ANALYTICAL SERVICES, INC

Westridge Hills
Potable Water Test Wells Project Report
Jefferson County, West Virginia
October 31, 2011

Environment | Safety & Health | Groundwater | Energy

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Prepared for:

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c/o
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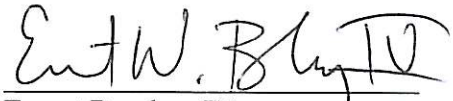
October 31, 2011



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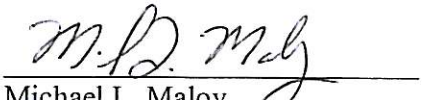

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Executive Summary

Analytical Services, Inc. (ASI) was awarded a contract by the County of Jefferson, West Virginia to identify well targets and develop new water supply wells that may be used to supplement the public water supply system at the Westridge Hills subdivision in eastern Jefferson County. ASI geologists completed a site assessment of the area, reviewed available geologic mapping and reports, and prepared a Preliminary Hydrogeologic Report (February 18, 2011) that identified drilling targets for test wells. Well construction permits were obtained from the State of West Virginia Office of Environmental Health Services (WVOEHS) and three new wells were drilled, two of which were subjected to pump testing. Based on the results of the drilling and testing program, additional groundwater supply was identified that, once permitted, could be used to supplement the existing water supply system that services Westridge Hills.

A new well location, installed and pump tested during this project has been identified as Well A. Well A is located in relatively close proximity to the existing "Jeep Trail" well and is believed to be a good source of supplemental water supply for the existing water system. This report documents the results of the 24-hour aquifer pumping test of Well A, which represents partial fulfillment of the permit application requirements of the WVOEHS for a new public water supply well. Additionally, a plan for the installation of a submersible pump, power supply, treatment equipment, and connective piping would need to be provided to the WVOEHS for their review and approval. Upon obtaining approval and applicable permits from the WVOEHS and making necessary preparation for hook-up, the connection of the supplemental groundwater well to the existing water system could be initiated.

1.0 Introduction

The Westridge Hills Subdivision is situated on the eastern edge of Jefferson County, located on the western slope of the Blue Ridge, just north of Keyes Gap, and just to the west of the Virginia state line (see Figure 1). The Westridge Hills Subdivision, hereafter referred to as the "site", lies within the Blue Ridge Physiographic Province. The site area is underlain by bedrock of the Chilhowee group, a metasedimentary suite of Cambrian age. Specifically, the bedrock is made up of metasandstone and phyllite of the Weverton-Loudoun formation, and metasiltstone, shale, slate, and phyllite of the Harpers formation.

The public water supply system which services the Westridge Hills Subdivision consists of a single well identified as the "Jeep Trail" well within this report. This well is reported to be 313 feet deep with an air lift yield of 60-plus gallons per minute (gpm) and is described as having good water quality. To date, the "Jeep Trail" well appears to have been largely capable of sustaining the immediate groundwater needs of the existing residential connections. At least one other well that had formerly been used to supply groundwater to the system was reported to have a low yield with less than desirable water quality. A supplemental groundwater well for the existing water supply system would provide an additional source of groundwater that could aid in maintaining flow to the residential connections and would represent an important safety factor for groundwater supply if the existing Jeep Trail were to experience an unanticipated outage.

This report documents the installation of three (3) test wells that were targeted within the Preliminary Hydrogeologic Report (issued February 28, 2011) and includes pump testing results generated from two of the wells. A copy of the Preliminary Report which documents the methodology utilized to select the well targets has been provided within Appendix A. Laboratory analytical results of groundwater samples are included in this report as well, along with a budgetary estimate for the connection of a supplemental well to the existing water supply system.

2.0 Background

As documented in the Preliminary Hydrogeologic Report Analytical Services, Inc. (ASI) distributed a questionnaire to Westridge Hills property owners to identify the local residents' water supply concerns. Although response rate was limited, general concern regarding water quality and availability was noted. Responses that were received included several from owners of vacant lots who expressed their desire to have access to water.

ASI conducted a bedrock geology review, fracture trace mapping, and performed geophysical surveys to determine optimum drilling targets for this project. Potential drilling target locations were limited by the fact that ASI only had deeded access to certain parcels within Westridge Hills for well installations. Four (4) drilling targets (referred to herein as Targets A, B, C, and D) were identified and field marked with labeled stakes. Once the chosen locations had been approved, ASI proceeded with permitting of the wells in accordance with WVOEHS guidelines. A permit for the construction of the wells is provided in Appendix B. Target C, located within a

utility right-of-way, fell in close proximity to multiple overhead power lines and was therefore not drilled due to safety concerns. Drilling commenced on June 22, 2011. The locations of the remaining targets, i.e. those that were drilled, are shown on Figure 2 (shown as current well locations).

Well A is located off of Jeep Trail on Parcel Number 0037, Map Number 13J. Well B is situated approximately 250 feet east of Route 32 near the southern end of a pond and is located on Parcel Number 0001, Map Number 13H. Well D is positioned along the southwestern boundary of the Westridge Hills Subdivision, on Oak Lane, and lies within Parcel Number 0238, Map Number 13K.

ASI used the services of Valley Drilling Co., Inc., of Upperville, Virginia to install the three new wells. Well construction information for these wells has been presented in Table 1 below and well completion reports and construction diagrams have been provided in Appendix C. Although three wells were drilled for this project, only wells A and D produced high enough air lift yields to accommodate pump testing. Well A was observed to have an air lift yield of 125 gpm and Well D was observed to have an air lift yield of 43 gpm (Table 1). Thus, Well A and Well D were both subjected to pump testing and each was pumped continually and analyzed separately for a 24-hour aquifer pumping test period. Well D was observed to be an artesian flowing well and required the installation of a specially fitted cap on the well to prevent flow following the well installation.

Table 1
Construction Summary of Westridge Hills Test Wells

Well ID	Total Depth (ft)	Casing Diameter (in)	Casing Depth (ft)	Air Lift Yield (gpm)	Aquifer Formation
Well A	580	8	80	125	Weverton-Loudoun
Well B	440	6	60	6	Harpers
Well D	600	6	119	43	Weverton-Loudoun

3.0 Aquifer Pump Testing

The aquifer pump testing took place during the week of July 18 to July 22, 2011. 24-hour duration testing was performed on Well A and Well D. The pumping rates imposed on the wells during the 24-hour test were chosen based upon the blown air lift yields measured during drilling. Minor adjustments were made to the pumping rates of both wells during the early stages of the test. The final pumping rates were 50 gpm for Well A and 45 gpm for Well D. Any

recorded variations in the pumping rate during the later stages of the test are considered attributable to decreased pump efficiency related to drawdown of the water column. A 10-horsepower well pump was installed and used in Well D and a 15-horsepower pump was used in Well A for the pump testing. Refer to Appendix D for the driller's diagrams of the down-well pump configurations which have been presented as Figures 3a and 3b. Both pumps were powered by portable generators continually throughout the pumping test.

Initiation of pumping was staggered at the onset of the test to investigate for any potential hydrologic connectivity between the two pumping wells, as they are located approximately 1000 feet apart (see Figure 2). Pumping of Well D began at 11:00 AM on Wednesday, July 20, 2011. No obvious response was observed in Well A, and pumping in Well A began at 11:30 AM. Data collection for the 24-hour pumping phase and subsequent recovery phase was completed without interruption and the pumping assembly operated smoothly at each well location. Groundwater samples were collected for laboratory submittal prior the end of the 24 hour pumping interval.

Throughout the test, the depth to water in Wells A and B was measured from the top of the well casing manually with an electronic water level meter. Because Well D exhibited artesian flow, it could not be monitored from the onset of the test with the same device used on the other wells. Thus, the height of the water column above the pump in Well D was measured via the "air bubbler" method, and then converted to drawdown during the post-test analysis. Measurements were read from a pressure gauge displaying the height of the water column above an attached downwell air tube as it correlates to hydrostatic pressure. The "air bubbler" method of taking water level measurements is widely accepted and is commonly implemented for measuring the height of a water column in a well (Trimmer 2000). The pumping rate was controlled by an inline ball valve and was measured using a 2-inch inline, impeller-type, totalizing flow meter. The well discharge was routed through 3-inch flexible piping approximately 150 feet from the respective pumping wells. Personnel were onsite during the pumping test to collect manual water level measurements and to oversee operation and maintenance of the pumping assemblies.

The "Jeep Trial" well, operated by Jefferson Utilities and representing the single source of groundwater supply to the Westridge Hills system was inaccessible for use as a monitoring point for the 24-hour aquifer pumping test. However, Jefferson Utility personnel were notified of the testing and their staff indicated that they did not identify any unusual operating conditions at the "Jeep Trail" well while they were onsite during the test.

The pumps were shut off after a minimum of 24 hours of continuous pumping and the water level in the pumping wells was allowed to recover beginning at 11:00 AM for Well D and at 12:00 noon for Well A on Thursday, July 21st. Full recovery of static (pre-pumping) water level in Well D was achieved within two minutes of pumping cessation. Final water level measurements collected approximately 24 hours after pumping cessation confirm that recovery to greater than 90% of static level in Well A was achieved and documented during the test. Well B, situated at a downhill location approximately 0.4 miles to the north of the two pumping wells was monitored periodically throughout the pumping and recovery phases of the test in attempt to document any potential drawdown in water level resulting from the pump test. No impacts were observed in Well B. The drawdown and recovery phase data for both wells are tabulated in Appendix E.

4.0 Discussion

4.1 Pump Test Analysis

Plots of water levels measured in the pumping wells during the drawdown and recovery phases of the pumping tests are also presented in Appendix E. The Well A water level reached stabilized conditions at a drawdown of about 205 feet at approximately the 17th hour of pumping. The total 24-hour volume of pumpage was 79,629 gallons, yielding an average pumping rate of 54.2 gpm for Well A. However the final pumping rate measured at the conclusion of the pumping test was 50 gpm. The water level in Well D stabilized very quickly twice during the test. That is, it stabilized at about ten minutes into the test, and then rapidly stabilized again after the pumping rate was increased about 100 minutes into the test. The total pumpage for Well D was 62,578 gallons, yielding an average pumping rate of 43.5 gpm. The final pumping rate was 45 gpm at the conclusion of the test. Maximum stabilized drawdown in Well A during the test was 206 feet. Maximum stabilized drawdown in Well D, which exhibited artesian flow, was 45 feet.

In general, conclusions based on a 24-hour pumping test should be regarded with caution to the extent that additional information regarding long term capacity of the well is possible with longer duration pumping tests. With that said, at the time of the test, both wells appeared to be promising candidates for use as supplemental public water supply wells. If a new well is put into service supplementing the existing public water system, it is recommended that the long-term use be evaluated further to better understand the well's capabilities and that the generated data be used to develop a pumping management plan for the well.

Estimates of transmissivity (T) and storativity (S) were calculated from the pump test data using the commercial software package, AQTESOLV. Transmissivity, expressed in units of length^2/time, is directly proportional to hydraulic conductivity and aquifer thickness. Storativity, a dimensionless value, is defined as the yield of water per unit decline in hydraulic head, per unit area of the aquifer. Both parameters give a good indication of how much pumpage a given aquifer could be expected to sustain. The Moench method for unconfined aquifers was used to estimate T and S for Well A and the Neuman-Witherspoon method for leaky confined aquifers was used for Well D. Please see Appendix F for AQTESOLV print-outs of the pump test analyses. It should be noted that no drawdown data from observation wells was available to further evaluate storativity calculations.

Due to the unusually high pressure of the artesian flowing well (Well D), a grouting failure was identified to have occurred following the aquifer pump testing where water actually was observed to flow from the annular borehole space around the six-inch well casing. A number of attempts were made to successfully re-grout this well with cement grout. These attempts included the use of in-well packers, and re-drilling and setting casing deeper into bedrock. Unfortunately the main water bearing zone in Well D was largely sealed off during the grouting effort. Valley Drilling went to great extents to attempt to re-open the water bearing zone, including re-drilling the entire length of the borehole and attempting to use a water well-grade chemical additive to degrade the grout. Only minor success was achieved during these attempts to revive Well D as a final yield of approximately 7 gpm was attained. This unforeseen change in the performance of Well D voids the applicability of the pump test results to this well. The

pump test data does however suggest that the area immediately surrounding Well D possesses very favorable potential for groundwater yield. Although the well no longer produces a high enough yield for it to be considered a candidate for use as a public supply well, the drilling of Well D provided a wealth of information about the hydrogeology of that particular location at the site. If further groundwater development at Westridge Hills were deemed necessary, ASI would recommend drilling in as close proximity to Well D as permittable, in an attempt to encounter the same water bearing formation.

4.2 Laboratory Analytical Results

Groundwater samples were collected from both wells on July 21, 2011 in laboratory-provided bottleware prior to the end of the pump testing, and immediately chilled on ice for transport to Reliance Laboratories in Martinsburg, West Virginia a WVDEP/WVDH/USEPA certified commercial laboratory. Samples were submitted for analysis of constituents included in the West Virginia Bureau for Public Health Public Drinking Water List of Required Contaminant Analyses (see Appendix G for list). The laboratory results document no Maximum Contaminant Level (MCL) exceedances of any of the required analytes, with the exception of manganese in both wells and coliform bacteria in Well A (see Appendix H for laboratory results). Only one coliform sample was collected and submitted for analysis from each well. Coliform bacteria occurrence in samples from otherwise clean wells is common and can indicate contamination of the sampling port at or before the time of sampling. ASI recommends additional disinfection of Well A with chlorine tablets, followed by resampling for coliform bacteria. The manganese concentrations in both of the tested Westridge wells were noted to exceed the drinking water MCL of 0.05 mg/L for manganese. Both Wells A and D produced samples with manganese concentrations of 0.17 mg/L. Other drinking water wells with known manganese exceedances in the vicinity of Westridge Hills are currently being treated with a polyphosphate treatment product called AQUA-MAG. Other common manganese treatment methods include water softening by ion exchange, chlorination followed by filtration, and greensand filtration. Further sampling and analysis for manganese may be necessary to determine optimum treatment strategies if the new Westridge Hills wells are developed for utilization as water supply sources in the future.

5.0 Budgetary Estimates for Well Connection

The connection of a new well to the existing public water system would require the submittal of a Public Water System Well Application to the West Virginia Bureau for Public Health. The application will need to include details on the well construction, planned treatment equipment, and planned connection routing necessary to supplement the existing water supply system. A copy of this pump test report would also need to accompany the application, demonstrating the 24-hour pump testing of the well along with the sampling and laboratory testing results of groundwater from the well. The following outline provides a summary of work that would be necessary to connect and utilize Well A to supplement the existing water supply system.

Based on discussions with the current water system operator, the following approach has been developed:

1) Choose an appropriate sized pump based on pump test data.

2) Coordinate the extension of a new power line to power the pump. An existing pole is already located in the Daisy Lane right-of-way near the well.

3) Install a large diameter pipe along Daisy Lane that extends from the new well to a connection location with the existing line on Jeep Trail. The estimated length of the pipe would be 525 feet. A pipe of approximately 16 inches in diameter would be expected to provide sufficient chlorine contact time prior to the first customer.

4) Pump control would be provided from the existing control system located in the "Jeep Trail" well house.

5) A hydro-cholorinator could also be housed in the existing "Jeep Trail" well house. A long solution tube could be placed within a conduit from the "Jeep Trail" well to the Well A discharge to avoid the need to have a building at the new well site. The length of the solution tube would be approximately 725 feet long. The solution tube would follow the same route as the control wiring.

6) A schematic diagram showing the planned system components and connection with the existing system should be prepared and submitted with the Public Water System Application.

A budgetary cost estimate has been provided based on the above planned approach. This budget should be considered an approximation of costs that may be involved in the connection of the well. Certainly any unforeseen circumstances, or conditions encountered during the construction could significantly increase costs. Appropriate permits should be obtained and firm costs identified prior to implementing the well connection project.

Budgetary Cost Estimate

Connection of Well A to Existing Water Supply System	$120,000 - $140,000

6.0 Conclusions

ASI geologists completed a site assessment of the Westridge Hills area and prepared a Preliminary Hydrogeologic Report (February 18, 2011) that identified drilling targets for test wells. Well permits were obtained from the State of West Virginia Office of Environmental Health Services and three new wells were drilled, two of which were subjected to pump testing.

Based on the results of the drilling and 24-hour testing program, an additional groundwater supply resource was identified that, upon being permitted by the WVOEHS, could be used to supplement the existing water supply system that services Westridge Hills. A new well location, identified as Well A, is located in relatively close proximity to the existing "Jeep Trail" well and

is believed to represent a good source of supplemental water supply for the existing water system. Upon connection to the existing public supply system, ASI would recommend that the long-term use of the well be evaluated further to better understand its capabilities and to develop an adequate pumping plan for the well to promote sustainability for long term use.

Pump testing and laboratory analysis of Well A represents partial fulfillment of the permit application requirements of the WVOEHS for a new public water supply well. Additionally, a plan for the installation of a submersible pump, power supply, treatment equipment, and connective piping would need to be provided to the WVOEHS for their review and approval. Upon obtaining approval and applicable permits from the WVOEHS and making necessary preparation for hook-up, the connection of the supplemental groundwater well to the existing water system could be initiated.

Aquifer testing performed at Well D provided favorable results. However, pressure from the artesian flow caused the grout seal on the well to be compromised following the pump testing event. Once the well was successfully grouted much of the initial flow had been lost. If further groundwater well development at Westridge Hills were deemed necessary, ASI would recommend the installation of an additional well in as close proximity to Well D as permittable, in an attempt to drill into the same water bearing formation initially encountered.

7.0 Limitations

The work performed in conjunction with this project, and the data developed, are intended as a description of available information at the sample locations indicated and the dates specified. Generally accepted industry standards were used in the preparation of this report.

Reported data are intended to approximate actual conditions at the time of sampling. Results from future testing may vary significantly as a result of natural conditions, a changing environment, or the limits of analytical capabilities. This report does not warrant against future operations or conditions, nor does it warrant against operations or conditions present of a type or at a specific location not investigated. The limited sampling conducted was intended to approximate subsurface conditions by extrapolation between data points. Actual conditions may vary.

8.0 References

County Commission of Jefferson County, West Virginia, 2008. *Mountain Communities Water Systems Improvements – Preliminary Engineering Report*. Jefferson County Document, notarized by Frederick L. Hypes.

Trimmer, W.L. 2000. *Measuring Well Water Levels*. Oregon State University Extension Service Publication # EC 1368. Reprinted August 2000.

FIGURES

Figure 1: Site Location Map

Legend

Westridge Hills Subdivision Boundary

0 0.25 0.5 1 Miles

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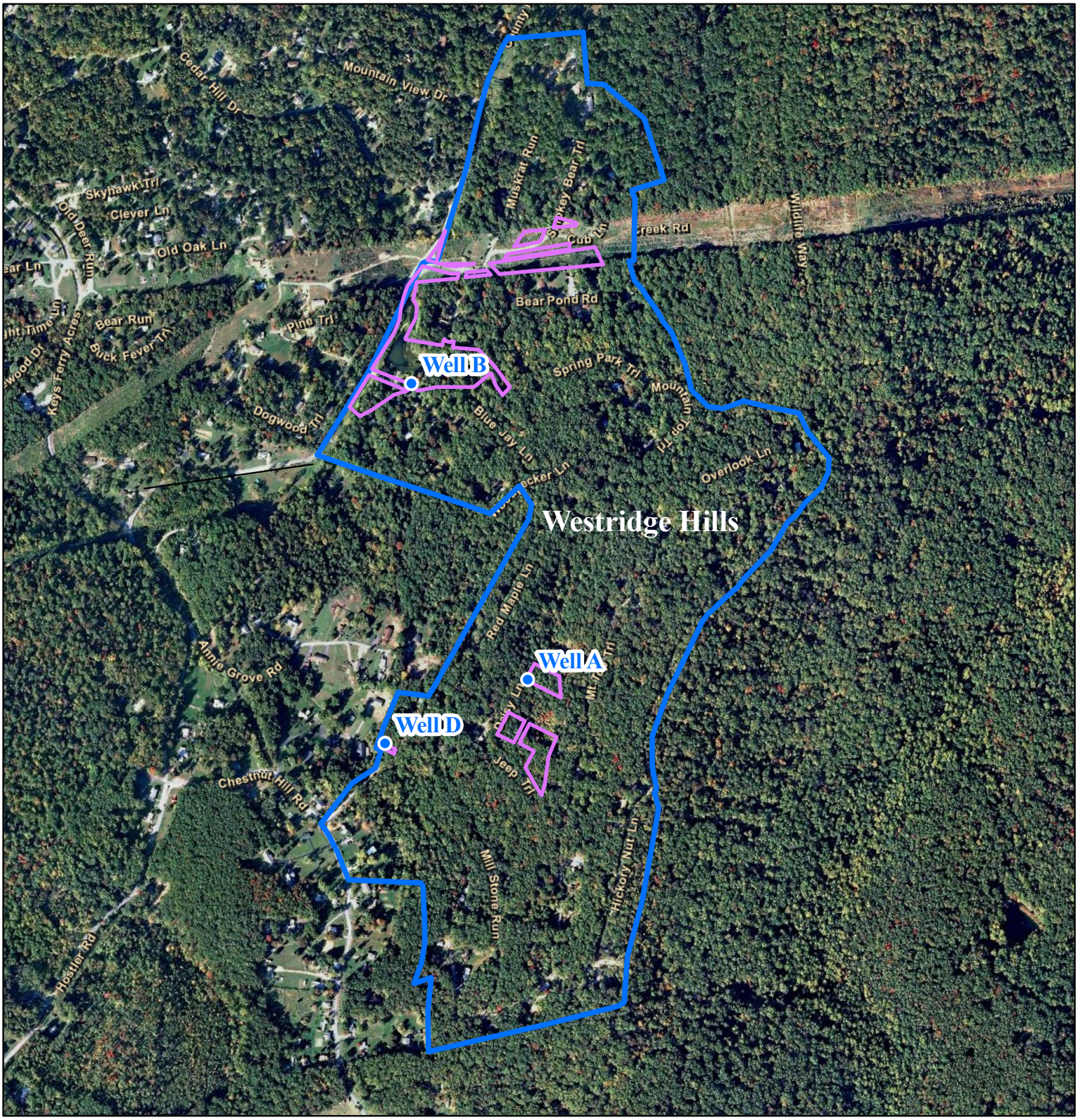

Figure 2: Well Locations Map

Legend

- Well Locations
- Available Parcels
- Westridge Hills Subdivision Boundary

0 550 1,100 2,200 Feet

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APPENDICES

Appendix A

Preliminary Hydrogeologic Report

ANALYTICAL SERVICES, INC

Preliminary Hydrogeologic Report
Westridge Hills Subdivision
Jefferson County, West Virginia

Environment | Safety & Health | Groundwater | Energy

Preliminary Hydrogeologic Report

On

Westridge Hills Subdivision
Jefferson County, WV
ASI Job No. 3313

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1.0 INTRODUCTION

Analytical Services, Incorporated (ASI) is pleased to submit the following Preliminary Hydrogeologic Report to the Jefferson County Engineering Department. The preliminary report summarizes the work that was completed in order to identify potential drilling targets that may provide additional potable water supply for the Westridge Hills Subdivision (Figure 1). ASI understands that additional water supply development may also aid the Mountain Communities water system that is maintained by Jefferson Utilities, Incorporated, which supplies water to approximately 400 residences in Keyes Ferry Acres, Harpers Ferry Campsites, and the Westridge Hills Subdivision.

ASI personnel initially gathered pertinent information regarding the local geology and topography, orientation and abundance of fracture traces, soil characteristics, and existing well locations at, or near, the site. Water system questionnaires were distributed to property owners in the Westridge Hills Subdivision to better understand any water quantity and quality concerns experienced by the residents. A community meeting was also held on January 19, 2011 at the Charles Town Library Meeting Room to provide residents and property owners information regarding the methodology that would be used to identify well drilling targets. A description of field activity that would be required during the study was also provided at the meeting.

Field work completed during the study included the completion of three (3) high-resolution electrical resistivity surveys within the Westridge Subdivision. The resulting data were reviewed and interpreted in order to aid in the targeting of the most favorable areas for on-site test wells. ASI geologists also evaluated the Keyes Ferry Acres and Harpers Ferry Campsites subdivisions via fracture trace analysis, review of geologic mapping and site reconnaissance. Although no geophysical surveys were completed and no potential well targets identified on these properties, ASI has included some recommendations pertaining to further investigation of these areas.

Based on the findings of this study, ASI has recognized three groundwater zones that appear to have unique characteristics across the larger study area. The larger study area consists of the property extending from the eastern boundary of Westridge Hills westward to the Shenandoah River. Drilling targets identified within this report are within the Westridge Hills Subdivision and are situated within two of the identified groundwater zones. The following report summarizes the data utilized to delineate the groundwater zones and the methodology used to select the proposed well drilling targets within the Westridge Hills Subdivision.

2.0 GEOLOGY

The study area lies within the Valley and Ridge Physiographic Province of West Virginia. The majority of the study area including the western part of the Westridge Hills Subdivision is underlain by metasiltstones and phyllites of the Harpers Formation (Ch), which is a part of the larger Chilhowee Group. The eastern and southeastern portions of the Westridge Hills area are underlain by a quartzite/pebble conglomerate unit of the

Weaverton-Loudoun Formation (Cwo), which is also associated with the Chilhowee Group. These Chilhowee Group rock formations are Cambrian aged metamorphosed sedimentary rocks (Southworth et al, 2003). Conglomeratic sandstone rocks were observed to have a low angle dip to the east near the ridge top along the eastern portion of Westridge Hills. Two measurements collected within the bedrock indicated strike orientations of North 10 degrees East and North 5 degrees East with corresponding dip measurements of 10 degrees to the East at each location.

The Keyes Ferry Acres and Harpers Ferry Campsites subdivisions are also primarily underlain by the Harpers Formation. However, the extreme western portions of these sites are underlain by the Antietam Formation quartzite which grades westward to thrust faulted contact with the dolomite/limestone/marbles of the Tomstown Dolomite located along the eastern bank of the Shenandoah River. Figure 2 illustrates the geology of the Westridge Hills Subdivision and surrounding areas.

3.0 AERIAL PHOTOGRAPHY

ASI obtained stereo pairs of aerial photographs covering the subject property from the United States Geological Survey (USGS) Mapping Department at a scale of 1:40,000 and from Air Photographics, Incorporated at a scale of 1:12,000. The photographs were dated March of 2000 and October of 2004, respectively. These photographs were stereoscopically analyzed and a fracture trace analysis was performed over the study area. Copies of the photos obtained for this study have been included in Appendix A.

During the completion of the fracture trace analysis, individual trace locations were interpreted on the photos and were then carefully transferred to a topographic base map. The fracture trace locations were field truthed by ASI geologists. Surficial expressions that have been interpreted as fracture trace lineaments have been identified on Figure 3. The fracture trace analysis results and available geologic mapping were utilized to interpret the most favorable site areas for the completion of electrical resistivity surveys on the Westridge Hills Subdivision properties. These data were also considered during the selection of the proposed test well target locations.

4.0 EXISTING WELL LOCATIONS

ASI contacted the Jefferson County Environmental Health Department to inquire about the availability of well records for the general site area. Health Department officials were able to provide locations of eleven (11) bedrock groundwater wells. Partial data sets were only available for seven (7) of the wells and these data have been summarized in Table 1, below. Figure 4 illustrates the locations of the subject water supply wells.

Table 1
Summary of Available Well Data

Well Identification	Well Yield (gpm)	Total Depth (feet)	Casing Length (feet)
WHWS-Jeep Trail Well	60+	313	40
KFA – North 1	60	505	21
KFA – North Backup	NA	590	NA
KFA – Central 1	55	645	63
KFA – South 1	NA	550	NA
KFA – South Backup	NA	NA	NA
"R" Section Well	NA	275	76

Note: gpm = gallons per minute NA = Not Available

Review of Table 1 indicates that the majority of the wells listed were completed to depths ranging from 275 to 645 feet below ground surface. Well yield data was available for less than 50% of the wells; however, the wells for which information was available indicated a maximum air lift yield of greater than sixty (60) gallons per minute (gpm). This particular well is located within Westridge Hills Subdivision and is currently understood to be the sole well supplying water to the Westridge Hills community. Casing length data suggest that less than eighty (80) feet of casing was required in four (4) of the wells.

An out-of-service well was identified on the Westridge Hills property just west of Turtle Run Lane. This well is positioned near a deteriorated structure and is believed to have been a former supply well. The well was uncapped and was observed to have very limited artesian flow. To prevent a possible contaminant conduit to the bedrock aquifer this well should be capped. Further research of this well should be conducted and if no further use is planned, it should be properly abandoned.

5.0 LITERATURE REVIEW

ASI performed a review of readily available literature to aid in evaluating the hydrogeologic and geologic framework of the general study area. ASI also contacted Dr. Henry Rauch of West Virginia University, who provided a list of publications regarding carbonate/karst hydrogeology and remote sensing techniques. Several sources were obtained and reviewed. The contents of these sources are summarized below.

Geology

Earlier geologic mapping of the site and surrounding areas was completed by Cardwell et al. (1986), Dean et al. (1987), Southworth et al. (2003), and McCoy et al. (2005). These mapping data indicate that the majority of the Keyes Ferry Acres, Harpers Ferry Campsites, and Westridge Hills subdivision areas are underlain by metasedimentary rocks of the Harpers Formation. The eastern portion of the Westridge Hills area is underlain by rocks of the Weaverton/Loudoun Formation (metasedimentary). The

western portion of the Harpers Ferry Campsites area is underlain by the metasedimentary rocks of the Antietam Formation. The Antietam Formation contact with the Tomstown Formation dolomite is bounded by a thrust fault that lies near to the eastern bank of the Shenandoah River.

