Appendix J

Opsitnick (2015): Reservoir quality of the Marcellus Shale Play in the Hill Unit 2H and 3H wells: Determining mineralogical and lithological properties

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I hereby acknowledge that I have fulfilled my responsibilities, as defined by the Honor Code, and maintained the integrity of both myself and the college community as a whole.

Alexandra M. Opsitnick

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List of Acronyms and Abbreviations

PaGS- Pennsylvania Geological Survey

USGS- United States Geological Survey

XRD- X-ray Diffraction

MMBbl- Million Barrels

GR- Gamma Ray

PE- Photoelectric Effect

NP- Neutron Porosity

DP- Density Porosity

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ABSTRACT

The Marcellus Formation is a valuable shale gas resource in Pennsylvania. In the southwest region of the state (particularly Washington and Greene counties), shale gas drilling and hydraulic fracturing are common. Recently, two wells were drilled in Washington County by Antero Resources, the Hill Unit 2H (API# 37-125-23880) and the Hill Unit 3H (API# 37-125-23879). The purpose of this study was to examine the lithology and the mineralogy of the Marcellus Formation in the 2H and the 3H wells using rock cuttings samples and geophysical well log data. Rock cutting samples from the vertical and lateral portions of the two wells were collected and evaluated for mineralogical content using XRD analysis. In addition, both wells are compared for similarities in lithological compositions based on geophysical well log interpretation.

Ideal properties for the Marcellus Formation need to consist of greater than 40% quartz and carbonates, and less than 30% clays. The Marcellus shale in the 3H well is more abundant in quartz and carbonate content, in both the vertical and lateral portions, than the 2H well. In addition, the clay mineral content in the 3H well lies at, or below, 30% in lateral portion of the Marcellus shale. The 2H well contains greater than 40% clay minerals, less than 10% carbonates, and roughly 50% quartz. The mineral percentages of the vertical and lateral depths of both wells suggest that the 2H resides in the Upper Marcellus while the 3H resides in the Lower Marcellus.

A geophysical log was only available for the 3H well. However both wells were drilled on the same well pad. If both wells contain a similar mineralogy, then the location of each formation in the 2H well will be roughly the same as the 3H well. Both wells show a similar relationship between mineralogy and depth as well as a relationship between mineralogy and lateral depth. Based on geophysical log interpretation, the Marcellus shale in the 3H well lies roughly 7,815 feet below the ground surface. The Marcellus shale displays a high gamma ray curve as well as a low density porosity and neutron porosity curve. The photoelectric curve ranges between 3 and 4, indicating a shale bed. Although the 3H well lies within the preferred mineralogy range for quartz, clay minerals, and carbonates, more work needs to be performed to further assess the reservoir quality of both wells.

1.0 Introduction

1.1 History of Shale Gas in Pennsylvania

Pennsylvania has a long history of oil and gas exploration and production. In 1859, the oil and gas industry began in Titusville, when Colonel Edwin Drake drilled a well to 69.5 feet and struck oil (Harper, 1998). Following this well's completion, the industry improving the technologies and methods of drilling as they went (Harper, 1998). Over the decades, the industry drilled both oil and gas wells in much of western Pennsylvania. These wells produced from a myriad of reservoirs, although the most popular (and prolific) were shallow Upper Devonian Venango and Bradford Group sandstones, and deep Lower Devonian Oriskany Sandstone wells (Harper, 2008). In 1939, companies drilled down to the Oriskany sandstone and discovered large quantities of natural gas (Harper, 2008). The gas originated from the Marcellus Formation, an organic-rich shale that was tens to hundreds of feet above the Oriskany (Harper, 2008). In these early days of oil and gas development, the occurrence of natural gas in the Marcellus shale was assumed to be in "pockets" and that flows could not be sustained for any length of time (Harper, 2008).

Oil and gas development in Washington County started in 1881 (Carter, K.M., 2003). Production was mostly limited to conventional, shallow reservoirs in the Upper Devonian Venango Group sands, with some production from the Upper Devonian Murrysville Sandstone, Mississippian Burgoon Sandstone, the Pennsylvanian Conemaugh Group and the Pottsville Formation (PA*IRIS/WIS, accessed January, 2015). Although the Marcellus shale contained natural gas, it was not considered a viable reservoir rock due to its low porosity and permeability characteristics (Carter et al., 2011). In 2004, the Marcellus Formation became a target of drilling activity when Range Resources Corporation (Range) discovered the play after completing the

Renz No. 1 well in Washington County (Carter et al., 2011). Since then, more than 500 Marcellus shale gas wells have been completed in Washington County (PA*IRIS/WIS, accessed January, 2015), and completing the Renz well, drilling activity associated with the Marcellus play has made southwestern Pennsylvania a hub for shale gas production (Carter et al, 2011).

1.2 Petroleum Systems

In a conventional hydrocarbon reservoir model, organic material matures in shale, a source rock for natural gas, and migrates to a porous and permeable reservoir rock (Cooney, 2013; Fig. 1). The reservoir is usually comprised of sandstone or limestone and sealed by an impermeable rock layer (Cooney, 2013). In contrast to this model, the unconventional reservoir model shows that the shale acts as a source, reservoir, trap, and seal in a petroleum system (Laughrey et al., 2014; Fig. 1).

Conventional petroleum systems consist of a source rock, such as an organic-rich shale bed, and a reservoir rock, such as a sandstone or a limestone bed (Harper and Kostelnik, accessed January, 2015; Fig. 1). Natural gas migrates from the source rock to the reservoir rock where it is stored in the pore spaces (Harper and Kostelnik, accessed January, 2015). A fault or unconformity overlies the source rock (Harper and Kostelnik, accessed January, 2015; Fig. 1). A sealant bed, such as a shale or a non-porous limestone bed, overlies faults and unconformities and thus provide a trap situation (Harper and Kostelnik, accessed January, 2015; Fig. 1). The trap keeps petroleum in the reservoir (Harper and Kostelnik, accessed January, 2015; Fig. 1). Organic shale reservoirs in a conventional petroleum system lie above the Tully Limestone and are Late Devonian age (Shultz, 2002). In an unconventional petroleum system, the organic shale bed acts

as a source and reservoir rock, a trap, and a seal (Harper and Kostelnik, accessed January, 2015; Fig. 1). The shale reservoirs underlie the Tully Limestone and are Middle Devonian age and older (Shultz, 2002).

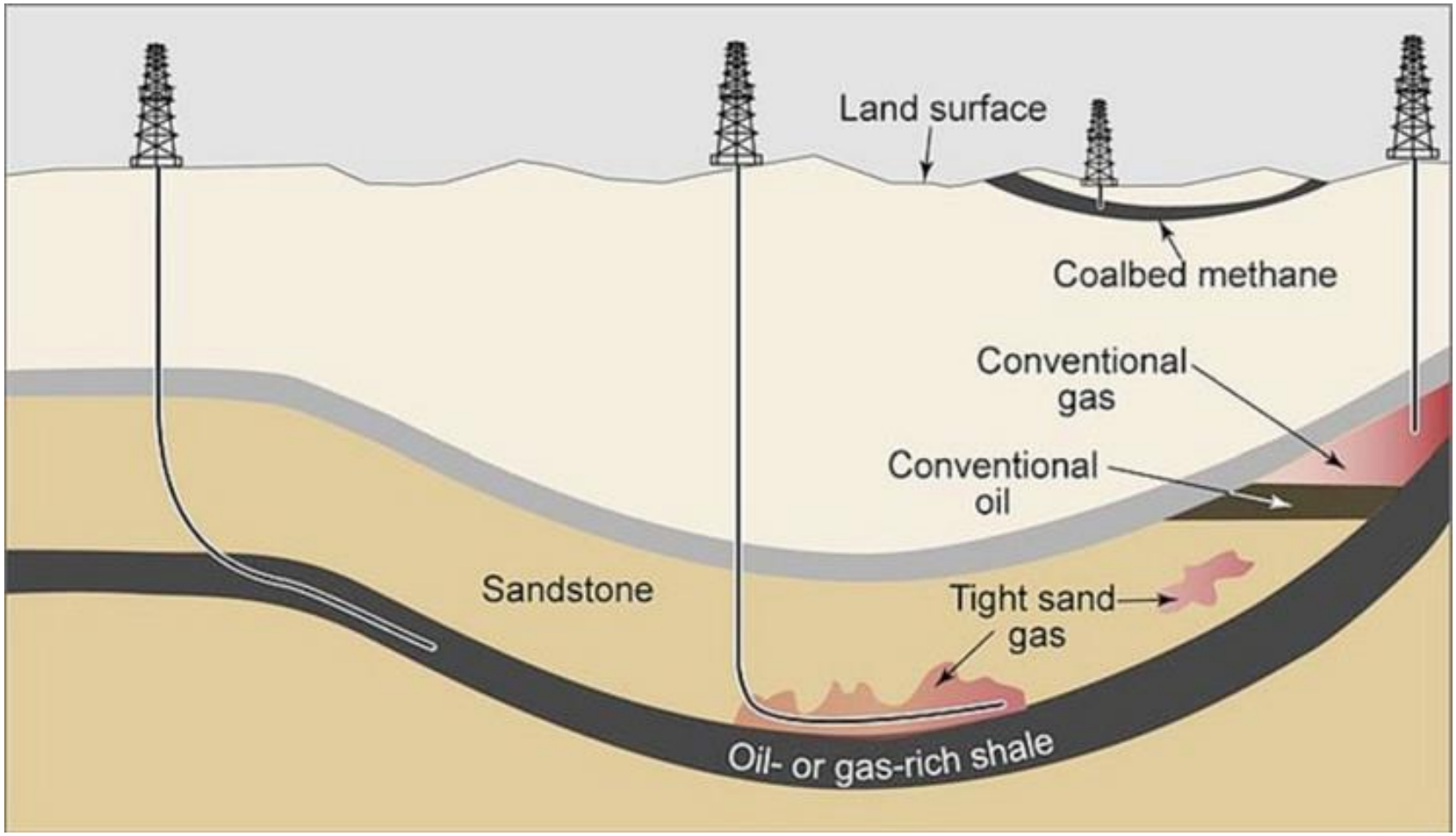

Figure 1: Diagram showing a conventional and an unconventional petroleum system. (Modified from USGS.gov).

1.3 A Significant Resource

The Marcellus Formation extends throughout New York, Pennsylvania, Ohio, West Virginia, Virginia, and eastern Kentucky (Fig. 2). Like most petroleum resources, the Marcellus formed either from continuous authigenic accumulations within Devonian black shale source rocks or within overlying and intertonguing Devonian siltstone and sandstone reservoirs (Milici and Swezy, 2006).

Pennsylvania has two core areas of Marcellus production, the northeast region and the southwest region. Drilling in northeastern Pennsylvania occurs in Bradford, Lycoming, Sullivan, Susquehanna, Tioga, and Wyoming counties (Harper and Kostelnik, accessed January, 2015; Fig. 2). Here, the Marcellus shale is thicker and contains a higher abundance of organic material (Harper and Kostelnik, accessed January, 2015; Fig. 2). In southwestern Pennsylvania, Marcellus production occurs in Allegheny, Armstrong, Beaver, Fayette, Greene, Indiana, Somerset, Washington, and Westmoreland counties (Harper and Kostelnik, accessed January, 2015; Fig. 2). Here, the Marcellus shale generally is less than 50 feet thick and contains a lower abundance in organic matter (Harper and Kostelnik, accessed January, 2015; Fig. 2). For this study, the focus is on Washington County.

Natural gas exploration began in Washington County, Pennsylvania in 1881 (Fig. 2). In 1885, the operators completed three wells that penetrated into Upper Devonian Venango Group sandstones rock units. These wells, however, produced oil instead of natural gas. The Gantz well was the first commercially productive oil well in Washington County. It produced roughly 50 barrels of oil per day from the Venango Group's Gantz sand. The Gordon well was drilled to a depth of 2,408 feet and produced 100 barrels of oil per day. The reservoir was a 16-feet-thick sandstone called the Gordon sand. As a result of the productivity from the Gordon well, there

was an incentive for active oil exploration and development throughout Washington County. The Gabby well drilled to a depth of 2,608 feet and produced oil from the Gordon and Gantz sands after stimulation using nitroglycerin torpedoes (Carter, 2003).

Current drilling activity in Washington County is mostly unconventional and the targeted resource is the Marcellus shale. According the U.S. Geological Survey (USGS), the Marcellus play has a mean undiscovered, technically recoverable natural gas resource potential of 84,198 billion cubic feet (Bcf) and 3,379 million barrels (MMBbl) natural gas liquids (Coleman et al, 2011).

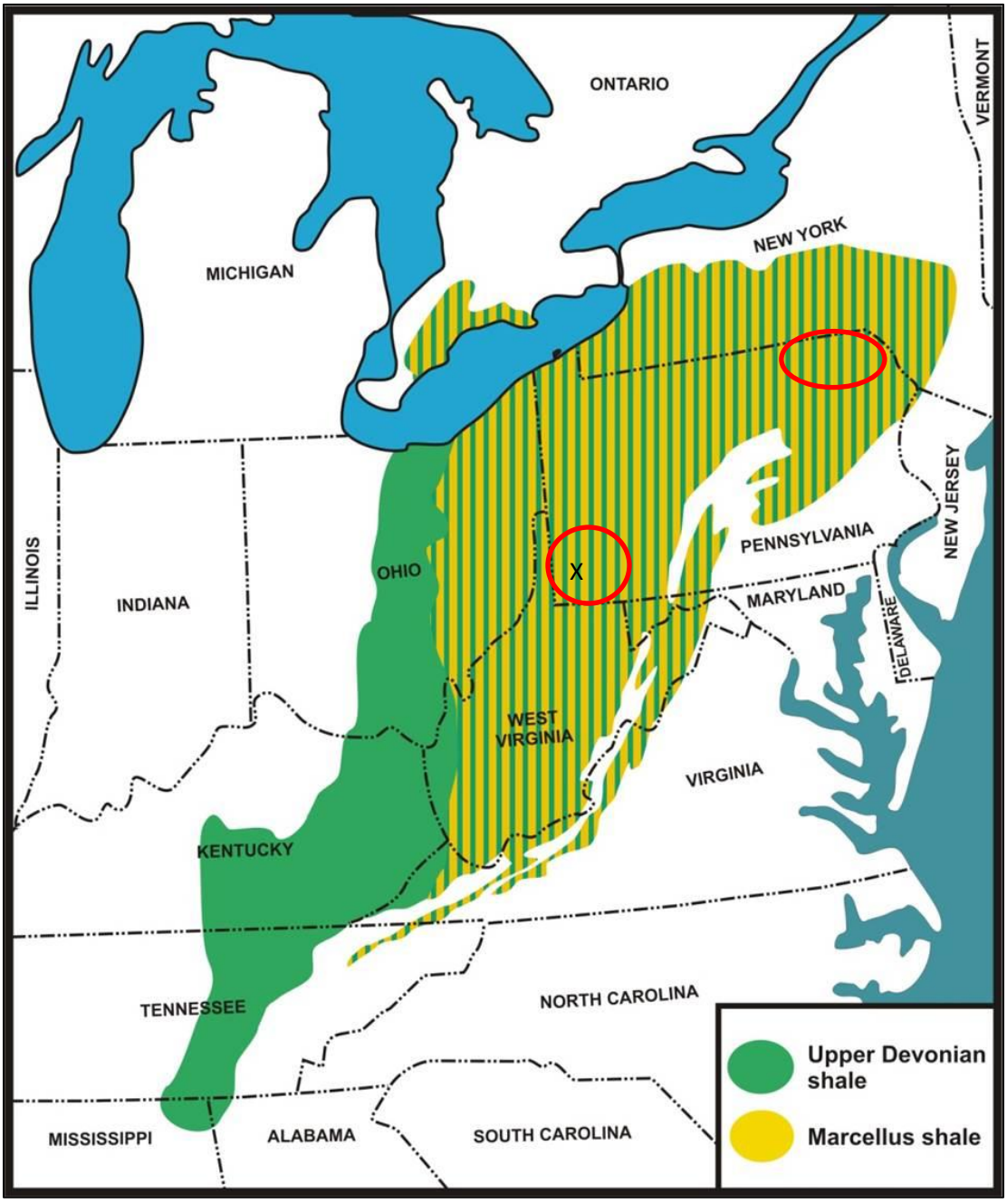

Figure 2: Extent of Devonian formations in the Appalachian basin. The red circles show the core areas of natural gas drilling in Pennsylvania while the X shows the location of Washington County (Modified from Milici and Swezey, 2006).

1.4 Statement of the Problem

Shale gas reservoirs often consist of complex lithological and mineralogical heterogeneities (Cooney, 2013). The amount of petroleum hydrocarbons that occur in Middle Devonian source rocks rely on two factors: 1) the amount of organic matter present in the rocks; and 2) the degree of conversion of the organic matter into petroleum (Harper and Laughrey, 1987). Variations in organic matter quantity in shale source rocks occur due to differences in depositional environments, whereas reservoir quality and production potential, characterized by thermal maturity assessments, may also be affected by shale mineralogy. Within the Marcellus Formation, mineralogy changes both vertically and laterally. These varying mineral compositions lead to differences in geochemical properties (Wang and Carr, 2013) and may affect the reservoir quality and production potential of the Marcellus shale. The industry is interested in the vertical and lateral change in mineralogy of the Marcellus shale, particularly the percentage of quartz, clays, and carbonates (Carter, et al. 2012). A higher abundance of quartz and carbonate content creates a more brittle formation, making the Marcellus shale more amenable to fracturing during stimulation (Cooney, 2013). The mineralogy differs in the Upper Marcellus and Lower Marcellus shale beds (Carter et al., 2011). The Lower Marcellus shale is the preferred shale bed (PA*IRIS/WIS, accessed January 2015).

1.5 Research Objective

The purpose of this study is to describe the mineralogical and lithological characteristics of the Marcellus shale in southwestern Pennsylvania, using geophysical well log data and rock cuttings samples associated with two wells in West Pike Run, Washington County.

2.0 REGIONAL GEOLOGY

The Marcellus Formation is a Devonian shale [415 – 355 Ma] that occurs in Canada, Pennsylvania, West Virginia, eastern Ohio, New York, Maryland, Virginia, and Tennessee (Fig. 2). During the Devonian period, the Tioga ash fall was immediately followed by a rapid subsidence within the foreland basin (Shultz, 2002). Sea level rise resulted in the Kaskaskia sequence and inundated the Appalachian Basin (Prothero and Dott, 2012). This resulted in the deposition of light gray shale and organic-rich black shale (Shultz, 2002). The Middle Devonian epoch ended with the spread of the argillaceous Tully Limestone across much of the Appalachian Basin (Shultz, 2002).

2.1 Lithology and Lithostratigraphy

The Marcellus Formation was named in 1839 by James Hall after a black shale outcrop near the village of Marcellus, New York (Hall, J., 1839). The Marcellus lies at the base of the Hamilton Group which comprises the Tully limestone, Moscow Formation, Ludlowville Formation, and the Skaneateles Formation (Fig. 3, 4). The Tully is a micritic brown to dark brownish-gray, argillaceous limestone that ranges from 20 to 60 feet thick (Harper and Laughrey, 1987). It is an important stratigraphic marker that indicates the boundary between Upper and Middle Devonian formations (Fig. 4). Where present, the Moscow shale underlies the Tully (Fig. 3). Underlying the Moscow shale is the Ludlowville shale (Fig. 3). The Skaneateles shale is bounded between the Ludlowville shale and the Centerfield limestone (Fig. 3). The Marcellus Formation is a black shale ranging from 20 to 70 feet thick in southwestern Pennsylvania (Harper and Laughrey, 1987; Fig. 5). It is organic-rich and serves as the source rock for many reservoirs in the Appalachian Basin. Although the primary lithology of the Marcellus is black shale, it also

consists of dark gray, fissile, carbonaceous shale with locally abundant pyrite, and contains few fossils (Shultz, 2002). In much of Pennsylvania the Marcellus includes a thin limestone (the Cherry Valley or Purcell) roughly three feet thick (Fig. 4). The limestone has been used to divide the formation into two parts, the Upper Marcellus and Lower Marcellus. The dark gray shale and carbonaceous shale makes up the Upper Marcellus while the organic black shale makes up the Lower Marcellus. In this study, geophysical logs were interpreted to determine the lithostratigraphy of the Marcellus shale and overlying Middle Devonian formations.

