | | | | | | (See Page 1) |
| (345 - 450 ft) Mica schist with some pink quartz No soft zones or fractures noted Boring terminated at 450 ft Final flow rate is estimated to be 100 GPM (continued) |  | 430 435 440 445 450 |  | 450.00 | TD | | |

LEGEND

-  FILTER PACK
-  BEDROCK
-  CEMENT GROUT
-  CUTTINGS / BACKFILL
-  STATIC WATER LEVEL
- TOC TOP OF CASING
- GS GROUND SURFACE
- BS BENTONITE SEAL
- BOC BASE OF OUTER CASING
- TSC TOP OF SCREEN
- BSC BOTTOM OF SCREEN
- TD TOTAL DEPTH
- CG CEMENT GROUT

MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-1**

COMPLETION REPORT OF WELL No. RW-2

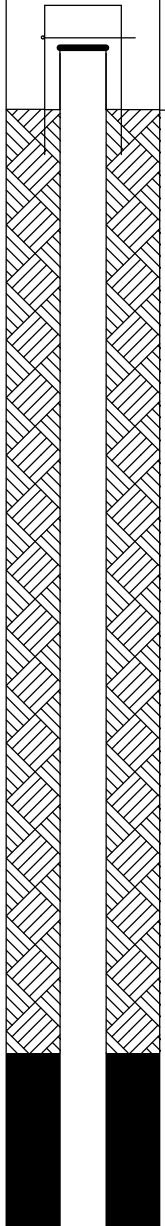
PROJECT: **Luck Stone**
 PROJECT NO: **4261-19-029**
 PROJECT LOCATION: **Chester, South Carolina**






WATER LEVEL: **Water at 11.30 Ft-BTOC**

DRILLING CONTRACTOR: **Faulkner Well Drilling**
 DRILLING METHOD: **Air Rotary**
 DATE COMPLETED: **6/7/19**

LATITUDE:
 LONGITUDE:
 TOP OF CASING ELEVATION:

DATUM:
 LOGGED BY: **J. Peele**






| STRATA | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|--------------------------|--|----------------|--------|--------------------|---|
| DESCRIPTION | SYMBOL DEPTH (ft.) | | | | | |
| | |  | 0.00 | GS | | PROTECTIVE CASING Diameter: Type: Interval: |
| | 0 | | 0.00 | CG | | |
| SANDY SILT (ML) brown, dry | 5 10 15 | | | | | RISER CASING Diameter: 6" Type: SCH 40 PVC Interval: -2.5 - 42 |
| | 20 | | | | | |
| PARTIALLY WEATHERED ROCK hard, gray, black, white gravelly sand, wet from ~22 ft | 25 30 35 40 | | | | | GROUT Type: #2 Grout Interval: 0 - 42 |
| | 45 | | | | | |
| Mafic Intermediate Metamorphic Rock Medium grained; black, gray, and white/tan; appears to be schist/mica schist. Fracture Zone (44 - 45) | 45 | | | | | SEAL Type: Interval: |
| | 42.00 | | 42.00 | BOC | | |
| | | | | | | FILTERPACK Type: Interval: |
| | | | | | | |
| | | | | | | SCREEN Diameter: Type: Interval: |
| | | | | | | |
| | | | | | | LEGEND |
| | | | | | | |

- | | |
|---|---|
| <ul style="list-style-type: none">  FILTER PACK  BEDROCK  CEMENT GROUT  CUTTINGS / BACKFILL  STATIC WATER LEVEL | <ul style="list-style-type: none"> TOC TOP OF CASING GS GROUND SURFACE BS BENTONITE SEAL BOC BASE OF OUTER CASING TSC TOP OF SCREEN BSC BOTTOM OF SCREEN TD TOTAL DEPTH CG CEMENT GROUT |
|---|---|






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



COMPLETION REPORT OF WELL No. RW-2

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|---|----------------|-----------------|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| | | | | | | | (See Page 1) |
| | | 50 | | | | | |
| ft) ~12 GPM |  | 55 | | | | | |
| | | 60 | | | | | |
| Fracture Zone (61 - 63 ft) Discoloration, ~30 GPM |  | 65 | | | | | |
| | | 70 | | | | | |
| | | 75 | | | | | |
| | | 80 | | | | | |
| | | 85 | | | | | |
| | | 90 | | | | | |
| Soft (95 ft) |  | 95 | | | | | |
| | | 100 | | | | | |
| Soft (102 - 105 ft) w/white Quartz in cuttings |  | 105 | | | | | |
| | | 110 | | | | | |
| Soft (109 - 110 ft) Rock same as above without Quartz |  | | | | | | |

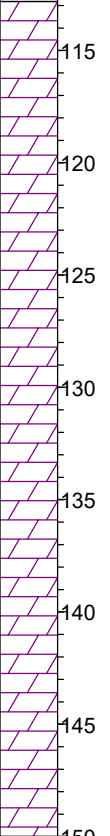
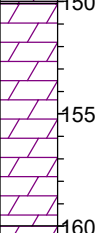
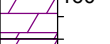

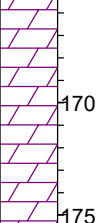
LEGEND

| | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-2**

| STRATA | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|---|-----------------|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | | | | | |
| | | | | | | (See Page 1) |
| |  | | | | | |
| White Quartz (150 ft) appears as thin coating on fractures |  | | | | | |
| Soft (160 - 162 ft) |  | | | | | |
| Soft (164 - 165 ft) |  | | | | | |
| |  | | | | | |

LEGEND

| | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
 WELL No. RW-2**

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|---|--------|----------------|-----------------|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| | | | | | | | (See Page 1) |
| | | 180 | | | | | |
| | | 185 | | | | | |
| | | 190 | | | | | |
| | | 195 | | | | | |
| (195 - 205 ft) Softer, higher concentrations of mica ~30 GPM | | 200 | | | | | |
| | | 205 | | | | | |
| | | 210 | | | | | |
| | | 215 | | | | | |
| (205 - 230 ft) Harder, higher quartz conent in cuttings | | 220 | | | | | |
| | | 225 | | | | | |
| | | 230 | | | | | |
| Pink/tan Quartz Veins (230 - 240 ft) ~30 GPM | | 235 | | | | | |



LEGEND

-  FILTER PACK
-  BEDROCK
-  CEMENT GROUT
-  CUTTINGS / BACKFILL
-  STATIC WATER LEVEL
- TOC TOP OF CASING
- GS GROUND SURFACE
- BS BENTONITE SEAL
- BOC BASE OF OUTER CASING
- TSC TOP OF SCREEN
- BSC BOTTOM OF SCREEN
- TD TOTAL DEPTH
- CG CEMENT GROUT






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-2**

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|--|--|--|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| | | | | | | | (See Page 1) |
| (240 - 395 ft) Black, gray and white mica schist, micaceous, hard No softer zones ~30 GPM (continued) |  | 305 310 315 320 325 330 335 340 345 350 355 360 |  | | | | |


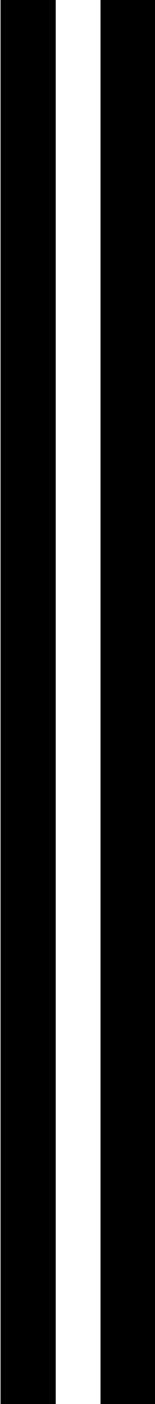



LEGEND

- | | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-2**

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|---|---|--|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| (See Page 1) | | | | | | | |
| (240 - 395 ft) Black, gray and white mica schist, micaceous, hard No softer zones ~30 GPM (continued) |  | 365 370 375 380 385 390 395 |  | | | | |
| Softer Zone (395 - 400 ft) Flow rate ~40 GPM |  | 400 | | | | | |
| Pink Quartz Vein (415 - 418 ft) |  | 405 410 415 | | | | | |
| Boring terminated (450 ft) in mica schist Final flow ~40 GPM |  | 420 425 | | | | | |
| | | | | | | | |


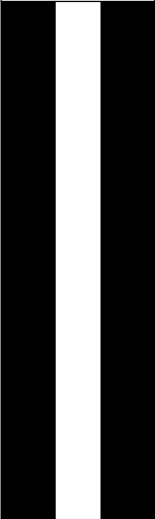
LEGEND

| | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-2**

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|---|---------------------------------|---|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| | | | | | | | (See Page 1) |
| Boring terminated (450 ft) in mica schist Final flow ~40 GPM <i>(continued)</i> |  | 430 435 440 445 450 |  | 450.00 | TD | | |

LEGEND

- | | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |

MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-2**

COMPLETION REPORT OF WELL No. RW-3

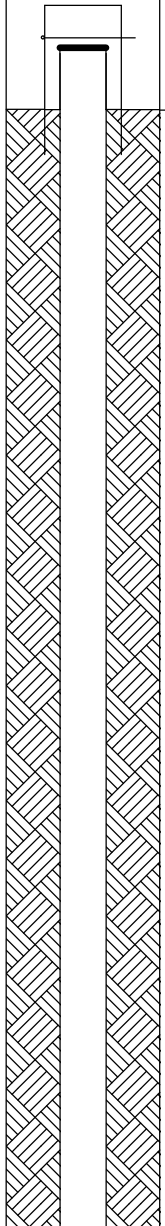

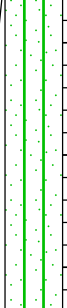
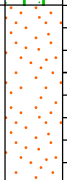