Jefferson County was structurally influenced by the geologic events that created the Appalachian Mountains, resulting in the presence of many folds and faults within the County. The principal features located within the County are associated with the Blue Ridge anticline and the Massanutten syncline. Cambrian aged metasedimentary rocks comprise the western limb of the Blue Ridge anticline and are exposed in the eastern part of Jefferson County. The eastern limb of the Massanutten syncline underlies Jefferson County and is defined by the presence of the Martinsburg Formation. Several smaller folds can be identified within the County along with an extensive array of thrust and cross-strike faults.

Orndorf et al. (1992) performed a detailed analysis of joint patterns present in folded carbonate rocks located in the Shenandoah Valley. The dominant orientation for joints that formed perpendicular to fold axes was found to be between North 60 to 80 degrees West. Joints forming parallel to fold axes were found to be most prevalent in the North 10 to 50 degrees East orientation. Work performed by Kozar et al. (2007) in the Leetown area correlated well with the joint orientation data presented by Orndorf et al. in 1992.

McCoy et al. (2005) mapped a total of 861 lineaments in the carbonate lithologies included within their 212 square mile study area. The dominant fracture orientations were found to be North 27 degrees East and North 67 degrees West. The two most prominent orientations were found to be roughly perpendicular to one another.

Well Yields

Bieber et al. (1961) were among the first to suggest that the highest yielding wells in Jefferson County were completed in carbonate lithologies. Bieber et al. (1961) also suggested that many prolific water bearing zones were encountered in the initial 50 feet of drilling but added that these zones were cased through more often than not due to concerns regarding contaminant threats. Hobba et al. (1972), Kozar et al. (1990), Shultz et al. (1995), were also among the authors who published studies that suggested that the bedrock lithology had a direct influence on well yield and that the carbonate units within the County generally yielded the greatest average yields. During research conducted on similar rock lithologies in Pennsylvania, Siddiqui and Parizek (1971) concluded that sandy and coarse grained dolomites were the highest average producers followed by limestone then fine grained dolomites and shale.

Work conducted by McCoy et al. (2005), stated that an increase in bedding planes intersected and contacts between differing lithologies encountered during drilling often lead to more favorable well yields. Their work also suggested that the proximity of well targets to geologic structures such as faults and fractures generally resulted in increased well yields. Data from the study also determined that wells located within 250 meters of

faults had higher median transmissivities than those located at a greater distance form geologic structures. Studies conducted by Hobba et al. (1976), Shultz et al. (1995), and Kozar et al. (2007), resulted in similar findings such as wells located less than 400 feet from a fault trace yielded up to 4 times more than wells located at 800 feet or more from fault zones. Other publications prepared by Rauch and Plitnik (1984) and Zewe (1991) concluded that wells that were completed in close proximity to lineaments yielded up to 5 times more than those not located near a fracture trace, and potentially up to 8 times greater when completed in areas where two or more lineaments were prevalent. It is also worth noting that Shultz et al. (1995) suggested that many of the larger springs in neighboring Berkeley County occur at limestone-shale contacts. Hobba et al. (1972) also stated that 16 of the 25 springs discharging more than 1,000 gallons per minute (gpm) are located on or near faults.

Golder Associates prepared a Hydrogeologic Report titled Groundwater Resource Evaluation of Jefferson Utilities Valley Water System in January of 2009. The report included a summary table of well yield data per rock formation that was compiled from various reports. Table 2 presented below is based on information provided in the Golder Associates report.

Table 2
Geologic Formations & Hydrogeologic Characteristics

Formation	Lithology	Thickness (feet)	Water Producing Characteristics
Tomstown Formation	Dolomite and dolomitic marble	1,175	Limited Data, Min: 5, Max: 64, Median: 34 (4 wells)
Antietam Formation	Metasandstone and metasiltstone	800	Insufficient Data
Harpers Formation	Metasiltstone, conglomerate, metasandstone	2,400	Min: 3, Max: 75, Median: 21 (14 wells)
Weaverton, Loudoun Formations	Quartzite, conglomerate, phyllite, metasandstone	225	Min: 2, Max: 5 (2 wells)

Review of Table 2 indicates that a limited amount of well data was available for the geologic formations present in the study area. Based on the data presented above, the median well yield in the Tomstown Formation was the highest observed.

Water Quality

Potential contaminant sources for groundwater wells include but are not limited to the following: underground and aboveground chemical storage tanks, landfills, septic systems, cemeteries, waste water treatment facilities, herbicides/pesticides, and industrial sites. Wells drilled in carbonate/karst lithologies are particularly vulnerable to such potential threats.

Hobba et al. (1972) states concerns with sulfide odors, nitrate contamination and contamination of groundwater due to the influence of pesticides and herbicides within the carbonate lithologies. Elevated turbidity levels are also sometimes noted to occur. Kozar et al. (1991) also note the presence of fecal coliform bacteria in many wells as a concern, along with elevated levels of manganese that sometimes require treatment. Hobba et al. (1976) and Shultz et al. (1995) indicate that wells completed in the carbonate formations are often very hard (high calcium and bicarbonate levels) and exhibit total dissolved solids concentrations in excess of 200 mg/L.

Despite the potential problems associated with the water quality of wells drilled in carbonate lithologies, the Golder Associates report indicates that the water quality in the active wells associated with the Walnut Grove, Meadow Brook, Shenandoah Junction, and Burr/Bardane components of the valley water system meets all standards. Well yields within these systems range from 20 to 2,000 gpm. Water filtration is required for some of the wells prior to chlorination however, no other treatment is necessary.

A preliminary engineering report prepared by Dunn Engineers in 2008, states that the water quality in the Keyes Ferry Acres, Harpers Ferry Campsites, and Westridge Hills has historically been poor. These wells have all been completed in fracture bedrock formations that are associated with the Chilhowee Group and the quality issues are primarily associated with iron, manganese, and radon. Data provided in the Golder Associates report indicates that five (5) active wells supply the Keyes Ferry Acres subdivision and the water extracted from each of these wells is treated with AQUA-MAG in order to remove iron and manganese prior to chlorination. Two (2) of the three (3) wells that supply the Harpers Ferry Campground area are also treated with AQUA-MAG. All of the wells associated with the Keyes Ferry Acres and Harpers Ferry Campsites subdivisions were drilled in the Harpers Formation. One (1) single well currently provides water to the Westridge Hill subdivision and this well reportedly requires no treatment beyond chlorination. Unlike the other wells being utilized in the area, the Westridge Hills well was drilled in the Weaverton/Loudoun Formation. Of interest, Kozar et al. (1991), indicates that elevated radon levels were noted to be present in four (4) wells that were included in the quality sampling activities. Based on maps and information in the report it appears likely that these wells have been completed in rocks of the Harpers Formation, suggesting that perhaps the presence of radon may be somewhat prevalent within the Harpers Formation lithology. It should be noted that radon analysis is required during the permitting process for a public water supply well.

6.0 INTERPRETATION OF GEOLOGIC DATA

ASI geologists stereoscopically analyzed multi-scale aerial photography to identify fracture trace lineaments typically associated with zones of fracture concentration. Concentrated fracture zones typically produce surficial expressions that can be identified via stereoscopic analysis. Figure 3 illustrates the relative locations of twenty-four (24) fracture trace lineaments mapped in the Westridge Hills, Keyes Ferry Acres, and Harpers Ferry Campsites areas. The orientations of the mapped lineaments were utilized to prepare a rose diagram. Review of the rose diagram suggests a strong overall north-

northeast to south-southwest trending orientation, with a smaller component, nearly perpendicular to the dominant fracture orientation. The prominent north-northeast trending lineaments appear to correspond well the overall strike of bedrock geology within the site area (Figure 2). Structural measurements noted particularly in the Harpers Formation indicate a similar north-northeast to south-southwest trending orientation. Although the mapped fracture traces identified during this study occur primarily within the metasedimentary rocks east of the Shenandoah River, it is worth noting that the primary orientations correspond well with the data presented by McCoy et al. (2005).

7.0 DELINEATION OF GROUNDWATER ZONES

ASI utilized the available geologic and hydrogeologic data that has been compiled for the study area to create a groundwater zone map. Each groundwater zone was delineated based on geologic and hydrogeologic conditions that were deemed somewhat unique to the designated areas. The delineation of the zones was completed to better understand potential favorability for the development of groundwater supply from these areas. It should be noted that the rankings are relative and based on information available locally, therefore these zones apply only to the specific study area and should not be considered to imply a broader scale assignment of potential groundwater zones throughout the region or County. Likewise anomalous conditions of groundwater quantity and quality may occur within each zone. The following paragraphs provide a summary of the general characteristics of each designated zone. Figure 5 illustrates the groundwater zone mapping completed during this study.

Zone A

Zone A is considered to be the most favorable of the three (3) zones in terms of potential for completing higher yielding wells (50+) that exhibit suitable water quality. The area adjacent to the Shenandoah River is underlain by carbonate rocks of the Tomstown dolomite. Works conducted by Bieber et al. (1961), Hobba et al. (1972), Kozar et al. (1990), and Shultz et al. (1995), all suggested that bedrock lithology had a direct influence on well yield and that the carbonate units within Jefferson County generally produced the greatest average yields. The Golder Associates report also suggests that the water quality and yields in the active wells associated with the Walnut Grove, Meadow Brook, Shenandoah Junction, and Burr/Bardane components of the valley water system (located on the western side of the Shenandoah River) are all favorable. Well yields within these systems were documented from 20 to 2,000 gpm. Although water filtration is required for some of these wells prior to chlorination, no other treatment was reported to be necessary.

The eastern portion of Zone A is underlain by metasedimentary rocks of the Antietam Formation. Little well yield information is available for this formation. However, it has been included within the most favorable zone due to the fact that the mapped contact between the geologic formations (Tomstown and Antietam) is bisected by a major thrust fault. Studies conducted by McCoy et al. (2005), Hobba et al. (1976), Shultz et al. (1995), and Kozar et al. (2007), concluded that wells located less than 400 feet from a

fault trace yielded up to four times more than wells located at 800 feet or more from fault zones. ASI believes that well targets could be identified within 400 feet of the thrust faulted zone, suggesting an increased possibility of locating wells with favorable yields. While Zone A is deemed to have favorable potential for the development of groundwater supply it should be noted that well data from the actual mapped area was not available. Additional investigation within Zone A would be recommended to better understand and assess its potential for groundwater development. ASI has identified an area of interest within Zone A that would be recommended for additional assessment in the event that Jefferson County wished to pursue such an evaluation.

Zone B

Zone B is considered to be the least favorable unit for the development of water supply. This assessment recognizes that higher yielding wells can be located within this zone and that water quality may vary based on specific locations. However, based on the available data identified during this study, Zone B appears to have the least potential for groundwater supply development relative to the other delineated units. This zone is underlain entirely by the metasedimentary rocks of the Harpers Formation. Historical data compiled in the Golder Associates report indicates that data for fourteen (14) wells that have been drilled in this formation locally was available. These data suggest well yields ranging from a low of three (3) gpm to a high of seventy-five (75) gpm, with a median yield of twenty-one (21) gpm. Several of these wells supply the Keyes Ferry Acres and Harpers Ferry Campsites water systems. Available information for said wells indicates well yields of 55 gpm, 55 gpm, and 60 gpm, respectively. Despite these favorable yields, it is noted in both the Dunn Engineers and Golder Associates report that water extracted from these wells requires treatment to remove iron and manganese. Radon contamination has also been noted as a concern for groundwater extracted in this area. Water quality associated with this zone may be a larger concern than quantity, as some wells with relatively high yields have been documented.

Zone C

Zone C is considered to be the second most favorable groundwater zone in the study area. The zone is underlain by the Weaverton/Loudoun geologic formation. Historical data compiled from various sources included data for only two (2) wells which yielded two (2) and five (5) gpm respectively. However, the well located along Jeep Trail, that currently services the Westridge Hills subdivision, was drilled within this geologic unit and reportedly had an air lift yield of 60+ gpm. Water quality was reported to require only chlorination with no additional treatment. Based on a review of aerial photographs and field observations made during site reconnaissance, the presence of fracture trace lineaments and/or geologic structure suggest the presence of potential water bearing features within the conglomeritic rock. The lithology within Zone C is composed of hard brittle rock that would be expected to possess primarily porosity features including fractures, joints, and remnant bedding planes. The presence of an existing higher yielding well within this zone that currently supplies favorable quality water to the Westridge Hills Subdivision further supports interest in this Zone in terms of

groundwater exploration. While relatively good water quality has been documented in this zone, there is limited well data and therefore little information available to evaluate groundwater quantity. Water quantity within this zone may therefore be a bigger concern than groundwater quality.

8.0 GEOPHYSICAL INVESTIGATION

Mapped fracture traces generated from the previously completed fracture trace analysis along with topographic features were utilized to aid in selecting geophysical survey line locations for high-resolution resistivity testing. Resistivity surveys provide data on values of electrical resistance within the subsurface. Conductive anomalies identified during the surveys are often associated with water bearing fractures. In addition to yielding information on the location of potential water bearing fractures, the resistivity surveys also can provide useful data toward interpreting the depth of overburden across a wide survey area.

Prior to conducting geophysical investigations at the Westridge Hills Subdivision property, ASI, with the aid of Jefferson County Engineering Department personnel, distributed questionnaires to property owners within the subdivision. A public meeting was held on January 19, 2010, in order to provide a summary of the activities that would be taking place during the geophysical investigation phase and the well drilling and testing phases of the project.

Electrical resistivity is a parameter that describes how easily a material can transmit electrical current. High values of resistivity imply that the material is very resistant to the flow of electricity and low values of resistivity imply that the material transmits electrical current more easily. The primary factors affecting resistivity of earth materials are porosity, water saturation, clay content and ionic strength of the pore water. The minerals comprising soil and rock generally do not readily conduct electric current. Most of the current flow takes place through the material's pore water. Resistivity decreases with increasing porosity and water saturation. Clay minerals are conductive because of the availability of free ions in the sheet structure of the clay particles. Resistivity values decrease with increasing clay content. Similarly, dissolved ions in groundwater make the water more conductive to electrical current.

On February 16th and 17th (2011), ASI personnel completed three (3) electrical resistivity surveys, designated as Lines 1-3 respectively, at the Westridge Hills Subdivision. Figure 6 illustrates the locations of each of the geophysical resistivity survey lines. The locations of the surveys were selected based on review of geologic mapping, fracture trace mapping results and parcels deemed to be accessible for drilling. The geophysical investigation was conducted to aid in evaluating the mapped fracture trace locations and to potentially identify any fractures that may not exhibit a surficial expression.

Line 1 was oriented slightly east of north and extended from Jeep Trail along the eastern edge of Possum Trail northward. Line 2 Crossed Line 1 along Possum Trail and was completed in a near north-south orientation. Both Lines 1 and 2 were used to evaluate

the conglomeratic rocks of the Weaverton-Loudoun Formation. Line 3 was completed in a near east-west orientation extending from Rt. 32 westward to Turtle Lane. Line 3 was completed within the Harpers Formation. The results of the geophysical survey data were used to prepare cross sectional graphics which have been presented in Figures 7-9 as referenced below.

The results generated from Line 1 suggest that resistive material lies near the surface (Figure 7). The presence of talus rock near the surface with minimal clay content may be responsible for the resistive nature of the shallower portion of this profile. While a few anomalies are identified between 50 and 100 feet below ground surface with lower resistivity characteristics the results generated from Line 1 primarily indicate the presence of resistive material.

Line 2 was completed in a manner that enabled an evaluation across varying topographic relief (approximately 130 feet of relief). The line began along Red Maple Lane, extended across Possum trail near its mid-point and then terminated in an upslope position near an apparent bedrock ledge positioned near the top of the ridge. Of interest, this profile suggests a less resistive area that is represented as a nearly straight feature which dips at a low angle to the east (Figure 8). The low angle dip direction corresponds with bedrock geometry measurements made near the top of the ridge along Mountain Top Trail. The low dipping feature lies nearly 150 feet below the ground surface near the mid-point of the survey line. Overlying this feature, the data suggests primarily resistive conditions within the subsurface.

Line 3 enabled an evaluation of subsurface conditions in the vicinity of a mapped fracture trace lineament near Route 32 and also in the area of an identified artesian well near Turtle Lane Road. A contrast in resistivity values was noted near the western portion of the line in the vicinity of the mapped lineament which suggests potential for water bearing characteristics. The majority of the eastern portion of the line, including the area of the artesian well, appeared to be underlain by resistive material (Figure 9).

9.0 PROPOSED DRILLING TARGETS

Results of the fracture trace mapping, bedrock geology review and geophysical surveys have been evaluated to determine optimum drilling targets for this project. Available parcels with deeded access for drilling have also influenced the drilling target locations. Using the above information, four (4) drilling targets have been identified and their locations have been depicted on Figure 10. The target locations have been field staked, labeled, and marked with florescent ribbon. An attempt has been made to locate each of the targets within a parcel that has deeded easement for drilling. ASI understands that the client will be arranging for a physical survey of each of the staked locations to ascertain their location with respect to the deeded easement property, including the distance from the property boundary.

Target A is positioned near Station #34 (544 feet) on Line 2 approximately 465 feet north of the existing well and pump house. Target A is located on Parcel Number 0037, Map

Number 13J. Target B is positioned near Station #15 (240 feet) on Line 3. This target is located approximately 240 east of Route 32 near the southern end of the pond. Target B is located on Parcel Number 0001, Map Number 13H. Target C is positioned on the north side of the pond and lies between a smaller power line and the large tower-mounted power lines. Due to the constraints associated with overhead power lines and apparent wetland near the northern edge of the pond, this target was located without the use of geophysics. This target may require coordination with the utility company to determine any restrictions that may be associated with the power line easement. Target C is also located within Parcel Number 0001; Map Number 13H. Target D is positioned along the southwestern boundary of the Westridge Hills Subdivision and lies within Parcel Number 0238, Map Number 13K. Target D is located on a very small parcel. Space constraints required the siting of this well without the use of geophysics.

The target locations have been limited to four (4) staked targets. These locations are deemed to represent the best areas available for drilling within the Westridge Hills Subdivision based on the findings of this study and considering the parcels that have deeded access for test drilling activity. An attempt has been made to identify targets within both Zone A (Weaverton-Loudoun Formations) and Zone B (Harpers Formation). While other parcels with deeded access were identified within Zone A, they were deemed to be too close to the existing water supply to warrant consideration.

Once the above targets are surveyed and confirmed acceptable for drilling based on the client's review, well permit applications will be made with The West Virginia Bureau for Public Health. In the event that any of the identified well targets are not granted permits for drilling, a discussion to determine if any other parcels may be available for test drilling would be necessary.

Upon obtaining permits and completing the test drilling program, ASI will be prepared to begin aquifer pump testing of the wells which are observed to have favorable air-lift yields. The pump testing methodology is further discussed below.

10.0 PUMP TEST METHODOLOGY

The West Virginia Bureau for Public Health Office of Environmental Health Services requires that a public water systems engineer or West Virginia Certified Well Driller perform yield and drawdown tests on every community well prior to the placement of the permanent pump. Furthermore, for community water supplies, it is required that the test pump capacity be at maximum anticipated drawdown at least 1.5 times the quantity anticipated and to provide for continuous pumping for a minimum of twenty-four (24) hours, or until stabilized drawdown has continued for at least six (6) hours when pumped at 1.5 times the design pumping rate.

Test wells with favorable well yields will be pump tested at a constant (or near constant) rate simultaneously for a minimum of twenty-four (24) hours. Discharge piping (outlet) will be placed a minimum of two hundred (200) feet away from each pumping well so as to avoid the potential induction of recharge during the pumping phase. The drilling

contractor will fit each well with; a drop tube to accommodate the use of an electric water level meter for collecting water level readings during the test, a rental submersible pump, an in-line adjustment valve, and a turbine/totalizing flow meter.

Manual measurements for each well will be collected via an electronic water level meter as per the following schedule.

Test Well Monitoring Frequency – Test Initiation – Drawdown Phase

Frequency, One Measurement Every:	Elapsed Time, For the First:
30 Seconds	0-3 minutes
1 Minute	3-10 Minutes
2 Minutes	10-30 Minutes
5 Minutes	30-60 Minutes
10 Minutes	1-2 Hours
15 minutes	2-5 Hours
30 Minutes	5-8 Hours
1 hour	8–24 Hours

Water quality samples will be collected from the well during the final hour of the test. The samples will be placed in a refrigerated cooler and transported to a certified laboratory for the list of analyses included in Appendix B.

Pumping will be ceased following a minimum twenty-four (24) hour pumping period. Recovery measurements for the test wells will be collected as per the following schedule. It should be noted that if 90% recovery is not observed within the first twelve (12) hours following the test, additional measurements will be collected.

Test Well Monitoring Frequency – Test Cessation – Recovery Phase

Frequency, One Measurement Every:	Elapsed Time, For the First:
30 Seconds	0-3 Minutes
1 Minute	3-10 Minutes
2 Minutes	10-30 Minutes
5 Minutes	30-60 Minutes
10 Minutes	1-2 Hours
15 minutes	2-5 Hours
30 Minutes	5-8 Hours
1 hour	8–12 Hours

11.0 FURTHER INVESTIGATION OF CONTIGUOUS SUBDIVISIONS

ASI personnel conducted a fracture trace analysis of the Keyes Ferry Acres and Harpers Ferry Campsite areas as well as a review of available geologic literature. Several

prominent lineaments were identified during the fracture trace analysis which has been depicted on the fracture trace mapping (Figure 3). During this study ASI prepared a Groundwater Zone Map. Groundwater Zone A, which is located near the eastern bank of the Shenandoah River and represents varying geology (including carbonate) along with the presence of a fault zone, has been deemed to represent the best area with regard to groundwater development potential within the larger study area. For the client's convenience, ASI has identified an area of interest within Zone A that would be recommended for additional assessment in the event that Jefferson County wished to pursue such an evaluation (Figure 5).

Based on the literature review, multiple sources have indicated that wells drilled in carbonate lithologies provide higher mean yields when compared to those completed in fractured rock. The Tomstown dolomite is present within Zone A and represents the only carbonate lithology available in the study area. Multiple sources also indicate that wells completed near faults and fractures generally exhibit higher yields. The identified area of interest within Zone A is bisected by a prominent thrust fault. These data indicate that the chance of completing a high-yield well that provides suitable water quality may be greater when drilling in the carbonate lithology, as opposed to the metasedimentary rocks of the Chilhowee Group. In fact, the Golder Associates report also included a recommendation to conduct a study of the carbonate aquifer system on the east side of the Shenandoah River near the Harpers Ferry Campsites. While the identified area of interest within Zone A appears to have good potential for groundwater development, additional assessment would be needed to further evaluate the feasibility of developing potable water supply wells in this area.

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FIGURES

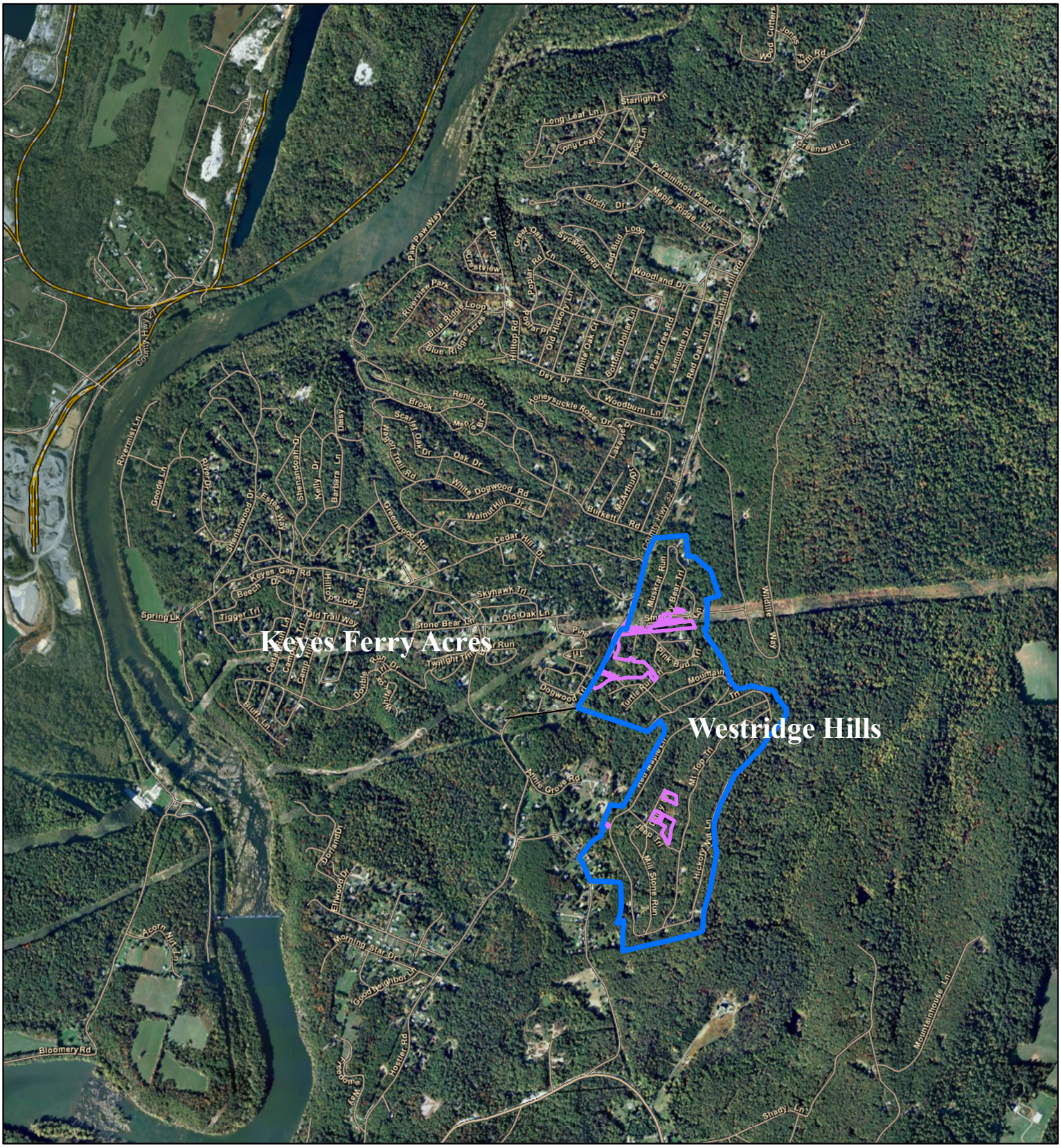

Figure 1: Site Location Map

Legend

- Westridge Hills Subdivision Boundary
- Available Parcels

0 0.25 0.5 1 Miles

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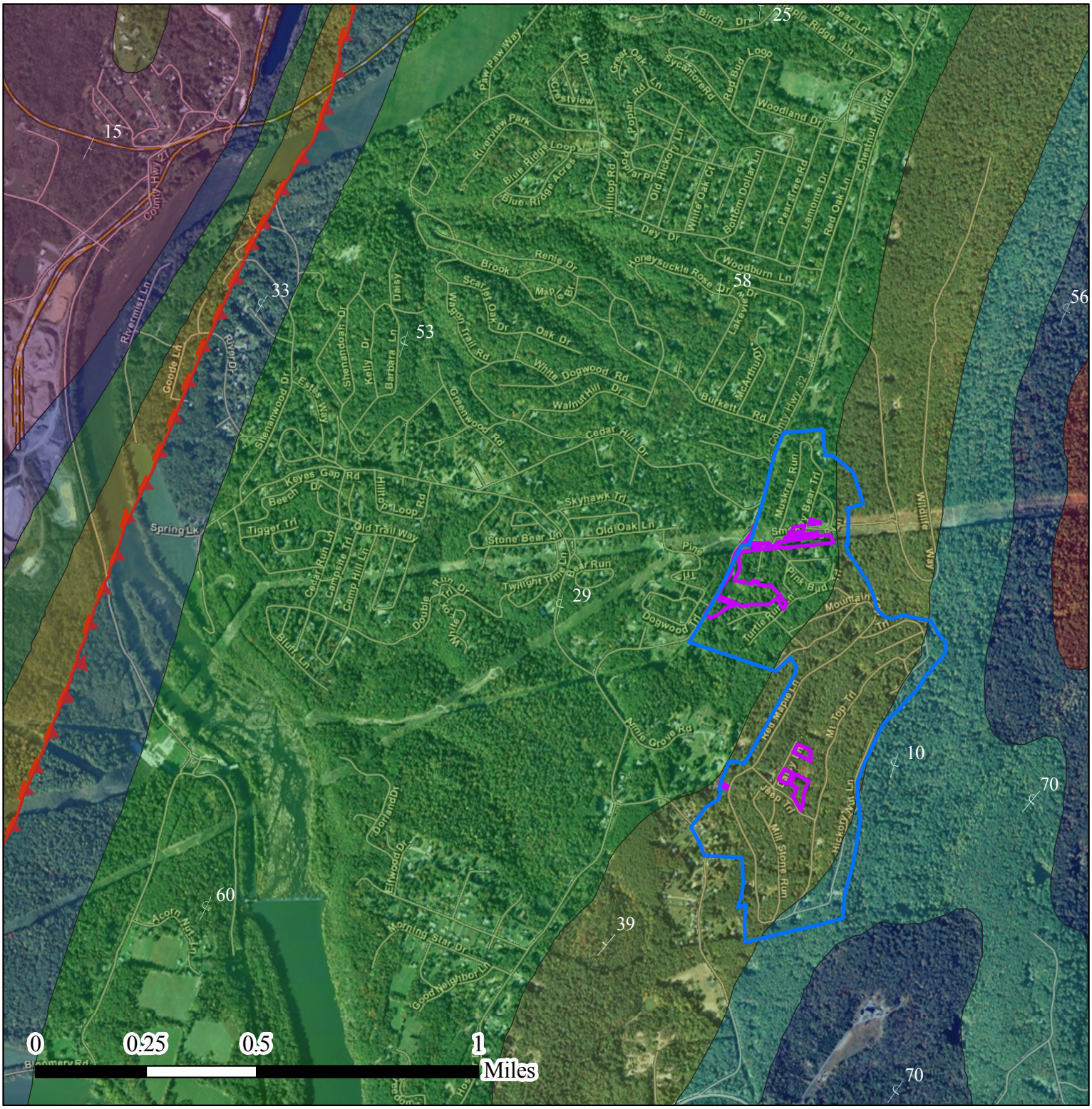