2.2 Depositional Environments/Paleogeography/Tectonism

The Devonian foreland basin setting was preceded by a prolonged history of during multiple sedimentary basins evolving since the Late Precambrian. Beginning in the Vendian and Cambrian periods, southwestern Pennsylvania was composed of terrigenous, silisiclastic rocks (Prothero and Dott, 2010). Sea level rose during the Sauk transgression sequence during the Vendian and Early Cambrian periods (Prothero and Dott, 2010). This resulted in terrigenous passive margin development followed by a dominance of carbonate passive margin sedimentation (Prothero and Dott, 2010). During the Middle Ordovician, North America collided with an island arc, resulting in the Taconian orogeny and the development of a corresponding foreland basin with Ordovician siliclastic fill (Shultz, 2002).

Devonian foreland basin evolution was the product of collision between North America and the micro continent, Avalonia, causing the Acadian Orogeny and further uplift in what is now central Pennsylvania (Fig. 6; Prothero and Dott, 2010). Terrigenous sediment from the Acadian orogenic belt and organic material from the remains of marine flora and fauna accumulated in the adjacent foreland basin (Prothero and Dott, 2010; Fig. 7). The abundance of organic matter

led to the development of disaerobic and anaerobic conditions (Prothero and Dott, 2010). The accumulation of organic material and anoxic conditions were ideal in the formation of black shale (Fig. 7).

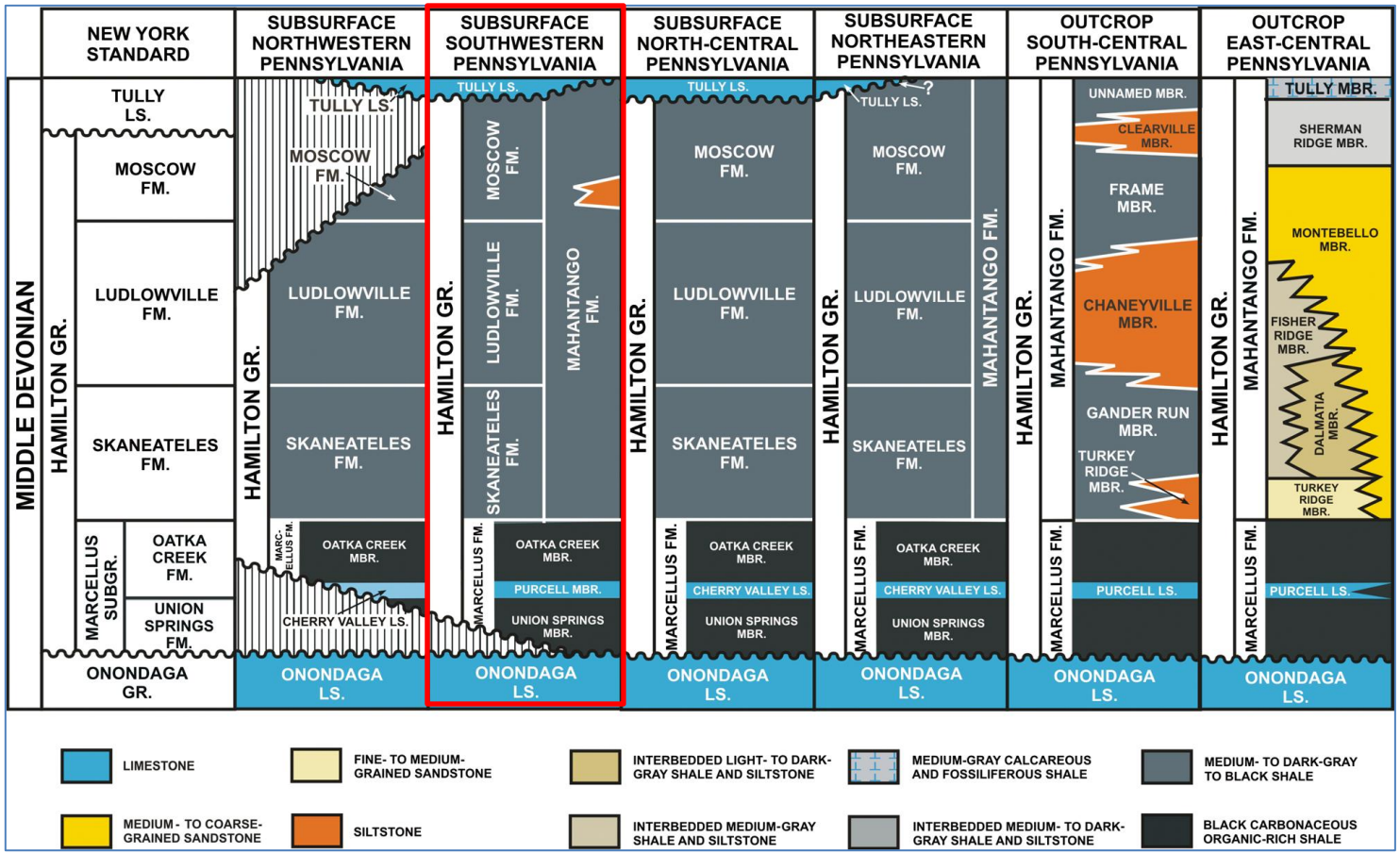

Figure 3: Stratigraphic column showing the correlation of Middle Devonian rocks in Pennsylvania. Note the red box around the section for southwestern Pennsylvania. FM. = Formation; LS. = Limestone; GR. = Group; SUBGR. = Subgroup; MBR. = Member. (Modified from Carter et al., 2011).

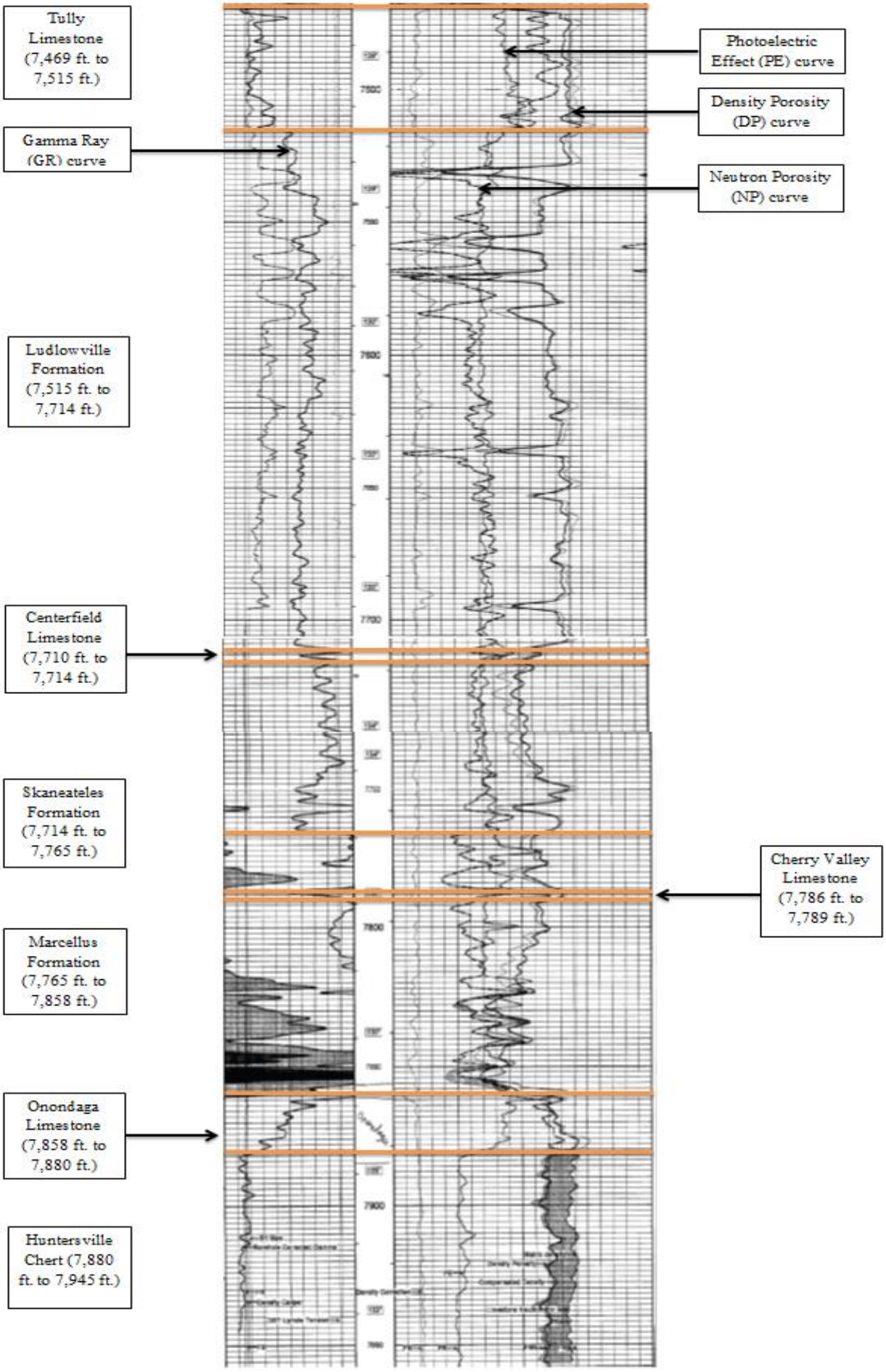

Figure 4: Well log of the Unit Hill 3H well showing the gamma ray curve (left) and the neutron porosity, density porosity, and photoelectric effect curve (right). The orange lines show groups of similar geophysical log signatures as well as the boundaries of individual formations.

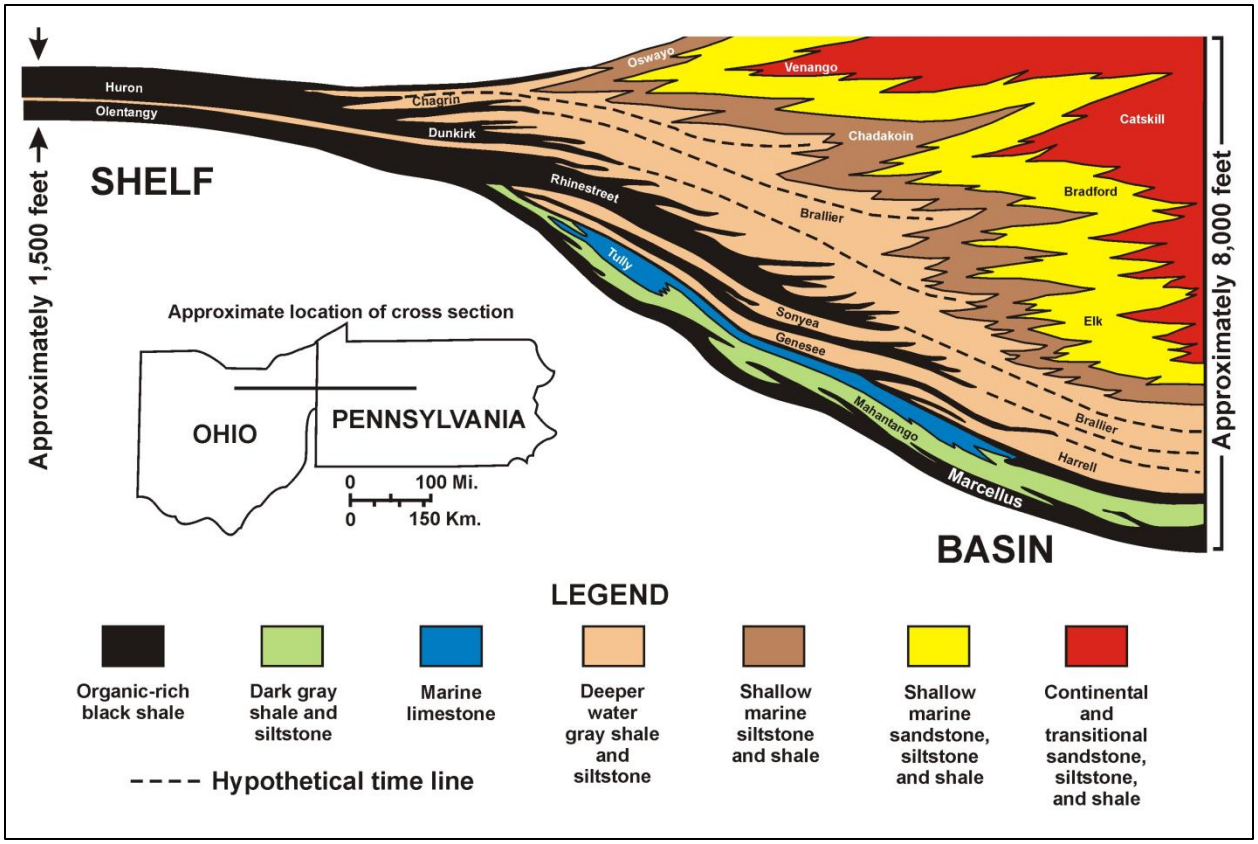

Figure 5: Generalized geologic cross section of western Pennsylvania showing the thickness of the Marcellus and overlying formations. Note how the Marcellus thickens from west to east. (Modified from Harper, 1987).

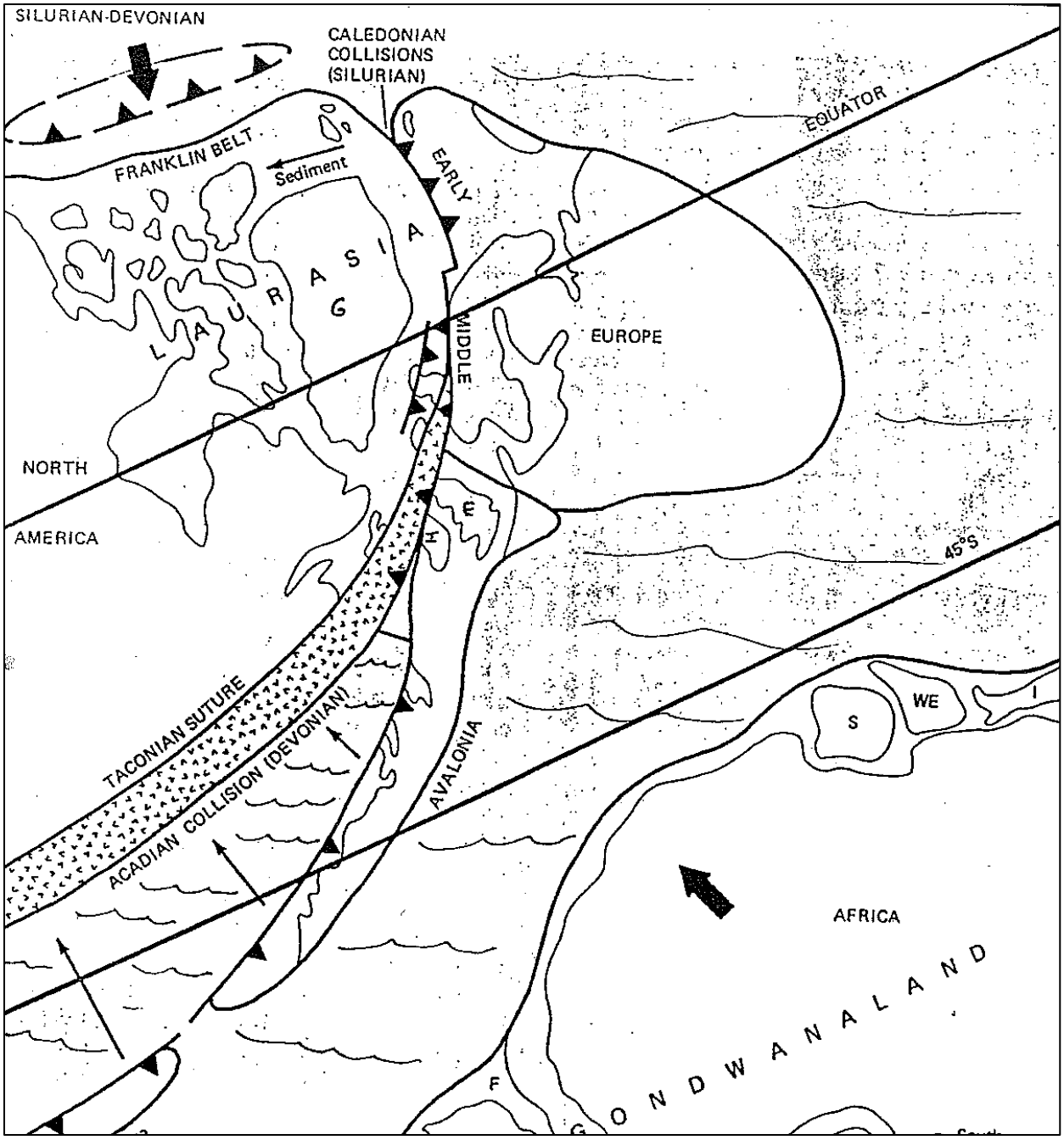

Figure 6: Paleotectonic map showing north to south collisions of North America with Europe and Avalonia during the Devonian period. These collisions caused the Caledonian and Acadian orogenies. Note the approach of the African part of Gondwanaland from the south and a microcontinent from the north. (F: Florida, S: Spain, WE: Western Europe, I: Italy, G: Greenland, E: Europe.) (Modified from Prothero and Dott, 2010).