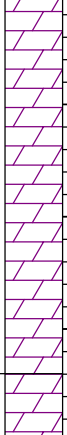
PROJECT: **Luck Stone**
 PROJECT NO: **4261-19-029**
 PROJECT LOCATION: **Chester, South Carolina**

WATER LEVEL: **Water at 31.59 Ft-BTOC**






DRILLING CONTRACTOR: **Faulkner Well Drilling**
 DRILLING METHOD: **Air Rotary**
 DATE COMPLETED: **6/5/19**

LATITUDE:
 LONGITUDE:
 TOP OF CASING ELEVATION:

DATUM:
 LOGGED BY: **J. Peele**

| STRATA | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|---|--|----------------|--------|--------------------|---|
| DESCRIPTION | SYMBOL DEPTH (ft.) | | | | | |
| | |  | 0.00 | GS | | PROTECTIVE CASING Diameter: Type: Interval: |
| TOPSOIL: (ML) Sandy Silt, brown, moist, high organic content |  0 | | 0.00 | CG | | |
| SANDY SILT (SP) brown, dry |  5 | | | | | RISER CASING Diameter: 6" Type: SCH 40 PVC Interval: -2.5 - 52 |
| | 10 | | | | | |
| SAND brown, gray, fine to coarse, wet/saturated ~2-3 GPM |  20 | | | | | GROUT Type: #2 Grout Interval: 0 - 52 |
| | 15 | | | | | |
| PARTIALLY WEATHERED ROCK hard, gray, black, dark brown, gravely sand size rock fragments |  25 | | | | | SEAL Type: Interval: |
| | 30 | | | | | |
| Mafic Intermediate Metamorphic Rock Medium grained; black, gray, and white/tan; appears to be schist/mica schist, but weak, soft |  35 | | | | | FILTERPACK Type: Interval: |
| | 40 | | | | | |
| | 45 | | | | | SCREEN Diameter: Type: Interval: |
| | | | | | | |

LEGEND

| | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



COMPLETION REPORT OF WELL No. RW-3

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|---|--------|----------------|-----------------|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| | | 50 | | | | | (See Page 1) |
| | | 55 | | | | | |
| | | 60 | | | | | |
| | | 65 | | | | | |
| | | 70 | | | | | |
| Softer Zone with Fractures (70 - 85 ft) Flow rate ~5 GPM | | 75 | | | | | |
| | | 80 | | | | | |
| | | 85 | | | | | |
| | | 90 | | | | | |
| | | 95 | | | | | |
| Intermittent Fractures (95 - 105 ft) Flow rate 8-10 GPM | | 100 | | | | | |
| | | 105 | | | | | |
| | | 110 | | | | | |
| | | | | 52.00 | BOC | | |

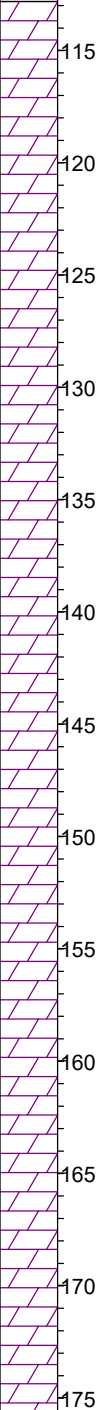
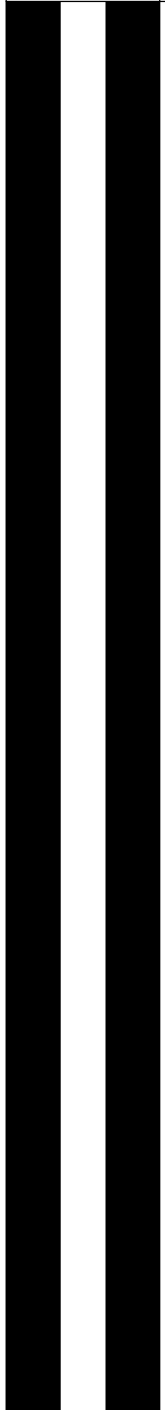
LEGEND






- | | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |

MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-3**

| STRATA | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|-------------|--|--|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL DEPTH (ft.) | | | | | |
| | | | | | | (See Page 1) |
| |  |  | | | | |

- LEGEND**
-  FILTER PACK
 -  BEDROCK
 -  CEMENT GROUT
 -  CUTTINGS / BACKFILL
 -  STATIC WATER LEVEL
 - TOC TOP OF CASING
 - GS GROUND SURFACE
 - BS BENTONITE SEAL
 - BOC BASE OF OUTER CASING
 - TSC TOP OF SCREEN
 - BSC BOTTOM OF SCREEN
 - TD TOTAL DEPTH
 - CG CEMENT GROUT






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
 WELL No. RW-3**

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|---|--------|----------------|-----------------|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| | | | | | | | (See Page 1) |
| | | 180 | | | | | |
| | | 185 | | | | | |
| | | 190 | | | | | |
| | | 195 | | | | | |
| Softer Zone, Intermittent Fractures (195 - 205 ft) Flow rate ~20 GPM | | 200 | | | | | |
| | | 205 | | | | | |
| | | 210 | | | | | |
| | | 215 | | | | | |
| | | 220 | | | | | |
| | | 225 | | | | | |
| | | 230 | | | | | |
| | | 235 | | | | | |

LEGEND

- | | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-3**

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|--------|----------------|-----------------|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| (See Page 1) | | | | | | | |
| | | 305 | | | | | |
| | | 310 | | | | | |
| | | 315 | | | | | |
| | | 320 | | | | | |
| Softer Zone (320 - 325 ft) No discoloration Gradual increase in flow rate to ~25 GPM | | 325 | | | | | |
| | | 330 | | | | | |
| | | 335 | | | | | |
| | | 340 | | | | | |
| Boring terminated (450 ft). Final flow rate ~25 GPM | | 345 | | | | | |
| | | 350 | | | | | |
| | | 355 | | | | | |
| | | 360 | | | | | |




LEGEND

- | | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-3**

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|---|--|-----------------|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| | | | | | | | (See Page 1) |
| Boring terminated (450 ft). Final flow rate ~25 GPM (continued) |  | 365 370 375 380 385 390 | | | | | |
| Pink Quartz/Quartzite Veins (390 - 395 ft) |  | 395 | | | | | |
| Boring terminated (450 ft). Final flow rate ~25 GPM |  | 400 405 410 415 420 425 | | | | | |


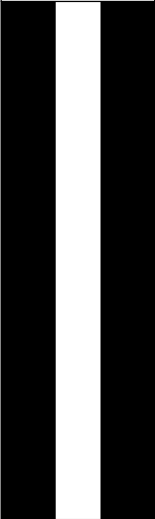
LEGEND

-  FILTER PACK
-  BEDROCK
-  CEMENT GROUT
-  CUTTINGS / BACKFILL
-  STATIC WATER LEVEL
- TOC TOP OF CASING
- GS GROUND SURFACE
- BS BENTONITE SEAL
- BOC BASE OF OUTER CASING
- TSC TOP OF SCREEN
- BSC BOTTOM OF SCREEN
- TD TOTAL DEPTH
- CG CEMENT GROUT






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-3**

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|---|---------------------------------|---|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| | | | | | | | (See Page 1) |
| Boring terminated (450 ft). Final flow rate ~25 GPM (continued) |  | 430 435 440 445 450 |  | 450.00 | TD | | |

LEGEND

- | | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |

MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-3**

COMPLETION REPORT OF WELL No. RW-4

PROJECT: **Luck Stone**
 PROJECT NO: **4261-19-029**
 PROJECT LOCATION: **Chester, South Carolina**

WATER LEVEL: **Water at 28.90 Ft-BTOC**

DRILLING CONTRACTOR: **Faulkner Well Drilling**
 DRILLING METHOD: **Air Rotary**
 DATE COMPLETED: **6/3/19**

LATITUDE:
 LONGITUDE:
 TOP OF CASING ELEVATION:


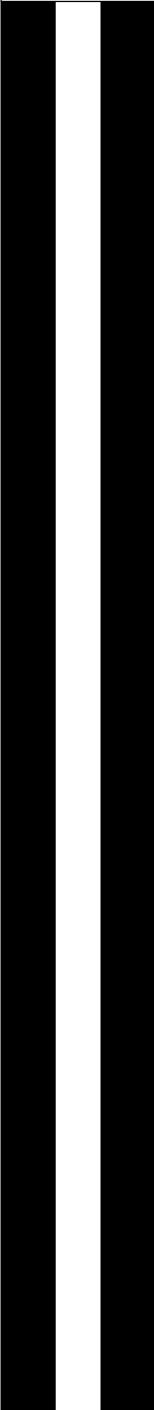
DATUM:
 LOGGED BY: **J. Peele**

| STRATA | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|--------------------------|-----------------|---------------------|--------|--------------------|---|
| DESCRIPTION | SYMBOL DEPTH (ft.) | | | | | |
| TOPSOIL Sandy Silt, brown, moist, high organic content | 0 | | 0.00 | GS | | PROTECTIVE CASING Diameter: Type: Interval: |
| | 5 | | 0.00 | CG | | |
| SANDY SILT (ML) brown, dry | 10 | | | | | RISER CASING Diameter: 6" Type: SCH 40 PVC Interval: -2.5 - 21 |
| | 15 | | | | | |
| Mafic Intermediate Metamorphic Rock (17 - 21 ft) - Very hard Medium grained; black, gray, and white/tan; appears to be schist/mica schist. 3-5 GPM from last 2 - 3 ft above rock | 20 | | 21.00 | BOC | | GROUT Type: #2 Grout Interval: 0 - 21 |
| Softer Zone (26 - 28 ft) Slight discoloration No increase in flow rate; ~5 GPM | 25 | | | | | |
| Medium grained; black, gray, and white/tan; appears to be schist/mica schist. | 30 | | | | | SEAL Type: Interval: |
| | 35 | | | | | |
| | 40 | | | | | FILTERPACK Type: Interval: |
| | 45 | | | | | |
| | | | | | | SCREEN Diameter: Type: Interval: |
| | | | | | | LEGEND |
| | | | FILTER PACK | | TOC | TOP OF CASING |
| | | | BEDROCK | | GS | GROUND SURFACE |
| | | | CEMENT GROUT | | BS | BENTONITE SEAL |
| | | | CUTTINGS / BACKFILL | | BOC | BASE OF OUTER CASING |
| | | | STATIC WATER LEVEL | | TSC | TOP OF SCREEN |
| | | | | | BSC | BOTTOM OF SCREEN |
| | | | | | TD | TOTAL DEPTH |
| | | | | | CG | CEMENT GROUT |