Figure 2: Geologic Map

Legend

- Westridge Hills Subdivision Boundary
- Available Parcels
- Fault
- Inclined Bedding
- Overturned Bedding

MapUnit, LithPri, LithSec

- Ca, metasandstone, metasiltstone
- Ch, metasiltstone, phyllite
- Clp, phyllite
- Ctb, dolomite
- Ctbh, limestone, marble
- Ctd, dolomite, limestone
- Ctf, dolomite
- Cwar, sandstone, shale
- Cwb, metagraywacke, metasiltstone
- Cwm, quartzite, metasiltstone
- Cwo, quartzite, pebble conglomerate

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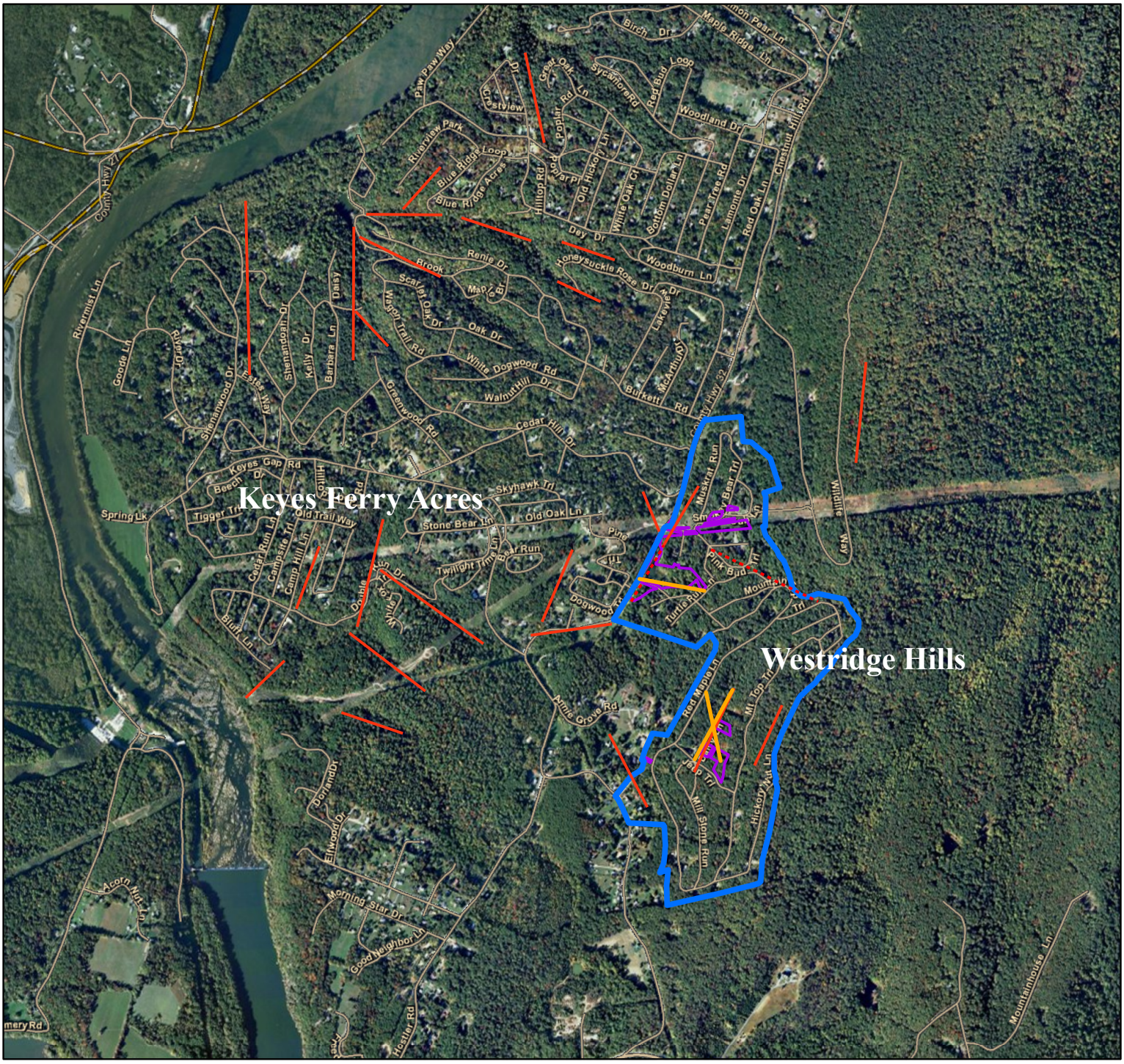
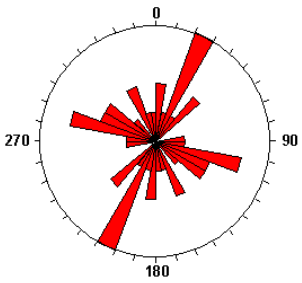


Figure 3: Fracture Trace Map

Legend

- Geophysical Survey Lines
- Fracture Traces
- Inferred Fracture Traces
- Westridge Hills Subdivision Boundary
- Available Parcels

0 0.25 0.5 1 Miles



Rose Diagram

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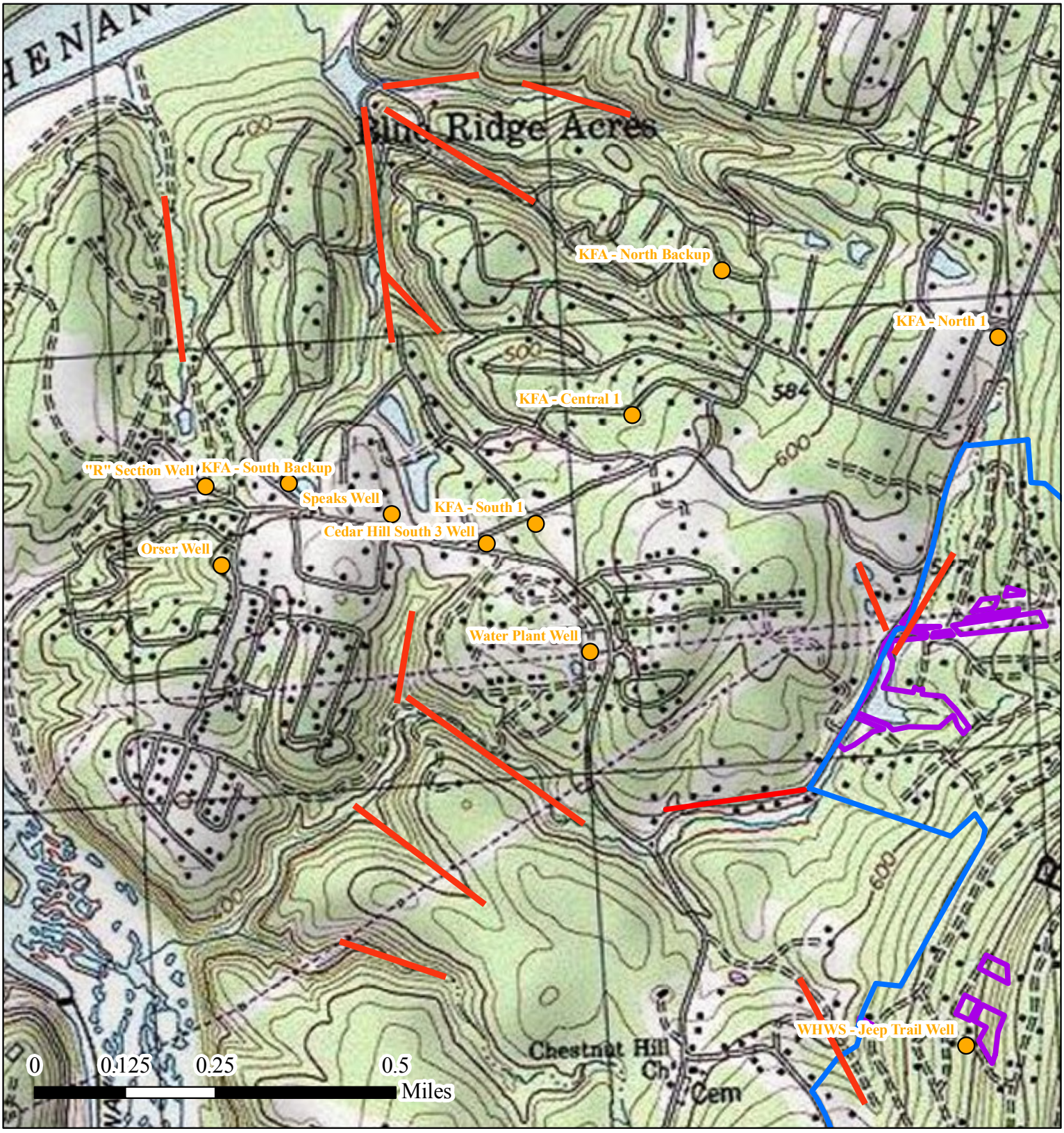

Figure 4: Existing Water Supply Wells Map

Legend

- Existing Wells
- Fracture Traces
- Westridge Hills Subdivision Boundary
- Available Parcels

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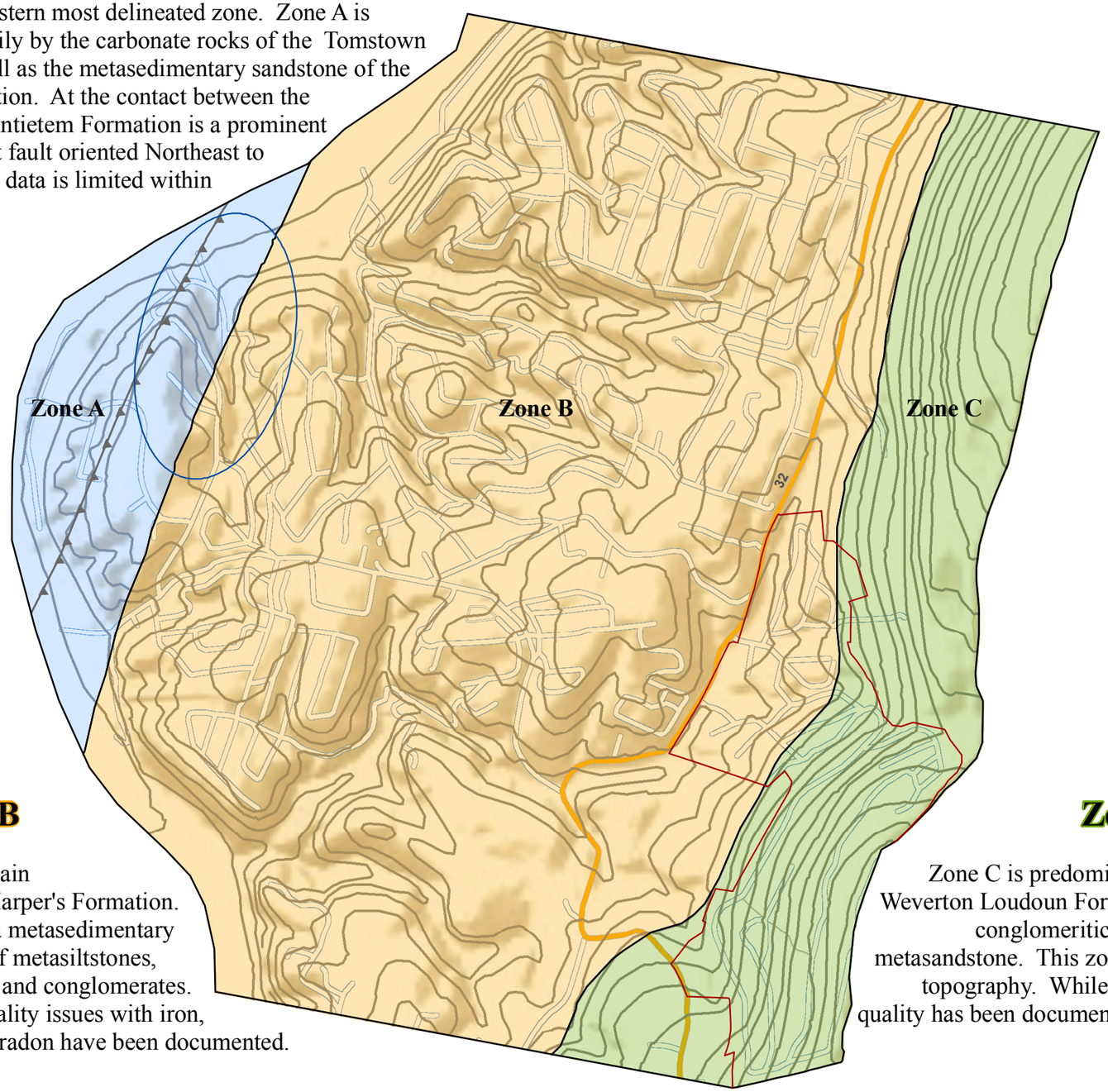
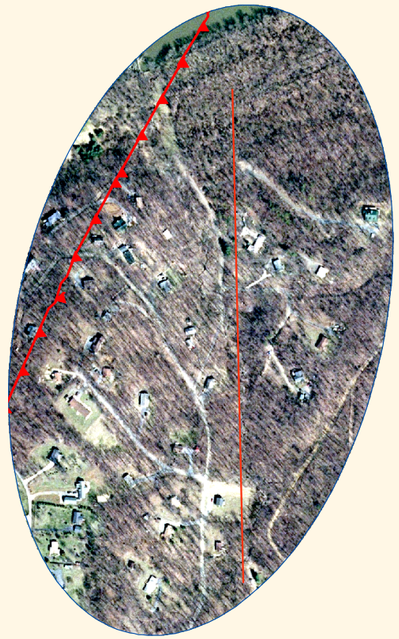
Figure 5: Groundwater Zones Map

Zone A

Zone A is the western most delineated zone. Zone A is underlain primarily by the carbonate rocks of the Tomstown Formation as well as the metasedimentary sandstone of the Antietem Formation. At the contact between the Tomstown and Antietem Formation is a prominent overturned thrust fault oriented Northeast to Southwest. Well data is limited within this zone.



Alternate Area of Interest



This area is characterized by a thrust fault, a prominent mapped lineament, and is underlain by the Tomstown, Antietem, and Harper's Formations.

Zone B

Zone B is underlain entirely by the Harper's Formation. The Harper's is a metasedimentary unit consisting of metasiltstones, metasandstones, and conglomerates. Groundwater quality issues with iron, manganese, and radon have been documented.

Zone C

Zone C is predominantly underlain by the Weverton Loudoun Formations and consists of conglomeritic quartzite, phyllite, and metasandstone. This zone lies on steep sloping topography. While favorable groundwater quality has been documented, available well data is limited.

Legend

- Alternate Area of Interest
- Westridge Hills Subdivision Boundary

0 1,000 2,000 4,000 Feet

N

ANALYTICAL SERVICES, INC.
402 N West Street
Culpeper, Virginia 22701
Telephone: (540) 829-5640 * Fax: (540) 829-5641
www.asincorp.com

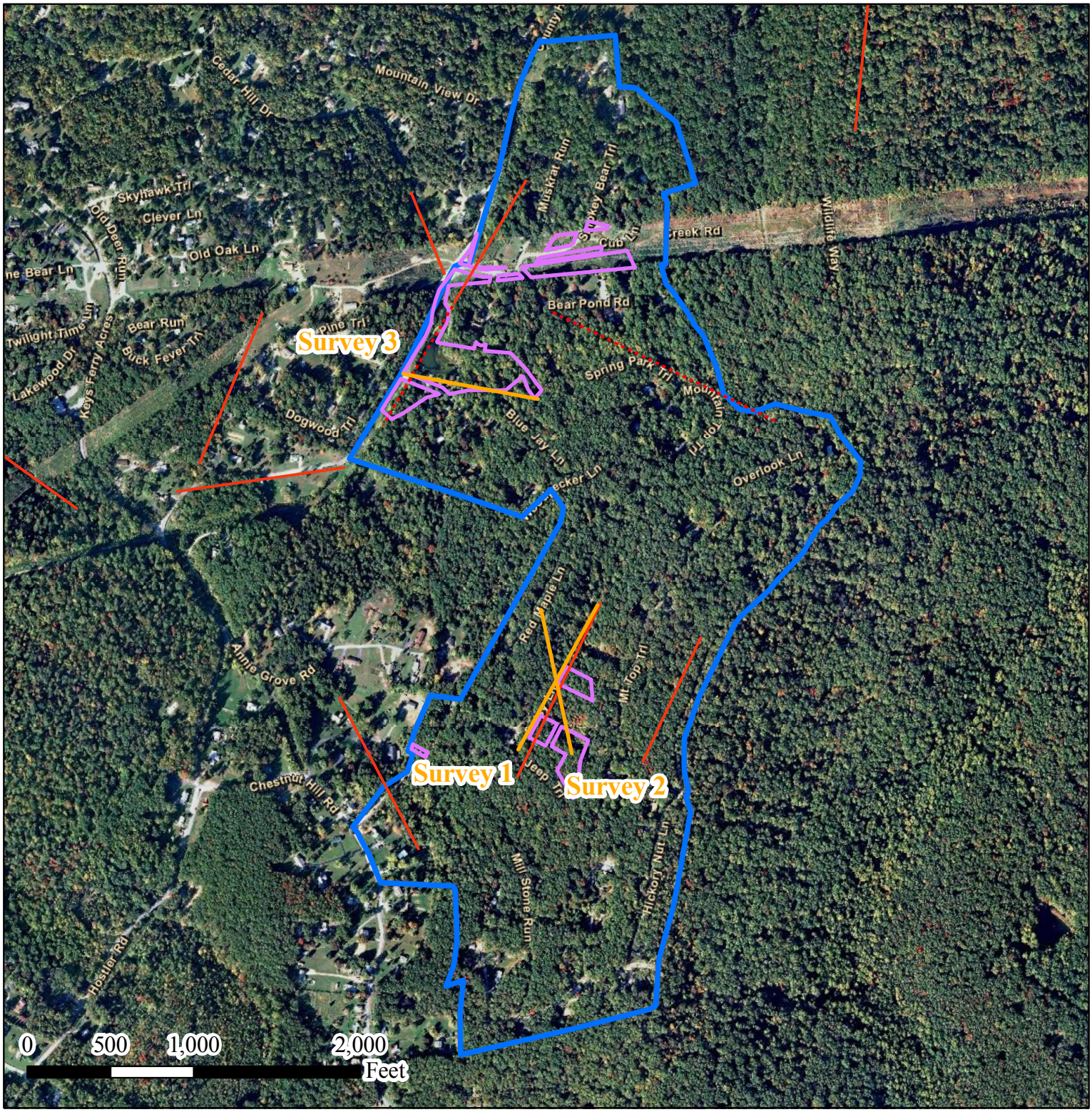


Figure 6: Geophysical Survey Locations Map

Legend

- Geophysical Survey Lines
- Fracture Traces
- Inferred Fracture Traces
- Available Parcels
- Westridge Hills Subdivision Boundary

N

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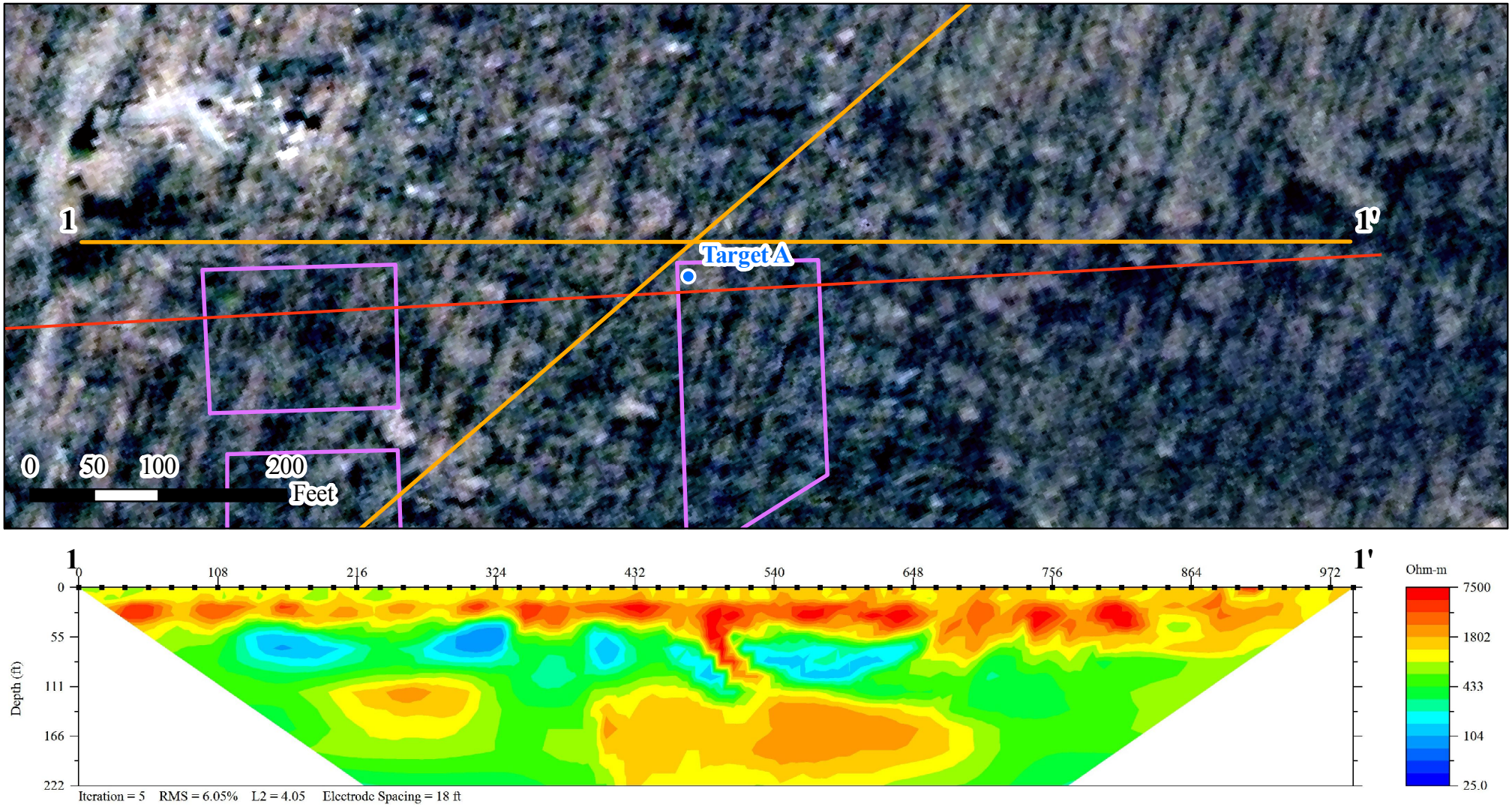

Figure 7: Geophysical Survey Line #1

Legend

- Well Targets
- Survey Lines
- Fracture Traces
- Available Parcels

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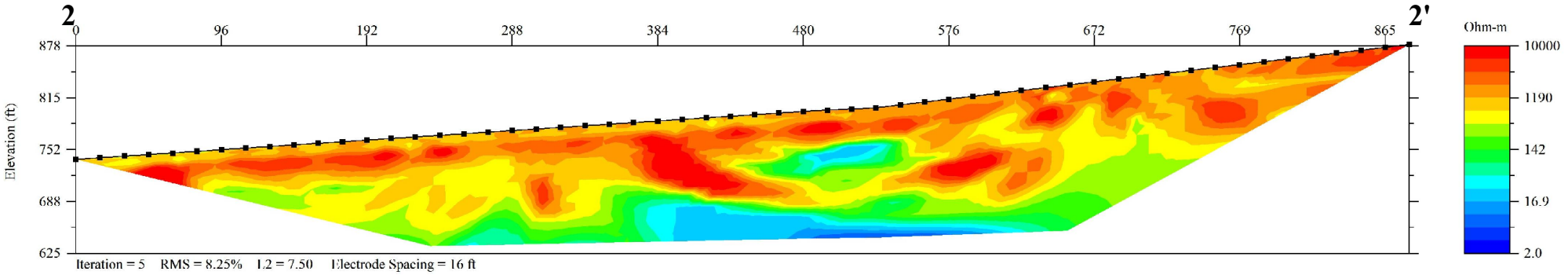

Figure 8: Geophysical Survey Line #2

Legend

- Well Targets
- Survey Lines
- Fracture Traces
- Available Parcels

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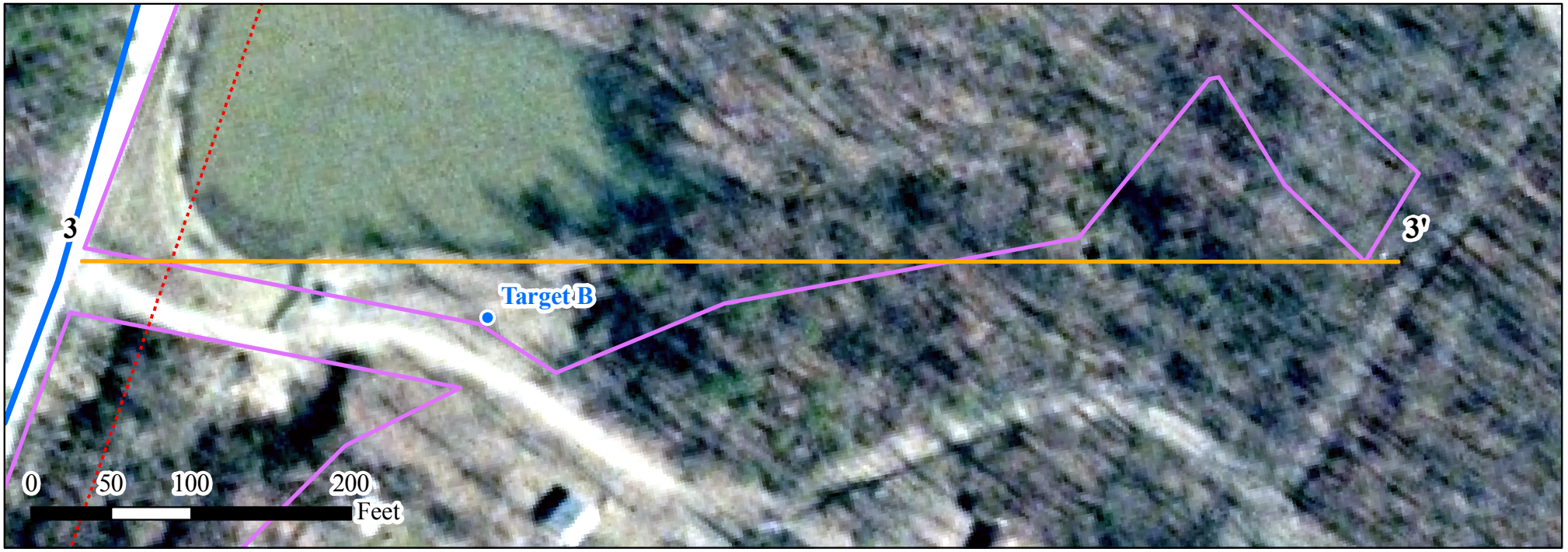

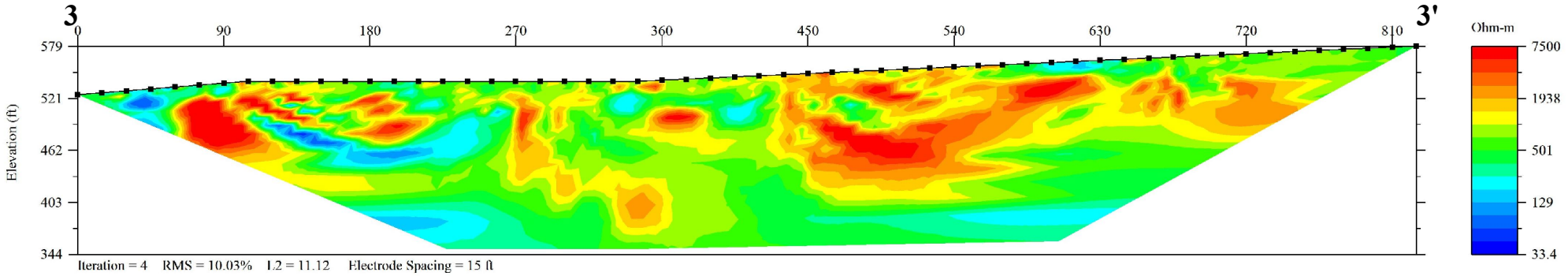

Figure 9: Geophysical Survey Line #3

Legend

- Well Targets
- Survey Line
- Inferred Fracture Traces
- Available Parcels
- Westridge Hills Subdivision Boundary