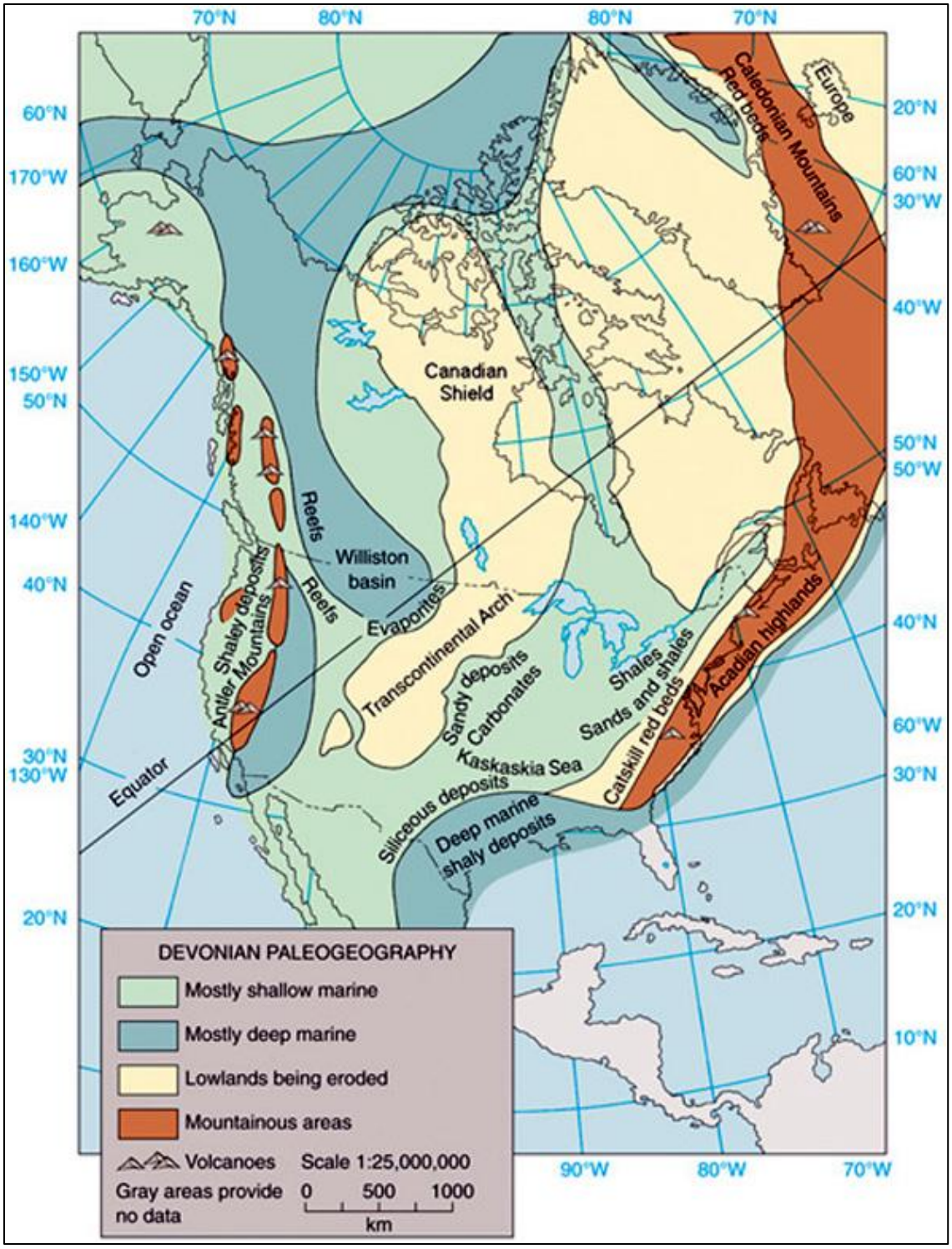

Figure 7: Paleogeographic map of the Devonian period showing the location of North America. Note the location of the Acadian Mountains in eastern North America. (Modified from americanroads.us).

3.0 METHODS

3.1 Geophysical Log Interpretation

Four well log curves aided in interpreting the lithology of the Hill Unit 3H well. These curves are the gamma ray (GR), neutron porosity (NP), density porosity (DP) and photoelectric effect (PE). The gamma ray index measures the natural radioactivity of geologic formations (Asquith and Krygowski, 2004). Rocks containing clay minerals (i.e. shales) tend to have higher GR readings because of the presence of potassium as well as thorium and uranium (Asquith and Krygowski, 2004; Fig. 4). High abundances of organic material are associated with shale while lower abundances correlate with sandstone or limestone rock units (Asquith and Krygowki, 2004; Fig. 4).

Density porosity measures the density of an entire rock formation. These measurements are recorded in grams per cubic centimeter. Density porosity curves evaluate shaly sand reservoirs and complex lithologies. Neutron porosity values measure the hydrogen concentration in a formation. The values vary depending on differences in lithology (e.g. sandstone, limestone, and dolomite) (Asquith and Krygowski, 2004; Fig. 4).

The photoelectric curve helps to determine if the lower gamma ray indices portray sandstone or limestone rock units (Asquith and Krygowski, 2004; Fig. 4). A PE curve of 2.5 indicates silica (e.g. sandstone), shale ranges between 3 and 4, and a curve near 5 indicates limestone (Asquith and Krygowski, 2004: Fig. 4). A geophysical well log was available for the Hill Unit 3H well (API# 37-125-23879), but not for the Hill Unit 2H well (API# 37-125-2388). As a result, lithological interpretations for the Hill Unit 2H well, drilled on the same well pad as the 3H well, are based upon the 3H geophysical log.

3.2 Sample Preparation

Dry well cuttings samples donated to the Pennsylvania Geological Survey (PaGS) by Antero Resources were analyzed for this project (Fig. 8). Cuttings samples taken were from the vertical and lateral sections of the Hill Unit 2H (API# 37-125-23880) and the Hill Unit 3H (API# 37-125-23879) (Fig. 8). For the 2H well, samples for mineralogical analysis were collected and provided at 30 foot intervals by Antero Resources for the vertical portion. The shallowest sample provided by Antero started at 7,200 feet and ended at 8,100 feet below ground surface. For the 3H well, the vertical samples were also provided by Antero Resources and collected at intervals ranging from 10 to 30 feet. Approximately 3.0 grams were measured from each interval, unless sample volumes were limited. In these instances, however, some of the cutting samples were in smaller amounts, so only 2.0-2.5 grams were measured and collected. Overall, 26 samples from the vertical portion of the 2H well, 31 from the 3H well, 5 from the horizontal 2H, and 3 from the horizontal 3H were sampled and evaluated for this work, for a grand total of 65 samples.

Bulk mineralogy samples were ground with a mortar and pestle until they reached the consistency of talcum powder and placed in clean sample bags for transport to the Middletown office of the PaGS (Fig. 9).

3.3 Mineralogical Analysis

Standard X-ray powder diffraction (XRD) techniques were used to determine bulk mineralogy of each cuttings sample prepared for this work. The analyses were run by John Barnes using a PANalytical Empyrean X-ray diffractometer (Fig. 10). X-ray scanning was performed between November 18, 2014 and December 8, 2014. For this study, the Rietveld method was used to

analyze the mineralogy of the rock cutting samples. The Rietveld considers the preferred orientation, cleavage and crystallinity of the minerals (Rietveld, 1967). Rietveld calculations were used to obtain a more reasonable estimate, rounded to the nearest tenth of a percent. In order to check for errors using the Rietveld method, the samples were first run automatically and then run manually.

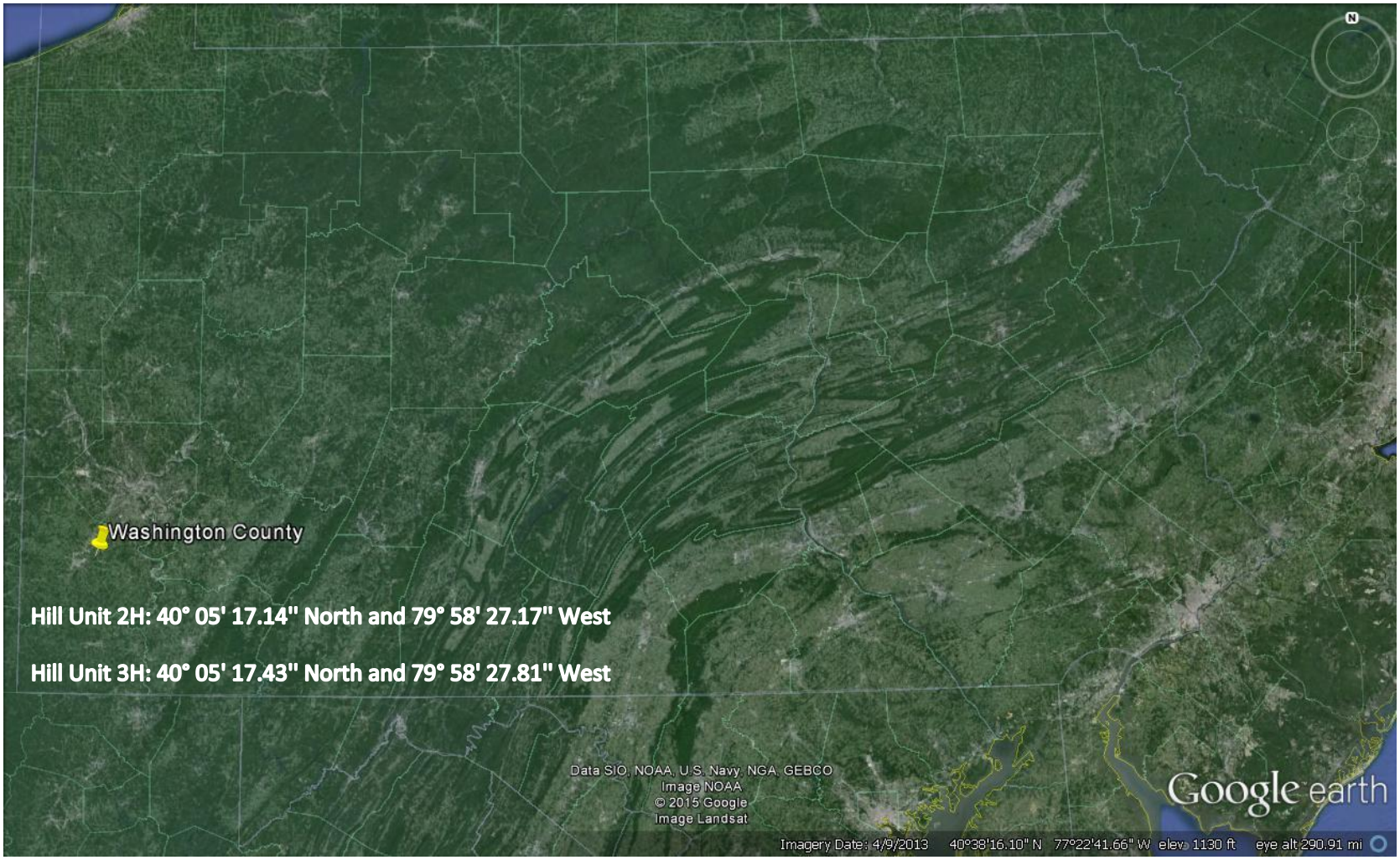

Figure 8: Google Earth image showing the location of Washington County where the 2H and 3H wells were drilled. (Modified in Google Earth)

Figure 9: Image of a PANalytical EMPYREAN X-ray diffraction machine. (Modified from http://www.panalytical.com/Empyrean.htm).

3.3 Possible Errors

3.3.1 Preferred Orientation

The preferred orientation of mineral grains, especially platy minerals, depends primarily on the grinding and method used to pack the samples into the sample holder (Chung, 1974). All samples for this study were ground to the equivalent of talcum powder. Each one was loaded into the sample holder using a method called back-packing where they are packed into a cavity, turned over in the device, and then removed from the bottom of the cavity. The surface exposed to the X-ray beam is the same surface as the bottom surface during sample packing. This makes a smoother surface and prevents pushing down on the X-rayed surface. If preferred orientation is not accounted for in the calculations, then higher percentages will result for minerals with perfect cleavage (i.e., muscovite) and lower for minerals with fractures (i.e., quartz) (Chung, 1974). By using the Rietveld calculations, the entire pattern for the mineral and not just the prominent peaks that are most affected by preferred orientation (Rietveld, 1967).

3.3.2 Sample Mixing

Grinding samples using a mortar and pestle mixes the clays, carbonates, and minerals. Inadequate mixing affects the bulk mineralogy results when a harder mineral over- or under-represented based on whether large grains of it are present on the X-rayed surface. This also occurs when a harder mineral is buried under finer minerals (Chung, 1974; Barnes, personal communication, January 2015). According to John Barnes (personal communication, January 2015), the samples were adequately mixed; therefore, any errors pertaining to sample mixing should be considered minuscule.

3.3.3 Crystallinity

Crystallinity is another variable that can affect mineralogy, particularly when platy minerals are evaluated using RIR calculations (Chung, 1974). For muscovite there are many polytypes and when mixed in with chlorite, feldspar, and quartz, it is difficult to know which polytype is present (Chung, 1974). The results also differ depending on the polytype used for muscovite. When analyzing platy minerals, the Rietveld method was used to calculate their percentages (Chung, 1974). The results are less dependent on muscovite polytypes (Chung, 1974).

3.3.4 Three Repeated Sections

Three sample analyses were replicated for this study, all of which were from the vertical section of the 2H well. The intervals were at 7,200, 7,230 and 7,260 feet (appendices). This was done to see if there were any changes that needed to be incorporated to the affected results. Out of the three replicated samples, only one was changed intentionally. The X-ray optics was changed to reduce a high background that was appearing at the start of each scan. Any other changes pertained to the packing of each sample.

4.0 RESULTS

4.1 Lithostratigraphy

The Marcellus shale is a black organic-rich shale that ranges from 20-70 feet thick in southwestern Pennsylvania and greater than 150 feet in northwestern Pennsylvania (Harper and Kostelnik, accessed January, 2015). Based on the geophysical well log for the Hill Unit 3H (API# 37-125-23879), the top of the Marcellus starts at 7,765 feet below the ground surface and the base reaches a depth of 7,858 feet (Fig. 4). The Marcellus shale is 93 feet thick. This interval is characterized by low neutron and low density porosity values as well as high gamma ray readings (Fig. 4). The PE curve ranges between 3 and 4, indicating a shale bed (Fig. 4).

Well log data for the Hill Unit 2H well (API# 37-125-3880) was not available for this study. The interpreted location of the Marcellus shale in the 3H well can be applied to the 2H since both wells are on the same well pad. In addition, the Tully Limestone, Ludlowville Formation, Skaneateles Formation, Centerfield Limestone, and the Onondaga Limestone will have correspondingly similar depths.

4.2 Mineralogy

Mineralogical results for the 65 samples evaluated by this study are presented below. Full analytical results are provided in Appendices A, B, C, and D.

4.2.1 Vertical Sections

Based upon the bulk mineralogy results (Appendix A, C), the vertical portions of both Antero wells have a similar mineralogy. In addition, the data shows that mineralogy varies with depth (Fig. 10, 11). Average percent, range, and standard deviation values for both wells were

calculated. The percent averages for the 2H well are 40% quartz, 43% clay minerals, and 17% carbonates (Appendix A). For the vertical portion of the 3H well, the average percent of total mineralogy amounted to 45% quartz, 41% clay minerals, and 14% carbonates (Appendix C). Both wells contain a low abundance of carbonates and a high abundance of quartz and clay minerals (Fig. 11; Appendix A, C).

4.2.2 Lateral Sections

The lateral portion of the 2H well displays an increase in quartz and clays with increasing measured depth (Fig. 12). The carbonate values, however, decrease with increasing measured depth (Fig. 12). Average values for quartz, clay minerals, and carbonates content are 36%, 43%, and 21% respectively (Appendix B). In the lateral portion of the 3H well, the abundance of quartz and clays decrease with increasing measured depth while the percentage of carbonates increases (Fig. 13). The calculated average percent of total mineralogy for quartz, clay minerals, and carbonates was 54%, 25%, and 21% respectively (Appendix D). There is also a relationship between mineral percentage and lateral depth (Fig. 13). These lateral section results suggest that the 2H well may be completed in the upper Marcellus horizon while the 3H well is in the lower Marcellus horizon.

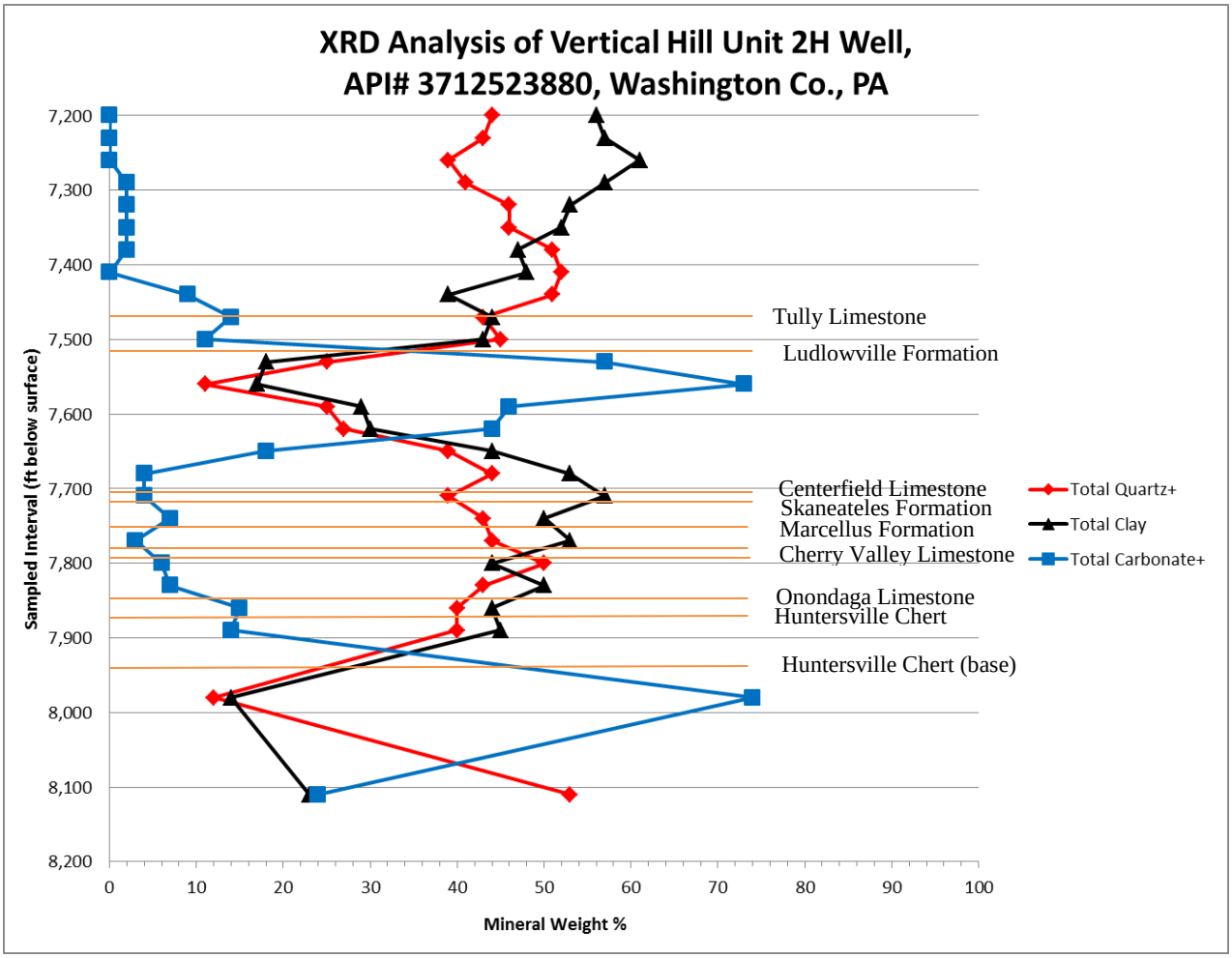

Figure 10: Graph showing the tops of each formation and the base of the Huntersville Chert in the vertical 2H well. Note how the quartz carbonate, and clay mineral content varies with depth.