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



COMPLETION REPORT OF WELL No. RW-4

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|--|----------------|--|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| | | | | | | | (See Page 1) |
| Medium grained; black, gray, and white/tan; appears to be schist/mica schist. <i>(continued)</i> |  | 50 |  | | | | |
| | | 55 | | | | | |
| | | 60 | | | | | |
| | | 65 | | | | | |
| | | 70 | | | | | |
| | | 75 | | | | | |
| | | 80 | | | | | |
| | | 85 | | | | | |
| | | 90 | | | | | |
| | | 95 | | | | | |
| | | 100 | | | | | |
| | | 105 | | | | | |
| 110 | | | | | | | |




LEGEND

-  FILTER PACK
-  BEDROCK
-  CEMENT GROUT
-  CUTTINGS / BACKFILL
-  STATIC WATER LEVEL
- TOC TOP OF CASING
- GS GROUND SURFACE
- BS BENTONITE SEAL
- BOC BASE OF OUTER CASING
- TSC TOP OF SCREEN
- BSC BOTTOM OF SCREEN
- TD TOTAL DEPTH
- CG CEMENT GROUT






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-4**

| STRATA | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|---|--|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL DEPTH (ft.) | | | | | |
| | | | | | | (See Page 1) |
| Medium grained; black, gray, and white/tan; appears to be schist/mica schist. <i>(continued)</i> |  115 120 125 130 135 140 145 150 155 160 165 170 175 |   | | | | |



LEGEND

| | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-4**

| STRATA | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|--|--|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL DEPTH (ft.) | | | | | |
| | | | | | | (See Page 1) |
| Medium grained; black, gray, and white/tan; appears to be schist/mica schist. <i>(continued)</i> |  180 185 190 195 200 205 210 215 220 225 230 235 |  | | | | |



LEGEND

- | | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-4**

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|--|---|--|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| | | | | | | | (See Page 1) |
| Medium grained; black, gray, and white/tan; appears to be schist/mica schist. <i>(continued)</i> |  | 240 245 250 255 260 265 270 275 280 285 290 295 300 |  | | | | |



LEGEND

- | | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-4**

| STRATA | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|--|--|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | | | | | |
| | | | | | | (See Page 1) |
| Medium grained; black, gray, and white/tan; appears to be schist/mica schist. <i>(continued)</i> |  |  | | | | |
| | 305 | | | | | |
| | 310 | | | | | |
| | 315 | | | | | |
| | 320 | | | | | |
| | 325 | | | | | |
| | 330 | | | | | |
| | 335 | | | | | |
| | 340 | | | | | |
| | 345 | | | | | |
| | 350 | | | | | |
| | 355 | | | | | |
| | 360 | | | | | |

LEGEND

| | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |

MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-4**

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|--------|---|-----------------|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| | | | | | | | (See Page 1) |
| Medium grained; black, gray, and white/tan; appears to be schist/mica schist. <i>(continued)</i> | | 365 370 375 380 385 390 395 400 405 410 415 420 425 | | | | | |
| Pink Quartz Seam (400 - 405 ft) No increase in flow or discoloration indicating a fracture | | 400 405 | | | | | |
| White Quartz Seam (410 - 415 ft) No increase in flow rate or discoloration | | 410 415 | | | | | |


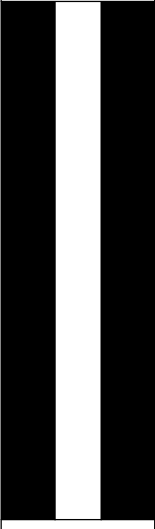




LEGEND

- FILTER PACK
- BEDROCK
- CEMENT GROUT
- CUTTINGS / BACKFILL
- STATIC WATER LEVEL
- TOC TOP OF CASING
- GS GROUND SURFACE
- BS BENTONITE SEAL
- BOC BASE OF OUTER CASING
- TSC TOP OF SCREEN
- BSC BOTTOM OF SCREEN
- TD TOTAL DEPTH
- CG CEMENT GROUT






MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



**COMPLETION REPORT OF
WELL No. RW-4**

| STRATA | | | WELL DETAILS | DEPTH (ft.) | LEGEND | ELEVATION (ft.) | WELL CONSTRUCTION DETAILS |
|--|---|----------------|---|----------------|--------|--------------------|---------------------------|
| DESCRIPTION | SYMBOL | DEPTH (ft.) | | | | | |
| | | | | | | | (See Page 1) |
| Softer Zone (~430 ft) Little brown discoloration Flow rate increase to ~23 GPM |  | 430 |  | | | | |
| |  | 435 | | | | | |
| |  | 440 | | | | | |
| |  | 445 | | | | | |
| Boring terminated (450 ft) in schist/mica schist, hard. Final flow rate ~23 GPM |  | 450 | | 450.00 | TD | | |

LEGEND

- | | | | |
|---|---------------------|-----|----------------------|
|  | FILTER PACK | TOC | TOP OF CASING |
|  | BEDROCK | GS | GROUND SURFACE |
|  | CEMENT GROUT | BS | BENTONITE SEAL |
|  | CUTTINGS / BACKFILL | BOC | BASE OF OUTER CASING |
|  | STATIC WATER LEVEL | TSC | TOP OF SCREEN |
| | | BSC | BOTTOM OF SCREEN |
| | | TD | TOTAL DEPTH |
| | | CG | CEMENT GROUT |