N

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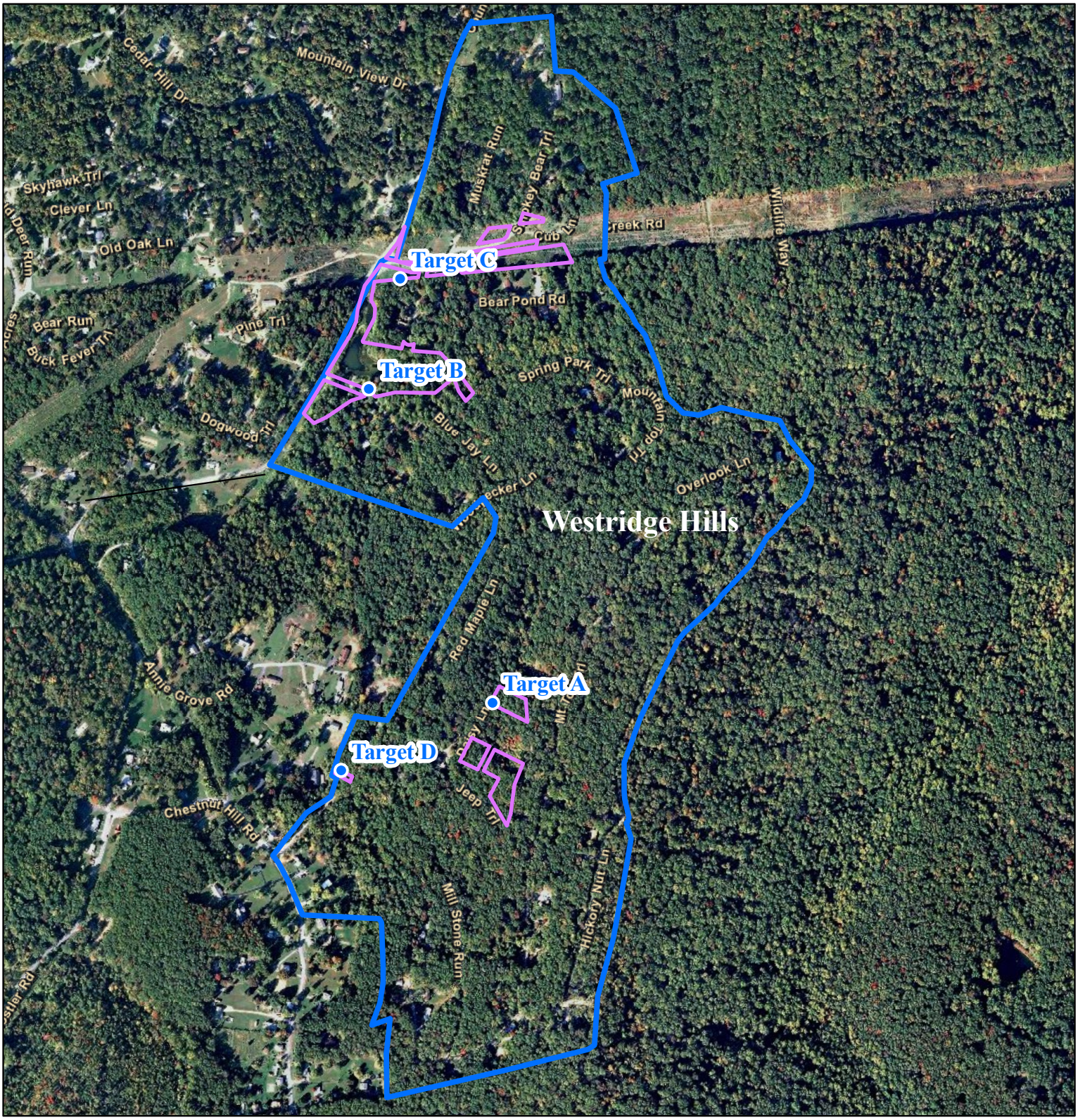

Figure 10: Proposed Well Locations Map

Legend

- Well Targets
- Available Parcels
- Westridge Hills Subdivision Boundary

0 500 1,000 2,000 Feet

N

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402 N West Street
Culpeper, Virginia 22701
Telephone: (540) 829-5640 * Fax: (540) 829-5641
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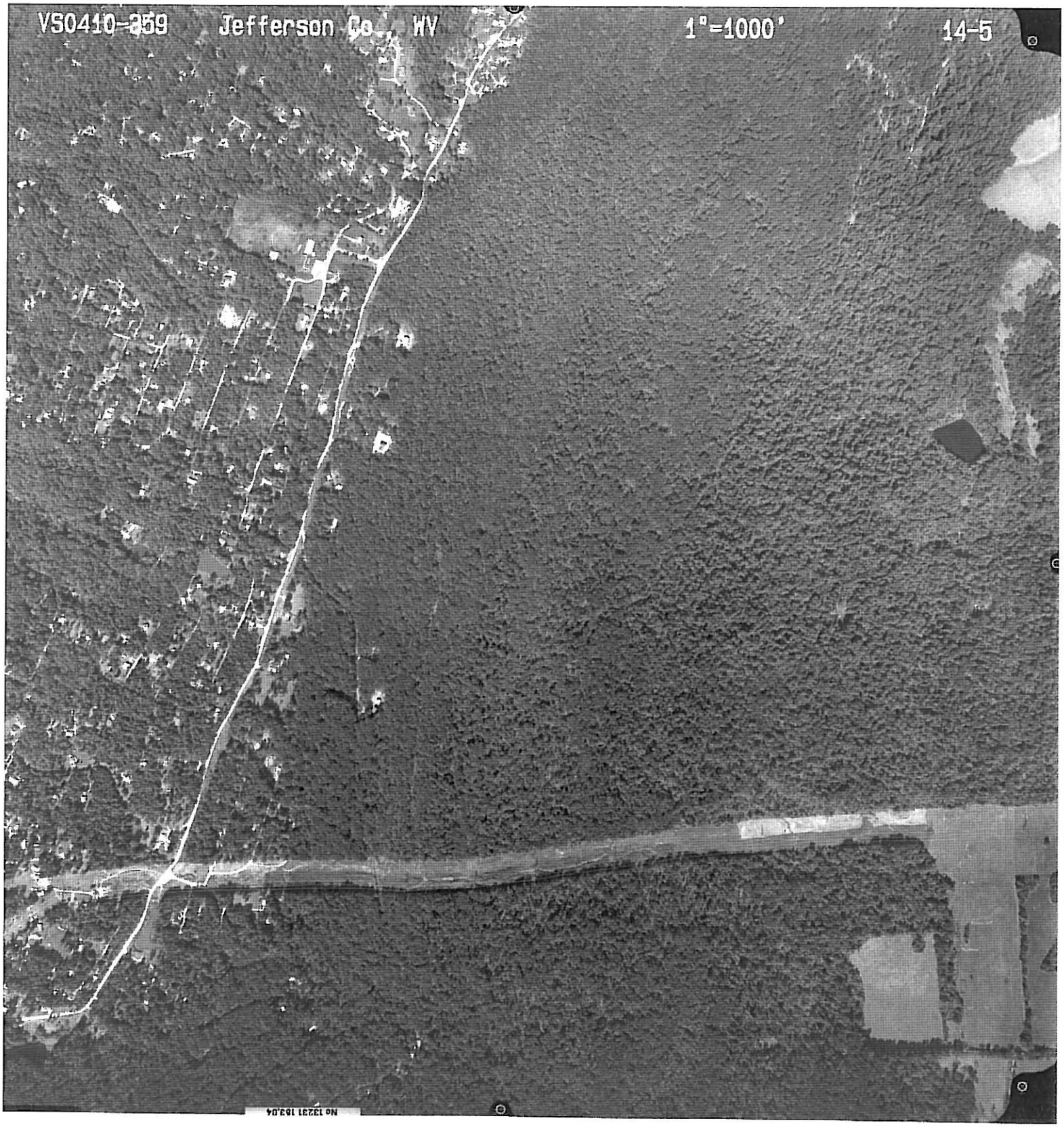
APPENDIX A

AERIAL PHOTOGRAPHS


VS0410-321
Jefferson Co., WV
1"=1000'
13-9


VS0410-320 Jefferson Co., WV 1"=1000' 13-B

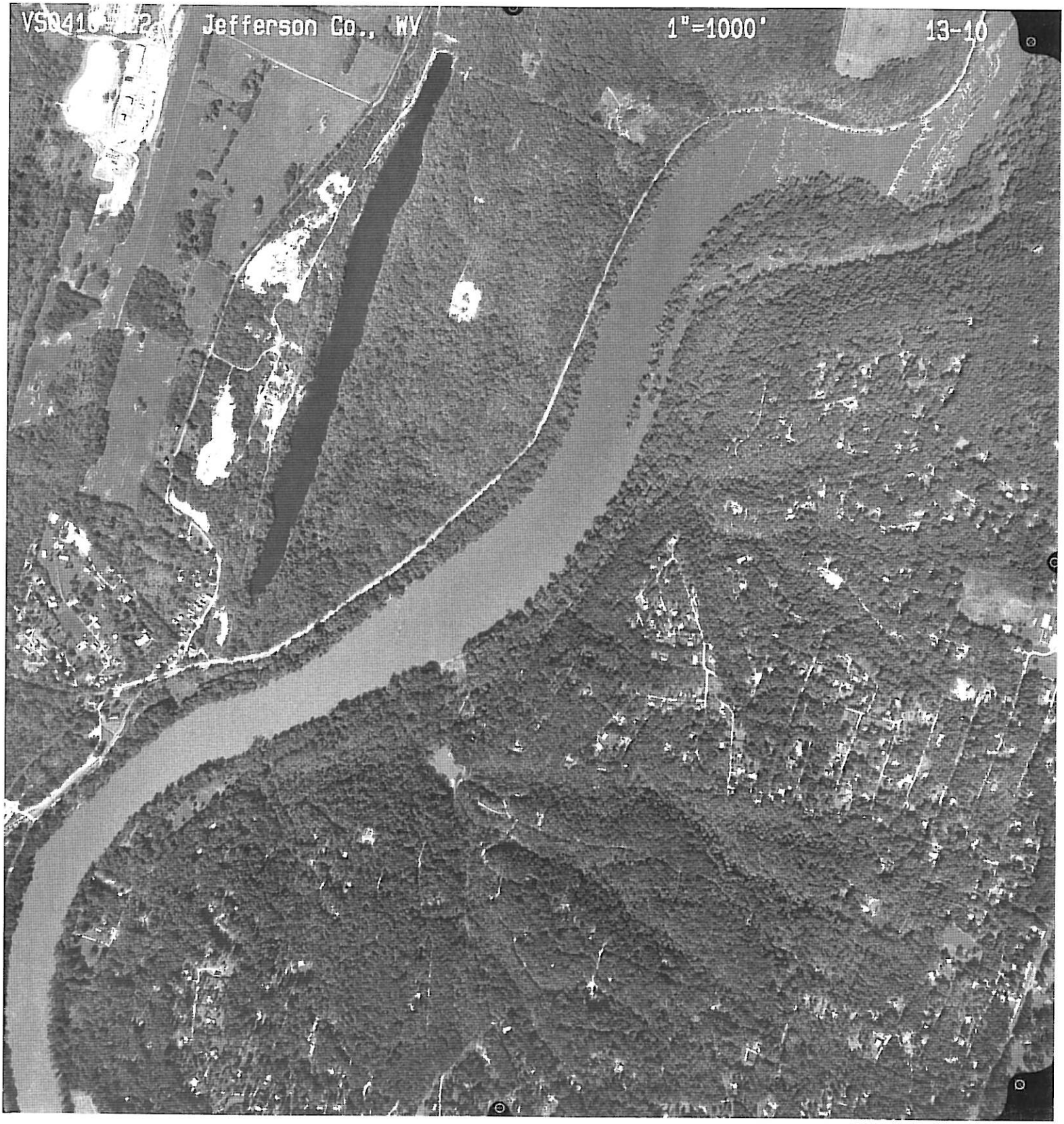

VS0410-358 Jefferson Co., WV 1"=1000' 14-6


VS0410-359 Jefferson Co., WV
1"=1000'
14-5


VSQ410-360 Jefferson Co., WV
1"=1000'
14-4


NAPP
12115-4
03-24-00


NAPP
12115-3
03-24-00


Jefferson Co., WV
1"=1000'
13-16

APPENDIX B

WATER QUALITY ANALYSES

WEST VIRGINIA BUREAU FOR PUBLIC HEALTH
Office of Environmental Health Services
Environmental Engineering Division
Capitol & Washington Streets
1 Davis Square, Suite 200
Charleston, WV 25301

PUBLIC DRINKING WATER - LIST OF REQUIRED CONTAMINANT ANALYSIS

Water intended for use as drinking water by community public water supplies and non-transient non-community public water supplies must be tested for the following contaminants and parameters. Analysis must be performed by a laboratory certified by the State of West Virginia to analyze drinking water samples, with the exception of Secondary Contaminants and TOC analysis. A list of approved laboratories is available upon request. Note: Transient non-community public water supplies need only analyze for Nitrate, Nitrite and Coliform Bacteria.

SECONDARY CONTAMINANTS

Parameter	MCL (mg/L)
pH	
Hardness	
Alkalinity	
Turbidity	
Sulfate	250
Silver	0.1
Aluminum	0.05
Chloride	250
Phosphate	
Iron	0.3
Manganese	0.05
Total Dissolved Solids	500
Zinc	5
Foaming Agents	0.5

RADIONUCLIDES
(Community Systems Only)

Gross Alpha Particle Activity	15 pCi/l
Radium 228	*5 pCi/l

*combined with Radium 226

MICROBIOLOGICAL

Coliform Bacteria

LEAD & COPPER

	AL*
Lead	0.015
Copper	1.3

*Action Level

INORGANIC CHEMICALS

Contaminant	MCL(mg/l)
Nitrate	10.0
Nitrite	1.0
Arsenic	0.010
Barium	2.0
Cadmium	0.005
Chromium	0.1
Fluoride	4.0
Mercury	0.002
Selenium	0.05
Antimony	0.006
Beryllium	0.004
Cyanide	0.2
Nickel	
Thallium	0.002
Sodium	**20

**there is no MCL for sodium

TOC

Total Organic Carbon
[Surface Water and Ground Water Under the Direct Influence (GWUDI) systems only]

REGULATED VOCs

Contaminant	MCL(mg/l)
Benzene	0.005
Carbon Tetrachloride	0.005
p-Dichlorobenzene	0.075
1,2-Dichloroethane	0.005
1,1-Dichloroethylene	0.007
1,1,1-Trichloroethane	0.2
Trichloroethylene	0.005
o-Dichlorobenzene	0.6
Cis-1,2-dichloroethylene	0.07
Trans-1,2-dichloroethylene	0.1
1,2-Dichloropropane	0.005
Ethylbenzene	0.7
Monochlorobenzene	0.1
Styrene	0.1
Tetrachloroethylene	0.005
Toluene	1.0
Xylenes	10.0
Dichloromethane	0.005
1,2,4-Trichlorobenzene	0.07
1,1,2-Trichloroethane	0.005
Vinyl Chloride	0.002

REG SOCs

Contaminant	MCL(mg/l)
Alachlor (Lasso)	0.002
Atrazine (Atranex, Crisazina)	0.003
Carbofuran (Furadan 4F)	0.04
Chlordane	0.002
2,4-D (Formula 40, Weedar 64)	0.07
Heptachlor (H-34,Heptox)	0.0004
Heptachlor Epoxide	0.0002
Lindane	0.0002
PCB's	0.0005
Oxamyl (Vydate)	0.2
Picloram	0.5
Simazine	0.004
Benzo(a)pyrene	0.0002
Di(2-ethylhexyl)adipate	0.4
Di(2-ethylhexyl)phthalate	0.006
Hexachlorocyclopentadiene	0.05

DISINFECTION BYPRODUCTS

Contaminant	MCL(mg/L)
TTHM	
Trichloromethane (chloroform)	
dibromochloromethane	
bromodichloromethane	
tribromomethane (bromoform)	
Total Trihalomethanes	0.080
HAA5	
monochloroacetic acid	
dichloroacetic acid	
trichloroacetic acid	
monobromoacetic acid	
dibromoacetic acid	
Total HAA5	0.060

MCL = Maximum Contaminant Level

www.asincorp.com | www.asgroundwaterservices.com | www.asfuelingsystems.com

ANALYTICAL SERVICES, INC.

Virginia Office

Analytical Services, Inc.
402 N. West Street
Culpeper, Virginia 22701
540-829-5640

North Carolina Office

Analytical Services, Inc.
808 Harper Avenue, Suite 207
Lenoir, North Carolina 28645
828-572-0408

Maryland Office

Analytical Services, Inc.
8600 Snowden River Pkwy.
Suite 300
Columbia, Maryland 21045
410-312-3535

Appendix B

Well Construction Permit

PWSID: WV3301943

State of West Virginia

OFFICE OF ENVIRONMENTAL HEALTH SERVICES

350 CAPITOL STREET, ROOM 313 CHARLESTON, WV 25301-3713

Telephone (304) 558-2981

PERMIT

PROJECT: (Wells) Westridge Hills Subdivision **PERMIT NO.:** 18,780

LOCATION: near Keys Ferry Acres **COUNTY:** Jefferson **DATE:** 4-6-2011

THIS IS TO CERTIFY that after reviewing plans, specifications, application forms, and other essential information that

Westridge Hills Owners Association, Inc.
55 Spring Rock Trail
Harpers Ferry, West Virginia 25425

is hereby granted approval to: install four (4) new public water system wells. Well construction is to be performed by a WV Certified Water Well Contractor. The wells are to be constructed according to the WV Bureau for Public Health's "Public Water Supply Systems Design Standards, 64CSR77," with particular attention to Section 5.3.e.9., Grouting Requirements. The wells shall be tested for chemical, radiological and microbiological contaminants, as required by the WV Bureau for Public Health's "Public Water Systems Regulations, 64CSR03."

Facilities are to serve the Westridge Hills Subdivision.

NOTE: 1. **It is the well owner's responsibility** that the well log, all yield & drawdown test results and contaminate results **are submitted** to the Wellhead Protection Program, Environmental Engineering Division, WV Bureau for Public Health, 350 Capitol Street, Room 313, Charleston, WV 25301-3713, **within 30 calendar days after the well is drilled.**

2. The yield and drawdown pump test shall be conducted according to the requirements of the "Public Water System Design Standards, 64CSR77"-Section 5.3.d.1.

Validity of this permit is contingent upon conformity with plans, specifications, application forms, and other information submitted to the West Virginia Bureau for Public Health.

FOR THE DIRECTOR

William S. Herold, Jr., P.E., Assistant Manager
Infrastructure and Capacity Development
Environmental Engineering Division

WSH:plk

pc: Analytical Services, Inc.
Valley Drilling Corporation
Brian A. Carr, DEP
Ingrid Ferrell, Engineering Division, PSC
Amy Swann, PSC
Jefferson County Health Department
OEHS-EED Kearneysville District Office
Source Water Protection Unit

Appendix C

Well Completion Reports, Borehole Logs and Construction Diagrams

Rev 3/08

ST/CO USE ONLY
DATE RECEIVED
MM DD YY
___ ___ ___

DATE THE WELL WAS COMPLETED
MM DD YY
6 29 11

PERMIT NO.
DW – 18,780

STATE OF WEST VIRGINIA WATER WELL COMPLETION REPORT

FORM SW-258
THIS REPORT MUST BE SUBMITTED WITHIN 30 DAYS AFTER WELL IS COMPLETED

FILL IN THIS FORM COMPLETELY PLEASE PRINT OR TYPE

LOCATION OF WELL
Well Owner: Last Name: Hills First Name Westridge Owners Association
Street/Road Jeep Lane County Jefferson Zip Code 45425

Latitude: 39° Deg 16 Min 3831 Sec
Longitude: 776 Deg 45 Min 6406 Sec
Acquired by: ☒ GPS ☐ Topo ☐ Other

AREA NAME/LOCATION:
Westridge Hills Subdivision Near Keys Acres

TYPE OF WELL:
☐ Potable ☒ Public Water Supply
☐ Geothermal ☐ Industrial
☐ Commercial ☐ Dewatering
☐ Irrigation ☐ Test/Exploratory
☐ Other

WELL LOG

Depth From (Ft.)	Depth To (Ft.)	State the kind of formation penetrated, their color, caves, and if water bearing with estimated flow (GPM).
0	25	Overburden
25	580	Blue Shale
230	231	Waterbearing @ 5 GPM
550	551	Waterbearing @ 145 GPM

If additional space is needed, use additional sheets and attach w/permit # at top.

DRILLING METHOD
☐ Cable Tool ☐ Rotary
☒ Rotary Hammer ☐ Other
Hole Diameter 6 (in)
Total Depth 580 (ft)

CASINGS RECORD
MAIN CASING TYPE
☒ Steel ☐ Plastic
☐ Other
Casing Diameter 8 (in)
Wall Thickness 28.5 (in)
Casing Length 84 (ft)
Other Casing or Liner Used
Type ☒ Steel ☐ Plastic
☐ Other
Casing/Liner Diameter ____ (in)
Length ____ (ft) from ____ (ft) to ____ (ft)

SCREEN RECORD
☒ Not Installed ☐ Installed
Material: ☐ Bronze ☐ Plastic
Diameter of screen ____ (in)
Slot Size ____
Length ____ (ft) from ____ (ft) to ____ (ft)

GRAVEL PACK RECORD
Gravel Pack: ☐ Yes ☒ No
From ____ (ft) to ____ (ft)

GROUTING RECORD
Grouting Material:
☐ Cement ☒ Bentonite Clay
Other
No. of Bags: 12
Installation Method: Pressure

PUMP INSTALLED
By Driller ☐ Yes ☒ No

ESTIMATED WELL YIELD
Estimated at 150 G.P.M.
Static Water Level 110 (ft)
*Pumping level below land surface 125 (ft) after 3 hrs. at 150 G.P.M. (Estimated)
*Note: For Public Water Supply wells please submit required yield and drawdown tests.

WELL HEAD COMPLETION
Casing height above grade 2 (ft)
Type of Well Cap Installed Watertight Cap

VARIANCE ISSUED ☐ Yes ☒ No
Request Number ____

COMMENTS BY INSTALLER:

I hereby certify that this well has been constructed in accordance with state rules and in conformance with all conditions stated in the above captioned permit, and that the information presented herein is accurate and complete to the best of my knowledge.

Company Name Valley Drilling Corporation of Virginia WV Contractor No. WV041745
Business Registration No. 1032-7028 Master Well Driller Certification No. 511
Master Well Driller (print) Rodney D. Powers
Master Well Drill Signature Rodney D Powers

SITE SUPERVISOR (SIGNATURE OF DRILLER OR JOURNEYMAN RESPONSIBLE FOR SITEWORK IF DIFFERENT FROM MASTER DRILLER)

Journeyman Well Driller Certification No. ____
Journeyman Well Driller (please print)
____
Apprentice and Name (s) ____, ____

PROJECT 3313	Water Supply Well A	PAGE 1 OF 6
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC.
Location: Jefferson County, WV	**Airlift Yield:** 125 gpm	
Logger: EWB, MLM	**Depth to Bedrock:** 70' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 82' bgs	
Well Depth: 580' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 8 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 278' bgs (5 gpm), 555' bgs (120 gpm)	**Completion Date:** 6/29/2011	
	Notes: Static DTW approx. 80' bgs	

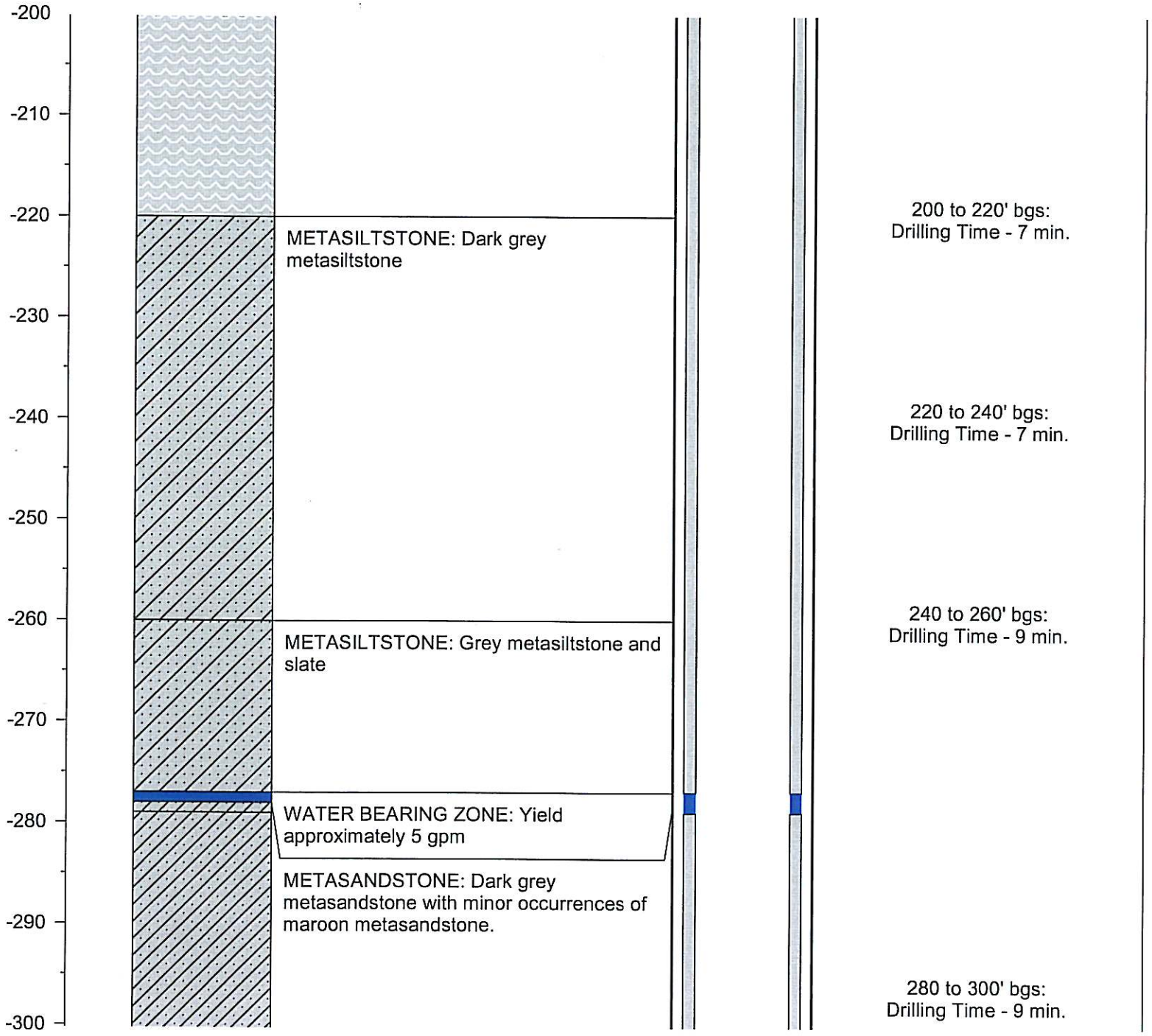
Depth (ft.)	Lithology	Lithology Description	Supply Well Diagram	Notes
0		SILT: Fine sandy silt with abundant light- to dark grey metasandstone fragments		
-10				
-20		SAPROLITE: Fine sandy silt with heavily weathered light brown shale fragments		
-30		WEATHERED ROCK: Brown, weathered shale		
-40				
-50		WEATHERED ROCK: Light brown to grey slate and weathered brown shale		
-60		WEATHERED ROCK: Brown, weathered shale		
-70		SLATE: Light brown to grey slate		50 to 70' bgs: Drilling Time - 7 min.
-80				
-90				
-100				80 to 100' bgs: Drilling Time - 5 min.

PROJECT 3313	Water Supply Well A	PAGE 2 OF 6
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC.
Location: Jefferson County, WV	**Airlift Yield:** 125 gpm	
Logger: EWB, MLM	**Depth to Bedrock:** 70' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 82' bgs	
Well Depth: 580' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 8 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 278' bgs (5 gpm), 555' bgs (120 gpm)	**Completion Date:** 6/29/2011	
	Notes: Static DTW approx. 80' bgs	

Depth (ft.)	Lithology	Lithology Description	Supply Well Diagram	Notes
-100		SHALE: Grey shale grading to softer tan shale		
-110		SLATE: Grey slate with shale		
-120				100 to 118' bgs: Drilling Time - 6 min.
-130				
-140		PHYLLITE: Grey phyllite and slate		120 to 140' bgs: Drilling Time - 7 min.
-150				
-160		SLATE: Black slate		140 to 160' bgs: Drilling Time - 6 min.
-170				
-180				160 to 180' bgs: Drilling Time - 7 min.
-190		PHYLLITE: Greenish grey phyllite and slate		
-200				180 to 200' bgs: Drilling Time - 7 min.

PROJECT 3313	Water Supply Well A	PAGE 3 OF 6
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC
Location: Jefferson County, WV	**Airlift Yield:** 125 gpm	
Logger: EWB, MLM	**Depth to Bedrock:** 70' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 82' bgs	
Well Depth: 580' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 8 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 278' bgs (5 gpm), 555' bgs (120 gpm)	**Completion Date:** 6/29/2011	
	Notes: Static DTW approx. 80' bgs	

Depth (ft.)	Lithology	Lithology Description	Supply Well Diagram	Notes



PROJECT 3313	Water Supply Well A	PAGE 4 OF 6
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC
Location: Jefferson County, WV	**Airlift Yield:** 125 gpm	
Logger: EWB, MLM	**Depth to Bedrock:** 70' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 82' bgs	
Well Depth: 580' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 8 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 278' bgs (5 gpm), 555' bgs (120 gpm)	**Completion Date:** 6/29/2011	
	Notes: Static DTW approx. 80' bgs	

Depth (ft.)	Lithology	Lithology Description	Supply Well Diagram	Notes
-300				
-310		METASANDSTONE: Dark grey metasandstone with minor occurrences of maroon metasandstone.		
-320				300 to 320' bgs: Drilling Time - 9 min.
-330				
-340				320 to 340' bgs: Drilling Time - 10 min.
-350				
-360				340 to 360' bgs: Drilling Time - 7 min.
-370				
-380				360 to 380' bgs: Drilling Time - 10 min.
-390				
-400				380 to 400' bgs: Drilling Time - 10 min.

PROJECT 3313	Water Supply Well A	PAGE 5 OF 6
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC
Location: Jefferson County, WV	**Airlift Yield:** 125 gpm	
Logger: EWB, MLM	**Depth to Bedrock:** 70' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 82' bgs	
Well Depth: 580' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 8 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 278' bgs (5 gpm), 555' bgs (120 gpm)	**Completion Date:** 6/29/2011	
	Notes: Static DTW approx. 80' bgs	

Depth (ft.)	Lithology	Lithology Description	Supply Well Diagram	Notes
-400				
-410		METASANDSTONE: Dark grey metasandstone with minor occurrences of maroon metasandstone.		
-420				400 to 420' bgs: Drilling Time - 10 min.
-430				
-440				420 to 440' bgs: Drilling Time - 10 min. Presence of vein quartz
-450				
-460				440 to 460' bgs: Drilling Time - 10 min.
-470				
-480				460 to 480' bgs: Drilling Time - 9 min.
-490				
-500				480 to 500' bgs: Drilling Time - 10 min.