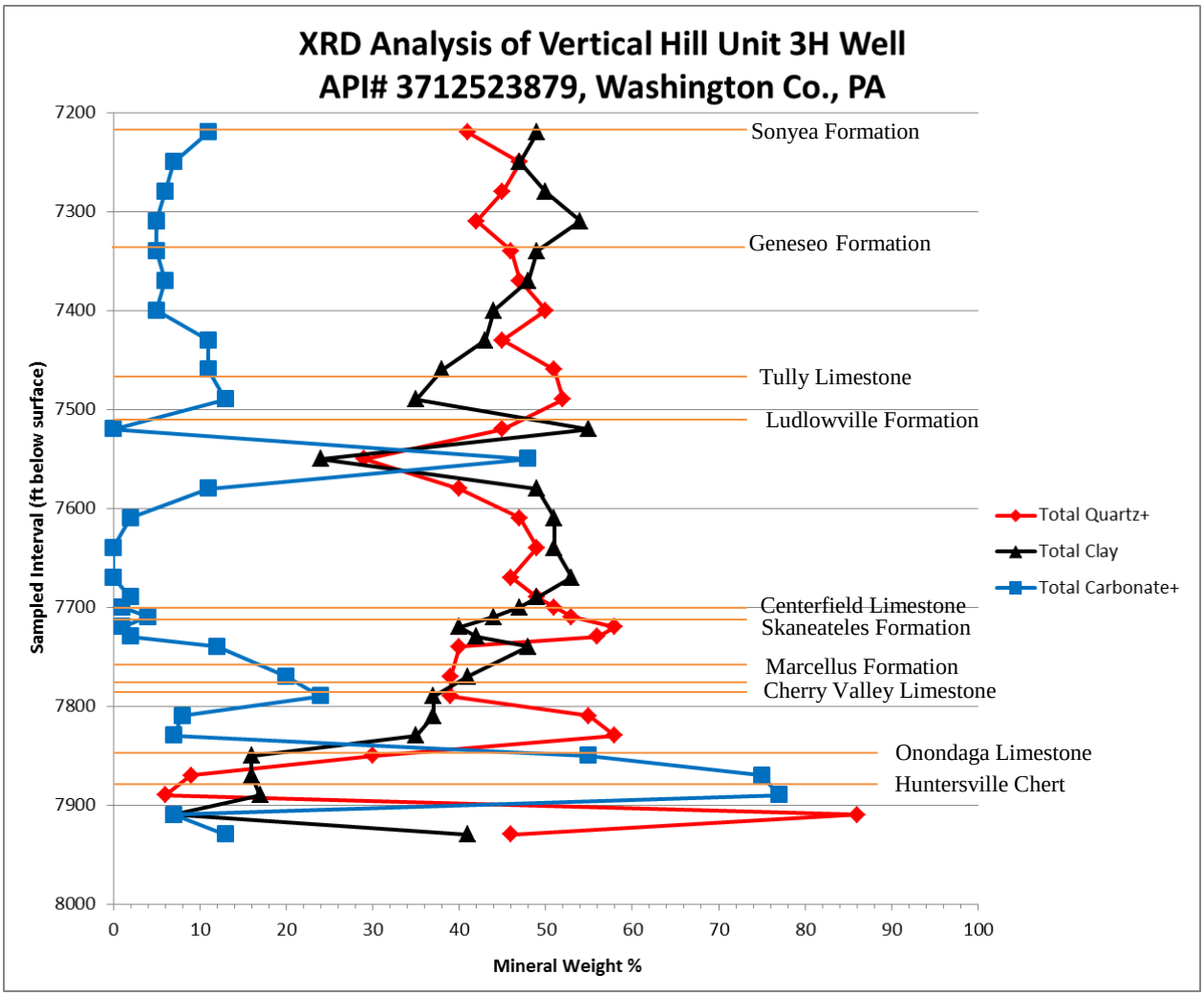

Figure 11: Graph showing the tops of the Tully Limestone through the Huntersville Chert in the vertical 3H well. Note how the quartz, carbonate, and clay mineral content varies with depth.

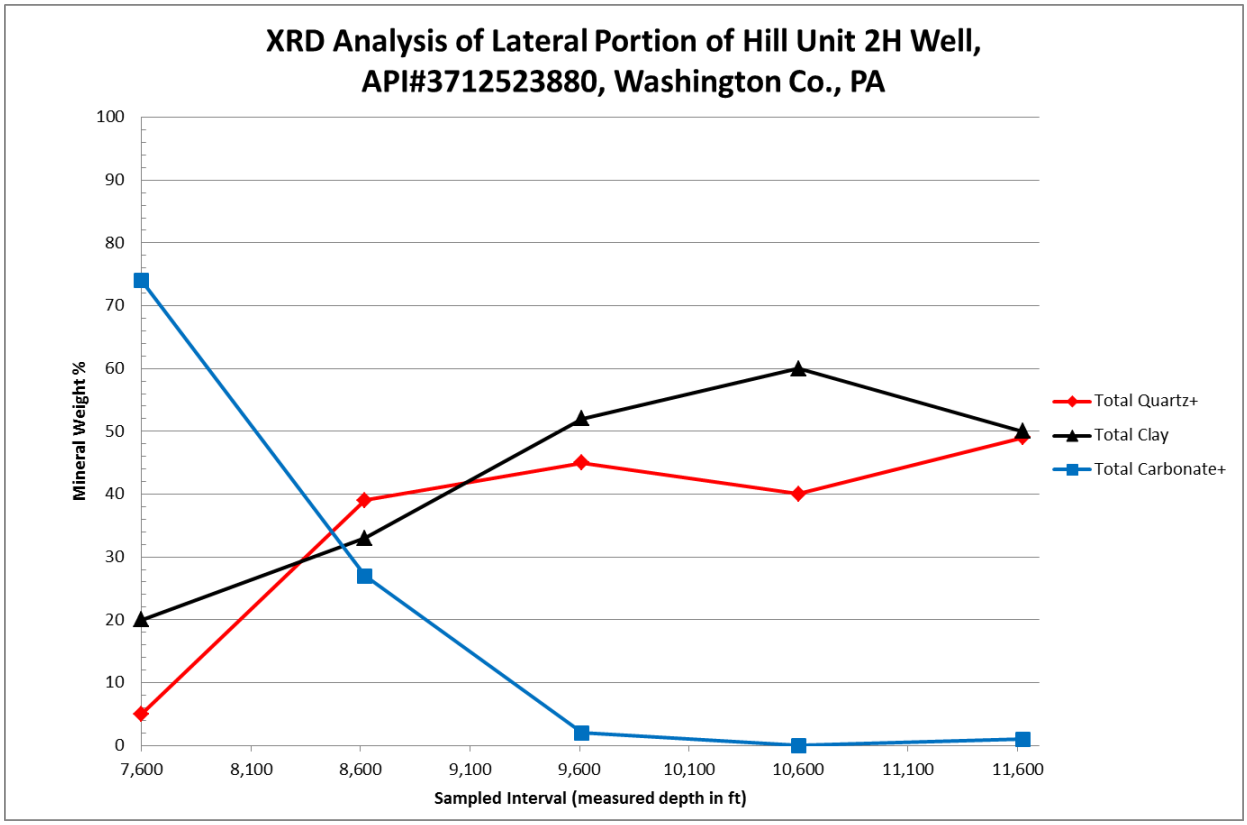

Figure 12: Graph showing the quartz, clay, and carbonate content in the lateral portion of the 2H well. Note how the samples at 7,600 feet are in the curve for this well. The mineralogy varies with lateral distance.

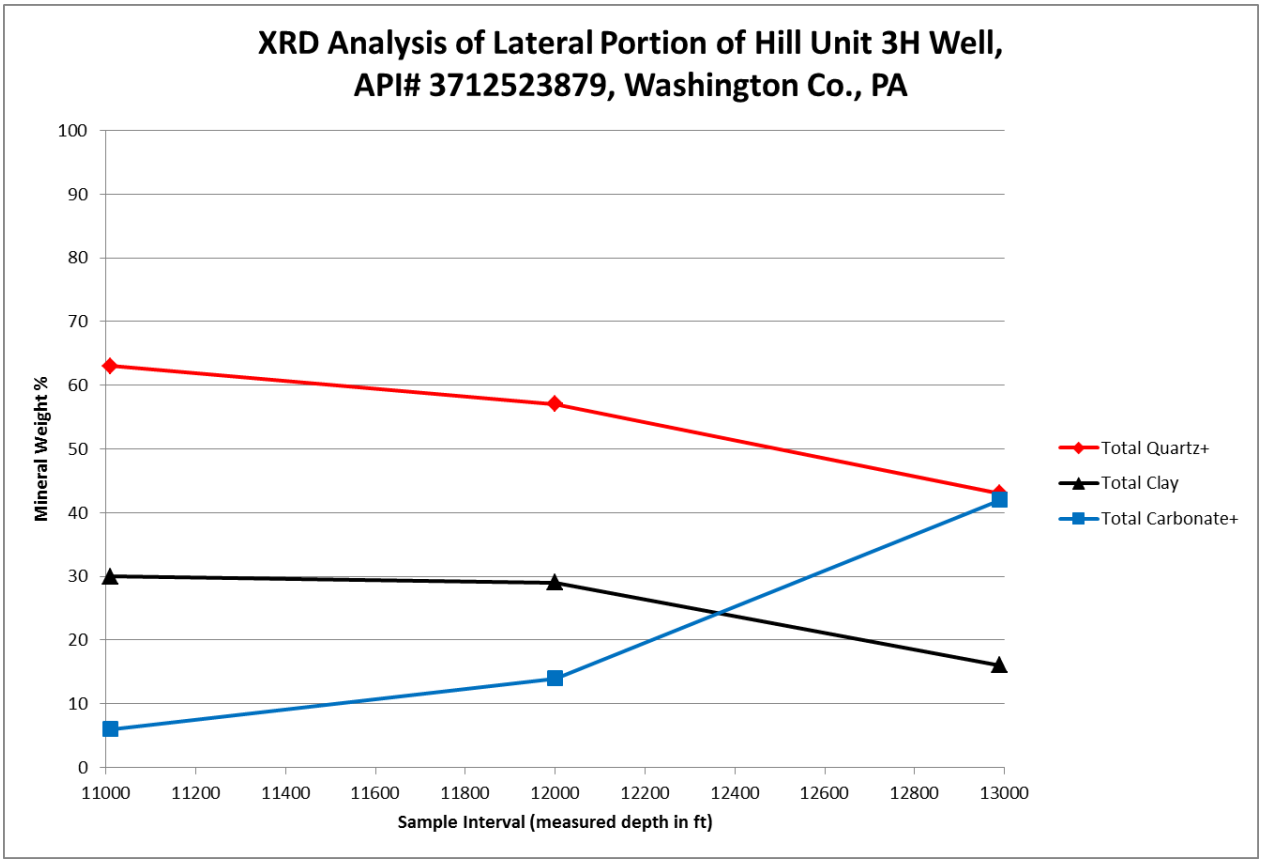

Figure 13: Quartz, clay, and carbonate content of the lateral 3H well. The quartz and carbonates increase while the clay mineral content decreases with lateral distance in the Marcellus shale.

4.2.3 Apatite

On mineralogy sample reported a large percentage (20%) of apatite. This sample was from 7,600 feet in the vertical portion of the Hill Unit 2H well (API# 37-125-23879) (Appendix A). This was the only detection of apatite reported for this study. When a high abundance of apatite shows up suddenly, it may indicate volcanic or sedimentary (phosphate) origins (Smith, personal communication 2015). According to Smith (personal communication, 2015), the apatite is a fossil bed.

5.0 DISCUSSION

5.1 Mineralogy

According to a study by Wang and Carr (2013), the three most important minerals to consider for evaluating natural gas shale reservoirs are quartz, clay minerals, and carbonates. Ideally for a productive reservoir, the quartz and carbonates amount need to be greater than 40% while the amount for clay minerals need to be less than 30% (Wang and Carr, 2013; Table 1). A Marcellus sample from 7,830 feet, analyzed for the Hill Unit 2H well (API# 37-125-23880) has a combined quartz and carbonates value above the 40% range, but the clay minerals value is above the 30% range (Appendix A). Similarly in the Hill Unit 3H (API# 37-125-23879), a Marcellus sample from 7,830 feet also shows a combined quartz and carbonates value above the 40% range and a clay mineral value above the 30% range (Appendix C). The sample taken at 7,850 feet is in the ideal mineral range. When comparing the lateral portions of both Antero wells, only one out of five cutting samples from the 2H and all three samples from the 3H well are within the ideal mineral range (Appendix B, D).

Overall mineralogy varies with depth, both vertically and laterally, within the Marcellus shale (Figs. 10-13). In the vertical portions of 2H and the 3H well, quartz, carbonate, and clay mineral content varies with depth in the Marcellus (Figs. 10, 11). According to Cooney (2013) an increase of quartz and carbonate content with depth, along with a commensurate decrease in clay mineral content with depth, promises greater petroleum reservoir potential. This increase allows for more brittle formations that may contain continuous free gas (Cooney, 2013) and certainly those that will respond well to hydraulic stimulation. Based upon the low clay mineral content and the higher quartz and carbonate contents, the 3H well is completed in the more promising hydrocarbon reservoir (Fig 13; Appendix D).

Table 1: Ideal Mineralogic Properties for Shale Gas Producing Reservoirs (Modified in Wang and Carr, 2013)	
Mineral Type	Percenatage
Quartz and Carbonates	Greater than or equal to 40%
Clays	Less than or equal to 30%

5.2 Implications For Reservoir Quality

From the mineralogy and geophysical log data, the Hill Unit 3H will likely be more productive than the Hill Unit 2H well. The Marcellus shale within the vertical portion of the 2H well contains 50% quartz by weight, but more than 40% clay minerals and less than 10% carbonates (Fig. 10). With lateral distance, quartz and clay mineral content varies while carbonate content decreases (Fig. 12). In comparison, the 3H well consists of more than 55% quartz and carbonates, but more than 30% clay minerals at the top of the Marcellus Formation (Fig. 11). The lateral portion of the 3H well shows an increase in carbonate content while clay mineral and quartz content decrease with lateral distance (Fig. 13). The lack of clay minerals reduces the tendency for hydrocarbons to be adsorbed to clay mineral surfaces (Cooney, 2013). With a smaller percent of clay minerals in the 3H well, the fracing process will be more successful in this rock, which leads to better gas drainage and a more productive well.

6.0 CONCLUSIONS

Based on mineralogy and geophysical well log interpretations, the Marcellus Formation in the 3H well is the more viable natural gas reservoir. Both the vertical and lateral portions of the 2H and well and the 3H well do not have similar mineralogical characteristics in the Marcellus (Appendix A, B, C, and D). In the vertical 2H well, the clay mineral content is above 30% , but the combined quartz and carbonates content is above 40% (Appendix A). For the vertical 3H well, the combined percentage of quartz and carbonates content is greater than 40% while the clay mineral content is equal to 30% (Appendix C).

The lateral portion of the 3H has a favorable mineralogy and is interpreted to within the lower Marcellus horizon (Appendix D). Average percent values for quartz, carbonates, and clay mineral content were 54%, 62%, and 25% respectively (Appendix D). The mineralogy within the lateral portion of the 2H well is less favorable and resides in the upper Marcellus horizon (Appendix B). Average percent values in the lateral 2H are 36% quartz, 43% clay minerals, and 21% carbonates (Appendix B).

Since the Hill Unit 2H and 3H wells lie on the same well pad, it can be inferred that the Marcellus intervals are at corresponding similar vertical depths (Appendix E, F). For the two wells, mineralogy varies with depth both vertically and laterally (Figs. 10, 11, 12, 13). Although mineralogy plays a role in reservoir quality, more work needs to be done in order to fully assess the reservoir quality of this shale, namely through the studies of thermal maturity and total organic carbon content of the Marcellus shale in this area of southwestern Pennsylvania.

7.0 REFERENCES CITED

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Appendices

Appendix A: Vertical 2H Results

Formation Sampled	Sampled Interval (ft below surface)	PERCENT OF MINERALOGY								PERCENT OF TOTAL MINERALOGY			TOTAL PERCENTAGE
		QUARTZ+			CLAY		CARBONATE +						
		Quartz	Plagioclase	Pyrite	Muscovite	Chlorite	Calcite	Dolomite	Apatite	Total Quartz+	Total Clay	Total Carbonate+	
Not Listed	7200	37	7	N.D.	41	15	N.D.	N.D.	N.D.	44	56	0	100
Not Listed	7230	36	6	1	33	24	N.D.	N.D.	N.D.	43	57	0	100
Not Listed	7260	33	6	N.D.	39	22	N.D.	N.D.	N.D.	39	61	0	100
Not Listed	7290	34	6	1	45	12	1	1	N.D.	41	57	2	100
Not Listed	7320	39	6	1	36	17	2	N.D.	N.D.	46	53	2	101
Not Listed	7350	38	7	1	35	17	2	N.D.	N.D.	46	52	2	100
Not Listed	7380	43	7	1	32	15	2	N.D.	N.D.	51	47	2	100
Not Listed	7410	44	7	1	38	10	N.D.	N.D.	N.D.	52	48	0	100
Not Listed	7440	45	5	1	32	7	9	N.D.	N.D.	51	39	9	99
Tully Limestone	7470	38	4	1	38	6	11	3	N.D.	43	44	14	101
Tully Limestone	7500	40	4	1	33	10	11	N.D.	N.D.	45	43	11	99
Ludlowville Formation	7530	22	3	N.D.	14	4	57	N.D.	N.D.	25	18	57	100
Ludlowville Formation	7560	11	N.D.	N.D.	13	4	72	1	N.D.	11	17	73	101
Ludlowville Formation	7590	24	1	N.D.	19	10	46	N.D.	N.D.	25	29	46	100
Ludlowville Formation	7620	25	2	N.D.	20	10	44	N.D.	N.D.	27	30	44	101
Ludlowville Formation	7650	33	4	2	37	7	18	N.D.	N.D.	39	44	18	101
Ludlowville Formation	7680	35	8	1	41	12	4	N.D.	N.D.	44	53	4	101
Centerfield Limestone	7710	35	4	N.D.	47	10	4	N.D.	N.D.	39	57	4	100
Skaneateles Formation	7740	38	5	N.D.	39	11	7	N.D.	N.D.	43	50	7	100
Marcellus Formation	7770	39	5	N.D.	42	11	3	N.D.	N.D.	44	53	3	100
Marcellus Formation	7800	42	5	3	32	12	6	N.D.	N.D.	50	44	6	100
Marcellus Formation	7830	37	4	2	45	5	7	N.D.	N.D.	43	50	7	100
Onondaga Formation	7860	34	4	2	31	13	15	N.D.	N.D.	40	44	15	99
Huntersville Chert	7890	33	4	3	32	13	14	N.D.	N.D.	40	45	14	99
Not Listed	7980	11	N.D.	1	14	N.D.	69	5	N.D.	12	14	74	100
Not Listed	8110	50	2	1	19	4	18	6	N.D.	53	23	24	100
Average percent of total mineralogy										40	43	17	N/A
Range										42	47	73	N/A
Standard Deviation										11	13	22	N/A

Appendix B: Lateral 2H Results

Mineralogy, by XRD analysis, of lateral 2H well Marcellus cuttings samples, Washington County, Pennsylvania.