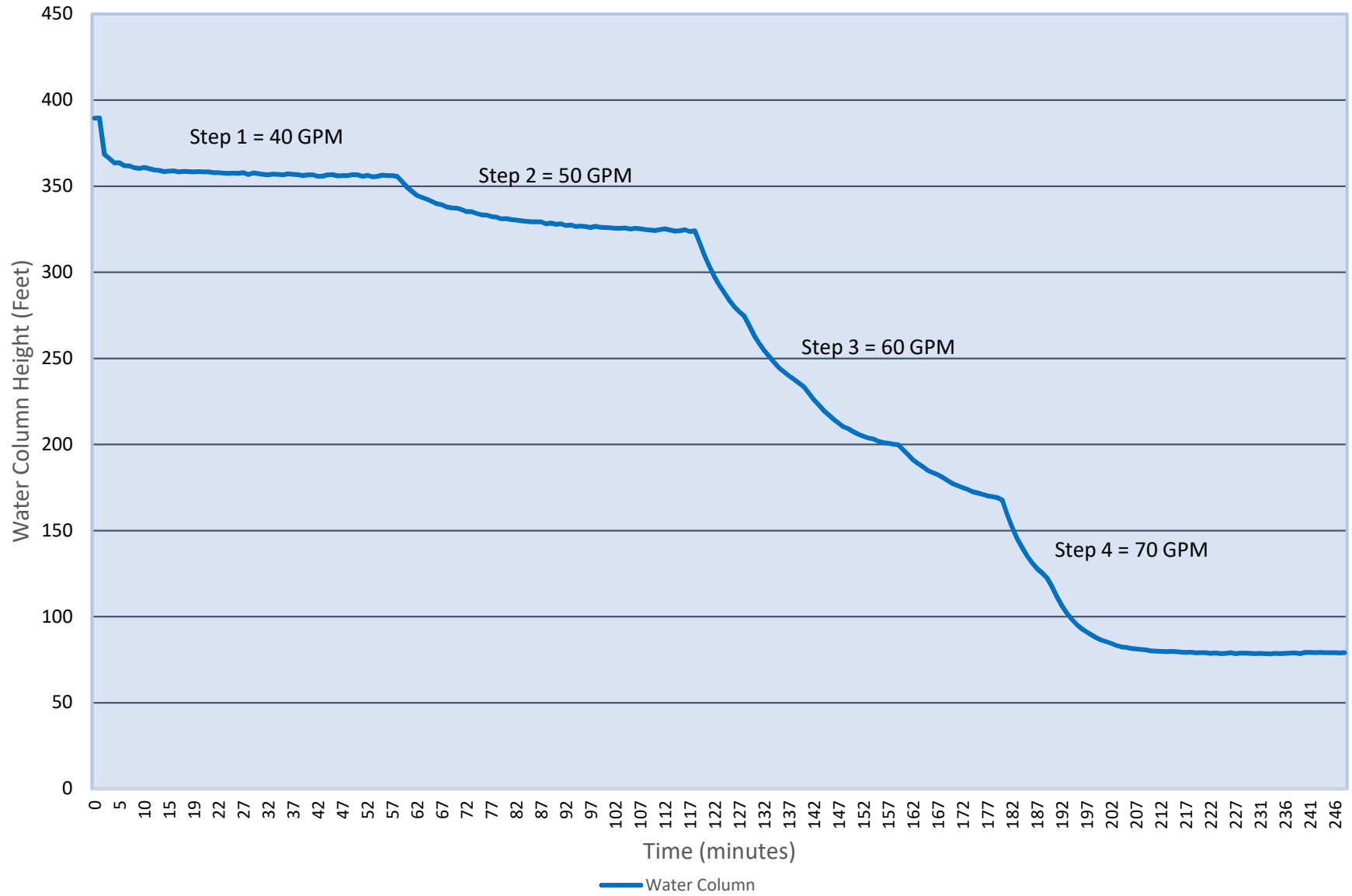
MONITORING WELL 4341-15-008 122 LYTLE ROAD BORINGS.GPJ WITH CPT.GDT 8/27/19



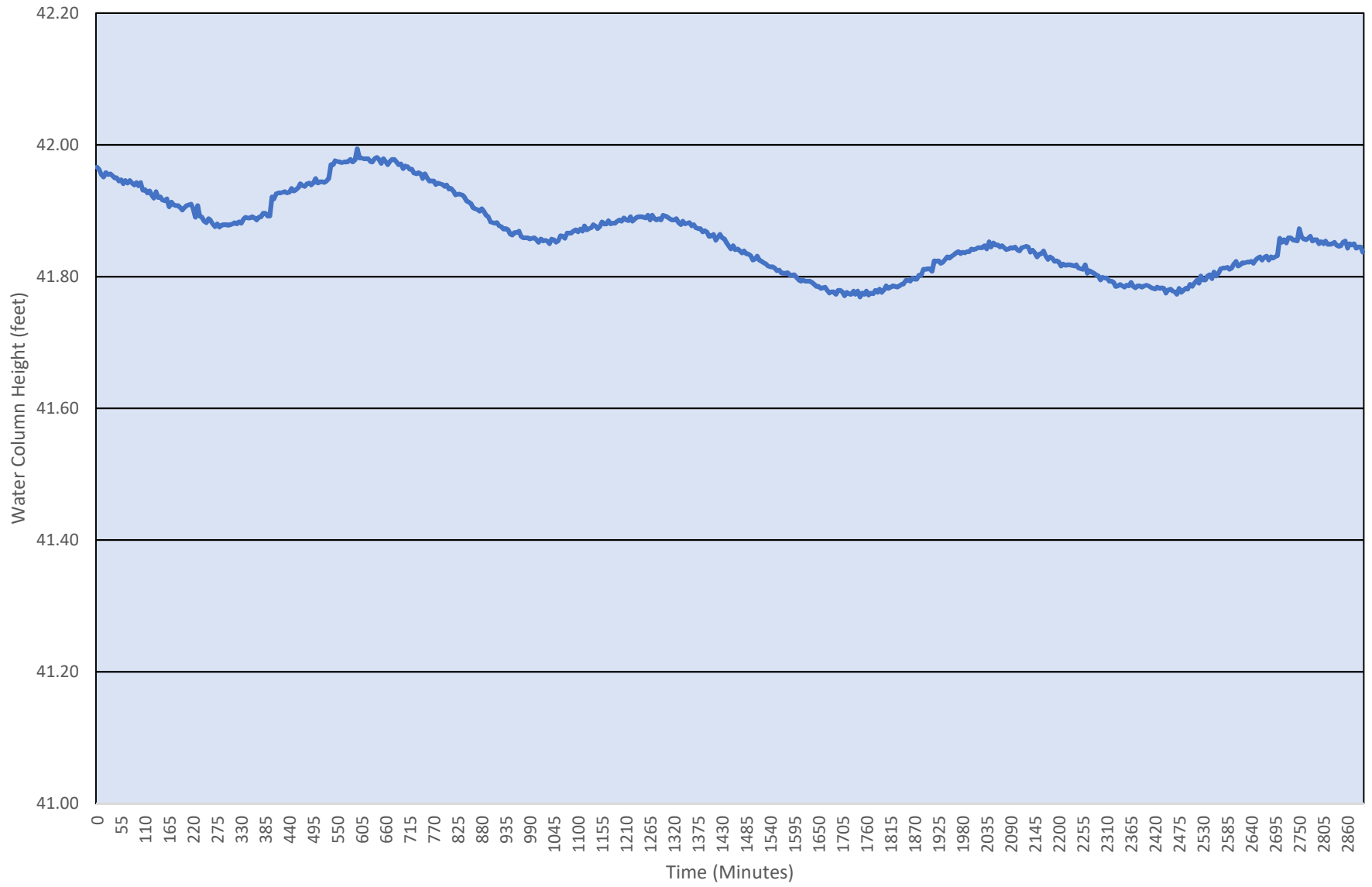
**COMPLETION REPORT OF
WELL No. RW-4**

Appendix V – Pump Test Charts

Step Test : RW-2 Change In Water Column

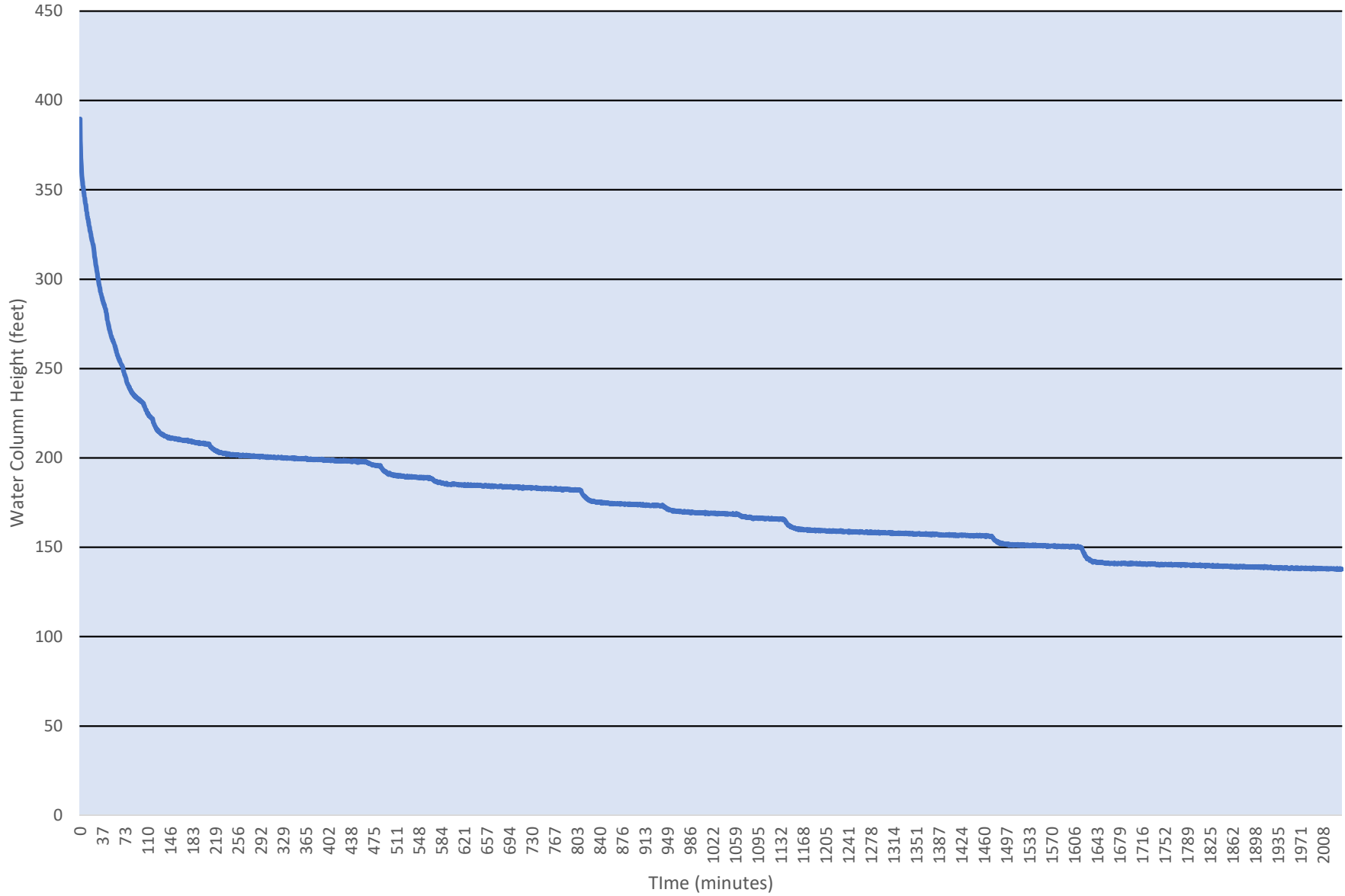


Constant Rate Test: RW-1 Change In Water Column Over Time



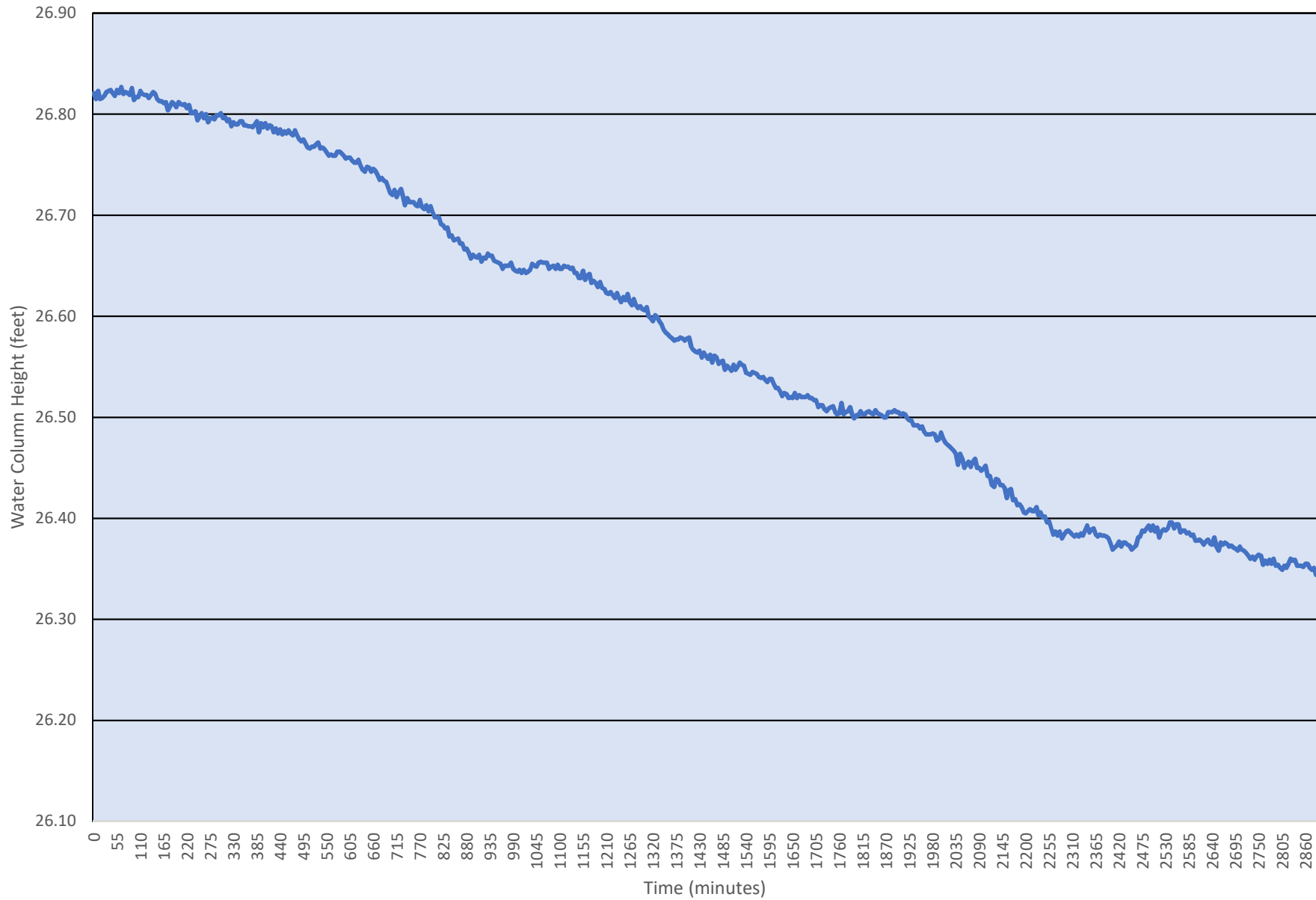
— Depth to Water

Constant Rate Test: RW-2 (Pumping Well) Change in Water Column Height

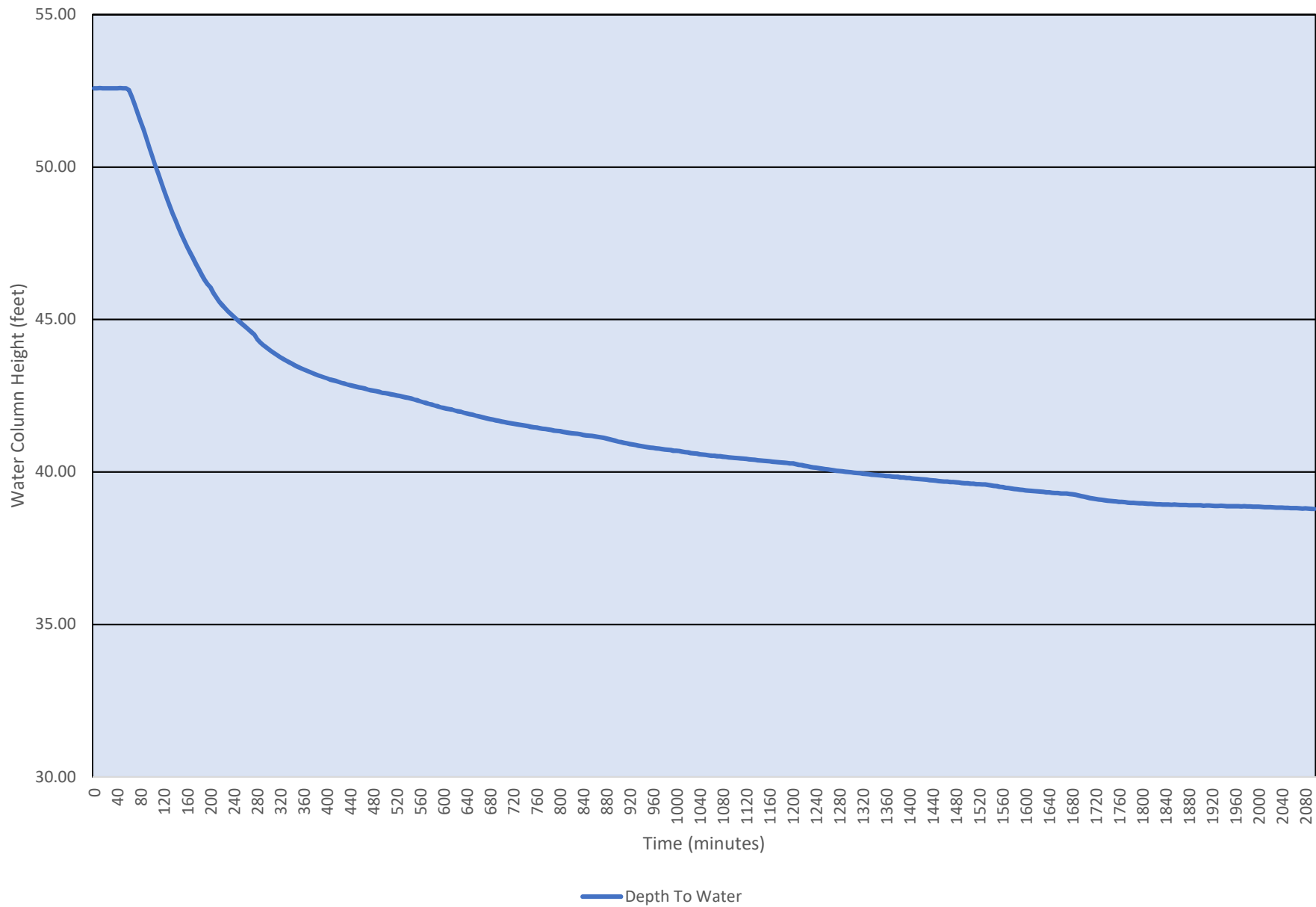


— Water Column Height

Constant Rate Test: RW-3 Change in Water Column Height Over Time



Constant Rate Test: RW-4 Change In Water Column Over Time



Appendix VI – Groundwater Model Charts

**Table 5.1.2
Regional Model and Pumping Test Model Input Parameters**



| Regional Projection Model | | | | |
|----------------------------------|--|---------------|---------------------------|--------------|
| Zone | Parameter | Symbol | Units | Value |
| Fractured Rock EPM | Hydraulic Conductivity in primary direction | Ky | ft/day | 0.081 |
| | Hydraulic Conductivity in cross direction | Kx | ft/day | 0.0031 |