PROJECT 3313	Water Supply Well A	PAGE 6 OF 6
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC.
Location: Jefferson County, WV	**Airlift Yield:** 125 gpm	
Logger: EWB, MLM	**Depth to Bedrock:** 70' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 82' bgs	
Well Depth: 580' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 8 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 278' bgs (5 gpm), 555' bgs (120 gpm)	**Completion Date:** 6/29/2011	
	Notes: Static DTW approx. 80' bgs	

Depth (ft.)	Lithology	Lithology Description	Supply Well Diagram	Notes
-510		METASANDSTONE: Dark grey metasandstone with minor occurrences of maroon metasandstone.		
-520				Trace of vein quartz
-530				
-540				
-550		WATER BEARING ZONE: Yield approximately 120 gpm		
-560		METASANDSTONE: Dark grey metasandstone, very little quatz, weak foliation		Significant amount of vein quartz
-570				
-580				

Rev 3/08

ST/CO USE ONLY
DATE RECEIVED
MM DD YY
___ ___ ___

DATE THE WELL WAS COMPLETED
MM DD YY
6 23 11

PERMIT NO.
DW – 18,780

STATE OF WEST VIRGINIA WATER WELL COMPLETION REPORT

FORM SW-258
THIS REPORT MUST BE SUBMITTED WITHIN 30 DAYS AFTER WELL IS COMPLETED

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

LOCATION OF WELL
Well Owner: Last Name: Hills First Name Westridge Owners Association
Street/Road Blue Jay Lane County Jefferson Zip Code 25425

Latitude: 39° Deg 16 Min 6.88 Sec
Longitude: 77° Deg 45 Min 7.66 Sec
Acquired by: ☒ GPS ☐ Topo ☐ Other

AREA NAME/LOCATION:
Westridge Hills Subdivison Near Keys Ferry Acres

TYPE OF WELL:
☐ Potable ☒ Public Water Supply
☐ Geothermal ☐ Industrial
☐ Commercial ☐ Dewatering
☐ Irrigation ☐ Test/Exploratory
☐ Other

WELL LOG

Depth From (Ft.)	Depth To (Ft.)	State the kind of formation penetrated, their color, caves, and if water bearing with estimated flow (GPM).
0	15	Overburden
15	440	Gray Shale
385	386	Waterbearing @ 3 GPM
415	416	Waterbearing @ 2 GPM

If additional space is needed, use additional sheets and attach w/permit # at top.

DRILLING METHOD
☐ Cable Tool ☐ Rotary
☒ Rotary Hammer ☐ Other
Hole Diameter 6 (in)
Total Depth 440 (ft)

CASINGS RECORD
MAIN CASING TYPE
☒ Steel ☐ Plastic
☐ Other
Casing Diameter 6 (in)
Wall Thickness 0.280 (in)
Casing Length 60 (ft)

Other Casing or Liner Used
Type ☒ Steel ☐ Plastic
☐ Other
Casing/Liner Diameter ____ (in)
Length ____ (ft) from ____ (ft) to ____ (ft)

SCREEN RECORD
☒ Not Installed ☐ Installed
Material: ☐ Bronze ☐ Plastic
Diameter of screen ____ (in)
Slot Size ____
Length ____ (ft) from ____ (ft) to ____ (ft)

GRAVEL PACK RECORD
Gravel Pack: ☐ Yes ☒ No
From ____ (ft) to ____ (ft)

GROUTING RECORD
Grouting Material:
☐ Cement ☒ Bentonite Clay
Other ____
No. of Bags: 6
Installation Method: Pressure

PUMP INSTALLED
By Driller ☐ Yes ☒ No

ESTIMATED WELL YIELD
Estimated at 5 G.P.M.
Static Water Level 35 (ft)
*Pumping level below land surface 45 (ft) after 3 hrs. at 5 G.P.M. (Estimated)
*Note: For Public Water Supply wells please submit required yield and drawdown tests.

WELL HEAD COMPLETION
Casing height above grade 2 (ft)
Type of Well Cap Installed Watertight

VARIANCE ISSUED ☐ Yes ☒ No
Request Number ____

COMMENTS BY INSTALLER:

I hereby certify that this well has been constructed in accordance with state rules and in conformance with all conditions stated in the above captioned permit, and that the information presented herein is accurate and complete to the best of my knowledge.

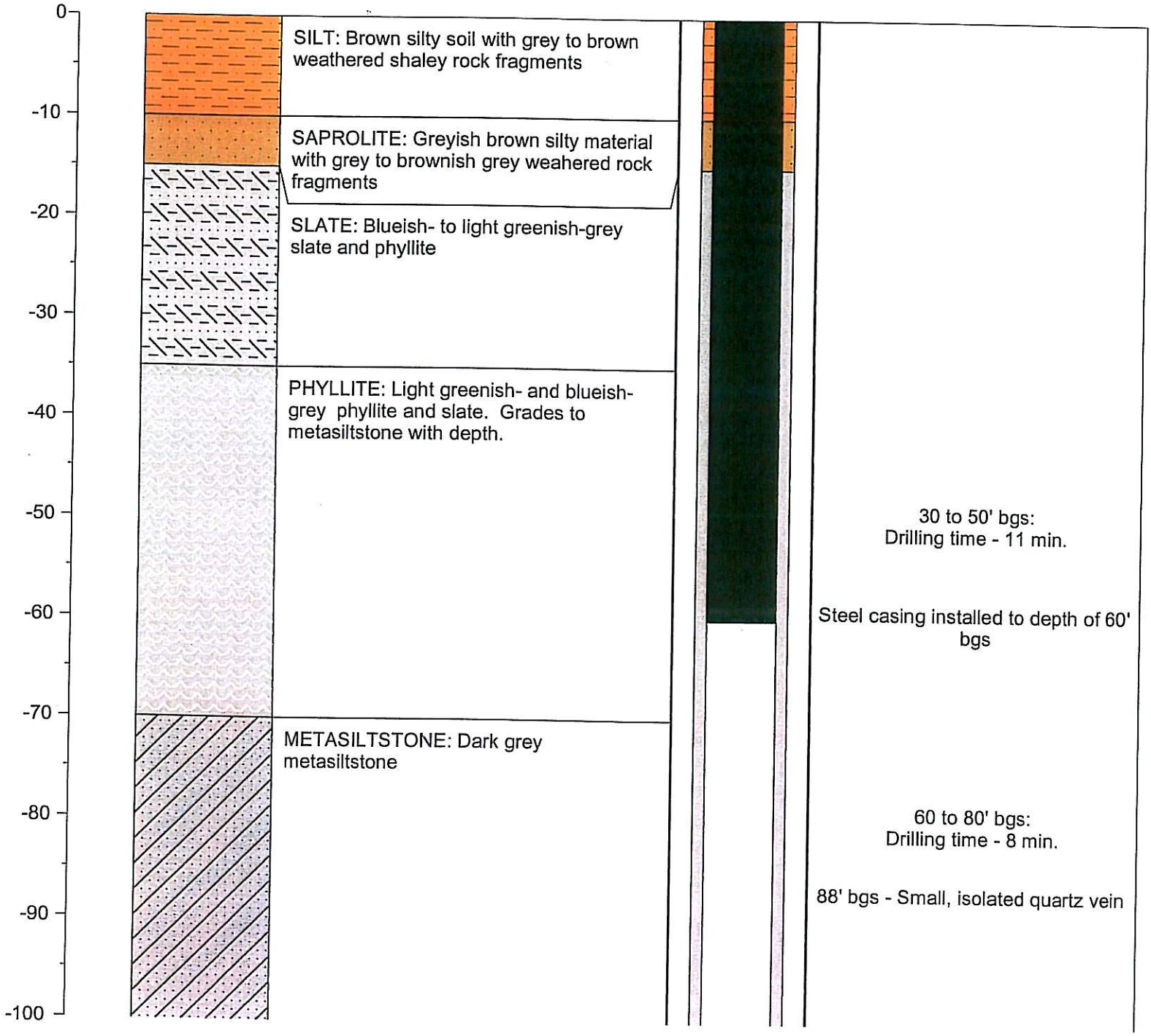
Company Name Valley Drilling Corporation of Virginia WV Contractor No. WV041745
Business Registration No. 1032-7028 Master Well Driller Certification No. 511
Master Well Driller (print) Rodney Powers
Master Well Drill Signature Rodney D Powers

SITE SUPERVISOR (SIGNATURE OF DRILLER OR JOURNEYMAN RESPONSIBLE FOR SITEWORK IF DIFFERENT FROM MASTER DRILLER)

Journeyman Well Driller Certification No. ____
Journeyman Well Driller (please print)
____
Apprentice and Name (s) ____, ____

PROJECT 3313	Water Supply Well B	PAGE 1 OF 5
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC
Location: Jefferson County, WV	**Airlift Yield:** 6 gpm	
Logger: Ernest Beasley	**Depth to Bedrock:** 15' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 60' bgs	
Well Depth: 440' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 6 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 385' bgs (3 gpm), 420' bgs (3 gpm)	**Completion Date:** 6/23/2011	
	Notes: Static water level approximately 50' bgs (estimated on 6/2/2011)	

Depth (ft.)	Lithology	Lithology Description	Supply Well Diagram	Notes



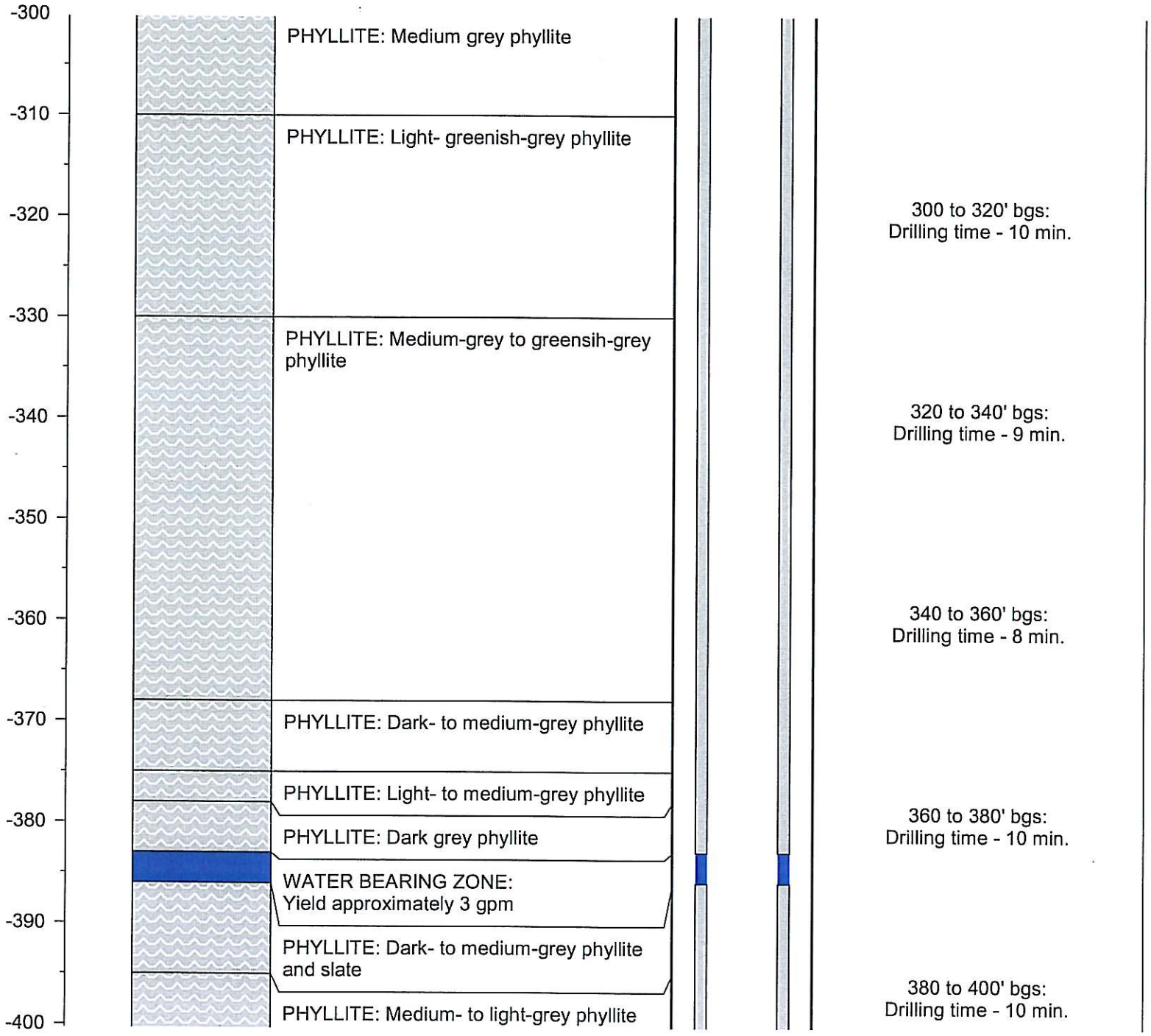
PROJECT 3313	Water Supply Well B	PAGE 2 OF 5
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC
Location: Jefferson County, WV	**Airlift Yield:** 6 gpm	
Logger: Ernest Beasley	**Depth to Bedrock:** 15' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 60' bgs	
Well Depth: 440' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 6 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 385' bgs (3 gpm), 420' bgs (3 gpm)	**Completion Date:** 6/23/2011	
	Notes: Static water level approximately 50' bgs (estimated on 6/2/2011)	

Depth (ft.)	Lithology	Lithology Description	Supply Well Diagram	Notes
-100				
-110		SLATE: Light- to medium-grey slate		
		METASILTSTONE: Dark grey metasiltstone		
-120		PHYLLITE: Light to medium grey phyllite		100 to 120' bgs: Drilling time - 8 min.
-130		PHYLLITE: Light-greenish-grey phyllite		138' bgs: Trace of vein quartz
-140		PHYLLITE: Medium- to light-grey phyllite		120 to 140' bgs: Drilling time - 7 min.
-150				
-160				140 to 160' bgs: Drilling time - 7 min.
-170				
-180				160 to 180' bgs: Drilling time - 8 min.
-190				
-200				180 to 200' bgs: Drilling time - 7 min.

PROJECT 3313	Water Supply Well B	PAGE 3 OF 5
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC
Location: Jefferson County, WV	**Airlift Yield:** 6 gpm	
Logger: Ernest Beasley	**Depth to Bedrock:** 15' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 60' bgs	
Well Depth: 440' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 6 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 385' bgs (3 gpm), 420' bgs (3 gpm)	**Completion Date:** 6/23/2011	
	Notes: Static water level approximately 50' bgs (estimated on 6/2/2011)	

Depth (ft.)	Lithology	Lithology Description	Supply Well Diagram	Notes
-200				
-210		PHYLLITE: Light- to medium grey phyllite		
-220				200 to 220' bgs: Drilling time - 9 min.
-230				
-240				220 to 240' bgs: Drilling time - 9 min.
-250				
-260				240 to 260' bgs: Drilling time - 8 min.
-270				
-280				260 to 280' bgs: Drilling time - 9 min.
-290				
-300				280 to 300' bgs: Drilling time - 9 min.

PROJECT 3313	Water Supply Well B	PAGE 4 OF 5
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC
Location: Jefferson County, WV	**Airlift Yield:** 6 gpm	
Logger: Ernest Beasley	**Depth to Bedrock:** 15' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 60' bgs	
Well Depth: 440' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 6 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 385' bgs (3 gpm), 420' bgs (3 gpm)	**Completion Date:** 6/23/2011	
	Notes: Static water level approximately 50' bgs (estimated on 6/2/2011)	



PROJECT 3313	Water Supply Well B	PAGE 5 OF 5
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC.
Location: Jefferson County, WV	**Airlift Yield:** 6 gpm	
Logger: Ernest Beasley	**Depth to Bedrock:** 15' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 60' bgs	
Well Depth: 440' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 6 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 385' bgs (3 gpm), 420' bgs (3 gpm)	**Completion Date:** 6/23/2011	
	Notes: Static water level approximately 50' bgs (estimated on 6/2/2011)	

Depth (ft.)	Lithology	Lithology Description	Supply Well Diagram	Notes
-400		with a trace of quartz		
-410		PHYLLITE: Light greenish-grey to blueish-grey phyllite		
-420		WATER BEARING ZONE: Yield approximately 3 gpm		415 to 420 ft. bgs: Significant amount of vein quartz
-430		PHYLLITE: Greenish-grey to medium-grey phyllite and slate		400 to 420' bgs: Drilling time - 10 min.
-440				440' bgs: E.O.B.

Rev 3/08

ST/CO USE ONLY
DATE RECEIVED
MM DD YY
___ ___ ___

DATE THE WELL WAS COMPLETED
MM DD YY
7 7 11

PERMIT NO.
DW – 18,780

STATE OF WEST VIRGINIA WATER WELL COMPLETION REPORT

FORM SW-258
THIS REPORT MUST BE SUBMITTED WITHIN 30 DAYS AFTER WELL IS COMPLETED

FILL IN THIS FORM COMPLETELY PLEASE PRINT OR TYPE

LOCATION OF WELL
Well Owner: Last Name: Hills First Name Westridge Owners Association
Street/Road Oak Lane County Jefferson Zip Code 25425

Latitude: 390 Deg 16 Min 390 n Sec
Longitude: 770 Deg 45 Min 8016 Sec
Acquired by: ☐ GPS ☐ Topo ☐ Other

AREA NAME/LOCATION:
Westridge Hills Subdivision Near Keys Ferry Acres

TYPE OF WELL:
☐ Potable ☒ Public Water Supply
☐ Geothermal ☐ Industrial
☐ Commercial ☐ Dewatering
☐ Irrigation ☐ Test/Exploratory
☐ Other

WELL LOG

Depth From (Ft.)	Depth To (Ft.)	State the kind of formation penetrated, their color, caves, and if water bearing with estimated flow (GPM).
0	15	Overburden
15	600	Bluestone & Shale Waterbearing @ 40 Gpm

If additional space is needed, use additional sheets and attach w/permit # at top.

DRILLING METHOD
☐ Cable Tool ☐ Rotary
☒ Rotary Hammer ☐ Other

Hole Diameter 6 (in)
Total Depth 600 (ft)

CASINGS RECORD
MAIN CASING TYPE
☒ Steel ☐ Plastic
☐ Other
Casing Diameter 6 (in)
Wall Thickness .0.280 (in)
Casing Length 61 (ft)

Other Casing or Liner Used
Type ☐ Steel ☐ Plastic
☐ Other
Casing/Liner Diameter ____ (in)
Length ____ (ft) from ____ (ft) to ____ (ft)

SCREEN RECORD
☒ Not Installed ☐ Installed
Material: ☐ Bronze ☐ Plastic
Diameter of screen ____ (in)
Slot Size ____
Length ____ (ft) from ____ (ft) to ____ (ft)

GRAVEL PACK RECORD
Gravel Pack: ☐ Yes ☒ No
From ____ (ft) to ____ (ft)

GROUTING RECORD
Grouting Material:
☐ Cement ☒ Bentonite Clay
Other
No. of Bags: 6
Installation Method: pressure

PUMP INSTALLED
By Driller ☐ Yes ☒ No

ESTIMATED WELL YIELD
Estimated at 40 G.P.M.
Static Water Level 1 (ft)
*Pumping level below land surface
8 (ft) after 3 hrs. at
40 G.P.M. (Estimated)
*Note: For Public Water Supply wells please submit required yield and drawdown tests.

WELL HEAD COMPLETION
Casing height above grade 2 (ft)
Type of Well Cap Installed Watertight Cap

VARIANCE ISSUED ☐ Yes ☒ No
Request Number ____

COMMENTS BY INSTALLER:

I hereby certify that this well has been constructed in accordance with state rules and in conformance with all conditions stated in the above captioned permit, and that the information presented herein is accurate and complete to the best of my knowledge.

Company Name Valley Drilling Corporation of Virginia WV Contractor No. WV041745
Business Registration No. 1032-7028 Master Well Driller Certification No. 511
Master Well Driller (print) Rodney D. Powers
Master Well Drill Signature Rodney D. Powers

SITE SUPERVISOR (SIGNATURE OF DRILLER OR JOURNEYMAN RESPONSIBLE FOR SITEWORK IF DIFFERENT FROM MASTER DRILLER)

Journeyman Well Driller Certification No. ____
Journeyman Well Driller (please print)
Apprentice and Name (s) ____, ____

Rev 3/08

ST/CO USE ONLY
DATE RECEIVED
MM DD YY
___ ___ ___

DATE THE WELL WAS COMPLETED
MM DD YY
7 7 11

PERMIT NO.
DW – 18,780

STATE OF WEST VIRGINIA WATER WELL COMPLETION REPORT

FORM SW-258
THIS REPORT MUST BE SUBMITTED WITHIN 30 DAYS AFTER WELL IS COMPLETED

FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE

LOCATION OF WELL
Well Owner: Last Name: Hills First Name Westridge Owners Association
Street/Road Oak Lane County Jefferson Zip Code 25425

Latitude: 390 Deg 16 Min 320 n Sec
Longitude: 770 Deg 45 Min 801 w Sec
Acquired by: ☐ GPS ☐ Topo ☐ Other

AREA NAME/LOCATION:
Westridge Hills Subdivision Near Keys Ferry Acres

TYPE OF WELL:
☐ Potable ☒ Public Water Supply
☐ Geothermal ☐ Industrial
☐ Commercial ☐ Dewatering
☐ Irrigation ☐ Test/Exploratory
☐ Other

WELL LOG

Depth From (Ft.)	Depth To (Ft.)	State the kind of formation penetrated, their color, caves, and if water bearing with estimated flow (GPM).
0	15	Overburden
15	600	Bluestone & Shale Waterbearing @ 40 Gpm

If additional space is needed, use additional sheets and attach w/permit # at top.

DRILLING METHOD
☐ Cable Tool ☐ Rotary
☒ Rotary Hammer ☐ Other

Hole Diameter 6 (in)
Total Depth 600 (ft)

CASINGS RECORD
MAIN CASING TYPE
☒ Steel ☐ Plastic
☐ Other
Casing Diameter 6 (in)
Wall Thickness .0.280 (in)
Casing Length 119 (ft)

Other Casing or Liner Used
Type ☐ Steel ☐ Plastic
☐ Other
Casing/Liner Diameter ____ (in)
Length ____ (ft) from ____ (ft)
to ____ (ft)

SCREEN RECORD
☒ Not Installed ☐ Installed
Material: ☐ Bronze ☐ Plastic
Diameter of screen ____ (in)
Slot Size ____
Length ____ (ft) from ____ (ft)
to ____ (ft)

GRAVEL PACK RECORD
Gravel Pack: ☐ Yes ☒ No
From ____ (ft) to ____ (ft)

GROUTING RECORD
Grouting Material:
☐ Cement ☒ Bentonite Clay
Other
No. of Bags: 6
Installation Method: pressure

PUMP INSTALLED
By Driller ☐ Yes ☒ No

ESTIMATED WELL YIELD
Estimated at 5 G.P.M.
Static Water Level 1 (ft)
*Pumping level below land surface
8 (ft) after 3 hrs. at
40 G.P.M. (Estimated) (7gpm)
*Note: For Public Water Supply wells please submit required yield and drawdown tests.

WELL HEAD COMPLETION
Casing height above grade 2 (ft)
Type of Well Cap Installed Watertight Cap

VARIANCE ISSUED ☐ Yes ☒ No
Request Number ____

COMMENTS BY INSTALLER:

I hereby certify that this well has been constructed in accordance with state rules and in conformance with all conditions stated in the above captioned permit, and that the information presented herein is accurate and complete to the best of my knowledge.

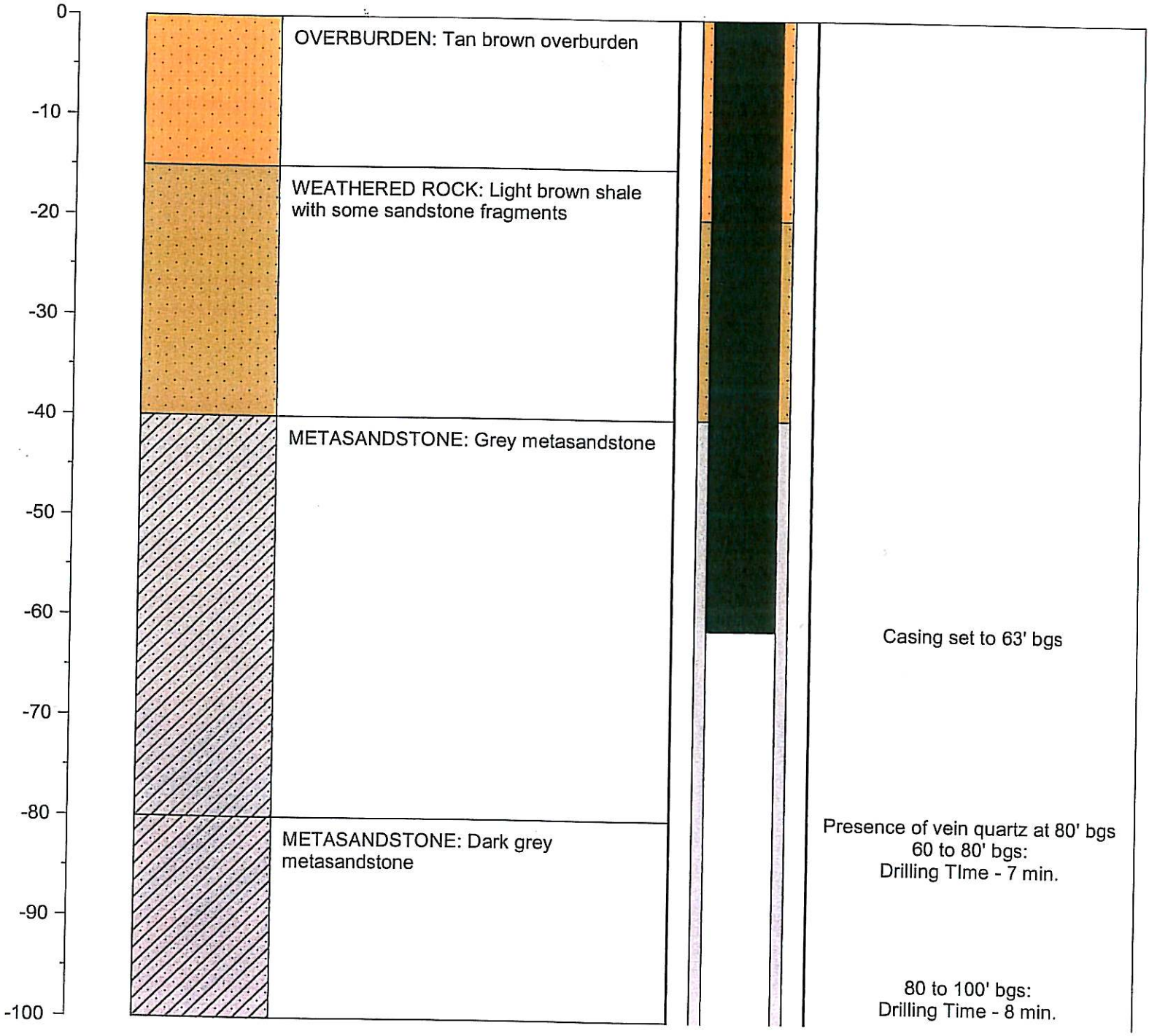
Company Name Valley Drilling Corporation of Virginia WV Contractor No. WV041745
Business Registration No. 1032-7028 Master Well Driller Certification No. 511
Master Well Driller (print) Rodney D. Powers
Master Well Drill Signature Rodney D Powers

SITE SUPERVISOR (SIGNATURE OF DRILLER OR JOURNEYMAN RESPONSIBLE FOR SITEWORK IF DIFFERENT FROM MASTER DRILLER)

Journeyman Well Driller Certification No. ____
Journeyman Well Driller (please print)
____
Apprentice and Name (s) ____, ____

PROJECT 3313	Water Supply Well D	PAGE 1 OF 6
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC
Location: Jefferson County, WV	**Airlift Yield:** 43 gpm; 7 gpm after re-grouting	
Logger: Michael Maloy, CPG	**Depth to Bedrock:** 20' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 61' for test, 119' after reset	
Well Depth: 600' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 6 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 468' bgs (35 gpm), 560' bgs (8 gpm)	**Completion Date:** 7/7/2011	
	Notes: Artesian-style flowing well at time of pump test	

Depth (ft.)	Lithology	Lithology Description	Supply Well Diagram	Notes
0		OVERBURDEN: Tan brown overburden		
-10				
-20		WEATHERED ROCK: Light brown shale with some sandstone fragments		
-30				
-40		METASANDSTONE: Grey metasandstone		
-50				
-60				Casing set to 63' bgs
-70				
-80		METASANDSTONE: Dark grey metasandstone		Presence of vein quartz at 80' bgs 60 to 80' bgs: Drilling TIme - 7 min.
-90				
-100				80 to 100' bgs: Drilling Time - 8 min.



PROJECT 3313	Water Supply Well D	PAGE 2 OF 6
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC
Location: Jefferson County, WV	**Airlift Yield:** 43 gpm; 7 gpm after re-grouting	
Logger: Michael Maloy, CPG	**Depth to Bedrock:** 20' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 61' for test, 119' after reset	
Well Depth: 600' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 6 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 468' bgs (35 gpm), 560' bgs (8 gpm)	**Completion Date:** 7/7/2011	
	Notes: Artesian-style flowing well at time of pump test	

Depth (ft.)	Lithology	Lithology Description	Supply Well Diagram	Notes
-100		METASANDSTONE: Grey metasandstone, increasing quartz		
-110				
-120		METASANDSTONE: Light grey metasandstone		100 to 120' bgs: Drilling Time - 8 min.
-130				
-140				120 to 140' bgs: Drilling Time - 8 min.
-150				
-160		METASANDSTONE: Grey metasandstone with varying quartz content		140 to 160' bgs: Drilling Time - 8 min.
-170				
-180				Iron staining @ 178' bgs 160 to 180' bgs: Drilling Time - 8 min.
-190				
-200				180 to 200' bgs: Drilling Time - 9 min.