Sampled Interval (lateral distance in ft)	PERCENT OF MINERALOGY								PERCENT OF TOTAL MINERALOGY			TOTAL PERCENTAGE
	QUARTZ+			CLAY		CARBONATE +						
	Quartz	Plagioclase	Pyrite	Muscovite	Chlorite	Calcite	Dolomite	Apatite	Total Quartz+	Total Clay	Total Carbonate+	
7600	5	N.D.	N.D.	20	N.D.	54	N.D.	20	5	20	74	99
8620	33	3	3	33	N.D.	27	N.D.	N.D.	39	33	27	99
9610	37	4	4	46	6	2	N.D.	N.D.	45	52	2	99
10600	33	4	3	52	8	N.D.	N.D.	N.D.	40	60	0	100
11624	42	3	4	43	7	1	N.D.	N.D.	49	50	1	100
Average percent of total mineralogy									36	43	21	N/A
Range									44	40	74	N/A
Standard Deviation									18	16	32	N/A

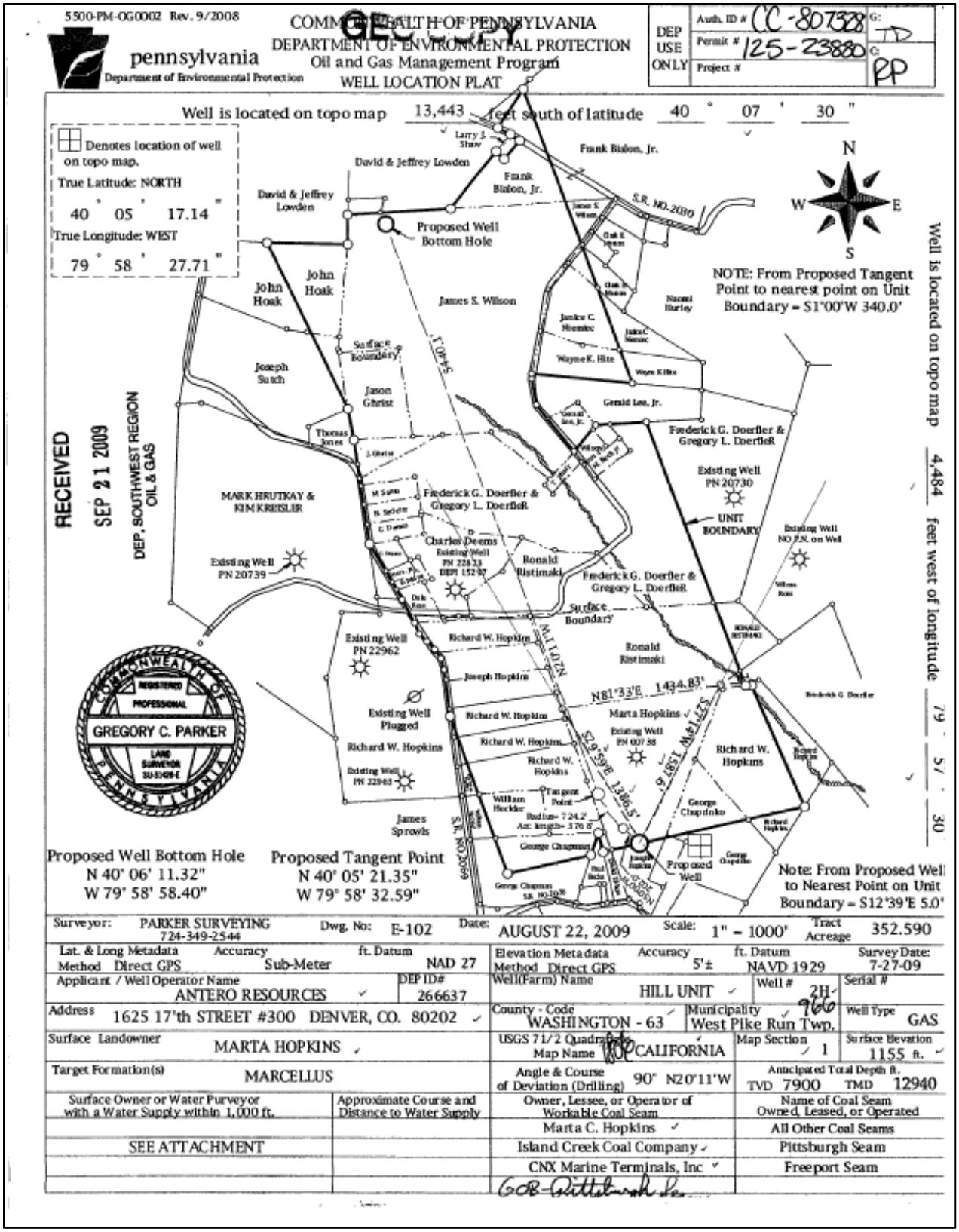
Mineralogy, by XRD analysis, of vertical 3H well Marcellus cuttings samples, Washington County, Pennsylvania.													
Formation Sampled	Sampled Interval (ft below surface)	PERCENT OF MINERALOGY								PERCENT OF TOTAL MINERALOGY			TOTAL PERCENTAGE
		QUARTZ +			CLAY		CARBONATE+						
		Quartz	Plagioclase	Pyrite	Muscovite	Chlorite	Calcite	Dolomite	Apatite	Total Quartz+	Total Clay	Total Carbonate+	
Sonyea Formation	7220	36	4	1	30	19	11	N.D.	N.D.	41	49	11	101
Sonyea Formation	7250	39	4	4	28	19	7	N.D.	N.D.	47	47	7	101
Sonyea Formation	7280	38	5	2	31	19	6	N.D.	N.D.	45	50	6	101
Sonyea Formation	7310	36	4	2	34	20	5	N.D.	N.D.	42	54	5	101
Sonyea Formation	7340	41	4	1	30	19	5	N.D.	N.D.	46	49	5	100
Geneseo Formation	7370	43	4	N.D.	32	16	6	N.D.	N.D.	47	48	6	101
Geneseo Formation	7400	44	5	1	26	18	5	N.D.	N.D.	50	44	5	99
Geneseo Formation	7430	41	3	1	29	14	11	N.D.	N.D.	45	43	11	99
Geneseo Formation	7460	46	5	N.D.	26	12	11	N.D.	N.D.	51	38	11	100
Tully Limestone	7490	44	6	2	22	13	12	1	N.D.	52	35	13	100
Ludlowville Formation	7520	37	7	1	35	20	N.D.	N.D.	N.D.	45	55	0	100
Ludlowville Formation	7550	28	1	N.D.	14	10	48	N.D.	N.D.	29	24	48	101
Ludlowville Formation	7580	35	4	1	30	19	11	N.D.	N.D.	40	49	11	100
Ludlowville Formation	7610	41	6	N.D.	32	19	2	N.D.	N.D.	47	51	2	100
Ludlowville Formation	7640	40	9	N.D.	32	19	N.D.	N.D.	N.D.	49	51	0	100
Ludlowville Formation	7670	41	4	1	33	20	N.D.	N.D.	N.D.	46	53	0	99
Ludlowville Formation	7690	44	5	N.D.	29	20	2	N.D.	N.D.	49	49	2	100
Ludlowville Formation	7700	45	6	N.D.	28	19	1	N.D.	N.D.	51	47	1	99
Centerfield Limestone	7710	46	7	N.D.	24	20	4	N.D.	N.D.	53	44	4	101
Skaneateles Formation	7720	52	3	3	26	14	1	N.D.	N.D.	58	40	1	99
Skaneateles Formation	7730	47	6	3	27	15	2	N.D.	N.D.	56	42	2	100
Skaneateles Formation	7740	37	2	1	34	14	11	1	N.D.	40	48	12	100
Marcellus Formation	7770	33	3	3	29	12	20	N.D.	N.D.	39	41	20	100
Marcellus Formation	7790	34	2	3	26	11	23	1	N.D.	39	37	24	100
Marcellus Formation	7810	47	4	4	34	3	8	N.D.	N.D.	55	37	8	100
Marcellus Formation	7830	51	3	4	35	N.D.	7	N.D.	N.D.	58	35	7	100
Marcellus Formation	7850	28	N.D.	2	12	4	55	N.D.	N.D.	30	16	55	101
Marcellus Formation	7870	8	N.D.	1	16	N.D.	61	14	N.D.	9	16	75	100
Huntersville Chert	7890	5	N.D.	1	15	2	63	14	N.D.	6	17	77	100
Huntersville Chert	7910	86	N.D.	N.D.	7	N.D.	1	6	N.D.	86	7	7	100
Huntersville Chert	7930	43	2	1	30	11	13	N.D.	N.D.	46	41	13	100
Average percent of total mineralogy										45	41	14	N/A
Range										80	47	77	N/A
Standard Deviation										14	12	21	N/A

Appendix D: Lateral 3H Results

Mineralogy, by XRD analysis, of lateral 3H Marcellus well cuttings samples, Washington County, Pennsylvania.

Sampled Interval (lateral distance in ft)	PERCENT OF MINERALOGY								PERCENT OF TOTAL MINERALOGY			TOTAL PERCENTAGE
	QUARTZ+			CLAY		CARBONATE+						
	Quartz	Plagioclase	Pyrite	Muscovite	Chlorite	Calcite	Dolomite	Apatite	Total Quartz+	Total Clay	Total Carbonate+	
11010	53	4	6	30	N.D.	6	N.D.	N.D.	63	30	6	99
12000	46	3	8	29	N.D.	14	N.D.	N.D.	57	29	14	100
12990	38	1	4	16	N.D.	42	N.D.	N.D.	43	16	42	101
Average percent total of mineralogy									54	25	21	N/A
Range									20	14	36	N/A
Standard Deviation									10	8	19	N/A

Appendix E: 2H Well Location Plat



5500-PM-OG0002 Rev. 9/2008

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Oil and Gas Management Program
WELL LOCATION PLAT
(ATTACHMENT, if needed)

DEP USE ONLY	Auth. ID # CC-807328

Applicant / Well Operator Name	DEP ID#	Well(Farm) Name	Well #	Serial #
ANTERO RESOURCES	266637	HILL UNIT	2H	

Surface Owner or Water Purveyor with a Water Supply within 1,000 ft.	Approximate Course and Distance to Water Supply	Owner, Lessee, or Operator of Workable Coal Seam	Name of Coal Seam Owned, Leased, or Operated
WILLIAM COTTLE			
168 S. CALIFORNIA DRIVE	S5°E 895'		
COAL CENTER, PA. 15423			
CHARLES O'DONNELL			
169 S. CALIFORNIA DRIVE	S25°E 920' (SPRING)		
COAL CENTER, PA. 15423			
ROBERT HOMME			
2910 KERRY FOREST PARKWAY	S30°E 990'		—
SUITE D4-360			
TALLAHASSEE, FL. 32309			
THEODORE DEMICHELE			
167 S. CALIFORNIA DRIVE	S17°E 645'		
COAL CENTER, PA. 15423			
JOSEPH VERNO			
157 S. CALIFORNIA DRIVE	S6°E 550'		
COAL CENTER, PA. 15423			
PAUL BECKA			
147 S. CALIFORNIA DRIVE	S30°W 585'		
COAL CENTER, PA. 15423			
MARY JANE RUSSELL			
137 S. CALIFORNIA DRIVE	S42°W 740'		
COAL CENTER, PA. 15423			
THOMAS HAVRILESKO			
122 S. CALIFORNIA DRIVE	S52°W 990'		
COAL CENTER, PA. 15423			
DAVID DILLON			
153 S. CALIFORNIA DRIVE	S22°W 415'		
COAL CENTER, PA. 15423			

RECEIVED
SEP 21 2009
DEP, SOUTHWEST REGION
OIL & GAS

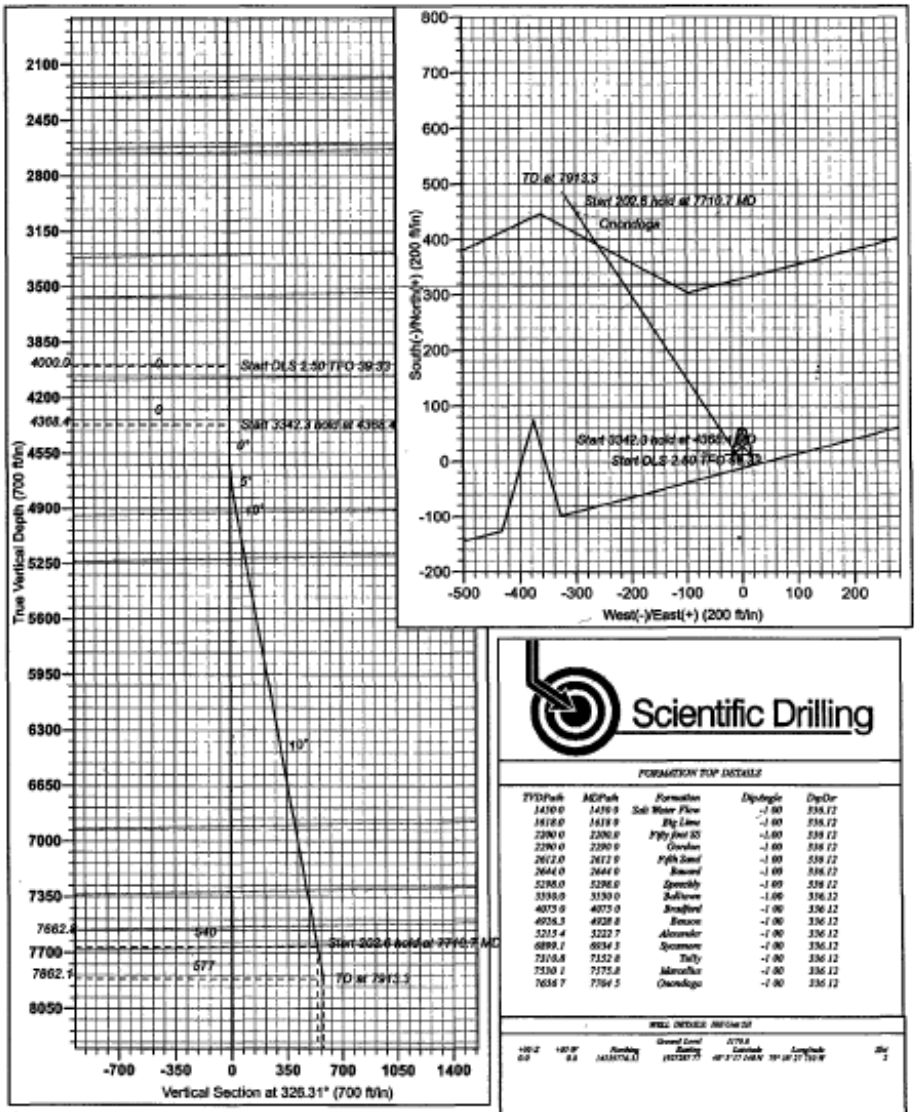
ANTERO RESOURCES

Antero Resources Corporation

Project: Washington County Pennsylvania
Site: Hopkins Pad
Well: Hill Unit 2H
WellBore: Directional Plan Hill Unit 2H
Design: Plan #1

Azimuths to Grid North
True North: -0.66°
Magnetic North: -9.68°

Magnetic Field
Strength: 53162.9nT
Dip Angle: 67.62°
Date: 7/31/2009
Model: IGRF200510



Scientific Drilling

FORMATION TOP DETAILS

TVDPath	MDPath	Formation	DipAngle	DipDir
1450.0	1450.0	Salt Water Flow	-1.00	336.12
1618.0	1618.0	Big Lime	-1.00	336.12
2290.0	2290.0	Fifty foot SS	-1.00	336.12
2590.0	2590.0	Gordon	-1.00	336.12
2612.0	2612.0	Fifth Sand	-1.00	336.12
2644.0	2644.0	Rescuer	-1.00	336.12
3298.0	3298.0	Speechley	-1.00	336.12
3330.0	3330.0	Balltown	-1.00	336.12
4073.0	4073.0	Bradford	-1.00	336.12
4926.3	4928.0	Benson	-1.00	336.12
5215.4	5222.7	Alexander	-1.00	336.12
6899.1	6934.3	Sycamore	-1.00	336.12
7310.8	7352.0	Tully	-1.00	336.12
7530.1	7575.8	Marcellus	-1.00	336.12
7656.7	7794.5	Onondaga	-1.00	336.12

WELL DETAILS: Hill Unit 2H

+N/-S	+E/-W	Northing	Easting	Latitude	Longitude	Slot
0.0	0.0	14539742.83	1925987.77	40° 5' 17.048 N	79° 58' 21.750 W	1

DESIGN TARGET DETAILS

Name	TVD	+N/-S	+E/-W	Northing	Easting	Latitude	Longitude	Shape
Onondaga Target 1H - plan hits target center	7666.0	450.0	-300.0	14569226.31	1926987.77	40° 5' 21.622 N	79° 58' 31.504 W	Point

SECTION DETAILS

Sec	MD	Inc	Azi	TVD	+N/-S	+E/-W	Dleg	TFace	VSect	Target
1	0.0	0.00	0.00	0.0	0.0	0.0	0.00	0.00	0.0	
2	4500.0	0.00	0.00	4500.0	0.0	0.0	0.00	0.00	0.0	
3	4914.4	10.36	326.31	4912.2	31.1	-20.7	2.50	326.31	37.4	
4	7713.9	10.36	326.31	7666.0	450.0	-300.0	0.00	0.00	540.8	Onondaga Target 1H
5	7917.2	10.36	326.31	7866.0	480.4	-320.3	0.00	0.00	577.4	

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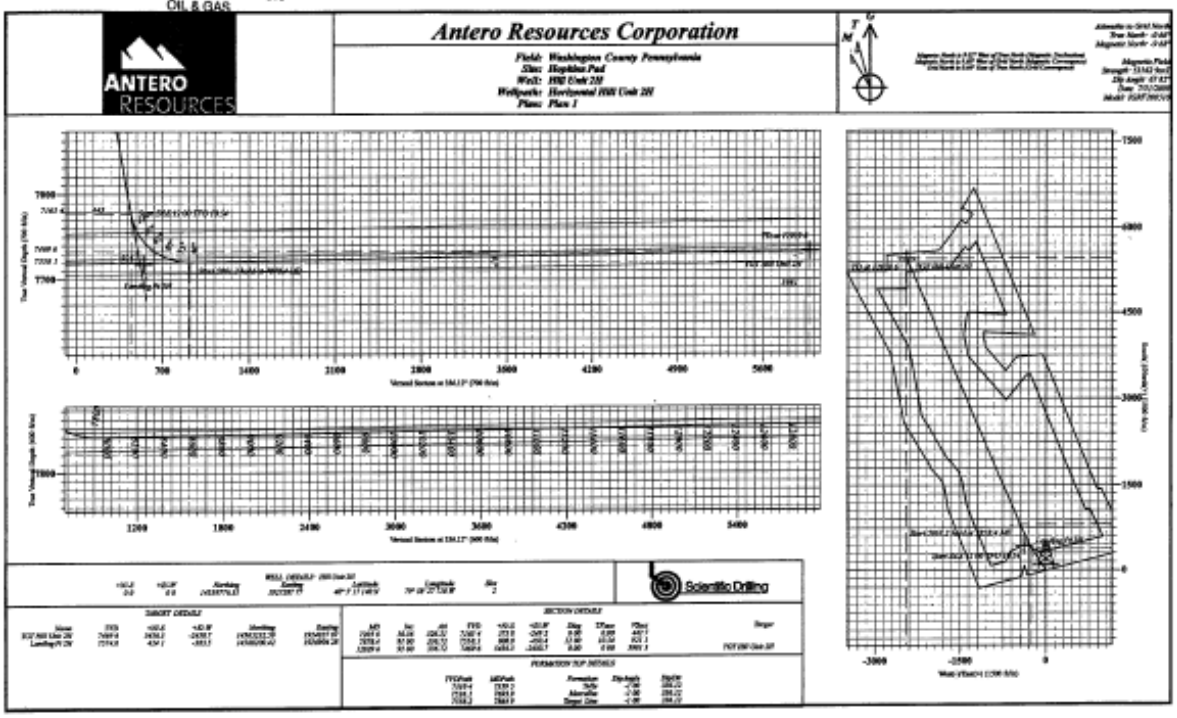