| | Hydraulic Conductivity in vertical direction | Kz | ft/day | 1 |
| | Specific Storage Coefficient | Ss | per ft | 5E-07 |
| | Specific Yield | Sy | unitless | 0.001 |
| | Saturated thickness | b | ft | 600 |
| | | | | |
| PWR | Conductance of RIV boundary cells per LF | - | ft ² /(day-ft) | 5 |
| | Hydraulic Conductivity (all directions) | K | ft/day | 0.1 |
| | Sy | Sy | unitless | 0.1 |
| | Saturated Thickness | b | ft | 25 |

| Pumping Test Model | | | | |
|------------------------------------|--|---------------|---------------------------|--------------|
| Zone | Parameter | Symbol | Units | Value |
| Fracture Zone | Hydraulic Conductivity, horizontal | Kh (Kx = Ky) | ft/day | 0.8 |
| | Hydraulic Conductivity, vertical | Kv (Kz) | ft/day | 10 |
| | Specific Storage Coefficient | Ss | per ft | 1.E-07 |
| Matrix Rock (Between Fractures) | Hydraulic Conductivity (all directions) | K | ft/day | 0.002 |
| | Specific Storage Coefficient | Ss | per ft | 6.E-07 |
| PWR | Hydraulic Conductivity (all directions) | K | ft/day | 0.1 |
| | Sy | Sy | unitless | 0.1 |
| | Conductance of RIV boundary cells per LF | - | ft ² /(day-ft) | 1.0 |