PROJECT 3313	Water Supply Well D	PAGE 3 OF 6
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC
Location: Jefferson County, WV	**Airlift Yield:** 43 gpm; 7 gpm after re-grouting	
Logger: Michael Maloy, CPG	**Depth to Bedrock:** 20' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 61' for test, 119' after reset	
Well Depth: 600' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 6 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 468' bgs (35 gpm), 560' bgs (8 gpm)	**Completion Date:** 7/7/2011	
	Notes: Artesian-style flowing well at time of pump test	

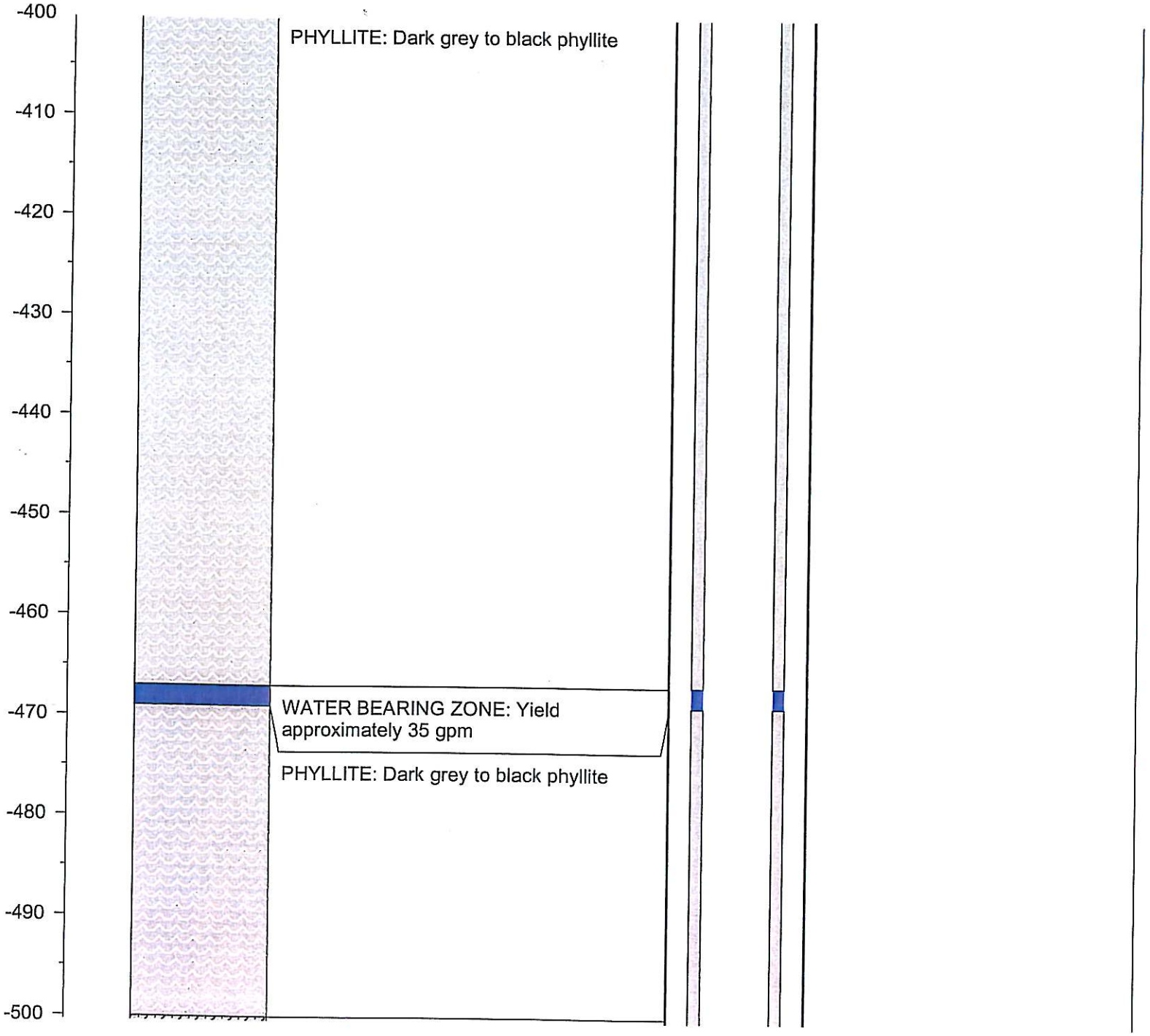
Depth (ft.)	Lithology	Lithology Description	Supply Well Diagram	Notes
-200				
-210				
-220				200 to 220' bgs: Drilling Time - 8 min.
-230				
-240				
-250				
-260		METASANDSTONE: Dark grey to grey metasandstone with varying quartz content		
-270				
-280				
-290				
-300				

PROJECT 3313	Water Supply Well D	PAGE 4 OF 6
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC
Location: Jefferson County, WV	**Airlift Yield:** 43 gpm; 7 gpm after re-grouting	
Logger: Michael Maloy, CPG	**Depth to Bedrock:** 20' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 61' for test, 119' after reset	
Well Depth: 600' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 6 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 468' bgs (35 gpm), 560' bgs (8 gpm)	**Completion Date:** 7/7/2011	
	Notes: Artesian-style flowing well at time of pump test	

Depth (ft.)	Lithology	Lithology Description	Supply Well Diagram	Notes
-300				
-310				
-320				
-330				
-340				
-350				
-360		PHYLLITE: Dark grey platy phyllite fragments with trace quartz		
-370				
-380		METASANDSTONE: Dark grey metasandstone cuttings, some variegated white/black		
-390				
-400				

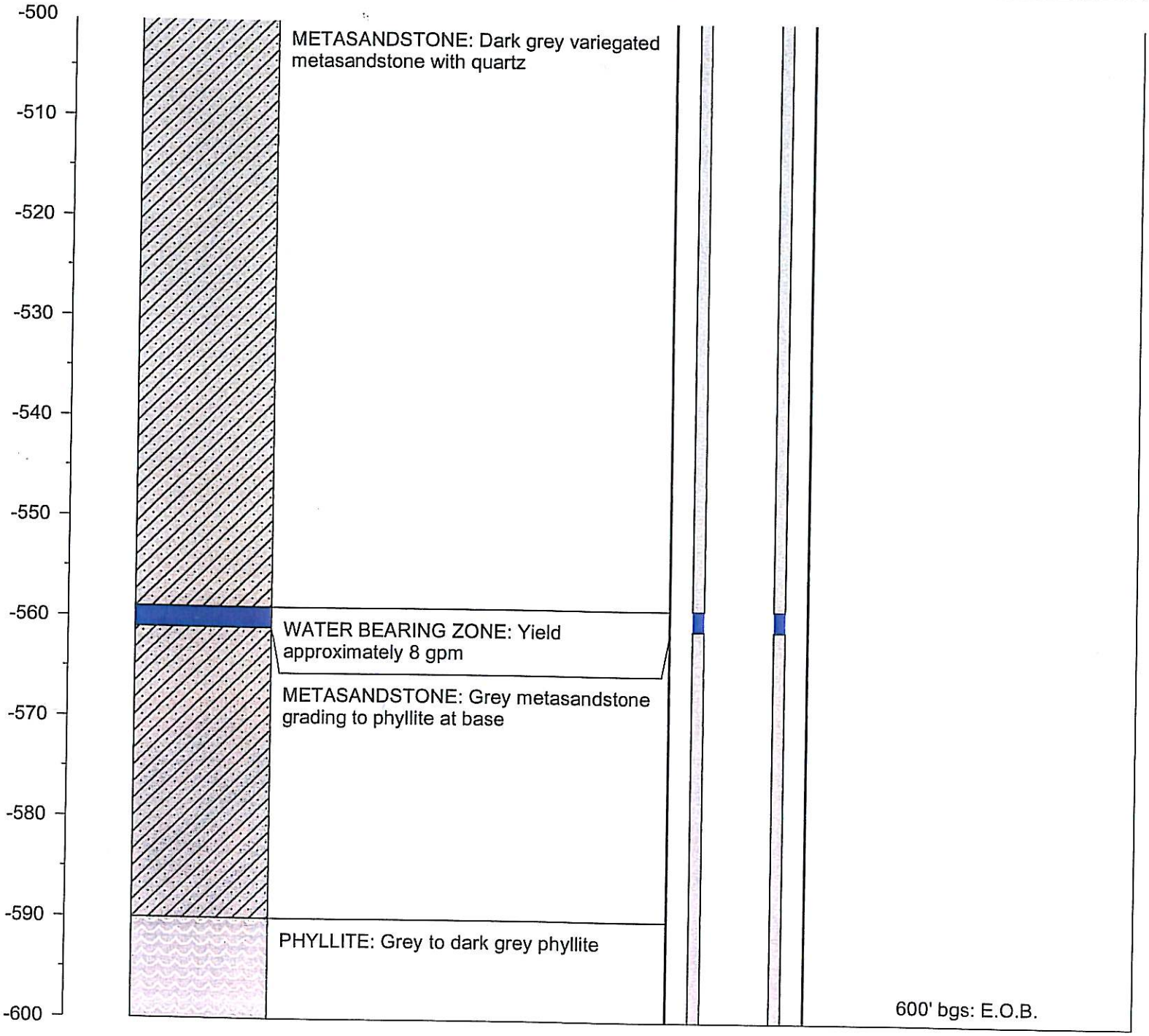
PROJECT 3313	Water Supply Well D	PAGE 5 OF 6
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC
Location: Jefferson County, WV	**Airlift Yield:** 43 gpm; 7 gpm after re-grouting	
Logger: Michael Maloy, CPG	**Depth to Bedrock:** 20' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 61' for test, 119' after reset	
Well Depth: 600' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 6 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 468' bgs (35 gpm), 560' bgs (8 gpm)	**Completion Date:** 7/7/2011	
	Notes: Artesian-style flowing well at time of pump test	

Depth (ft.)	Lithology	Lithology Description	Supply Well Diagram	Notes



PROJECT 3313	Water Supply Well D	PAGE 6 OF 6
Name: Westridge Hills	**Well Data**	ANALYTICAL SERVICES, INC
Location: Jefferson County, WV	**Airlift Yield:** 43 gpm; 7 gpm after re-grouting	
Logger: Michael Maloy, CPG	**Depth to Bedrock:** 20' bgs	
Manager: Michael Maloy, CPG	**Casing Depth:** 61' for test, 119' after reset	
Well Depth: 600' bgs	**Well Coordinates:** Not Surveyed	
Well Diameter: 6 inch	**Drilling Company:** Valley Drilling	
TOC Elevation: Not Surveyed	**Drilling Method:** Air Rotary	
Water Bearing Zones: 468' bgs (35 gpm), 560' bgs (8 gpm)	**Completion Date:** 7/7/2011	
	Notes: Artesian-style flowing well at time of pump test	

Depth (ft.)	Lithology	Lithology Description	Supply Well Diagram	Notes



Appendix D

Down-well Pump Configurations (Figures 3a & 3b)

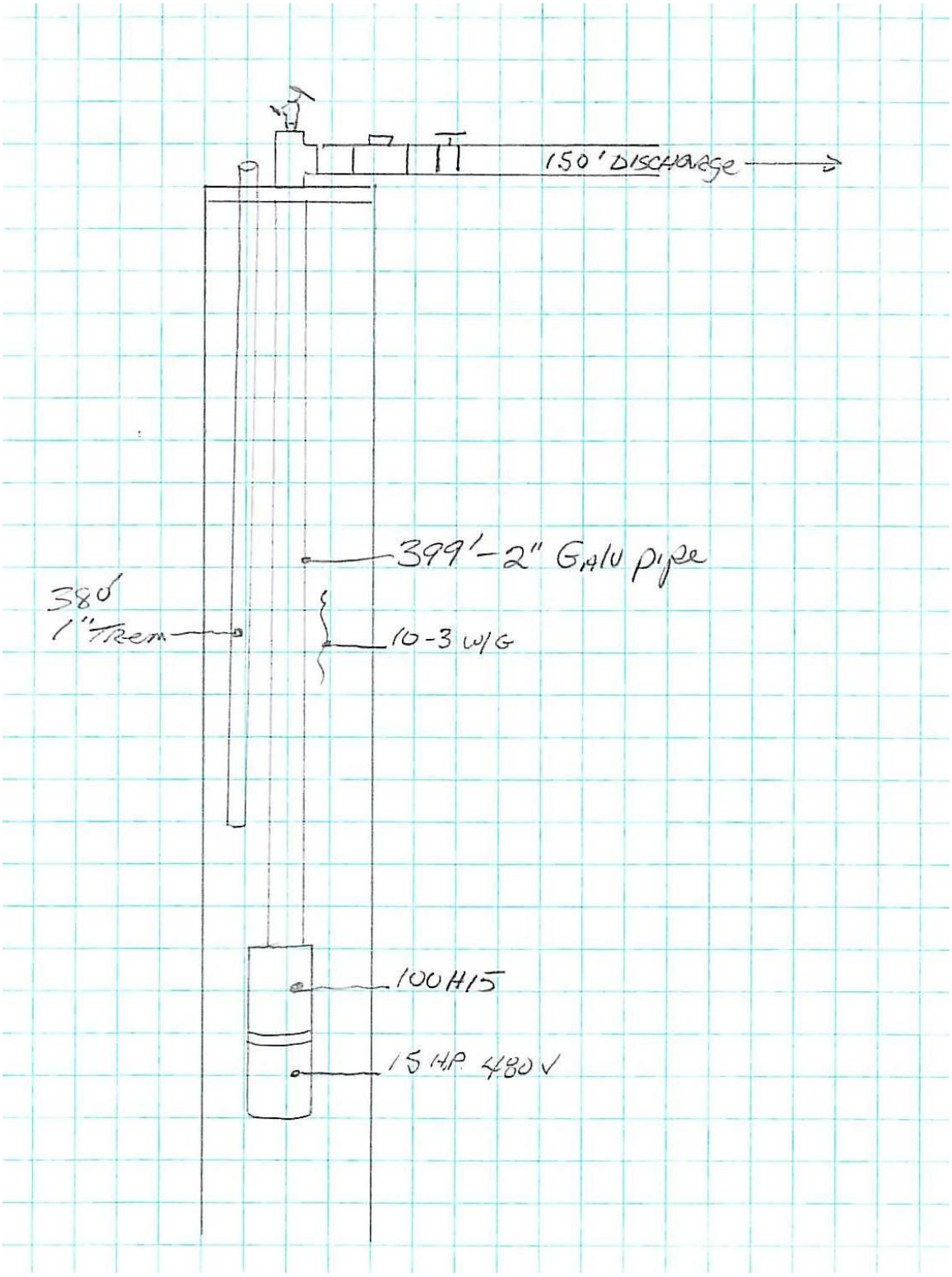


Figure 3a – Driller's Pump Setup Diagram for Well A

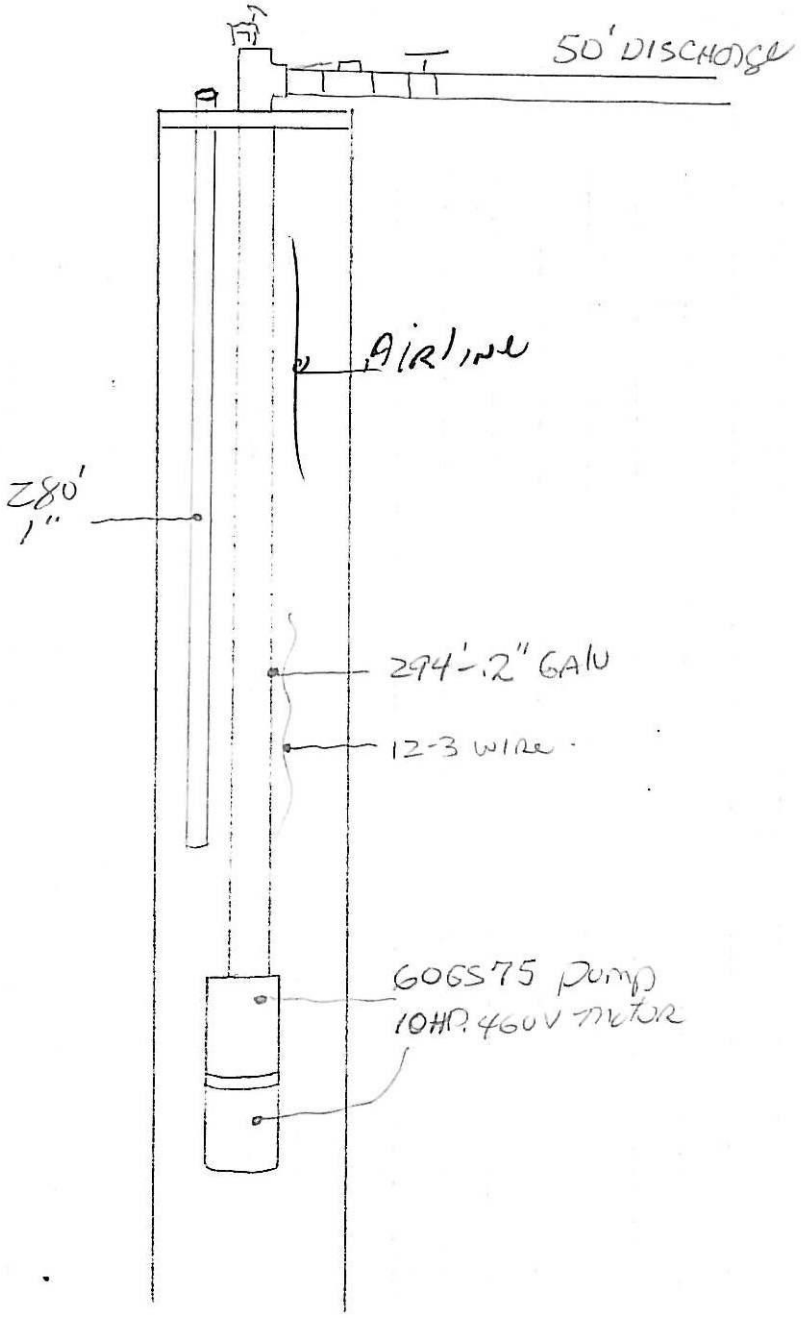


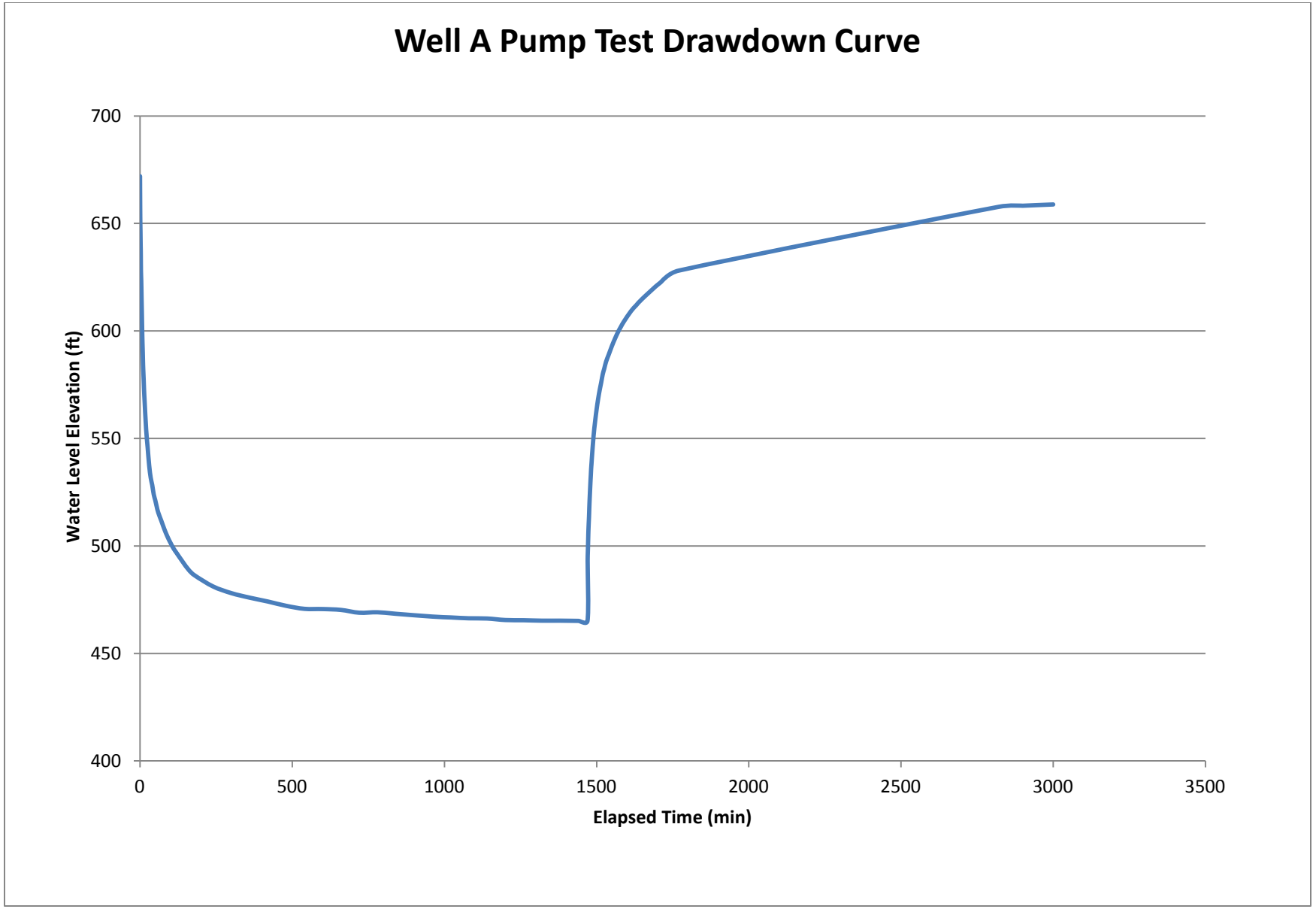
Figure 3b – Driller's Pump Setup Diagram for Well D

Appendix E

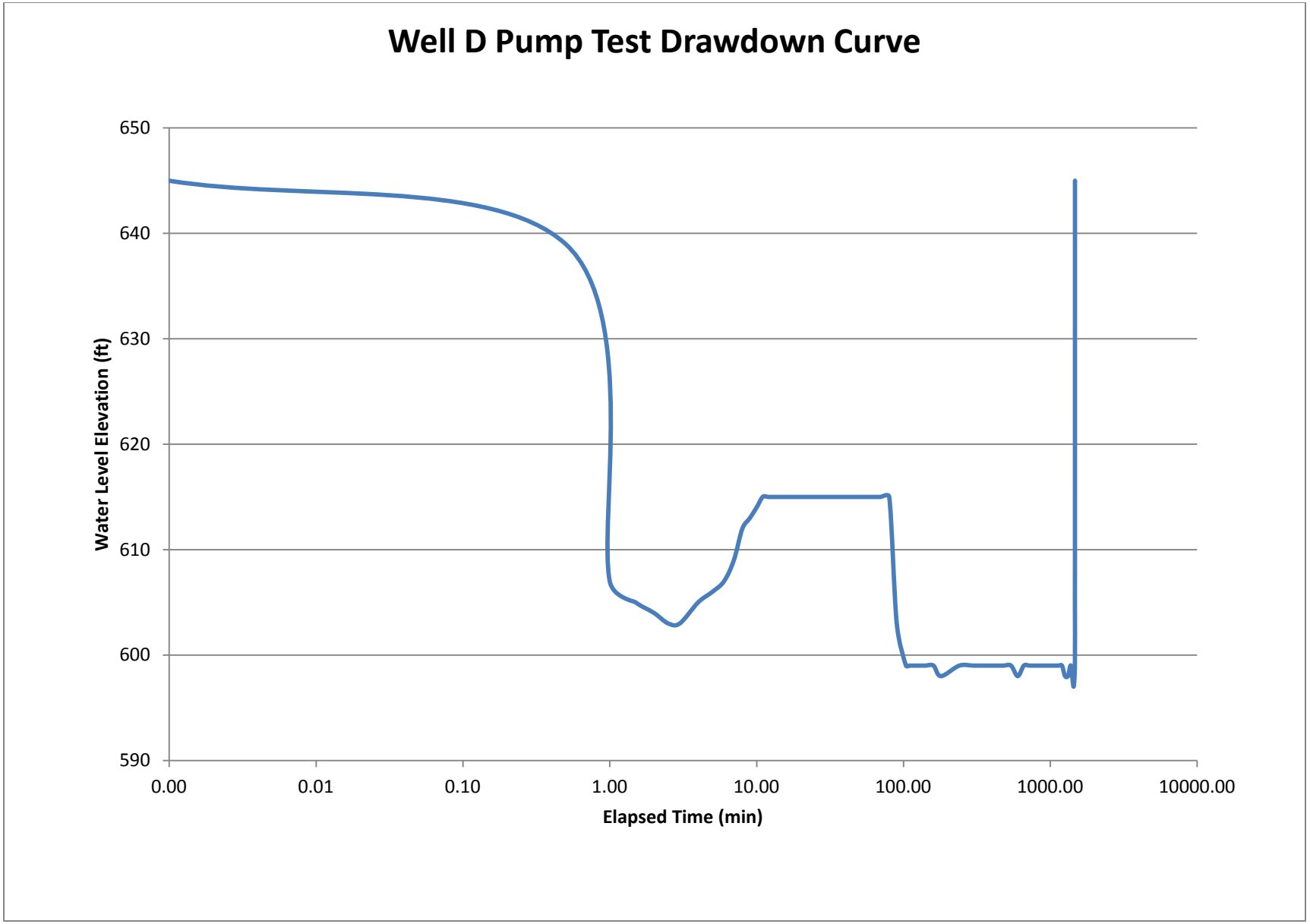
Drawdown and Recovery Data with Plots

Well A Pump Test Data		(continued)		(continued)	
Time (min)	Drawdown (ft)	Time (min)	Drawdown (ft)	Time (min)	Drawdown (ft)
0.0	0	720.0	202.95	1590.0	67.49
0.5	13.95	780.0	202.75	1613.0	62.73
1.0	21.85	840.0	203.45	1630.0	60.02
1.5	25.85	960.0	204.75	1650.0	57
2.0	31.85	1020.0	205.15	1710.0	49.4
2.5	35.9	1080.0	205.55	1770.0	43.88
3.0	43.95	1140.0	205.65	2820.0	14.26
4.0	48.65	1200.0	206.35	2900.0	13.73
5.0	56.25	1260.0	206.45	3000.0	13.14
6.0	63.35	1320.0	206.65		
7.0	71.05	1380.0	206.65		
8.0	77.35	1440.0	206.75		
9.0	82.05	1470.0	206.75		
10.0	87.75	*1470.5	*178.85		
11.0	91.35	1471.0	175.45		
12.0	94.75	1471.5	173.1		
13.0	98.55	1472.0	170.33		
14.0	101.8	1472.5	167.55		
15.0	104.45	1473.0	164.94		
20.0	117.65	1474.0	161.45		
25.0	126.05	1475.0	158.23		
30.0	134.45	1476.0	154		
35.0	140.15	1477.0	150.45		
40.0	143.55	1478.0	147.33		
45.0	147.95	1479.0	144.3		
50.0	150.65	1480.0	141.35		
55.0	153.75	1481.0	138.8		
60.0	156.45	1482.0	135.95		
70.0	160.25	1483.0	134.02		
80.0	164.15	1484.0	131.87		
90.0	167.55	1485.0	129.83		
100.0	170.45	1490.0	120.68		
110.0	173.05	1495.0	114.06		
120.0	175.15	1500.0	108.36		
140.0	179.25	1505.0	103.55		
160.0	183.05	1510.0	99.46		
180.0	185.65	1515.0	95.95		
240.0	190.75	1520.0	92.12		
300.0	193.85	1525.0	89.53		
360.0	195.95	1531.0	86.25		
420.0	197.75	1540.0	82.84		
480.0	199.75	1550.0	79.02		
540.0	201.15	1560.0	75.62		
600.0	201.25	1570.0	72.54		
660.0	201.65	1580.0	69.93		