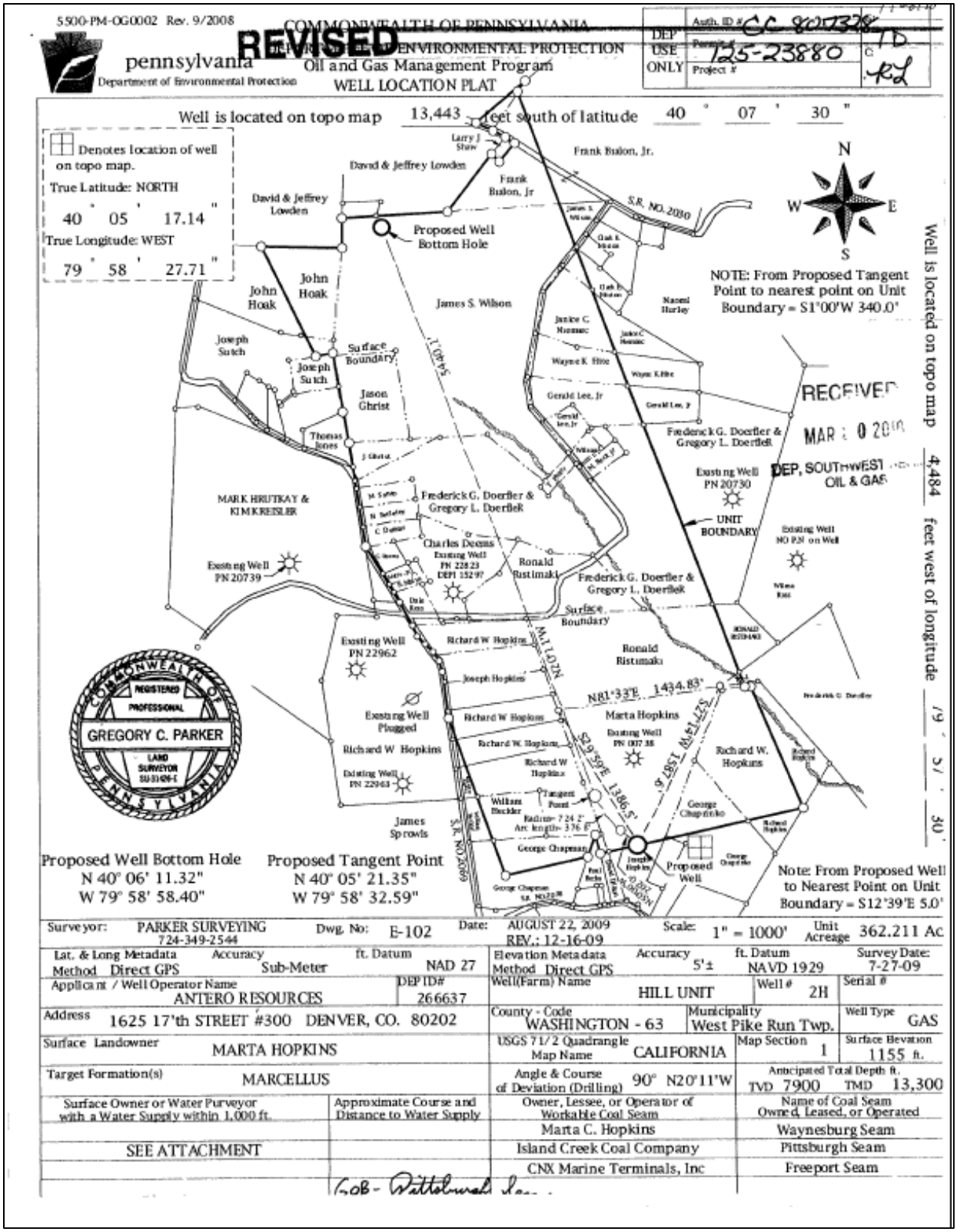

Surveyor: PARKER SURVEYING 724-349-2544	Dwg. No: E-102	Date: AUGUST 22, 2009 REV.: 12-16-09	Scale: 1" = 1000'	Unit Acreage 362.211 Ac	
Lat. & Long Metadata Method Direct GPS	Accuracy Sub-Meter	ft. Datum NAD 27	Elevation Metadata Method Direct GPS	Accuracy 5'±	ft. Datum NAVD 1929
Survey Date: 7-27-09					
Applicant / Well Operator Name ANTERO RESOURCES		DEP ID# 266637	Well(Farm) Name HILL UNIT	Well # 2H	Serial #
Address 1625 17'th STREET #300 DENVER, CO. 80202			County - Code WASHINGTON - 63	Municipality West Pike Run Twp.	Well Type GAS
Surface Landowner MARTA HOPKINS			USGS 7 1/2 Quadrangle Map Name CALIFORNIA	Map Section 1	Surface Elevation 1155 ft.
Target Formation(s) MARCELLUS			Angle & Course of Deviation (Drilling) 90° N20°11'W	Anticipated Total Depth ft. TVD 7900 TMD 13,300	
Surface Owner or Water Purveyor with a Water Supply within 1,000 ft.	Approximate Course and Distance to Water Supply		Owner, Lessee, or Operator of Workable Coal Seam	Name of Coal Seam Owned, Leased, or Operated	
SEE ATTACHMENT			Marta C. Hopkins	Waynesburg Seam	
			Island Creek Coal Company	Pittsburgh Seam	
			CNX Marine Terminals, Inc	Freeport Seam	

GOB - Wittelsmark Lease

Output from NADCON for station

North American Datum Conversion

NAD 27 to NAD 83

125-23880

NADCON Program Version 2.11

==========

Transformation #: 1 Region: Conus

	Latitude	Longitude	
NAD 27 datum values:	40 05 17.14000	79 58 27.71000	
NAD 83 datum values:	40 05 17.40133	79 58 26.89310	
NAD 83 - NAD 27 shift values:	0.26133	-0.81690	(secs.)
	8.060	-19.352	(meters)

Magnitude of total shift: 20.964 (meters)

NGS HOME PAGE

5500-PM-OG0002 Rev. 9/2008

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COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Oil and Gas Management Program
WELL LOCATION PLAT
(ATTACHMENT, if needed)

DEP USE ONLY — Auth. ID # CC 807328 — 125-23880

Applicant / Well Operator Name	DEP ID#	Well(Farm) Name	Well #	Serial #
ANTERO RESOURCES	266637	HILL UNIT	2H	

Surface Owner or Water Purveyor with a Water Supply within 1,000 ft.	Approximate Course and Distance to Water Supply	Owner, Lessee, or Operator of Workable Coal Seam	Name of Coal Seam Owned, Leased, or Operated
WILLIAM COTTLE			
168 S. CALIFORNIA DRIVE	S5°E 895'		
COAL CENTER, PA. 15423			
CHARLES O'DONNELL			
169 S. CALIFORNIA DRIVE	S25°E 920' (SPRING)		
COAL CENTER, PA. 15423			
ROBERT HOMME			
2910 KERRY FOREST PARKWAY	S30°E 990'		
SUITE D4-360			
TALLAHASSEE, FL. 32309			
THEODORE DEMICHELE			
167 S. CALIFORNIA DRIVE	S17°E 645'		
COAL CENTER, PA. 15423			
JOSEPH VERNO			
157 S. CALIFORNIA DRIVE	S6°E 550'		
COAL CENTER, PA. 15423			
PAUL BECKA			
147 S. CALIFORNIA DRIVE	S30°W 585'		
COAL CENTER, PA. 15423			
MARY JANE RUSSELL			
137 S. CALIFORNIA DRIVE	S42°W 740'		
COAL CENTER, PA. 15423			
THOMAS HAVRILESKO			
122 S. CALIFORNIA DRIVE	S52°W 990'		
COAL CENTER, PA. 15423			
DAVID DILLON			
153 S. CALIFORNIA DRIVE	S22°W 415'		
COAL CENTER, PA. 15423			

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MAR 30 2010

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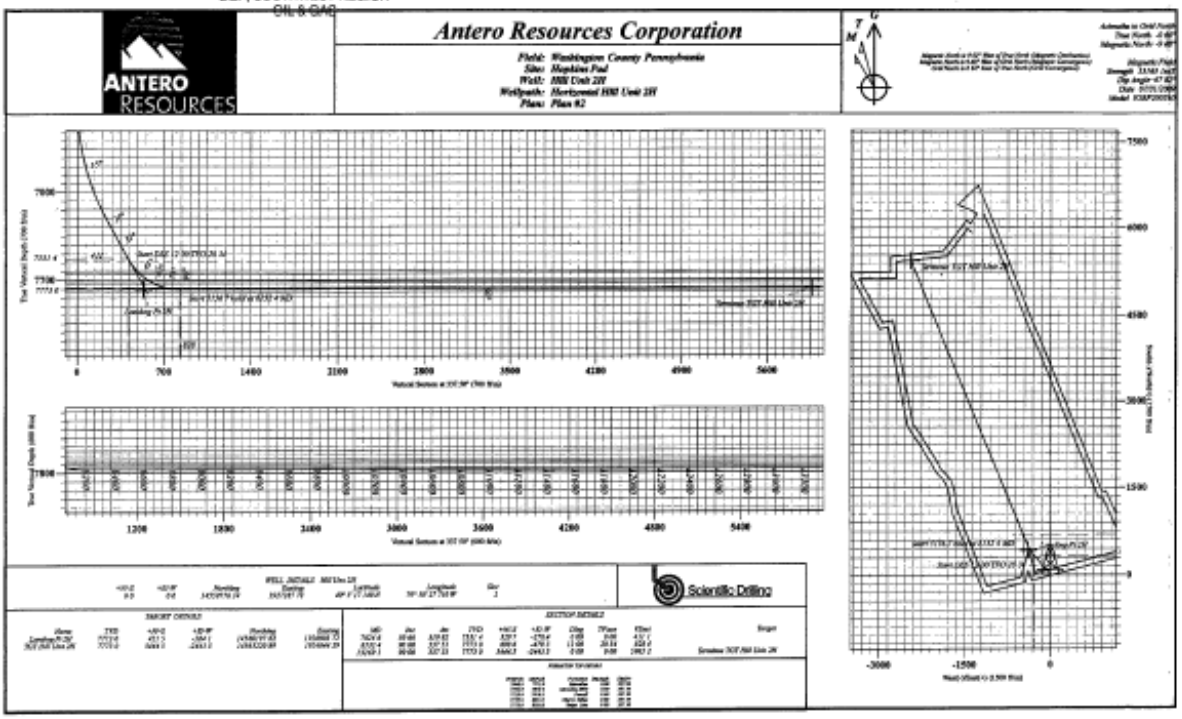

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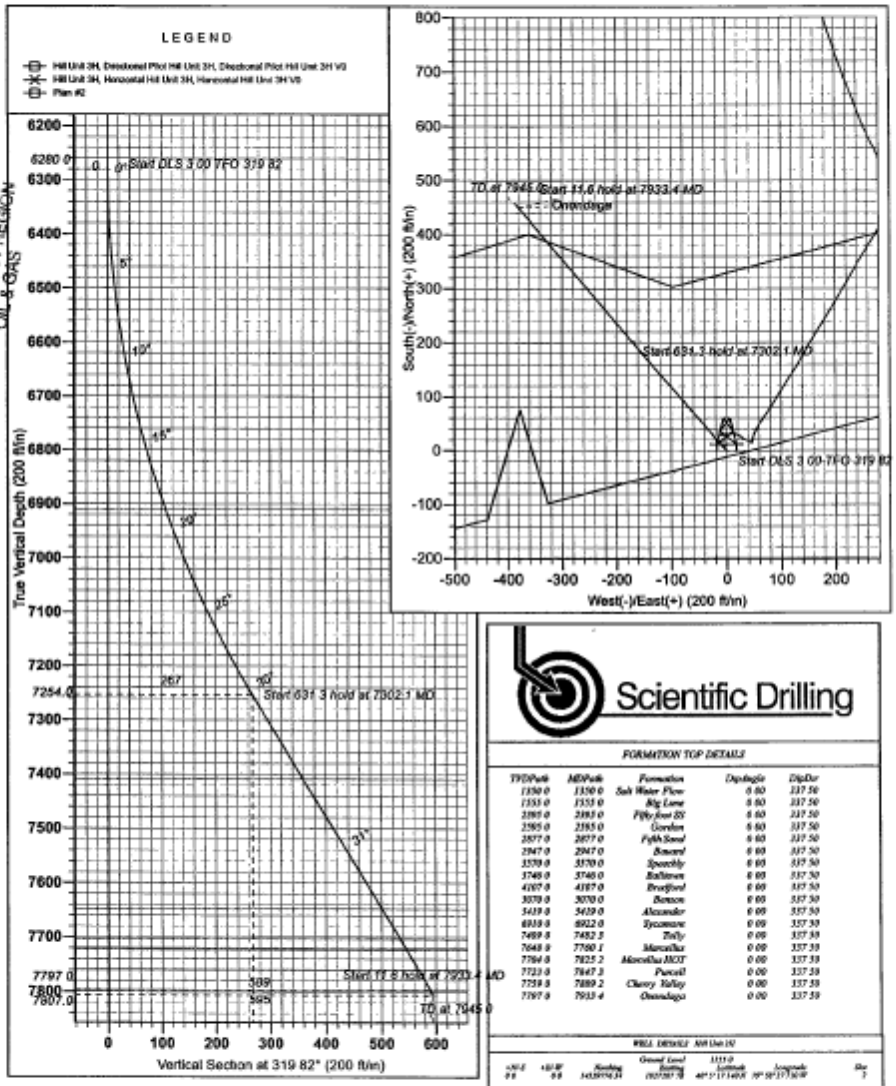
REVISED 12523880

Antero Resources Corporation

Project: Washington County Pennsylvania
Site: Hopkins Pad
Well: Hall Unit 2H
Wellbore: Directional Pilot Hall Unit 2H
Design: Plan #2

Azimuths to Grid North
True North: -0.68°
Magnetic North: -8.68°

Magnetic Field
Strength: 53163.1nT
Dip Angle: 67.02°
Date: 07/31/2009
Model: IGRF200510



Scientific Drilling

FORMATION TOP DETAILS

TVDPath	MDPath	Formation	DipAngle	DipDir
1350.0	1350.0	Salt Water Flow	0.00	337.50
1355.0	1355.0	Big Lime	0.00	337.50
2395.0	2395.0	Fifty foot SS	0.00	337.50
2585.0	2585.0	Gordon	0.00	337.50
2877.0	2877.0	Fifth Sand	0.00	337.50
2947.0	2947.0	Bayard	0.00	337.50
3570.0	3570.0	Speechly	0.00	337.50
3748.0	3748.0	Balltown	0.00	337.50
4107.0	4107.0	Bradford	0.00	337.50
5070.0	5070.0	Benson	0.00	337.50
5439.0	5439.0	Alexander	0.00	337.50
6910.0	6922.0	Sycamore	0.00	337.50
7489.9	7482.5	Tully	0.00	337.50
7648.9	7790.1	Marcellus	0.00	337.50
7704.0	7825.2	Marcellus MOT	0.00	337.50
7723.0	7847.3	Purcell	0.00	337.50
7754.5	7889.2	Cherry Valley	0.00	337.50
7797.0	7933.4	Onondaga	0.00	337.50

WELL DETAILS: Hall Unit 2H

+N/-S	+E/-W	Northing	Ground Level	3333.0 Easting	Latitude	Longitude	Slot
0.0	0.0	143859834.34	1925907.78		40° 5' 17.875 N	79° 58' 32.564 W	1

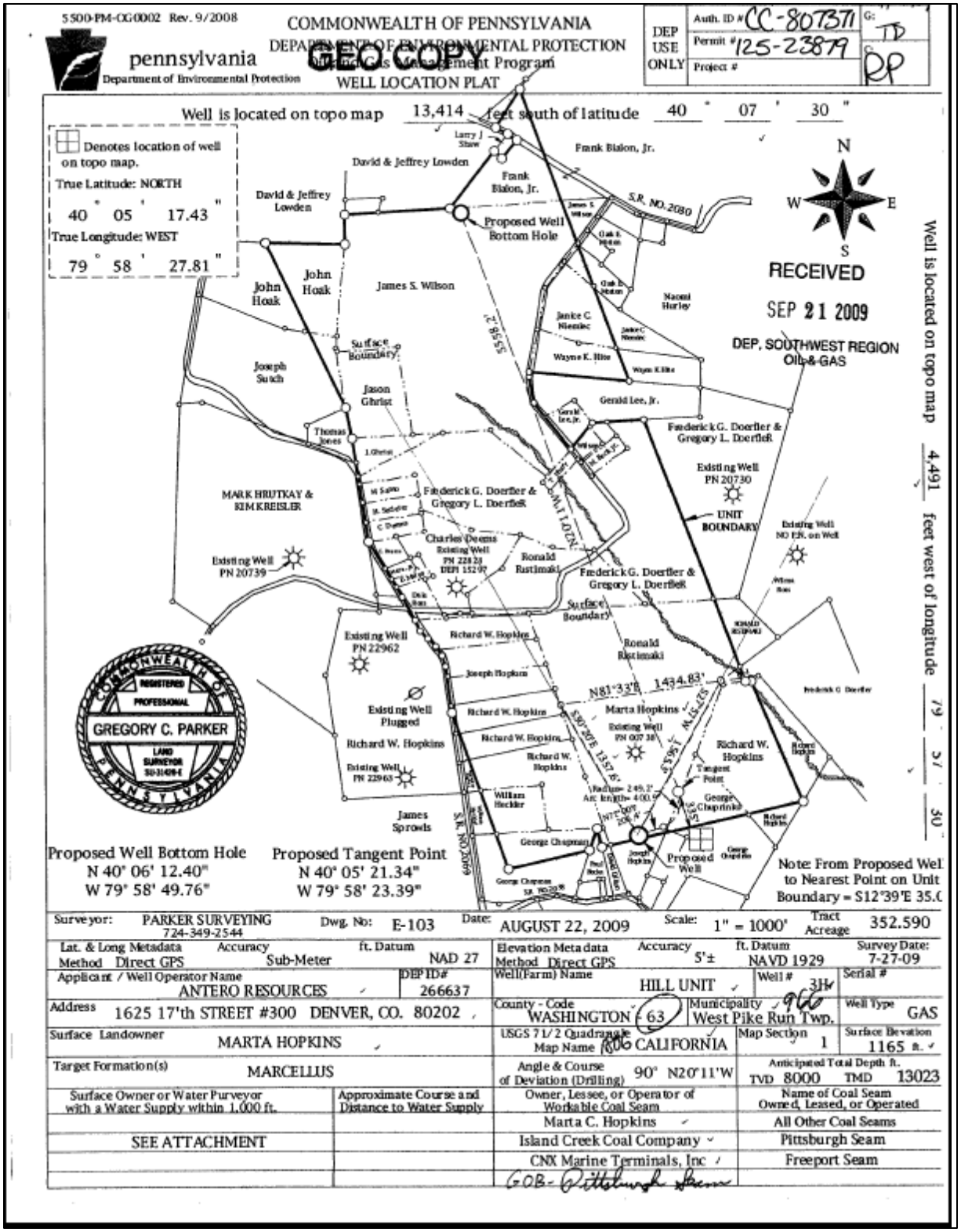
DESIGN TARGET DETAILS

Name	TVD	+N/-S	+E/-W	Northing	Easting	Latitude	Longitude
330 Point	7797.0	70.0	-378.0	143359846.34	1926909.78	40° 5' 17.875 N	79° 58' 32.564 W
Onondaga Target 2H	7797.0	450.0	-380.0	143560226.31	1926907.78	40° 5' 21.631 N	79° 58' 32.534 W

SECTION DETAILS

Sec	MD	Inc	Azi	TVD	+N/-S	+E/-W	DLeg	TFace	VSect	Target
1	0.0	0.00	0.00	0.0	0.0	0.0	0.00	0.00	0.0	
2	6280.0	0.00	0.00	6280.0	0.0	0.0	0.00	0.00	0.0	
3	7902.1	30.66	319.82	7254.0	204.0	-172.3	3.00	319.82	267.0	
4	7933.4	30.66	319.82	7797.0	450.0	-380.0	0.00	0.00	589.0	Onondaga Target 2H
5	7945.0	30.66	319.82	7807.0	454.5	-383.8	0.00	0.00	594.9	

Appendix F: 3H Well Location Plat



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COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Oil and Gas Management Program

WELL LOCATION PLAT
(ATTACHMENT, if needed)

DEP USE ONLY	Auth. ID # CC-807371

Applicant / Well Operator Name	DEP ID#	Well(Farm) Name	Well #	Serial #
ANTERO RESOURCES	266637	HILL UNIT	3H	