Chart 5.1.4-A

Observed and Modeled Drawdown, RW-1, RW-2 (PW), RW-3 and RW-4

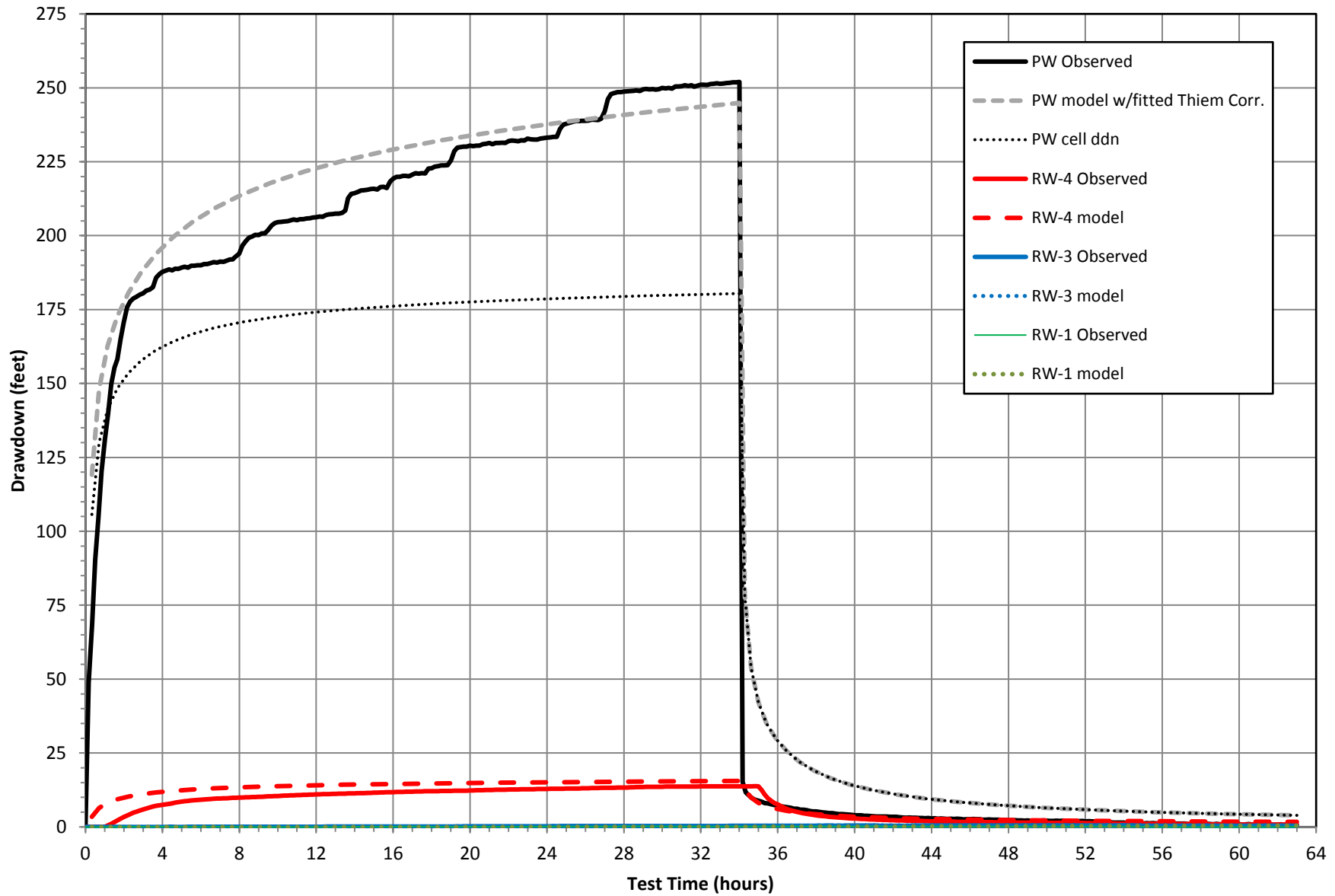


Chart 5.1.4-B

Observed and Modeled Drawdown, Observation Wells RW-1, RW-3 and RW-4

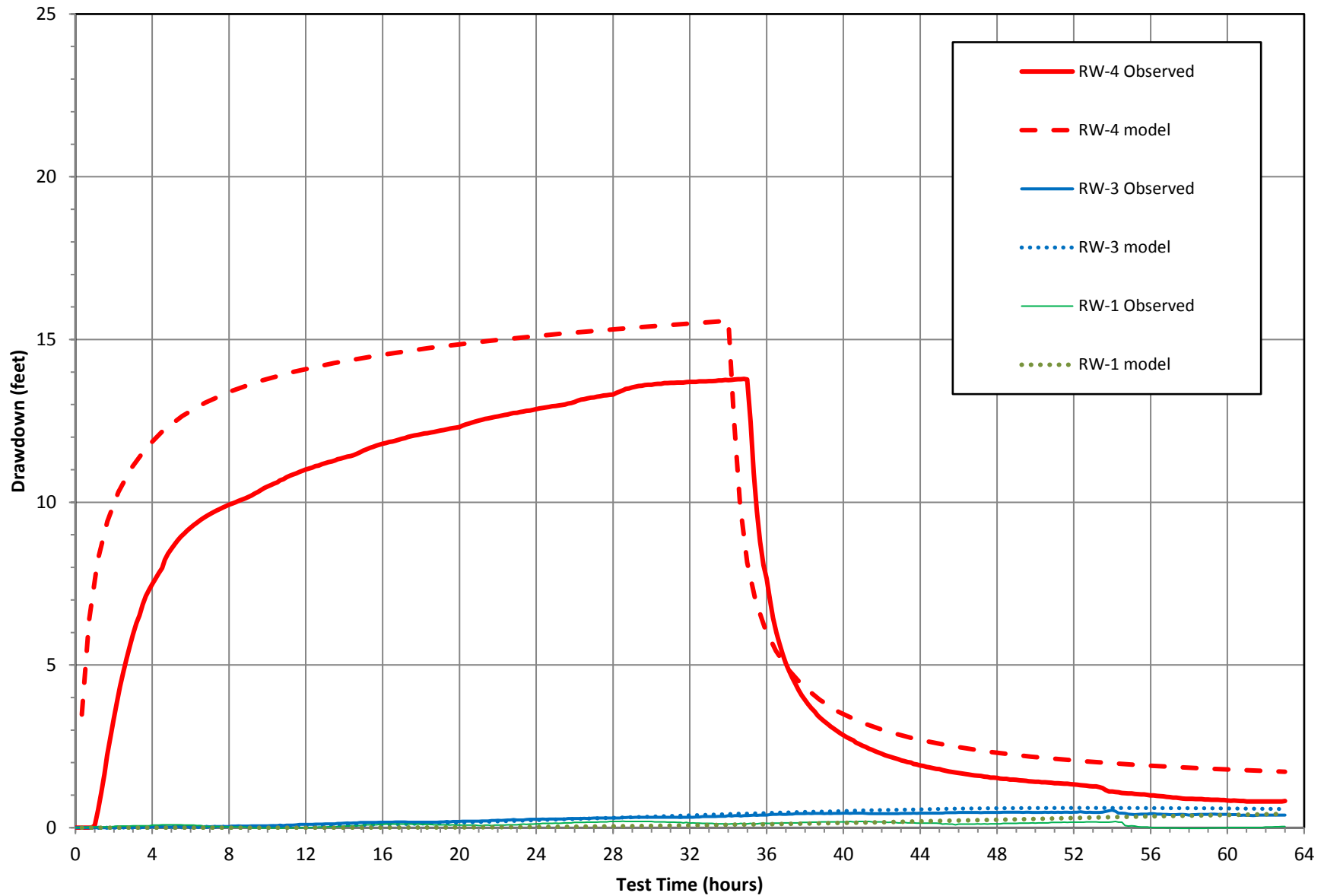


Chart 5.1.4-C