* indicates first recovery measurement

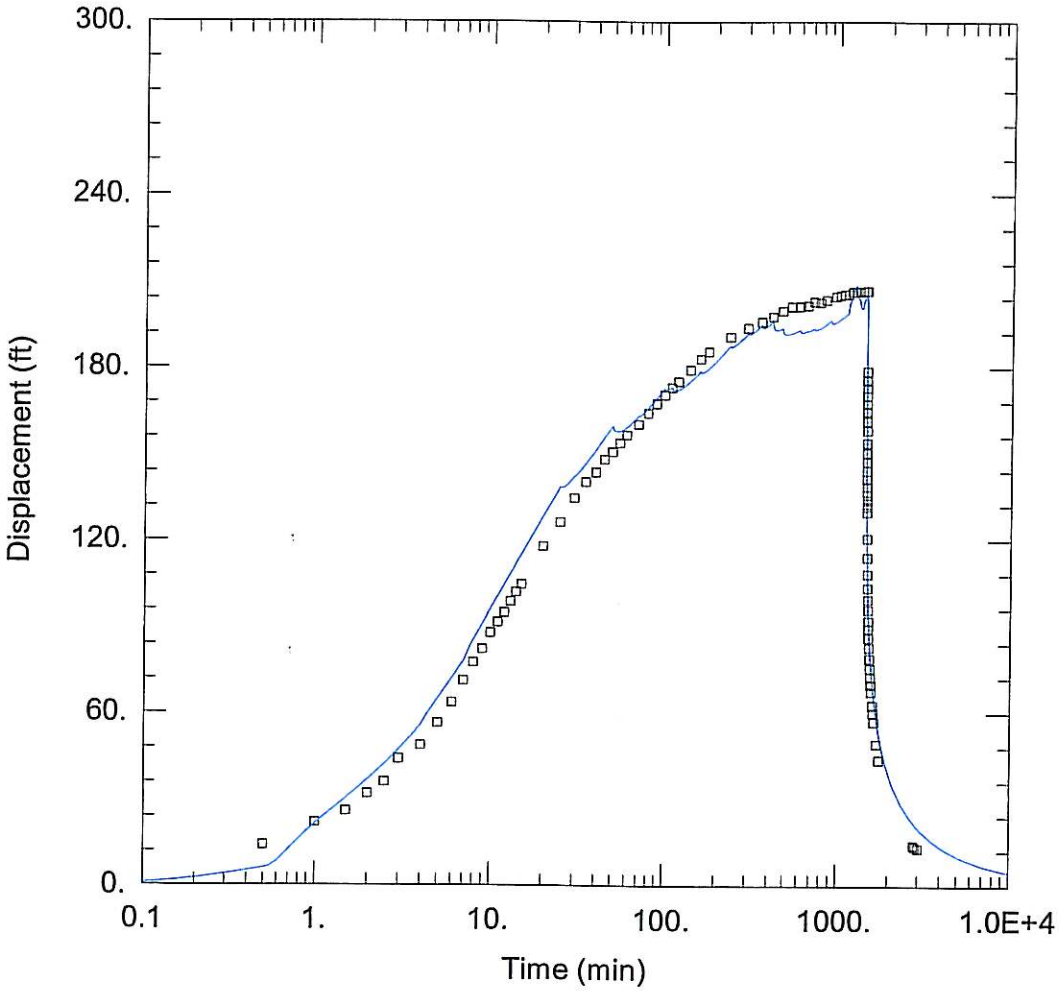

Well A Pump Test Drawdown Curve
700
650
600
550
500
450
400
Water Level Elevation (ft)
0
500
1000
1500
2000
2500
3000
3500
Elapsed Time (min)

Well D Pump Test Data		(continued)	
Time (min)	Drawdown (ft)	Time (min)	Drawdown (ft)
0.00	0	600.00	47
0.50	6	660.00	46
1.00	38	720.00	46
1.50	40	780.00	46
2.00	41	960.00	46
2.50	42	1080.00	46
3.00	42	1140.00	46
4.00	40	1200.00	46
5.00	39	1260.00	47
6.00	38	1320.00	47
7.00	36	1380.00	46
8.00	33	1440.00	48
9.00	32	1470.00	46
10.00	31	1470.50	40
11.00	30	1471.00	38
12.00	30	1471.50	33
13.00	30	1472.00	0
14.00	30		
15.00	30		
20.00	30		
25.00	30		
30.00	30		
35.00	30		
40.00	30		
45.00	30		
50.00	30		
55.00	30		
60.00	30		
70.00	30		
80.00	30		
90.00	42		
104.00	46		
110.00	46		
120.00	46		
140.00	46		
160.00	46		
180.00	47		
240.00	46		
300.00	46		
360.00	46		
420.00	46		
480.00	46		
540.00	46		


Well D Pump Test Drawdown Curve
650
640
630
620
610
600
590
Water Level Elevation (ft)
0.00
0.01
0.10
1.00
10.00
100.00
1000.00
10000.00
Elapsed Time (min)

Appendix F

AQTESOLV Graphic Analysis



WELL TEST ANALYSIS

Data Set:
Date: 08/09/11 Time: 12:11:49

PROJECT INFORMATION

Company: ASI
Client: Jefferson County
Project: 3313
Location: Westridge Hills
Test Well: Well A
Test Date: 7/20/2011

AQUIFER DATA

Saturated Thickness: 465. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well A	0	0

Observation Wells

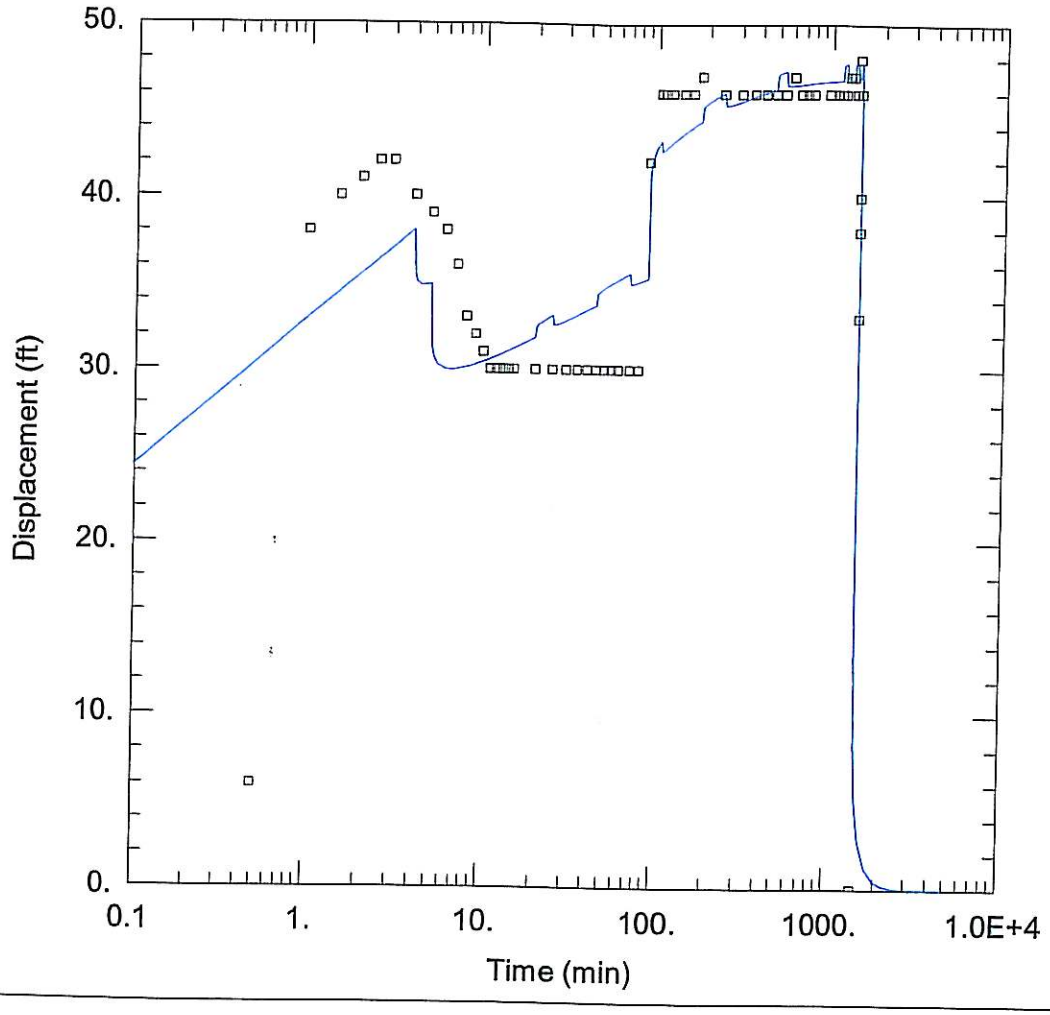
Well Name	X (ft)	Y (ft)
▫ Well A	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 27.17 ft^2/day
Sy = 0.07685

S = 0.03211
ß = 0.4599



WELL TEST ANALYSIS

Data Set: P:\Project Folder\Project 3313 Westridge Hills\Pump Test Report\Welld D unconf.aqt
Date: 08/09/11 Time: 14:52:30

PROJECT INFORMATION

Company: ASI
Client: Jefferson County
Project: 3313
Location: Westridge Hills
Test Well: Well D
Test Date: 7/20/2011

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well D	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
Well D	0	0

SOLUTION

Aquifer Model: Leaky
Solution Method: Hantush-Jacob

T = 206.3 ft^2/day
r/B = 0.0008606
b = 600. ft

S = 0.000184
Kz/Kr = 14.4

Appendix G

List of Required Contaminant Analyses

WEST VIRGINIA BUREAU FOR PUBLIC HEALTH
Office of Environmental Health Services
Environmental Engineering Division
Capitol & Washington Streets
1 Davis Square, Suite 200
Charleston, WV 25301

PUBLIC DRINKING WATER - LIST OF REQUIRED CONTAMINANT ANALYSIS

Water intended for use as drinking water by community public water supplies and non-transient non-community public water supplies must be tested for the following contaminants and parameters. Analysis must be performed by a laboratory certified by the State of West Virginia to analyze drinking water samples, with the exception of Secondary Contaminants and TOC analysis. A list of approved laboratories is available upon request. Note: Transient non-community public water supplies need only analyze for Nitrate, Nitrite and Coliform Bacteria.

SECONDARY CONTAMINANTS

Parameter	MCL (mg/L)
pH	
Hardness	
Alkalinity	
Turbidity	
Sulfate	250
Silver	0.1
Aluminum	0.05
Chloride	250
Phosphate	
Iron	0.3
Manganese	0.05
Total Dissolved Solids	500
Zinc	5
Foaming Agents	0.5

RADIONUCLIDES
(Community Systems Only)

Gross Alpha Particle Activity	15 pCi/l
Radium 228	*5 pCi/l

*combined with Radium 226

MICROBIOLOGICAL

Coliform Bacteria

LEAD & COPPER

	AL*
Lead	0.015
Copper	1.3

*Action Level

INORGANIC CHEMICALS

Contaminant	MCL(mg/l)
Nitrate	10.0
Nitrite	1.0
Arsenic	0.010
Barium	2.0
Cadmium	0.005
Chromium	0.1
Fluoride	4.0
Mercury	0.002
Selenium	0.05
Antimony	0.006
Beryllium	0.004
Cyanide	0.2
Nickel	
Thallium	0.002
Sodium	**20

**there is no MCL for sodium

TOC

Total Organic Carbon
[Surface Water and Ground Water Under the Direct Influence (GWUDI) systems only]

REGULATED VOCs

Contaminant	MCL(mg/l)
Benzene	0.005
Carbon Tetrachloride	0.005
p-Dichlorobenzene	0.075
1,2-Dichloroethane	0.005
1,1-Dichloroethylene	0.007
1,1,1-Trichloroethane	0.2
Trichloroethylene	0.005
o-Dichlorobenzene	0.6
Cis-1,2-dichloroethylene	0.07
Trans-1,2-dichloroethylene	0.1
1,2-Dichloropropane	0.005
Ethylbenzene	0.7
Monochlorobenzene	0.1
Styrene	0.1
Tetrachloroethylene	0.005
Toluene	1.0
Xylenes	10.0
Dichloromethane	0.005
1,2,4-Trichlorobenzene	0.07
1,1,2-Trichloroethane	0.005
Vinyl Chloride	0.002

REG SOCs

Contaminant	MCL(mg/l)
Alachlor (Lasso)	0.002
Atrazine (Atranex, Crisazina)	0.003
Carbofuran (Furadan 4F)	0.04
Chlordane	0.002
2,4-D (Formula 40, Weedar 64)	0.07
Heptachlor (H-34,Heptox)	0.0004
Heptachlor Epoxide	0.0002
Lindane	0.0002
PCB's	0.0005
Oxamyl (Vydate)	0.2
Picloram	0.5
Simazine	0.004
Benzo(a)pyrene	0.0002
Di(2-ethylhexyl)adipate	0.4
Di(2-ethylhexyl)phthalate	0.006
Hexachlorocyclopentadiene	0.05

DISINFECTION BYPRODUCTS

Contaminant	MCL(mg/L)
TTHM	
Trichloromethane (chloroform)	
dibromochloromethane	
bromodichloromethane	
tribromomethane (bromoform)	
Total Trihalomethanes	0.080
HAA5	
monochloroacetic acid	
dichloroacetic acid	
trichloroacetic acid	
monobromoacetic acid	
dibromoacetic acid	
Total HAA5	0.060

MCL = Maximum Contaminant Level

Appendix H

Laboratory Analytical Results

RELIANCE LABORATORIES, INC. - CHAIN OF CUSTODY RECORD

$2900.00 cc
*please invoi

☐ 2044 MEADOWBROOK ROAD
POST OFFICE BOX 4657
BRIDGEPORT, WV 26330
TEL. (304) 842-5285 • FAX (304) 842-5351
E-MAIL reliancelabs@wvdsl.net
INTERNET www.RelianceLabs.net

☒ RIDGEFIELD BUSINESS CENTER
25 CRIMSON CIRCLE
MARTINSBURG, WV 25403
TEL. (304) 596-2084 • FAX (304) 596-2086

*CLIENT NAME Analytical Services

*ADDRESS 402 N. West St. Culpeper, VA 22701

CUSTOMER # Col6354 TEL.#829-5040 FAX 829-5041 x1002

*SAMPLER (S) A. Carter E-MAIL malapasi@aol.com

SHEET NO. 1 OF 1

LABORATORY #	*DATE	*TIME	COMP	GRAB	MATRIX W, DW, S, O, M	TEMP. ≤ 4°C Yes / No	*# OF CONTAIN.	HN03	H2S04	HCL	NaOH	BAC-T	NO PRES.	other	2ry Cont.	MUG; Phbly	Inorg/ANN	Tot; VOC	Haas; THM	SOC; Gross A/B	Radium 226/228	*PROJECT/REMARKS
well A	7/21/11	11:15		✓	DW	13	~~28~~ 30	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	lab # 163512
well D	7/21/11	10:30		✓	DW	13	~~28~~ 30	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	163513

SAMPLES DO ✓ DO NOT ____ MEET USEPA GUIDELINES FOR HOLDING TIMES
SAMPLES DO ✓ DO NOT ____ MEET USEPA GUIDELINES FOR CHEMICAL PRESERVATIVES
SAMPLES DO ✓ DO NOT ____ MEET USEPA GUIDELINES FOR SAMPLE CONTAINERS
SAMPLES ARE ✓ ARE NOT ____ FOR REGULATORY COMPLIANCE PURPOSES

*RELINQUISHED BY:	*DATE/TIME	*RECEIVED BY:
PRINT: Andrew Carter	DATE: 7/21/11	PRINT: W. L. Omdorff
SIGN: [signature]	TIME: 12:00 PM	SIGN: W. L. Omdorff
*RELINQUISHED BY:	*DATE/TIME	*RECEIVED BY:
PRINT: W. L. Omdorff	DATE: 7-21-11	PRINT: M Ramirez
SIGN: W. L. Omdorff	TIME: 1307	SIGN: Megan Ramirez
*RELINQUISHED BY:	*DATE/TIME	*RECEIVED BY:
PRINT: Megan Ramirez	DATE: 7-21-11	PRINT: Fedex
SIGN: Megan Ramirez	TIME: 1600	SIGN: Fedex
*COURIER: Fed Ex	*DATE/TIME	*RECEIVED BY:
TRACKING #:	DATE: 7-22-11	PRINT:
	TIME: 8:50	SIGN: Freeman

REMARKS:

PWS# ____

PO# 3113

* Please email results along w/ paper copy

WEATHER/TEMPERATURE:

☐ RUSH STATUS (INITIAL ACCEPTANCE ____)

* ADDITIONAL LABORATORY FEES MAY APPLY***

EXTENT OF LIABILITY

SHOULD RELIANCE LABORATORIES, INC. BE AT FAULT AND ANY DISPUTE ARISE REGARDING ANALYTICAL DATA GENERATED BY THE LABORATORY, THE EXTENT OF THE LIABILITY TO RELIANCE WILL BE A DUPLICATE ANALYSIS OF THAT SAMPLE (PROVIDING ADEQUATE SAMPLE REMAINS) OR A REFUND OF THE ANALYTICAL FEE. IN NO EVENT WILL RELIANCE LABORATORIES BE LIABLE FOR DAMAGES INCLUDING BUT NOT LIMITED TO DIRECT, INDIRECT OR CONSEQUENTIAL DAMAGES ARISING FROM SUCH DISPUTE.

NOTE: TYPICAL SAMPLE TURN AROUND FOR ROUTINE SAMPLES IS 5 TO 10 WORKING DAYS. THIS IN NOT A GUARANTEE THAT SAMPLES WILL BE COMPLETED IN THIS TIME FRAME, HOWEVER. NON-ROUTINE SAMPLES MAY REQUIRE ADDITIONAL TIME.

* TO BE COMPLETED BY CLIENT

ORIGINAL CHAIN OF CUSTODY DOCUMENT MUST BE EXECUTED IN INK

WHITE - LABORATORY YELLOW - CLIENT

RELIANCE LABORATORIES, INC.

ENVIRONMENTAL ANALYSTS AND CONSULTANTS

BRIDGEPORT, WV www.RellanceLabs.net *MARTINSBURG, WV*

Certifications: WV Department of Health #: 00354, 00433 | WV Department of Environmental Protection #: 158, 181
MD Department of Environment #: 336, 337 | US Environmental Protection Agency #: WV00042, WV00901

PURGEABLE ORGANICS – CHAIN OF CUSTODY & SAMPLE COLLECTION PROCEDURE

1. Samples should be grab samples and should be taken from a cold water tap where drinking water or water for human consumption is normally obtained.
2. Sample bottles should be handled aseptically to prevent contamination of samples. Do not touch the inside of the bottles or caps. Do not allow either to touch the faucet. Do not remove any preservatives present.
3. Open the cold water tap and allow water to run evenly for three to five minutes in order to equilibrate system. Generally, the water temperature will stabilize indicating complete equilibration.
4. Collect grab samples in 40 ml glass vials. Slowly fill each container to overflowing, place the Teflon lined cap on the vial and seal. Invert the sample to check for air bubbles, if bubbles are present remove cap and continue filling vial. Fill all empty vials.
5. Return trip blank unaltered to the laboratory with sample vials.
6. Carefully pack all sample containers in ice to maintain 4 degrees Celsius.
7. Complete all information below and return with sample and trip blank to the laboratory.

Please provide all necessary information.

SAMPLING INFORMATION – COMPLETE THIS DOCUMENT IN INDELIBLE INK

Firm: Analytical Services Contact: Michael Maloy

Address: 402 N. West St. Culpeper, VA 22701

Telephone: 540-829-5640 x1002 Fax: 540-829-5641

Public Water System (PWS) I.D.: _____

Describe Sample Location: well A

Sample Date: 7-21-11 Sample Time: 1115 Collected By: A. Carter

Sample Witnessed By: _____ Date Received at Laboratory: 7-21-11

Preserved at Lab (Y/N): ✓ Proper Preservatives: ✓ Proper Containers Used: ✓

Holding Times Observed: ✓ Disinfectant Residual: _____

Sample Temperature Upon Receipt: 13°C Received By: Megan

Shipper/Tracking #: _____

Results Authorized By: _____ Date: _____

2044 MEADOWBROOK ROAD | P.O. BOX 4657 | BRIDGEPORT, WV 26330 | VOICE: 304-842-5285 | FAX: 304-842-5351
RIDGEFIELD BUSINESS CENTER | 25 CRIMSON CIRCLE | MARTINSBURG, WV 25403 | VOICE: 304-596-2084 | FAX: 304-596-2086
EMAIL: RELIANCELABS@WVDSL.NET | WEB: WWW.RELIANCELABS.NET

RELIANCE LABORATORIES, INC.

ENVIRONMENTAL ANALYSTS AND CONSULTANTS

BRIDGEPORT, WV www.RelianceLabs.net *MARTINSBURG, WV*

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MD Department of Environment #: 336, 337 | US Environmental Protection Agency #: WV00042, WV00901

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1. Samples should be grab samples and should be taken from a cold water tap where drinking water or water for human consumption is normally obtained.
2. Sample bottles should be handled aseptically to prevent contamination of samples. Do not touch the inside of the bottles or caps. Do not allow either to touch the faucet. Do not remove any preservatives present.
3. Open the cold water tap and allow water to run evenly for three to five minutes in order to equilibrate system. Generally, the water temperature will stabilize indicating complete equilibration.
4. Collect grab samples in 40 ml glass vials. Slowly fill each container to overflowing, place the Teflon lined cap on the vial and seal. Invert the sample to check for air bubbles, if bubbles are present remove cap and continue filling vial. Fill all empty vials.
5. Return trip blank unaltered to the laboratory with sample vials.
6. Carefully pack all sample containers in ice to maintain 4 degrees Celsius.
7. Complete all information below and return with sample and trip blank to the laboratory.

Please provide all necessary information.

SAMPLING INFORMATION - COMPLETE THIS DOCUMENT IN INDELIBLE INK

Firm: Analytical Services Contact: Michael Maloy

Address: 402 N. West St. Culpeper, VA 22701

Telephone: 540-829-3040 x1002 Fax: 540-829-5041

Public Water System (PWS) I.D.: _____

Describe Sample Location: well D

Sample Date: 7-21-11 Sample Time: 1000 Collected By: A. Carter

Sample Witnessed By: _____ Date Received at Laboratory: 7-21-11

Preserved at Lab (Y/N): ✓ Proper Preservatives: ✓ Proper Containers Used: ✓

Holding Times Observed: ✓ Disinfectant Residual: _____

Sample Temperature Upon Receipt: 13°C Received By: Megan

Shipper/Tracking #: _____

Results Authorized By: _____ Date: _____

2044 MEADOWBROOK ROAD | P.O. BOX 4657 | BRIDGEPORT, WV 26330 | VOICE: 304-842-5285 | FAX: 304-842-5351
RIDGEFIELD BUSINESS CENTER | 25 CRIMSON CIRCLE | MARTINSBURG, WV 25403 | VOICE: 304-596-2084 | FAX: 304-596-2086
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RELIANCE LABORATORIES, INC.

ENVIRONMENTAL ANALYSTS AND CONSULTANTS

BRIDGEPORT, WV www.RelianceLabs.net MARTINSBURG, WV

Certifications: WV Department of Health #: 00354, 00433 | WV Department of Environmental Protection #: 158, 181
MD Department of Environment #: 336, 337 | US Environmental Protection Agency #: WV00042, WV00901

LABORATORY REPORT SUMMARY

Client: C06354 **Thursday, August 18, 2011**

ANALYTICAL SERVICES, INC.
402 NORTH WEST STREET
CULPEPER VA 22701-

Total Number of Pages: 9
(Not Including C.O.C.)
Page 1 of 9

Lab ID	Sample ID	Sample ID 2	Sample Date
163512-2011-DW	Well A		7/21/2011
163513-2011-DW	Well D		7/21/2011

The enclosed results have been analyzed according to the referenced method and SOP. Any deviations to the method have been noted on the report. Unless otherwise noted, all results have been verified to meet quality control requirements of the method. This report may not be reproduced, except in full, without written approval of Reliance Laboratories, Inc.

Report Reviewed By:

RLI.012

ANALYTICAL SERVICES, INC.
402 NORTH WEST STREET

CULPEPER, VA 22701-

Thursday, August 18, 2011

Lab Number: 163512-2011-DW **Sample ID:** Well A

Parameter	Value	Units	Method	Date/Time Analyzed		Analyst	MRL	MCL
Analyte Group: Inorganics								
Total Organic Carbon	0.11	mg/l	SM5310C	7/28/2011	9:00	A.Seitz	0.1	
Total Lead	ND	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.005	0.015
Free Cyanide	ND	mg/l	SM4500CNF	8/3/2011	9:30	A.Seitz	0.05	0.2
Total Antimony	ND	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.004	0.006
Total Arsenic	ND	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.005	0.01
Total Barium	0.05	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.01	2
Total Beryllium	ND	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.002	0.004
Total Cadmium	ND	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.002	0.005
Total Chromium	ND	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.01	0.10
Total Fluoride	ND	mg/l	EPA 300.0	7/23/2011	2:36	T. Miller	0.2	4.0
Total Mercury	ND	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.001	0.002
Total Nickel	ND	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.01	0.10
Total Nitrate as N	ND	mg/l	EPA 300.0	7/23/2011	2:36	T. Miller	0.1	10
Total Nitrite as N	ND	mg/l	EPA 300.0	7/23/2011	2:36	T. Miller	0.2	1
Total Selenium	ND	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.01	0.05
Total Sodium	2.00	mg/l	EPA 200.7	8/9/2011	12:24	T.Hanshaw	1	[20]
Total Thallium	ND	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.001	0.002
E. coli (Chromogenic)@	Absent		SM9223B	7/21/2011	16:30	A.Bixler		
Total Coliform (Chromogenic)@	Present		SM9223B	7/21/2011	16:30	A.Bixler		
pH	7.38	S.U.	SM4500H+B	8/1/2011	13:39	A.Tonkery		
Phenol	ND	mg/l	EPA 420.1	8/8/2011	12:32	C.Parker	0.05	
Total Alkalinity	76.6	mg/l	SM2320B	8/1/2011	13:39	A.Tonkery	2.81	
Total Chloride	0.93	mg/l	EPA 300.0	8/8/2011	20:26	M.Coffman	0.15	[250]
Total Dissolved Solids	104	mg/l	SM 2540C	7/28/2011	10:00	A.Seitz	10	[500]
Total Hardness	96.0	mg/l	SM 2340C	8/1/2011	8:46	C.Parker	1	

Remarks:

Date Sample Collected: 7/21/2011 11:15
Sample Submitted By: A. Carter
Date Sample Received: 7/21/2011 13:07
ND = Not Detected at the MDL or MRL
MDL - Minimum Detectable Limit **MRL - Minimum Reporting Limit**
MCL - Maximum Contaminant Level, USEPA Regulated **[MCL] = Maximum Contaminant Level, Non-Regulated**

***Method Code: STANDARD METHODS 19TH ED; US EPA METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES, Rev. 83; US EPA METHODS FOR THE DETERMINATION OF METALS IN ENVIRONMENTAL SAMPLES, May 1994; TEST METHODS FOR EVALUATING SOLID WASTE, SW-846, 3rd ED; USEPA Manual for Certification of Laboratories Analyzing Drinking Water, 5th ED. In accordance with EPA Regulations, all reports, including raw data and quality control data, are maintained by the laboratory for a minimum of 5 years.**

NOTE: This sample does not meet standards set for Total Coliform and E Coli by the State of West Virginia, 64-3-10, Code of State Regulations, adopted July 1, 2002 by the Bureau For Public Health. Sample Analyzed by Certified Laboratory #00354CM and #00443
@Parameter analyzed by Reliance Laboratories, Martinsburg, WV

NOTE: ND or Not Detected indicates that the analytical value obtained is below the practical quantifiable limit (PQL) which is equivalent to the lowest standard utilized in preparation of the method calibration curve

RLI.012

ANALYTICAL SERVICES, INC.
402 NORTH WEST STREET

CULPEPER, VA 22701-

Thursday, August 18, 2011

Lab Number: 163512-2011-DW **Sample ID:** Well A

Parameter	Value	Units	Method	Date/Time Analyzed		Analyst	MRL	MCL
Total Phosphorus	ND	mg/l	SM4500P-E	8/1/2011	10:30	M.Coffman	0.1	
Total Sulfate	6.03	mg/l	EPA 300.0	8/8/2011	20:26	M.Coffman	0.5	[250]
Total Surfactant	ND	mg/l	SM5540C	7/22/2011	9:00	A.Tonkery	0.2	[0.5]
Turbidity	ND	N.T.U.	EPA 180.1	7/22/2011	9:00	A.Tonkery	0.22	
Total Aluminum	0.020	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.01	[0.05]
Total Copper	0.023	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.01	1.3
Total Iron	ND	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.1	[0.3]
Total Manganese	0.17	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.01	[0.05]
Total Silver	ND	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.01	[0.10]
Total Zinc	0.143	mg/l	EPA 200.8	8/9/2011	12:24	T.Hanshaw	0.01	[5.0]

Remarks:

Date Sample Collected: 7/21/2011 11:15
Sample Submitted By: A. Carter
Date Sample Received: 7/21/2011 13:07
ND = Not Detected at the MDL or MRL
MDL - Minimum Detectable Limit **MRL - Minimum Reporting Limit**
MCL - Maximum Contaminant Level, USEPA Regulated **[MCL] = Maximum Contaminant Level, Non-Regulated**

***Method Code: STANDARD METHODS 19TH ED; US EPA METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES, Rev. 83; US EPA METHODS FOR THE DETERMINATION OF METALS IN ENVIRONMENTAL SAMPLES, May 1994; TEST METHODS FOR EVALUATING SOLID WASTE, SW-846, 3rd ED; USEPA Manual for Certification of Laboratories Analyzing Drinking Water, 5th ED. In accordance with EPA Regulations, all reports, including raw data and quality control data, are maintained by the laboratory for a minimum of 5 years.**

NOTE: This sample does not meet standards set for Total Coliform and E Coli by the State of West Virginia, 64-3-10, Code of State Regulations, adopted July 1, 2002 by the Bureau For Public Health. Sample Analyzed by Certified Laboratory #00354CM and #00443
@Parameter analyzed by Reliance Laboratories, Martinsburg, WV

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RLI.012

ANALYTICAL SERVICES, INC.
402 NORTH WEST STREET

CULPEPER, VA 22701-

Thursday, August 18, 2011

Lab Number: 163512-2011-DW **Sample ID:** Well A

Parameter	Value	Units	Method	Date/Time Analyzed	Analyst	MRL	MCL
Analyte Group: Organics							
1, 1, 1-Trichloroethane	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.20
1, 1, 2-Trichloroethane	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.005
1, 2, 4-Trichlorobenzene	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.07
1, 2-Dichloroethane	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.005
1, 2-Dichloropropane	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.005
1,1-Dichloroethylene	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.007
Benzene	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.005
Carbon Tetrachloride	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.005
Chlorobenzene	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.10
cis-1, 2-Dichloroethylene	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.07
Dichloromethane	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.005
Ethylbenzene	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.70
o-Dichlorobenzene	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.60
p-Dichlorobenzene	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.075
Styrene	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.10
Tetrachloroethylene	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.005
Toluene	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	1.0
trans-1, 2-Dichloroethylene	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.1
Trichloroethylene	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.005
Vinyl Chloride	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	0.002
Xylenes	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	10
1,4-dichlorobenzene-d4 (Surrogate)	82.6	%	EPA 524.2	7/28/2011 14:06	A.Seitz		
4-Bromofluorobenzene (Surrogate)	101	%	EPA 524.2	7/28/2011 14:06	A.Seitz		
Bromodichloromethane	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	
Bromoform	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	