Surface Owner or Water Purveyor with a Water Supply within 1,000 ft.	Approximate Course and Distance to Water Supply	Owner, Lessee, or Operator of Workable Coal Seam	Name of Coal Seam Owned, Leased, or Operated
WILLIAM COTTLE			
168 S. CALIFORNIA DRIVE	S5°E 905'		
COAL CENTER, PA. 15423			
CHARLES O'DONNELL			
169 S. CALIFORNIA DRIVE	S25°E 920' (SPRING)		
COAL CENTER, PA. 15423			
ROBERT HOMME			
2910 KERRY FOREST PARKWAY	S30°E 990'		
SUITE D4-360			
TALLAHASSEE, FL. 32309			
THEODORE DEMICHELE			
167 S. CALIFORNIA DRIVE	S17°E 655'		
COAL CENTER, PA. 15423			
JOSEPH VERNO			
157 S. CALIFORNIA DRIVE	S6°E 560'		
COAL CENTER, PA. 15423			
PAUL BECKA			
147 S. CALIFORNIA DRIVE	S30°W 590'		
COAL CENTER, PA. 15423			
MARY JANE RUSSELL			
137 S. CALIFORNIA DRIVE	S42°W 745'		
COAL CENTER, PA. 15423			
THOMAS HAVRILESKO			
122 S. CALIFORNIA DRIVE	S52°W 990'		
COAL CENTER, PA. 15423			
DAVID DILLON			
153 S. CALIFORNIA DRIVE	S22°W 420'		
COAL CENTER, PA. 15423			

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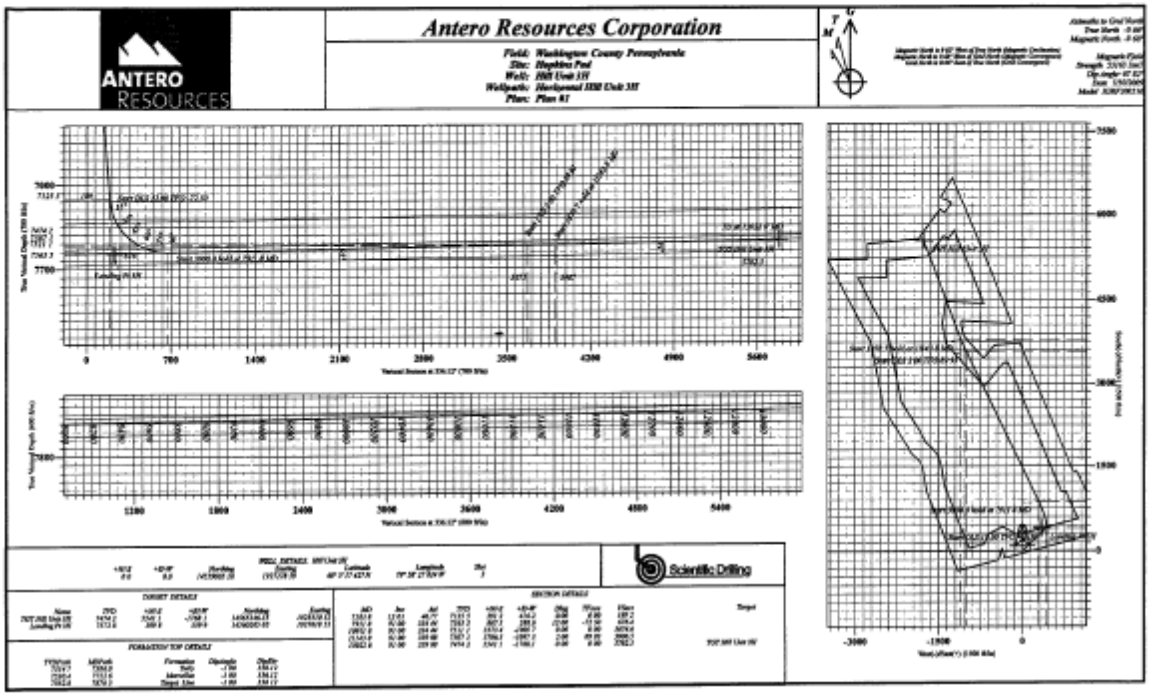

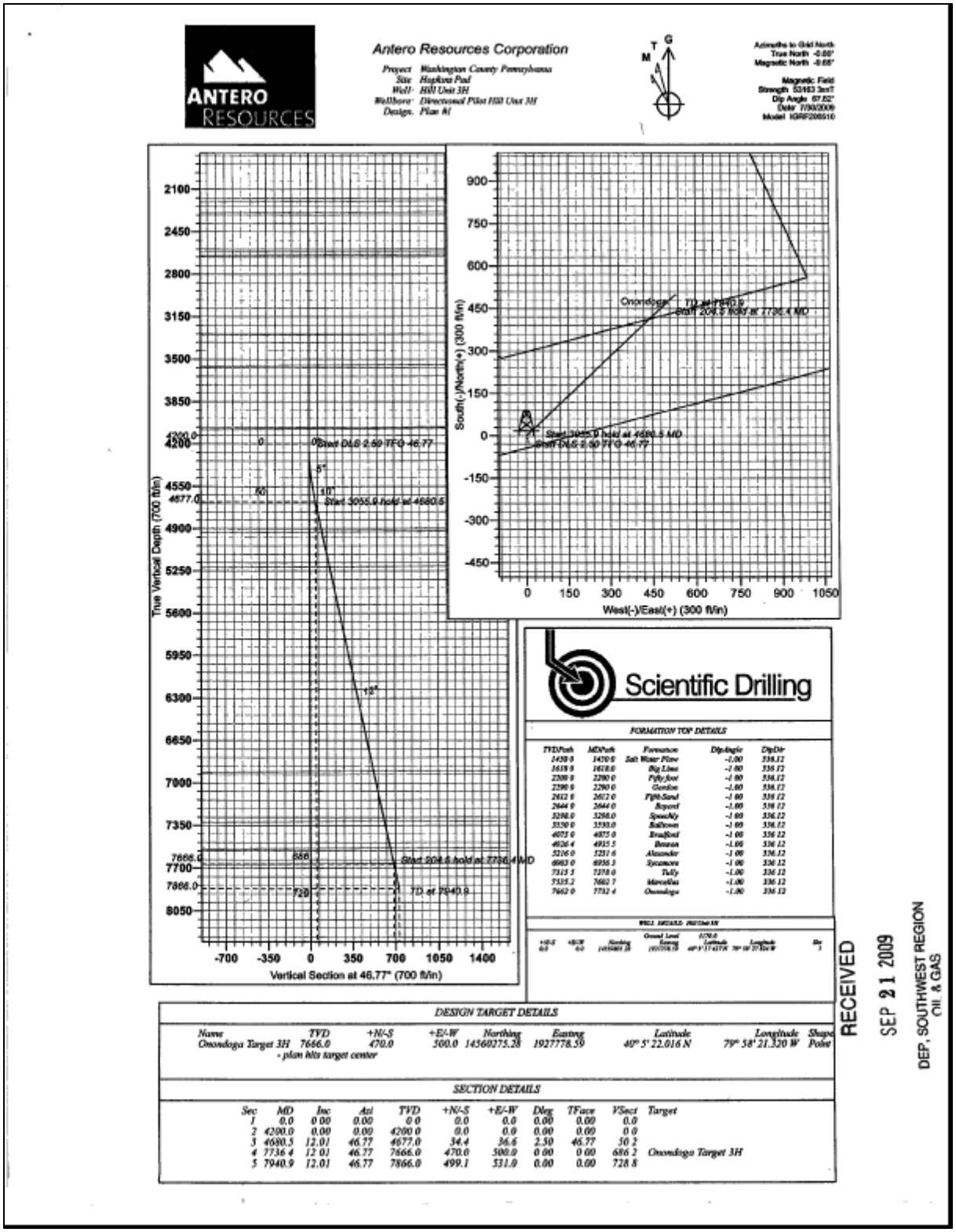
ANTERO RESOURCES
Antero Resources Corporation
Project: Washington County Pennsylvania
Site: Hopkins Pad
Well: Hill Unit 3H
Wellbore: Directional Pilot Hill Unit 3H
Design: Plan #1
Azimuths to Grid North
True North -0.65°
Magnetic North -0.65°
Magnetic Field
Strength: 53463.3nT
Dip Angle: 67.62°
Date: 7/30/2009
Model: IGRF200510
True Vertical Depth (700 ft/in)
Vertical Section at 46.77° (700 ft/in)
Start DLS 2.50 TFO 46.77
Start 3055.0 hold at 4680.5
Start 204.5 hold at 7736.4 MD
TD at 7940.9
South(-)/North(+) (300 ft/in)
West(-)/East(+) (300 ft/in)
Onondaga
Scientific Drilling
FORMATION TOP DETAILS
TVDPath MDPath Formation Dip Angle Dip Dir
1450.0 1450.0 Salt Water Flow -1.00 336.12
1618.0 1618.0 Big Lime -1.00 336.12
2200.0 2200.0 Fifty foot -1.00 336.12
2290.0 2290.0 Gordon -1.00 336.12
2612.0 2612.0 Fifth Sand -1.00 336.12
2644.0 2644.0 Bayard -1.00 336.12
3298.0 3298.0 Speechly -1.00 336.12
3530.0 3530.0 Balltown -1.00 336.12
4075.0 4075.0 Bradford -1.00 336.12
4926.4 4915.5 Benson -1.00 336.12
5216.0 5211.6 Alexander -1.00 336.12
6983.0 6956.3 Sycamore -1.00 336.12
7315.1 7278.0 Tully -1.00 336.12
7335.2 7682.7 Marcellus -1.00 336.12
7662.0 7732.4 Onondaga -1.00 336.12
WELL DETAILS: Plan#1 3H
+N/-S +E/-W Northing Easting Latitude Longitude Slot
0.0 0.0 14560275.28 1927778.59 40° 5' 22.016 N 79° 58' 21.320 W 1
DESIGN TARGET DETAILS
Name TVD +N/-S +E/-W Northing Easting Latitude Longitude Shape
Onondaga Target 3H 7666.0 470.0 500.0 14560275.28 1927778.59 40° 5' 22.016 N 79° 58' 21.320 W Point
- plan hits target center
SECTION DETAILS
Sec MD Inc Azi TVD +N/-S +E/-W Dleg TFace VSect Target
1 0.0 0.00 0.00 0.0 0.0 0.0 0.00 0.00 0.0
2 4200.0 0.00 0.00 4200.0 0.0 0.0 0.00 0.00 0.0
3 4680.5 12.01 46.77 4677.0 34.4 36.6 2.50 46.77 50.2
4 7736.4 12.01 46.77 7666.0 470.0 500.0 0.00 0.00 686.2 Onondaga Target 3H
5 7940.9 12.01 46.77 7866.0 499.1 531.0 0.00 0.00 728.8
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Appendix G: 2H Well Completion Report

5500-FM-OG0004 Rev 1/2010

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
OIL AND GAS MANAGEMENT PROGRAM

Well Record and Completion Report

Amended

DEP USE ONLY	
Site ID	Primary Fac ID
Client Id	Subfacility Id

Well Operator	DEP ID#	Well API # (Permit / Reg)	Project Number	Acres
Antero Resources Appalachian Corp	266637	37125-23880-00		

Address	Well Farm Name	Well #	Serial #
1625 17th Street	Hill Unit	2H	

City	State	Zip Code	County	Municipality
Denver	CO	80202	Washington	West Pike Run

Phone	Fax	USGS 7.5 min. quadrangle map
303-357-7310	303-357-7315	California

Check all that apply: ☐ Original Well Record ☒ Original Completion Report ☐ Amended Well Record ☐ Amended Completion Report

WELL RECORD

Well Type: ☐ Gas ☐ Oil ☐ Combination Oil & Gas ☐ Injection ☐ Storage ☐ Disposal

Drilling Method: ☐ Rotary – Air ☐ Rotary – Mud ☐ Cable Tool

Date Drilling Started	Date Drilling Completed	Surface Elevation	Total Depth – Driller	Total Depth - Logger
		ft	ft	ft

Casing and Tubing

Cement returned on surface casing? ☐ Yes ☐ No
Cement returned on coal protective casing? ☐ Yes ☐ No ☐ N/A

Hole Size	Pipe Size	Wt	Thread / Weld	Amount in Well (ft)	Material Behind Pipe Type and Amount	Packer / Hardware / Centralizers Type	Size	Depth	Date Run

COMPLETION REPORT

Perforation Record

Date	Interval Perforated From	To
	Please See	Attachment

Stimulation Record

Date	Interval Treated	Fluid Type	Propping Agent Type	Amount	Average Injection Rate
	Please See Attachment				

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OIL & GAS

Natural Open Flow	None Taken	Natural Rock Pressure	None Taken	Hours	Days
After Treatment Open Flow	None Taken	After Treatment Rock Pressure	5208 psig (Estimated using frac gradient survey)	Hours	4 Days

Well Service Companies -- Provide the name, address, and phone number of all well service companies involved

Name	Address	City - State – Zip	Phone
Cal Frac Well Services Corp	717 17th Street, Suite 1445	Denver, CO 80202	303-293-2931

- 1 -

Hill Unit 2H (API# 37-125-23880-00)
Antero Resources Appalachian Corporation

COMPLETION REPORT ATTACHMENT

Perforation Record			Stimulation Record						
Date	Interval Perforated From	To	Date	Interval Treated	Fluid Type	Fluid Amount	Propping Agent Type	Propping Agent Amount	Average Injection Rate
7/30/2010	11328'	11560'	8/29/2010	Marcellus	Water/15% HCl	8616 bbl	Sand	175182#	59 bbl/min
9/2/2010	11003'	11235'	9/03/2010	Marcellus	Water/15% HCl	10076 bbl	Sand	145000#	49.5 bbl/min
9/3/2010	10583'	10910'	9/03/2010	Marcellus	Water/15% HCl	9952 bbl	Sand	196180#	53 bbl/min
9/4/2010	9703'	10539'	9/04/2010	Marcellus	Water/15% HCl	7487 bbl	Sand	191000#	51.5 bbl/min
9/5/2010	9378'	9610'	9/04/2010	Marcellus	Water/15% HCl	8758 bbl	Sand	379700#	64 bbl/min
9/6/2010	8728'	9285'	9/05/2010	Marcellus	Water/15% HCl	9810 bbl	Sand	189560#	54.2 bbl/min
9/7/2010	8078'	8635'	9/05/2010	Marcellus	Water/15% HCl	10441 bbl	Sand	369010#	69.1 bbl/min
			9/06/2010	Marcellus	Water/15% HCl	9732 bbl	Sand	348380#	64.8 bbl/min
			9/07/2010	Marcellus	Water/15% HCl	8328 bbl	Sand	346360#	67.2 bbl/min
			9/07/2010	Marcellus	Water/15% HCl	8515 bbl	Sand	381440#	70.5 bbl/min
			9/08/2010	Marcellus	Water/15% HCl	8241 bbl	Sand	380480#	70.2 bbl/min

5500-FM-OG0004 Rev. 1/2010

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
OIL AND GAS MANAGEMENT PROGRAM

Well Record and Completion Report

DEP USE ONLY	
Site ID	Primary Fac ID
Client Id	Subfacility Id

Well Operator	DEP ID#	Well API # (Permit / Reg)	Project Number	Acres
Antero Resources Appalachian Corp.	266637	37125-23880-00		

Address	Well Farm Name	Well #	Serial #
1625 17th Street	Hill Unit	2H	

City	State	Zip Code	County	Municipality
Denver	CO	80202	Washington	West Pike Run

Phone	Fax	USGS 7.5 min. quadrangle map
303-357-7310	303-357-7315	California

Check all that apply: ☒ Original Well Record ☐ Original Completion Report ☐ Amended Well Record ☐ Amended Completion Report

WELL RECORD

Well Type	☒ Gas	☐ Oil	☐ Combination Oil & Gas	☐ Injection	☐ Storage	☐ Disposal
Drilling Method	☒ Rotary – Air	☒ Rotary – Mud	☐ Cable Tool			

Date Drilling Started	Date Drilling Completed	Surface Elevation	Total Depth – Driller	Total Depth - Logger
3/29/2010	5/12/2010	1196' ft.	11,624' MD ft.	11,583' MD ft.

Casing and Tubing

Cement returned on surface casing? ☐ Yes ☒ No
Cement returned on coal protective casing? ☒ Yes ☐ No ☐ N/A

Hole Size	Pipe Size	Wt.	Thread / Weld	Amount in Well (ft)	*Material Behind Pipe* Type and Amount	*Packer / Hardware / Centralizers* Type	Size	Depth	Date Run
24"	20"	133#	STC	40'	109 sx Class H				3/30/10
17-1/2"	13-3/8"	48#	STC	485'	555 sx Class H				4/2/10
12-1/4"	9-5/8"	36"	LTC	1844'	670 sx Class H				4/4/10
					170 sx Class H	Cmt Plug	300'	7832'	4/16/10
8-1/2"	5-1/2"	20#	Buttress	11,624'	Lead 1250 sx, Tail 670 sx Class H				5/10/10

COMPLETION REPORT

Perforation Record

Date	Interval Perforated From	To

Stimulation Record

Date	Interval Treated	*Fluid* Type	Amount	*Propping Agent* Type	Amount	Average Injection Rate

JUN 18 2010
DEP, SOUTHWEST REGION
OIL & GAS

Natural Open Flow		Natural Rock Pressure	Hours	Days
After Treatment Open Flow		After Treatment Rock Pressure	Hours	Days

Well Service Companies -- Provide the name, address, and phone number of all well service companies involved.

Name	Name	Name
Bronco Drilling Company, Inc.	Scientific Drilling	
Address	Address	Address
16217 N. May Ave.	421 South Eagle Lane	
City - State – Zip	City - State – Zip	City - State – Zip
Edmond, OK 73013	Oklahoma City, OK 73128	
Phone	Phone	Phone
405-562-4128	405-787-3663	

5500-FM-OG0004 Rev. 1/2010

LOG OF FORMATIONS

Well API#: 37-125-23880-00

(If you will need more space than this page, please photocopy the blank form before filling it in.)