Observed and Modeled Drawdown, RW-1 and RW-3

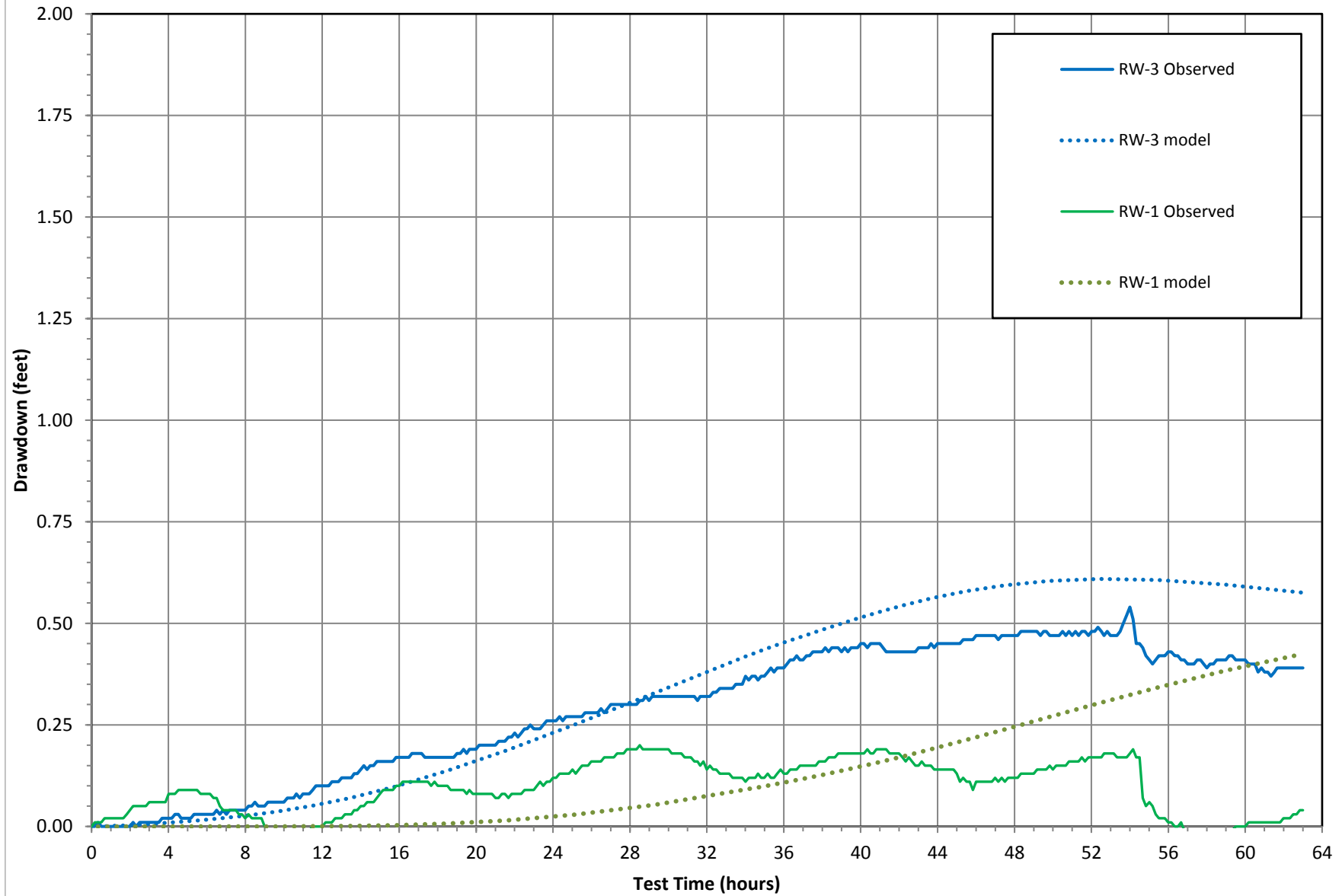


Chart 5.1.4-D
Observed and Modeled Drawdown on Log Scale

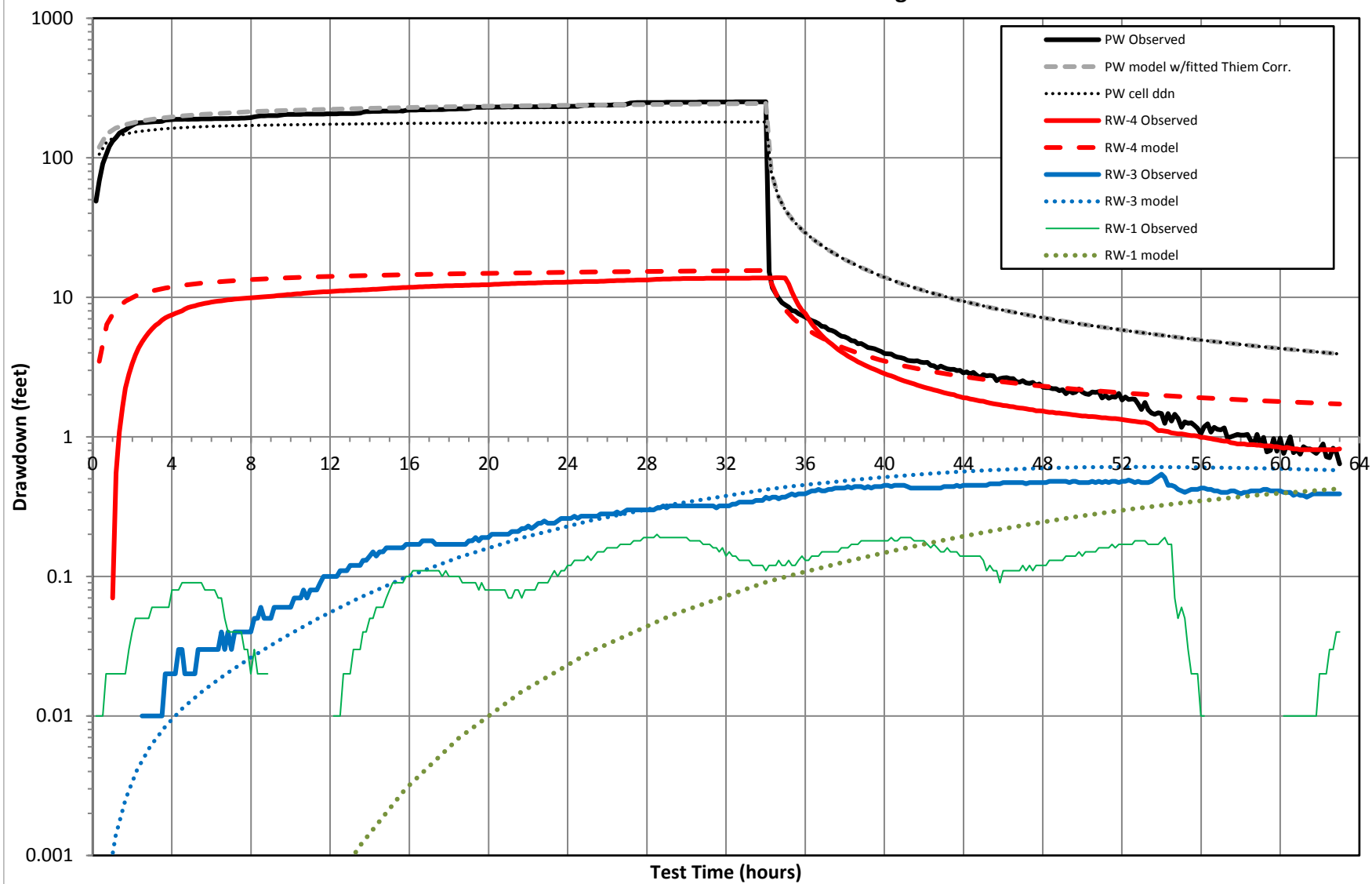
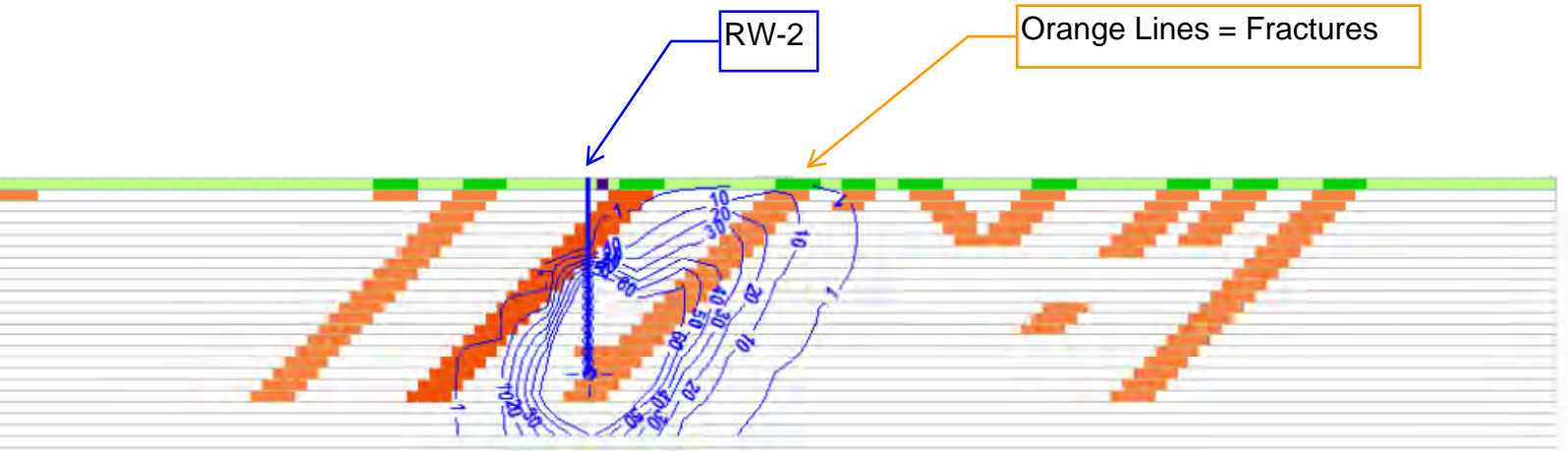


Chart 5.1.6 Fracture Adjustments

Cross-Section View (West - East)