Remarks:

Date Sample Collected: 7/21/2011 11:15
Sample Submitted By: A. Carter
Date Sample Received: 7/21/2011 13:07
ND = Not Detected at the MDL or MRL
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MCL - Maximum Contaminant Level, USEPA Regulated **[MCL] = Maximum Contaminant Level, Non-Regulated**

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RLI.012

ANALYTICAL SERVICES, INC.
402 NORTH WEST STREET

CULPEPER, VA 22701-

Thursday, August 18, 2011

Lab Number: 163512-2011-DW **Sample ID:** Well A

Parameter	Value	Units	Method	Date/Time Analyzed	Analyst	MRL	MCL
Chloroform	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	
Dibromochloromethane	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz	0.0005	
Total Trihalomethanes	ND	mg/l	EPA 524.2	7/28/2011 14:06	A.Seitz		0.08
1,4-dichlorobenzene-d4 (Surrogate)	82.6	%	EPA 524.2	7/28/2011 14:06	A.Seitz		
4-Bromofluorobenzene (Surrogate)	101	%	EPA 524.2	7/28/2011 14:06	A.Seitz		
Bromoacetic Acid	ND	mg/l	EPA 552.3	8/1/2011 18:56	A.Seitz	0.001	
Chloroacetic Acid	ND	mg/l	EPA 552.3	8/1/2011 18:56	A.Seitz	0.002	
Dibromoacetic Acid	ND	mg/l	EPA 552.3	8/1/2011 18:56	A.Seitz	0.001	
Dichloroacetic Acid	ND	mg/l	EPA 552.3	8/1/2011 18:56	A.Seitz	0.001	
Total Haloacetic Acids	ND	mg/l	EPA 552.3	8/1/2011 18:56	A.Seitz		0.060
Trichloroacetic Acid	ND	mg/l	EPA 552.3	8/1/2011 18:56	A.Seitz	0.001	
2-bromobutanoic acid (Surrogate)	100	%	EPA 552.3	7/28/2011 14:06	A.Seitz		

Remarks:

Date Sample Collected: 7/21/2011 11:15
Sample Submitted By: A. Carter
Date Sample Received: 7/21/2011 13:07
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RLI.012

ANALYTICAL SERVICES, INC.
402 NORTH WEST STREET

CULPEPER, VA 22701-

Thursday, August 18, 2011

Lab Number: 163513-2011-DW **Sample ID:** Well D

Parameter	Value	Units	Method	Date/Time Analyzed		Analyst	MRL	MCL
Analyte Group: Inorganics								
Total Organic Carbon	ND	mg/l	SM5310C	7/28/2011	9:00	A.Seitz	0.1	
Total Lead	ND	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.005	0.015
Free Cyanide	ND	mg/l	SM4500CNF	8/3/2011	9:30	A.Seitz	0.05	0.2
Total Antimony	ND	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.004	0.006
Total Arsenic	ND	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.005	0.01
Total Barium	0.15	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.01	2
Total Beryllium	ND	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.002	0.004
Total Cadmium	ND	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.002	0.005
Total Chromium	ND	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.01	0.10
Total Fluoride	0.22	mg/l	EPA 300.0	7/23/2011	3:07	T. Miller	0.2	4.0
Total Mercury	ND	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.001	0.002
Total Nickel	ND	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.01	0.10
Total Nitrate as N	ND	mg/l	EPA 300.0	7/23/2011	3:07	T. Miller	0.1	10
Total Nitrite as N	ND	mg/l	EPA 300.0	7/23/2011	3:07	T. Miller	0.2	1
Total Selenium	ND	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.01	0.05
Total Sodium	4.16	mg/l	EPA 200.7	8/9/2011	12:31	T.Hanshaw	1	[20]
Total Thallium	ND	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.001	0.002
E. coli (Chromogenic)@	Absent		SM9223B	7/21/2011	16:30	A.Bixler		
Total Coliform (Chromogenic)@	Absent		SM9223B	7/21/2011	16:30	A.Bixler		
pH	7.99	S.U.	SM4500H+B	8/1/2011	13:41	A.Tonkery		
Phenol	ND	mg/l	EPA 420.1	8/8/2011	12:32	C.Parker	0.05	
Total Alkalinity	84.6	mg/l	SM2320B	8/1/2011	13:41	A.Tonkery	2.81	
Total Chloride	1.00	mg/l	EPA 300.0	8/8/2011	20:57	M.Coffman	0.15	[250]
Total Dissolved Solids	114	mg/l	SM 2540C	7/28/2011	10:00	A.Seitz	10	[500]
Total Hardness	92.0	mg/l	SM 2340C	8/1/2011	8:46	C.Parker	1	

Remarks:

Date Sample Collected: 7/21/2011 10:00
Sample Submitted By: A. Carter
Date Sample Received: 7/21/2011 13:07
ND = Not Detected at the MDL or MRL
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RLI.012

ANALYTICAL SERVICES, INC.
402 NORTH WEST STREET

CULPEPER, VA 22701-

Thursday, August 18, 2011

Lab Number: 163513-2011-DW **Sample ID:** Well D

Parameter	Value	Units	Method	Date/Time Analyzed		Analyst	MRL	MCL
Total Phosphorus	ND	mg/l	SM4500P-E	8/1/2011	10:30	M.Coffman	0.1	
Total Sulfate	7.98	mg/l	EPA 300.0	8/8/2011	20:57	M.Coffman	0.5	[250]
Total Surfactant	ND	mg/l	SM5540C	7/22/2011	9:00	A.Tonkery	0.2	[0.5]
Turbidity	1.3	N.T.U.	EPA 180.1	7/22/2011	9:00	A.Tonkery	0.22	
Total Aluminum	0.022	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.01	[0.05]
Total Copper	ND	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.01	1.3
Total Iron	0.27	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.1	[0.3]
Total Manganese	0.17	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.01	[0.05]
Total Silver	ND	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.01	[0.10]
Total Zinc	0.016	mg/l	EPA 200.8	8/9/2011	12:31	T.Hanshaw	0.01	[5.0]

Remarks:

Date Sample Collected: 7/21/2011 10:00
Sample Submitted By: A. Carter
Date Sample Received: 7/21/2011 13:07
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RLI.012

ANALYTICAL SERVICES, INC.
402 NORTH WEST STREET

CULPEPER, VA 22701-

Thursday, August 18, 2011

Lab Number: 163513-2011-DW **Sample ID:** Well D

Parameter	Value	Units	Method	Date/Time Analyzed	Analyst	MRL	MCL
Analyte Group: Organics							
1, 1, 1-Trichloroethane	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.20
1, 1, 2-Trichloroethane	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.005
1, 2, 4-Trichlorobenzene	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.07
1, 2-Dichloroethane	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.005
1, 2-Dichloropropane	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.005
1,1-Dichloroethylene	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.007
Benzene	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.005
Carbon Tetrachloride	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.005
Chlorobenzene	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.10
cis-1, 2-Dichloroethylene	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.07
Dichloromethane	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.005
Ethylbenzene	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.70
o-Dichlorobenzene	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.60
p-Dichlorobenzene	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.075
Styrene	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.10
Tetrachloroethylene	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.005
Toluene	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	1.0
trans-1, 2-Dichloroethylene	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.1
Trichloroethylene	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.005
Vinyl Chloride	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	0.002
Xylenes	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	10
1,4-dichlorobenzene-d4 (Surrogate)	82.0	%	EPA 524.2	7/28/2011 14:37	A.Seitz		
4-Bromofluorobenzene (Surrogate)	89.4	%	EPA 524.2	7/28/2011 14:37	A.Seitz		
Bromodichloromethane	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	
Bromoform	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	

Remarks:

Date Sample Collected: 7/21/2011 10:00
Sample Submitted By: A. Carter
Date Sample Received: 7/21/2011 13:07
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RLI.012

ANALYTICAL SERVICES, INC.
402 NORTH WEST STREET

CULPEPER, VA 22701-

Thursday, August 18, 2011

Lab Number: 163513-2011-DW **Sample ID:** Well D

Parameter	Value	Units	Method	Date/Time Analyzed	Analyst	MRL	MCL
Chloroform	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	
Dibromochloromethane	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz	0.0005	
Total Trihalomethanes	ND	mg/l	EPA 524.2	7/28/2011 14:37	A.Seitz		0.08
1,4-dichlorobenzene-d4 (Surrogate)	82.0	%	EPA 524.2	7/28/2011 14:37	A.Seitz		
4-Bromofluorobenzene (Surrogate)	89.4	%	EPA 524.2	7/28/2011 14:37	A.Seitz		
Bromoacetic Acid	ND	mg/l	EPA 552.3	8/1/2011 19:37	A.Seitz	0.001	
Chloroacetic Acid	ND	mg/l	EPA 552.3	8/1/2011 19:37	A.Seitz	0.002	
Dibromoacetic Acid	ND	mg/l	EPA 552.3	8/1/2011 19:37	A.Seitz	0.001	
Dichloroacetic Acid	ND	mg/l	EPA 552.3	8/1/2011 19:37	A.Seitz	0.001	
Total Haloacetic Acids	ND	mg/l	EPA 552.3	8/1/2011 19:37	A.Seitz		0.060
Trichloroacetic Acid	ND	mg/l	EPA 552.3	8/1/2011 19:37	A.Seitz	0.001	
2-bromobutanoic acid (Surrogate)	98.3	%	EPA 552.3	7/28/2011 14:37	A.Seitz		

Remarks:

Date Sample Collected: 7/21/2011 10:00
Sample Submitted By: A. Carter
Date Sample Received: 7/21/2011 13:07
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RLI.012

SUMMIT
ENVIRONMENTAL TECHNOLOGIES, INC.
Analytical Laboratories

LABORATORY REPORT

Client
Reliance Laboratories, Inc
Benedum Industrial Park
Bridgeport, WV 26330

Order Number
1114942

Project Number
163512-2011-DW

Issued
Monday, August 22, 2011

Total Number of Pages
6 (excluding C.O.C. and cooler receipt form)

Approved By : _____
QA Manager

NELAC Accreditation #E87688

SUMMIT
ENVIRONMENTAL TECHNOLOGIES, INC.
Analytical Laboratories

Sample Summary

Client: Reliance Laboratories, Inc
Order Number: 1114942

Laboratory ID	Client ID	Matrix	Sampling Date
1114942-01	163512	Drinking Water	07/21/2011

Report Narrative

Client: Reliance Laboratories, Inc

Order Number: 1114942

No problems were encountered during analysis of this order number, except as noted.

Data Qualifiers:
B = Analyte found in the method blank
J = Estimated concentration of analyte between MDL (LOD) and Reporting Limit (LOQ)
C = Analyte has been confirmed by another instrument or method
E = Analyte exceeds the upper limit of the calibration curve
D = Sample or extract was analyzed at a higher dilution
X = User defined data qualifier.
S = Surrogate out of control limits
U = Undetected
a = Not Accredited by NELAC

ND = Non Detected at LOQ
DF = Dilution Factor

Limit Of Quantitation (LOQ) = Laboratory Reporting Limit (not adjusted for dilution factor)
Limit Of Detection (LOD) = Laboratory Detection Limit

Matrices
A = Air
C = Cream
DW = Drinking Water
L = Liquid
O = Oil
SL = Sludge
SO = Soil
S = Solid
T = Tablet
TC = TCLP Extract
WW = Waste Water
W = Wipe

Estimated uncertainty values are available upon request.

SUMMIT
ENVIRONMENTAL TECHNOLOGIES, INC.
Analytical Laboratories

August 22, 2011

Client: Reliance Laboratories, Inc
Address: Benedum Industrial Park
Bridgeport, WV 26330

Received: 07/22/2011
Project #: 163512-2011-DW

Client ID#	Lab ID#	Collected	Analyte	Result	Units	Matrix	Method	DF	LOQ	Run	Analyst
163512	1114942-01	21-Jul-11	Gross Alpha	U +/- 1.65	pci/l	DW	900.0	1	3	27-Jul-11	MO

Client ID#	Lab ID#	Collected	Analyte	Result	Units	Matrix	Method	DF	LOQ	Run	Analyst
163512	1114942-01	21-Jul-11	Radium-226	U +/- 0.09	pci/l	DW	903.0	1	1	01-Aug-11	MO

Client ID#	Lab ID#	Collected	Analyte	Result	Units	Matrix	Method	DF	LOQ	Run	Analyst
163512	1114942-01	21-Jul-11	Radium-228	U +/- 0.3	pci/l	DW	904.0	1	1	01-Aug-11	MO

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Web Site: www.settek.com

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ENVIRONMENTAL TECHNOLOGIES, INC.

Analytical Laboratories

Safe Drinking Water Program Laboratory Reporting Form

August 22, 2011

Client: Reliance Laboratories, Inc
Address: Benedum Industrial Park
Bridgeport, WV 26330

Date Collected: 07/21/2011
Date Received: 07/22/2011
Project #: 163512-2011-DW
Client ID #: 163512
Laboratory ID #: 1114942-01
Matrix: Drinking Water

Parameter	MCL	Units	Results	Qualifier	Method	PQL	MDL	Date of Analysis	Extraction Date	Analyst
Endrin	0.002	mg/L	ND	U	EPA508	0.000022	0.00002	08/06/2011 12:00 AM	07/27/2011	JRT
Lindane	0.0002	mg/L	ND	U	EPA508	0.000044	0.00002	08/06/2011 12:00 AM	07/27/2011	JRT
Methoxychlor	0.04	mg/L	ND	U	EPA508	0.000022	0.00002	08/06/2011 12:00 AM	07/27/2011	JRT
Toxaphene	0.003	mg/L	ND	U	EPA508	0.0022	0.0007	08/06/2011 12:00 AM	07/27/2011	JRT
Dalapon	0.2	mg/L	ND	U	EPA515.1	0.0022	0.0007	08/09/2011 10:37 AM	08/01/2011	JRT
Di(2-ethylhexyl)adipate	0.4	mg/L	ND	U	EPA525.2	0.0013	0.0004	08/10/2011 01:05 AM	08/01/2011	JRT
Oxamyl	0.2	mg/L	ND	U	EPA531.2	0 0044	0.0006	08/05/2011 04:04 PM	NA	JRT
Simazine	0.004	mg/L	ND	U	EPA525.2	0.0002	0.00015	08/10/2011 01:05 AM	08/01/2011	JRT
Di(2-ethylhexyl)phthalate	0.006	mg/L	ND	U	EPA525.2	0.003	0.001	08/10/2011 01:05 AM	08/01/2011	JRT
Picloram	0.5	mg/L	ND	U	EPA515 1	0.00022	0.0001	08/09/2011 10:37 AM	08/01/2011	JRT
Dinoseb	0.007	mg/L	ND	U	EPA515.1	0.00044	0.0003	08/09/2011 10:37 AM	08/01/2011	JRT
Hexachlorocyclopentadiene	0.05	mg/L	ND	U	EPA525.2	0.00022	0.0002	08/10/2011 01:05 AM	08/01/2011	JRT
Carbofuran	0.04	mg/L	ND	U	EPA531.2	0 003	0.0007	08/05/2011 04:04 PM	NA	JRT
Atrazine	0.003	mg/L	ND	U	EPA525.2	0.00022	0.0002	08/10/2011 01:05 AM	08/01/2011	JRT
Alachlor	0.002	mg/L	ND	U	EPA525.2	0 00044	0.0002	08/10/2011 01:05 AM	08/01/2011	JRT
Heptachlor	0.0004	mg/L	ND	U	EPA508	0 000088	0.00005	08/06/2011 12:00 AM	07/27/2011	JRT
Heptachlor Epoxide	0.0002	mg/L	ND	U	EPA508	0.000044	0.00001	08/06/2011 12:00 AM	07/27/2011	JRT
2,4 - D	0.07	mg/L	ND	U	EPA515.1	0.00022	0.0001	08/09/2011 10:37 AM	08/01/2011	JRT
2,4,5 - TP (Silvex)	0.05	mg/L	ND	U	EPA515 1	0 00044	0.0003	08/09/2011 10:37 AM	08/01/2011	JRT
Hexachlorbenzene	0.001	mg/L	ND	U	EPA525.2	0.00022	0.0001	08/10/2011 01:05 AM	08/01/2011	JRT

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ENVIRONMENTAL TECHNOLOGIES, INC.

Analytical Laboratories

Safe Drinking Water Program Laboratory Reporting Form

August 22, 2011

Client: Reliance Laboratories, Inc
Address: Benedum Industrial Park
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Date Collected: 07/21/2011
Date Received: 07/22/2011
Project #: 163512-2011-DW
Client ID #: 163512
Laboratory ID #: 1114942-01
Matrix: Drinking Water

Parameter	MCL	Units	Results	Qualifier	Method	PQL	MDL	Date of Analysis	Extraction Date	Analyst
Benzo(a) pyrene	0.0002	mg/L	ND	U	EPA525.2	0.0001	0.0001	08/10/2011 01:05 AM	08/01/2011	JRT
Pentachlorophenol	0.001	mg/L	ND	U	EPA515.1	0.000088	0.00008	08/09/2011 10:37 AM	08/01/2011	JRT
Aroclor - 1221	0.0005	mg/L	ND	U	EPA508	0.0002	0.00008	08/06/2011 12:00 AM	07/27/2011	JRT
Aroclor - 1232	0.0005	mg/L	ND	U	EPA508	0.0001	0.00003	08/06/2011 12:00 AM	07/27/2011	JRT
Aroclor - 1242	0.0005	mg/L	ND	U	EPA508	0.0001	0.00005	08/06/2011 12:00 AM	07/27/2011	JRT
Aroclor - 1248	0.0005	mg/L	ND	U	EPA508	0.0001	0.00007	08/06/2011 12:00 AM	07/27/2011	JRT
Aroclor - 1016	0.0005	mg/L	ND	U	EPA508	0.0001	0.00003	08/06/2011 12:00 AM	07/27/2011	JRT
Aroclor - 1254	0.0005	mg/L	ND	U	EPA508	0.0001	0.00005	08/06/2011 12:00 AM	07/27/2011	JRT
Aroclor - 1260	0.0005	mg/L	ND	U	EPA508	0.0001	0.00002	08/06/2011 12:00 AM	07/27/2011	JRT
1,2-Dibromo-3-chloropropane	0.0002	mg/L	ND	U	EPA504.1	0.00004	0.00003	08/05/2011 04:06 PM	08/01/2011	JRT
Ethylene Dibromide	0.00005	mg/L	ND	U	EPA504.1	0.00002	0.00001	08/05/2011 04:06 PM	08/01/2011	JRT
Chlordane	0.002	mg/L	ND	U	EPA508	0.00044	0.00003	08/06/2011 12:00 AM	07/27/2011	JRT

Summit Environmental Technologies, Inc.
Gross Alpha/Beta
QC Report

Batch ID 458

	Gross Alpha %Rec.	%RPD	Gross Beta %Rec.	%RPD
Blank	<3pci/l		<4pci/l	
LCS	81.3		98	
LCSD	104.7	24.6	108.5	10
MS	117.3		84.0	
Sample/ Sample DUP		0		11.8

Summit Environmental Technologies, Inc.
Method 903.0/9315(Radium-226)
QC Report

Batch ID 505

		%Rec.	%RPD
Blank	<1pci/l		
LCS		74.4	
MS		109.2	
Sample/ Sample DUP			0.0

Summit Environmental Technologies, Inc.
Method 904.0/9320(Radium-228)
QC Report

Batch ID 504

		%Rec.	%RPD
Blank	<1pci/l		
LCS		71.2	
MS		80.4	
Sample/ Sample DUP			13.7

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ENVIRONMENTAL TECHNOLOGIES, INC.
Analytical Laboratories

LABORATORY REPORT

Client
Reliance Laboratories, Inc
Benedum Industrial Park
Bridgeport, WV 26330

Order Number
1114941

Project Number
163513-2011-DW

Issued
Monday, August 22, 2011

Total Number of Pages
6 (excluding C.O.C. and cooler receipt form)

Approved By : R S Gibas
QA Manager

NELAC Accreditation #E87688

Sample Summary

Client: Reliance Laboratories, Inc
Order Number: 1114941

Laboratory ID	Client ID	Matrix	Sampling Date
1114941-01	163513	Drinking Water	07/21/2011

Report Narrative

Client: Reliance Laboratories, Inc
Order Number: 1114941

No problems were encountered during analysis of this order number, except as noted.

Data Qualifiers:
B = Analyte found in the method blank
J = Estimated concentration of analyte between MDL (LOD) and Reporting Limit (LOQ)
C = Analyte has been confirmed by another instrument or method
E = Analyte exceeds the upper limit of the calibration curve
D = Sample or extract was analyzed at a higher dilution
X = User defined data qualifier.
S = Surrogate out of control limits
U = Undetected
a = Not Accredited by NELAC

ND = Non Detected at LOQ
DF = Dilution Factor

Limit Of Quantitation (LOQ) = Laboratory Reporting Limit (not adjusted for dilution factor)
Limit Of Detection (LOD) = Laboratory Detection Limit

Matrices:
A = Air
C = Cream
DW = Drinking Water
L = Liquid
O = Oil
SL = Sludge
SO = Soil
S = Solid
T = Tablet
TC = TCLP Extract
WW = Waste Water
W = Wipe

Estimated uncertainty values are available upon request.

SUMMIT
ENVIRONMENTAL TECHNOLOGIES, INC.
Analytical Laboratories

August 22, 2011

Client: Reliance Laboratories, Inc
Address: Benedum Industrial Park
Bridgeport, WV 26330

Received: 07/22/2011
Project #: 163513-2011-DW

Client ID#	Lab ID#	Collected	Analyte	Result	Units	Matrix	Method	DF	LOQ	Run	Analyst
163513	1114941-01	21-Jul-11	Gross Alpha	6.42 +/- 3.1	pci/l	DW	900.0	1	3	27-Jul-11	MO

Client ID#	Lab ID#	Collected	Analyte	Result	Units	Matrix	Method	DF	LOQ	Run	Analyst
163513	1114941-01	21-Jul-11	Radium-226	U +/- 0.09	pci/l	DW	903.0	1	1	01-Aug-11	MO

Client ID#	Lab ID#	Collected	Analyte	Result	Units	Matrix	Method	DF	LOQ	Run	Analyst
163513	1114941-01	21-Jul-11	Radium-228	1.4 +/- 0.45	pci/l	DW	904.0	1	1	01-Aug-11	MO

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ENVIRONMENTAL TECHNOLOGIES, INC.

Analytical Laboratories

Safe Drinking Water Program Laboratory Reporting Form

August 22, 2011

Client: Reliance Laboratories, Inc
Address: Benedum Industrial Park
Bridgeport, WV 26330

Date Collected: 07/21/2011
Date Received: 07/22/2011
Project #: 163513-2011-DW
Client ID #: 163513
Laboratory ID #: 1114941-01
Matrix: Drinking Water

Parameter	MCL	Units	Results	Qualifier	Method	PQL	MDL	Date of Analysis	Extraction Date	Analyst
Endrin	0.002	mg/L	ND	U	EPA508	0.000022	0.00002	08/19/2011 12:00 AM	07/27/2011	JRT
Lindane	0.0002	mg/L	ND	U	EPA508	0 000044	0.00002	08/19/2011 12:00 AM	07/27/2011	JRT
Methoxychlor	0.04	mg/L	ND	U	EPA508	0.000022	0.00002	08/19/2011 12:00 AM	07/27/2011	JRT
Toxaphene	0.003	mg/L	ND	U	EPA508	0 0022	0.0007	08/19/2011 12:00 AM	07/27/2011	JRT
Dalapon	0.2	mg/L	ND	U	EPA515.1	0 0022	0.0007	08/09/2011 10:02 AM	08/01/2011	JRT
Di(2-ethylhexyl)adipate	0.4	mg/L	ND	U	EPA525.2	0.0013	0.0004	08/09/2011 12:38 AM	08/01/2011	JRT
Oxamyl	0.2	mg/L	ND	U	EPA531.2	0.0044	0.0006	08/05/2011 03:07 PM	NA	JRT
Simazine	0.004	mg/L	ND	U	EPA525.2	0.0002	0.00015	08/09/2011 12:38 AM	08/01/2011	JRT
Di(2-ethylhexyl)phthalate	0.006	mg/L	ND	U	EPA525.2	0 003	0.001	08/09/2011 12:38 AM	08/01/2011	JRT
Picloram	0.5	mg/L	ND	U	EPA515.1	0.00022	0.0001	08/09/2011 10:02 AM	08/01/2011	JRT
Dinoseb	0.007	mg/L	ND	U	EPA515.1	0 00044	0.0003	08/09/2011 10:02 AM	08/01/2011	JRT
Hexachlorocyclopentadiene	0.05	mg/L	ND	U	EPA525.2	0.00022	0.0002	08/09/2011 12:38 AM	08/01/2011	JRT
Carbofuran	0.04	mg/L	ND	U	EPA531.2	0 003	0.0007	08/05/2011 03:07 PM	NA	JRT
Atrazine	0.003	mg/L	ND	U	EPA525.2	0.00022	0.0002	08/09/2011 12:38 AM	08/01/2011	JRT
Alachlor	0.002	mg/L	ND	U	EPA525.2	0.00044	0.0002	08/09/2011 12:38 AM	08/01/2011	JRT
Heptachlor	0.0004	mg/L	ND	U	EPA508	0.000088	0.00005	08/19/2011 12:00 AM	07/27/2011	JRT
Heptachlor Epoxide	0.0002	mg/L	ND	U	EPA508	0.000044	0.00001	08/19/2011 12:00 AM	07/27/2011	JRT
2,4 - D	0.07	mg/L	ND	U	EPA515 1	0.00022	0.0001	08/09/2011 10:02 AM	08/01/2011	JRT
2,4,5 - TP (Silvex)	0.05	mg/L	ND	U	EPA515.1	0 00044	0.0003	08/09/2011 10:02 AM	08/01/2011	JRT
Hexachlorbenzene	0.001	mg/L	ND	U	EPA525.2	0.00022	0.0001	08/09/2011 12:38 AM	08/01/2011	JRT

Summit

ENVIRONMENTAL TECHNOLOGIES, INC.

Analytical Laboratories

Safe Drinking Water Program Laboratory Reporting Form

August 22, 2011

Client: Reliance Laboratories, Inc
Address: Benedum Industrial Park
Bridgeport, WV 26330

Date Collected: 07/21/2011
Date Received: 07/22/2011
Project #: 163513-2011-DW
Client ID #: 163513
Laboratory ID #: 1114941-01
Matrix: Drinking Water

Parameter	MCL	Units	Results	Qualifier	Method	PQL	MDL	Date of Analysis	Extraction Date	Analyst
Benzo(a) pyrene	0.0002	mg/L	ND	U	EPA525.2	0.0001	0.0001	08/09/2011 12:38 AM	08/01/2011	JRT
Pentachlorophenol	0.001	mg/L	ND	U	EPA515.1	0.000088	0.00008	08/09/2011 10:02 AM	08/01/2011	JRT
Aroclor - 1221	0.0005	mg/L	ND	U	EPA508	0.0002	0.00008	08/19/2011 12:00 AM	07/27/2011	JRT
Aroclor - 1232	0.0005	mg/L	ND	U	EPA508	0.0001	0.00003	08/19/2011 12:00 AM	07/27/2011	JRT
Aroclor - 1242	0.0005	mg/L	ND	U	EPA508	0 0001	0.00005	08/19/2011 12:00 AM	07/27/2011	JRT
Aroclor - 1248	0.0005	mg/L	ND	U	EPA508	0.0001	0.00007	08/19/2011 12:00 AM	07/27/2011	JRT
Aroclor - 1016	0.0005	mg/L	ND	U	EPA508	0.0001	0.00003	08/19/2011 12:00 AM	07/27/2011	JRT
Aroclor - 1254	0.0005	mg/L	ND	U	EPA508	0.0001	0.00005	08/19/2011 12:00 AM	07/27/2011	JRT
Aroclor - 1260	0.0005	mg/L	ND	U	EPA508	0 0001	0.00002	08/19/2011 12:00 AM	07/27/2011	JRT
1,2-Dibromo-3-chloropropane	0.0002	mg/L	ND	U	EPA504.1	0.00004	0.00003	08/05/2011 03:21 PM	08/01/2011	JRT
Ethylene Dibromide	0.00005	mg/L	ND	U	EPA504.1	0.00002	0.00001	08/05/2011 03:21 PM	08/01/2011	JRT
Chlordane	0.002	mg/L	ND	U	EPA508	0.00044	0.00003	08/19/2011 12:00 AM	07/27/2011	JRT

Summit Environmental Technologies, Inc.
Gross Alpha/Beta
QC Report

Batch ID 457

	Gross Alpha %Rec.	Gross Alpha %RPD	Gross Beta %Rec.	Gross Beta %RPD
Blank	<3pci/l		<4pci/l	
LCS	77.3		91.5	
LCSD	76.7	0.8	86.8	5.3
MS	116.0		92.0	
Sample/ Sample DUP		0		0.5

Summit Environmental Technologies, Inc.
Method 903.0/9315(Radium-226)
QC Report

Batch ID 505

		%Rec.	%RPD
Blank	<1pci/l		
LCS		74.4	
MS		109.2	
Sample/ Sample DUP			0.0

Summit Environmental Technologies, Inc.
Method 904.0/9320(Radium-228)
QC Report

Batch ID 504

		%Rec.	%RPD
Blank	<1pci/l		
LCS		71.2	
MS		80.4	
Sample/ Sample DUP			13.7