Plan View

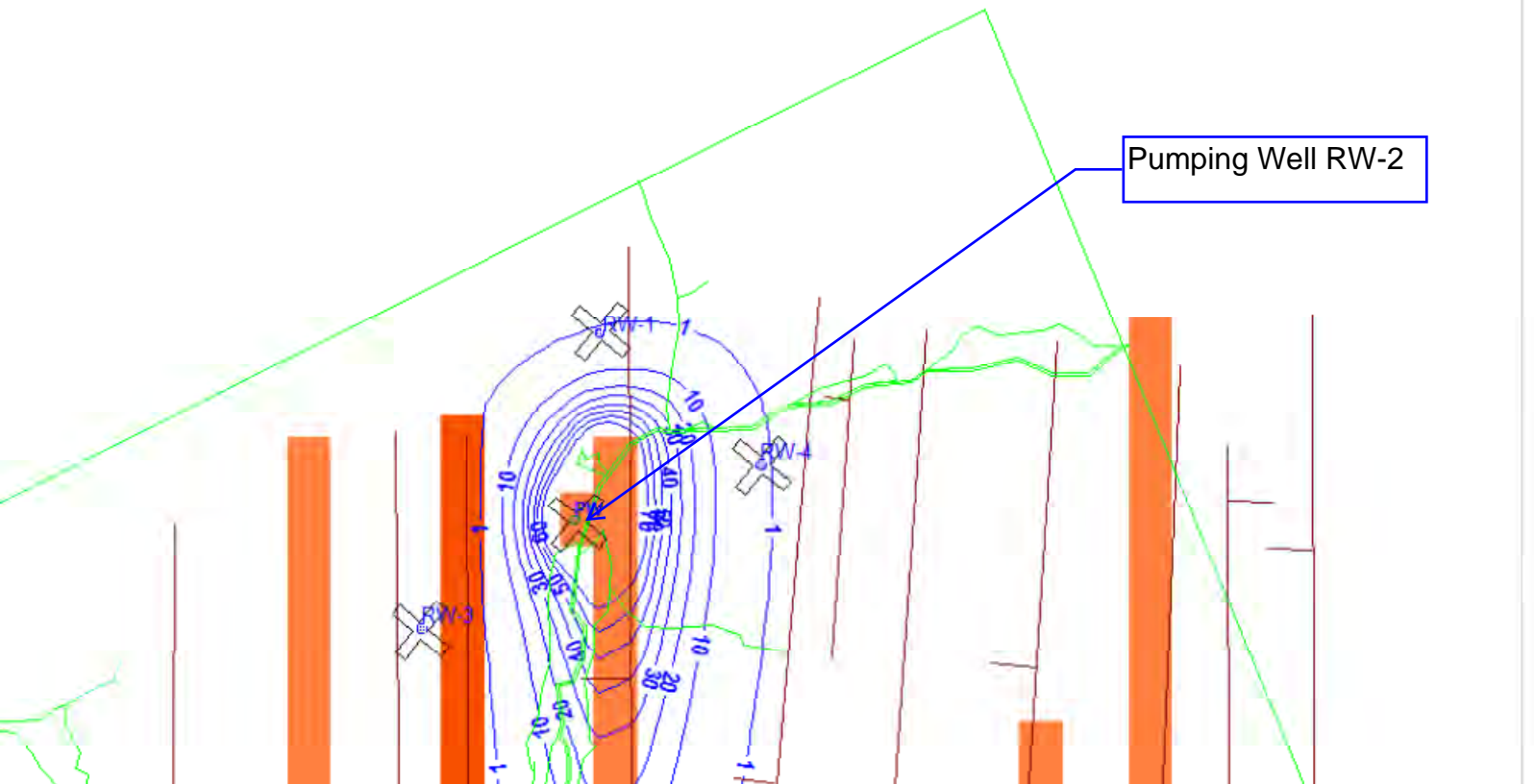


Chart 6.1.2 Regional Model - Dewatering Level (as drawdown) inside the two pits.

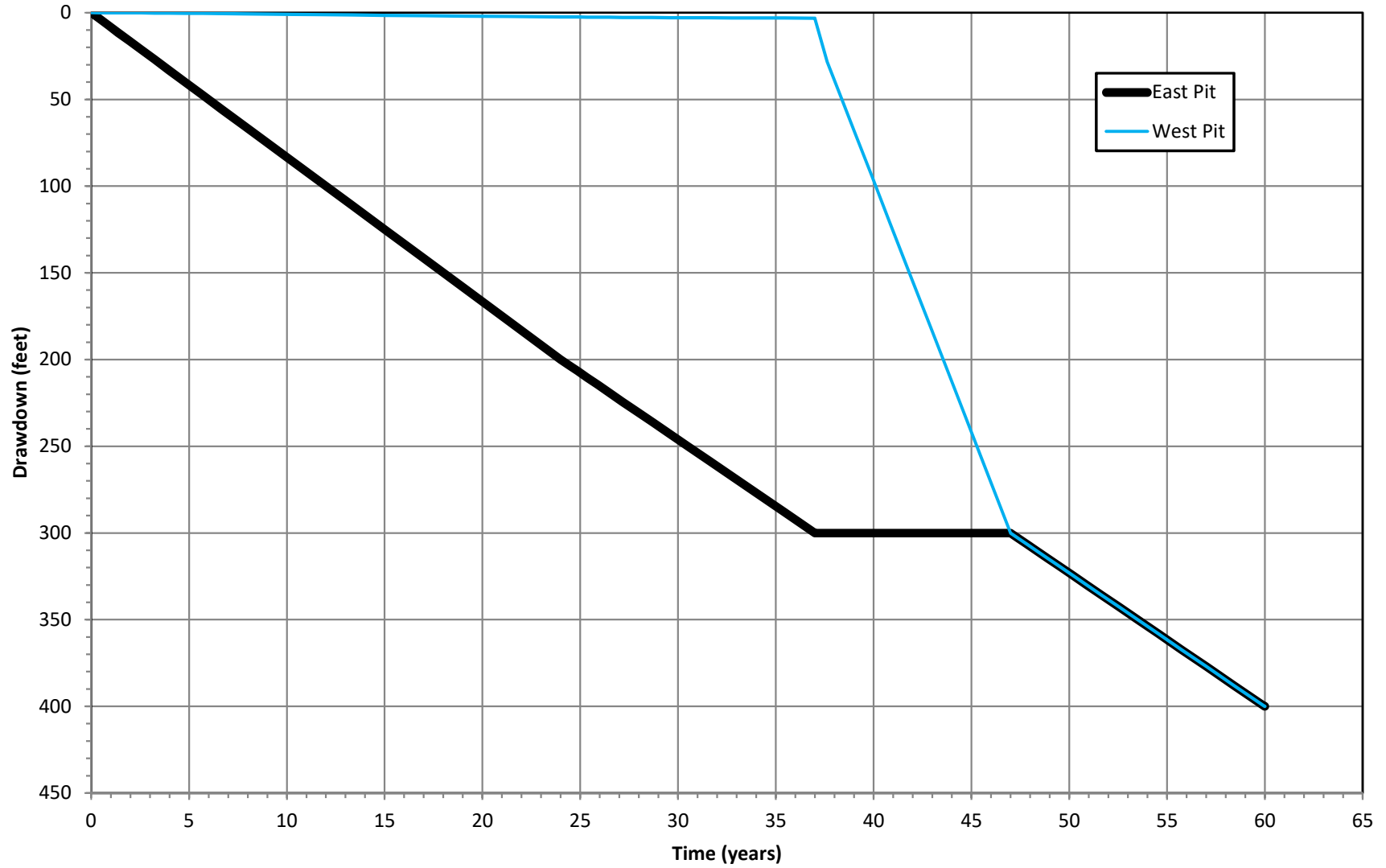


Chart 6.2: Regional Model - Dewatering Level (as drawdown) inside the two pits.

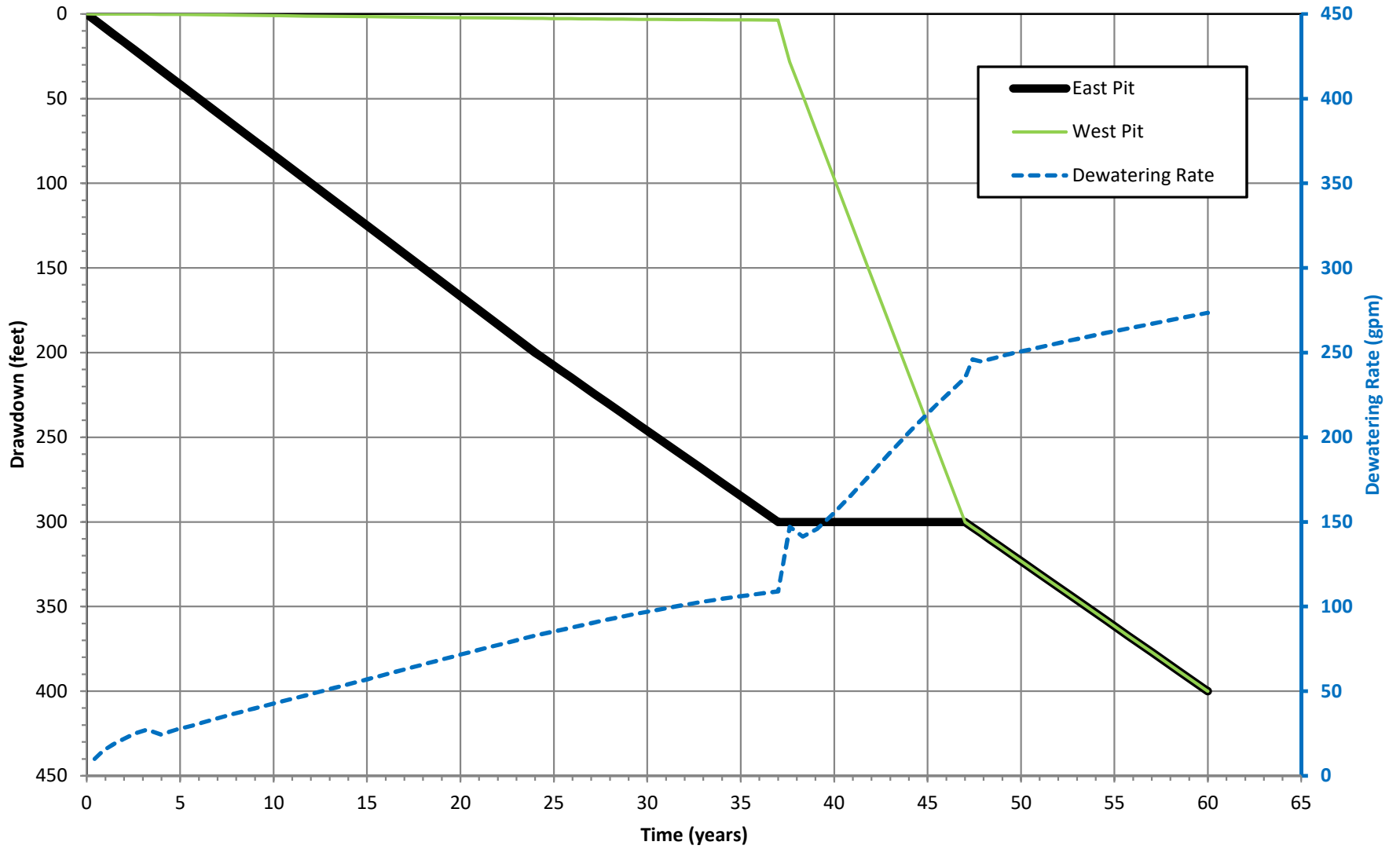


Figure 6.1.1 Regional Model - Creek Boundary Conditions