Formation Name or Type	Top (feet)	Bottom (feet)	Gas at (feet)	Oil at (feet)	Water at (fresh / brine; ft.)	Source of Data
Sand and Shale (TVD)	7227'	7506'				MWD Gamma Ray
Shale	7506'	7529'				MWD Gamma Ray
Limestone	7529'	7586'				MWD Gamma Ray
Sand and Shale	7586'	7810'				MWD Gamma Ray
Shale	7810'	7969'				MWD Gamma Ray
Limestone	7969'	8019'				Mudlogging/Lithologic Sample Description
Horizontal Marcellus Top	7841'	MD				MWD Gamma
TD (Measured Depth)		11624'				

JUN 1 8 2010

DEP, SOUTHWEST REGION
OIL & GAS

I do hereby certify to the best of my knowledge, information and belief that the well identified on this Well Record and Completion Report has been properly cased and cemented in accordance with the requirements of 25 Pa. Code Chapter 78 and any conditions contained in the permit for this well. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Signature: Ashley Mihalcin

Title: Permit Representative

Date: 6/15/2010

DEP USE ONLY

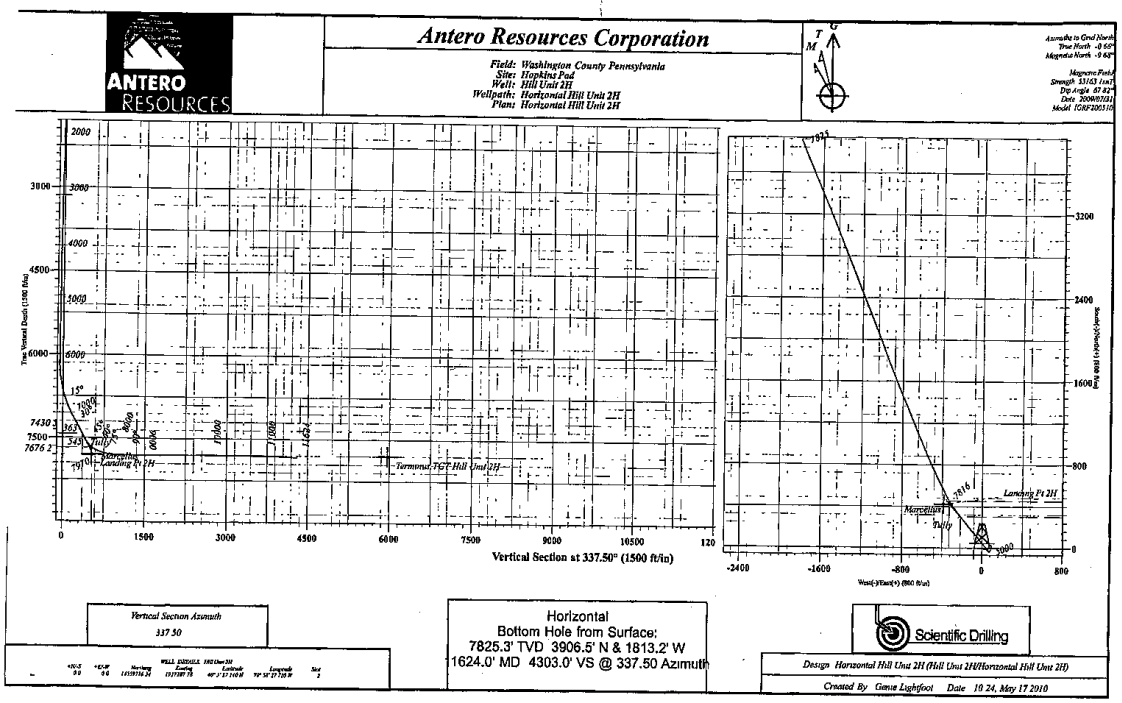
Reviewed by:

Date:

Comments:

DEP, SOUTHWEST REGION

JUN 18 2010



ANTERO RESOURCES

Antero Resources Corporation

Washington County Pennsylvania
Hopkins Pad
Hill Unit 2H - Slot 2
Directional Pilot Hill Unit 2H

Design: Directional Pilot Hill Unit 2H

Survey Completion Report

17 May, 2010

Scientific Drilling

Scientific Drilling International

Survey Completion Report

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 2H - Slot 2
Project:	Washington County Pennsylvania	**TVD Reference:**	2H @ 1175 0ft
Site:	Hopkins Pad	**MD Reference:**	2H @ 1175.0ft
Well:	Hill Unit 2H	**North Reference:**	Grid
Wellbore:	Directional Pilot Hill Unit 2H	**Survey Calculation Method:**	Minimum Curvature
Design:	Directional Pilot Hill Unit 2H	**Database:**	EDMOKC

Project	Washington County Pennsylvania, SW Pennsylvania		
Map System:	Universal Transverse Mercator (US Survey Fee	**System Datum:**	Mean Sea Level
Geo Datum:	NAD 1927 - Eastern US		
Map Zone:	Zone 17N (84 W to 78 W)		

Site	Hopkins Pad, Pad Center				
Site Position:		**Northing:**	14,559,794.17 ft	**Latitude:**	40° 5' 17 317 N
From:	Map	**Easting:**	1,927,276.73 ft	**Longitude:**	79° 58' 27.850 W
Position Uncertainty:	0.0 ft	**Slot Radius:**	0"	**Grid Convergence:**	0 66 °

Well	Hill Unit 2H - Slot 2,					
Well Position	**+N/-S**	0.0 ft	**Northing:**	14,559,776 34 ft	**Latitude:**	40° 5' 17 140 N
	+E/-W	0.0 ft	**Easting:**	1,927,287.78 ft	**Longitude:**	79° 58' 27 710 W
Position Uncertainty		0.0 ft	**Wellhead Elevation:**	1,175 0 ft	**Ground Level:**	1,155.0 ft

Wellbore	Directional Pilot Hill Unit 2H				
Magnetics	**Model Name**	**Sample Date**	**Declination (°)**	**Dip Angle (°)**	**Field Strength (nT)**
	IGRF200510	2009/07/31	-9.02	67.82	53,163

Design	Directional Pilot Hill Unit 2H				
Audit Notes:					
Version:	1 0	**Phase:**	ACTUAL	**Tie On Depth:**	0 0
Vertical Section:	**Depth From (TVD) (ft)**	**+N/-S (ft)**	**+E/-W (ft)**	**Direction (°)**	
	0.0	0 0	0.0	319 82	

Survey Program — **Date** 2010/04/17

From (ft)	To (ft)	Survey (Wellbore)	Tool Name	Description
100 0	6,032.0	Survey #1 Gyro (Directional Pilot Hill Unit :	KPR-SR-SS	SDC Keeper - surface ref s/s
6,129 0	7,970.0	Survey #2 SDI MWD (Directional Pilot Hill	SDI MWD	SDI MWD/Gamma

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Survey

MD (ft)	Inc (°)	Azi (azimuth) (°)	TVD (ft)	N/S (ft)	E/W (ft)	V. Sec (ft)	DLeg (°/100ft)
0.0	0.00	0.00	0 0	0.0	0 0	0 0	0.00
100 0	0 99	98.36	100 0	-0.1	0 9	-0 6	0.99
200 0	1 53	89.96	200 0	-0.3	3.0	-2.2	0.57
300.0	1 01	92.43	299 9	-0.3	5.3	-3 6	0.52
400.0	1.13	92 79	399.9	-0 4	7.1	-4.9	0.12
500 0	1 30	97.76	499 9	-0.6	9 2	-6.4	0 20
600.0	0.99	96 15	599.9	-0 8	11.2	-7.9	0 31
700 0	0.84	101 96	699.9	-1 1	12.8	-9.1	0 18
800 0	1 25	94.46	799.9	-1 3	14 6	-10 4	0.43
900 0	1 41	120.86	899 8	-2 0	16.7	-12.3	0.63
1,000.0	0.89	104 26	999.8	-2.8	18 6	-14.1	0.61

Scientific Drilling International

Survey Completion Report

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 2H - Slot 2
Project:	Washington County Pennsylvania	**TVD Reference:**	2H @ 1175 0ft
Site:	Hopkins Pad	**MD Reference:**	2H @ 1175 0ft
Well:	Hill Unit 2H	**North Reference:**	Grid
Wellbore:	Directional Pilot Hill Unit 2H	**Survey Calculation Method:**	Minimum Curvature
Design:	Directional Pilot Hill Unit 2H	**Database:**	EDMOKC

Survey

MD (ft)	Inc (°)	Azi (azimuth) (°)	TVD (ft)	N/S (ft)	E/W (ft)	V. Sec (ft)	DLeg (°/100ft)
1,100.0	0.77	108.34	1,099 8	-3 2	19.9	-15 3	0.13
1,200.0	0.65	120 06	1,199 8	-3 7	21.1	-16.4	0.19
1,300 0	0.61	115 20	1,299.8	-4.2	22.0	-17 5	0 07
1,400.0	1 59	84.21	1,399 8	-4.3	23 9	-18 7	1 11
1,500 0	0 21	92.70	1,499.8	-4 2	25 5	-19.6	1.38
1,600.0	1 57	125.44	1,599 7	-5.0	26 8	-21 1	1.40
1,700 0	0 87	95 14	1,699.7	-5 9	28.6	-23.0	0.93
1,800 0	0.83	104 98	1,799.7	-6.1	30.1	-24 1	0.15
1,900 0	0 90	107 86	1,899.7	-6.6	31 5	-25.4	0 08
2,000.0	1 42	94.22	1,999 7	-6 9	33 5	-26.9	0 59
2,100 0	1.44	94 73	2,099.6	-7.1	36.0	-28 6	0 02
2,200 0	0 99	118.88	2,199.6	-7.6	38.0	-30.3	0.67
2,300 0	1.49	77 14	2,299.6	-7 7	40.0	-31.7	1 00
2,400 0	0 94	123 33	2,399 6	-7 9	42 0	-33.1	1 08
2,500.0	0 76	155.17	2,499.6	-8.9	43.0	-34.6	0.50
2,600 0	1 03	117.46	2,599.6	-10.0	44.0	-36.0	0.63
2,700 0	1 79	127.52	2,699.5	-11.3	46.1	-38.4	0.80
2,800 0	1 72	103.95	2,799.5	-12.6	48.8	-41.1	0.72
2,900 0	0 50	139.12	2,899.5	-13.3	50.5	-42.8	1.34
3,000.0	0 65	130.09	2,999.5	-14.0	51.2	-43.8	0.17
3,100.0	0.60	131 64	3,099 4	-14.7	52.1	-44.8	0.05
3,200 0	0.89	125 72	3,199 4	-15 5	53 1	-46.1	0.30
3,300.0	1 03	118.72	3,299.4	-16.4	54.5	-47 7	0.18
3,400.0	0.91	121 70	3,399 4	-17.3	56.0	-49.3	0.13
3,500 0	0 95	118.02	3,499.4	-18.1	57 4	-50.8	0.07
3,600 0	0 89	127.82	3,599 4	-18.9	58.7	-52.4	0.17
3,700.0	0.76	110.88	3,699 4	-19 7	59 9	-53 7	0.27
3,800.0	0.83	127 54	3,799 4	-20 3	61 1	-55 0	0 24
3,900.0	0.46	133 61	3,899.4	-21.1	62 0	-56.1	0.38
4,000.0	0.37	144.05	3,999 4	-21.6	62.5	-56.8	0.12
4,100.0	1 75	154.39	4,099 3	-23.2	63.3	-58 6	1.39
4,200.0	0 30	167.62	4,199 3	-24 9	64.1	-60 3	0.46
4,300.0	0.34	186.50	4,299.3	-25.4	64.1	-60.8	0.11
4,400 0	0.38	209.70	4,399 3	-26.0	63.9	-61.1	0.15
4,500.0	0.39	184 73	4,499 3	-26 6	63 7	-61.4	0.17
4,600 0	0 42	134.05	4,599.3	-27 2	63 9	-62.0	0 35
4,700.0	0.28	184 65	4,699.3	-27.7	64.2	-62 6	0.32
4,800 0	0 30	177.34	4,799.3	-28.2	64 2	-63.0	0.04
4,900.0	1 00	89.01	4,899.3	-28 5	65 0	-63.7	1.04
5,000.0	0 33	159.70	4,999.3	-28 7	66 0	-64 5	0.94
5,100.0	0.35	138 53	5,099.3	-29.2	66.3	-65 1	0.13
5,200 0	0.28	143 13	5,199 3	-29.6	66 7	-65.7	0.07
5,300 0	0.72	126 41	5,299 3	-30.2	67 3	-66.5	0 46
5,400.0	0.74	148 04	5,399.3	-31 1	68 2	-67.8	0 27

Scientific Drilling International

Survey Completion Report

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 2H - Slot 2
Project:	Washington County Pennsylvania	**TVD Reference:**	2H @ 1175.0ft
Site:	Hopkins Pad	**MD Reference:**	2H @ 1175 0ft
Well:	Hill Unit 2H	**North Reference:**	Grid
Wellbore:	Directional Pilot Hill Unit 2H	**Survey Calculation Method:**	Minimum Curvature
Design:	Directional Pilot Hill Unit 2H	**Database:**	EDMOKC

Survey

MD (ft)	Inc (°)	Azi (azimuth) (°)	TVD (ft)	N/S (ft)	E/W (ft)	V. Sec (ft)	DLeg (°/100ft)
5,500 0	0 68	143.45	5,499.3	-32 2	68 9	-69 0	0.08
5,600 0	0 63	150 54	5,599.3	-33 1	69 5	-70.1	0 10
5,700 0	0.69	135.50	5,699 3	-34.0	70.2	-71.3	0 18
5,800.0	0 64	129 93	5,799.3	-34.8	71 0	-72 4	0.08
5,900 0	0 53	124.04	5,899 2	-35.4	71.8	-73.4	0.13
6,000 0	0.88	110 33	5,999.2	-36.0	72.9	-74 5	0 39
6,032.0	0 72	120.47	6,031 2	-36 1	73.3	-74.9	0 67
6,129.0	1.10	351.90	6,128.2	-35 5	73 7	-74 7	1.70
6,193 0	1 80	330 10	6,192.2	-34 0	73.2	-73.2	1.37
6,231 0	2 30	332.36	6,230.2	-32.9	72.5	-71.9	1 33
6,294.0	4.00	328 50	6,293 1	-29.9	70 8	-68 5	2.72
6,389 0	7.30	320 40	6,387 6	-22 4	65 2	-59 2	3.57
6,484.0	9 70	320 70	6,481 6	-11.5	56 3	-45.1	2.53
6,579.0	12.10	318.10	6,574 8	2.1	44 5	-27 2	2.58
6,641.0	14 20	314.70	6,635.2	12.3	34.8	-13 1	3.61
6,736.0	17 30	315.40	6,726 6	30.5	16 6	12.6	3.27
6,831 0	19.50	319.40	6,816 8	52.6	-3 6	42.5	2 67
6,926 0	22 70	320.70	6,905.4	78 8	-25 6	76 7	3.40
7,021.0	26 06	319.22	6,991 9	108.8	-50 8	115 9	3.59
7,114.0	28 70	320 30	7,074 5	141.5	-78 4	158.7	2.89
7,209 0	31.60	318.90	7,156 6	177.8	-109.4	206.4	3.14
7,341 0	32 10	320.05	7,268 8	230 8	-154.6	276 1	0.60
7,435 0	30 42	318 94	7,349.1	267 9	-186 3	324.8	1 89
7,528.0	29.52	318.86	7,429.7	302.9	-216.8	371.3	0.97
7,623.0	29 50	317.33	7,512 3	337.7	-248 1	418 1	0 79
7,718.0	29 07	317.50	7,595 2	371.9	-279.5	464.5	0 46
7,799 9	28.72	318 27	7,666.9	401 3	-306.1	504.1	0 62
330 Point							
7,813.0	28.67	318.40	7,678.4	406.0	-310 3	510 3	0.62
7,936.7	29 17	319 19	7,786 6	450 9	-349 7	570.1	0 51
Onondoga Target 2H							
7,940.0	29 18	319.21	7,789.6	452.2	-350 7	571 8	0 51
7,970 0	28 92	318 82	7,815 8	463 2	-360.3	586.3	1 07

Checked By: _____ Approved By: _____ Date: _____

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Antero Resources Corporation

Washington County Pennsylvania
Hopkins Pad
Hill Unit 2H - Slot 2
Horizontal Hill Unit 2H

Design: Horizontal Hill Unit 2H

Survey Completion Report

17 May, 2010

Scientific Drilling

Scientific Drilling International
Survey Completion Report

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 2H - Slot 2
Project:	Washington County Pennsylvania	**TVD Reference:**	2H @ 1175.0ft
Site:	Hopkins Pad	**MD Reference:**	2H @ 1175 0ft
Well:	Hill Unit 2H	**North Reference:**	Grid
Wellbore:	Horizontal Hill Unit 2H	**Survey Calculation Method:**	Minimum Curvature
Design:	Horizontal Hill Unit 2H	**Database:**	EDMOKC

Project	Washington County Pennsylvania, SW Pennsylvania		
Map System:	Universal Transverse Mercator (US Survey Fee	**System Datum:**	Mean Sea Level
Geo Datum:	NAD 1927 - Eastern US		
Map Zone:	Zone 17N (84 W to 78 W)		

Site	Hopkins Pad, Pad Center				
Site Position:		**Northing:**	14,559,794.17 ft	**Latitude:**	40° 5' 17 317 N
From:	Map	**Easting:**	1,927,276.73 ft	**Longitude:**	79° 58' 27 850 W
Position Uncertainty:	0 0 ft	**Slot Radius:**	0"	**Grid Convergence:**	0 66 °

Well	Hill Unit 2H - Slot 2,					
Well Position	**+N/-S**	0.0 ft	**Northing:**	14,559,776.34 ft	**Latitude:**	40° 5' 17.140 N
	+E/-W	0 0 ft	**Easting:**	1,927,287 78 ft	**Longitude:**	79° 58' 27.710 W
Position Uncertainty		0 0 ft	**Wellhead Elevation:**	1,175.0 ft	**Ground Level:**	1,155.0 ft

Wellbore	Horizontal Hill Unit 2H				
Magnetics	**Model Name**	**Sample Date**	**Declination (°)**	**Dip Angle (°)**	**Field Strength (nT)**
	IGRF200510	2009/07/31	-9 02	67.82	53,163

Design	Horizontal Hill Unit 2H				
Audit Notes:					
Version:	1.0	**Phase:**	ACTUAL	**Tie On Depth:**	7,341 0
Vertical Section:	**Depth From (TVD) (ft)**	**+N/-S (ft)**	**+E/-W (ft)**	**Direction (°)**	
	0 0	0 0	0.0	337.50	

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Survey Program **Date** 2010/05/17

From (ft)	To (ft)	Survey (Wellbore)	Tool Name	Description
100 0	6,032 0	Survey #1 Gyro (Directional Pilot Hill Unit 2	KPR-SR-SS	SDC Keeper - surface ref s/s
6,129 0	7,341 0	Survey #2 SDI MWD (Directional Pilot Hill	SDI MWD	SDI MWD/Gamma
7,435 0	11,624 0	MWD (Horizontal Hill Unit 2H)	SDI MWD	SDI MWD/Gamma

Survey

MD (ft)	Inc (°)	Azi (azimuth) (°)	TVD (ft)	N/S (ft)	E/W (ft)	V. Sec (ft)	DLeg (°/100ft)
0.0	0 00	0.00	0.0	0 0	0 0	0.0	0.00
100.0	0.99	98.36	100 0	-0.1	0 9	-0 4	0.99
200.0	1 53	89.96	200.0	-0 3	3.0	-1 4	0 57
300 0	1 01	92 43	299.9	-0 3	5.3	-2 3	0 52
400.0	1.13	92.79	399 9	-0.4	7 1	-3.1	0.12
500.0	1.30	97.76	499.9	-0.6	9 2	-4.1	0.20
600.0	0 99	96 15	599 9	-0 8	11.2	-5 0	0 31
700.0	0.84	101.96	699 9	-1.1	12 8	-5.9	0 18
800.0	1 25	94 46	799.9	-1.3	14.6	-6 8	0.43
900.0	1 41	120 86	899.8	-2 0	16 7	-8 3	0.63

Scientific Drilling International

Survey Completion Report

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 2H - Slot 2
Project:	Washington County Pennsylvania	**TVD Reference:**	2H @ 1175 0ft
Site:	Hopkins Pad	**MD Reference:**	2H @ 1175.0ft
Well:	Hill Unit 2H	**North Reference:**	Grid
Wellbore:	Horizontal Hill Unit 2H	**Survey Calculation Method:**	Minimum Curvature
Design:	Horizontal Hill Unit 2H	**Database:**	EDMOKC

Survey

MD (ft)	Inc (°)	Azi (azimuth) (°)	TVD (ft)	N/S (ft)	E/W (ft)	V. Sec (ft)	DLeg (°/100ft)
1,000 0	0 89	104.26	999.8	-2.8	18 6	-9 7	0 61
1,100.0	0.77	108 34	1,099 8	-3.2	19 9	-10 6	0.13
1,200.0	0 65	120 06	1,199 8	-3.7	21.1	-11.5	0.19
1,300 0	0 61	115 20	1,299 8	-4 2	22.0	-12 4	0 07
1,400.0	1.59	84.21	1,399.8	-4 3	23 9	-13 2	1.11
1,500.0	0.21	92.70	1,499 8	-4.2	25 5	-13.6	1 38
1,600.0	1.57	125.44	1,599.7	-5.0	26.8	-14 9	1.40
1,700.0	0.87	95.14	1,699 7	-5.9	28.6	-16 4	0.93
1,800 0	0 83	104 98	1,799.7	-6 1	30.1	-17 2	0 15
1,900.0	0.90	107.86	1,899.7	-6 6	31 5	-18 1	0.08
2,000 0	1.42	94 22	1,999.7	-6.9	33.5	-19.2	0 59
2,100.0	1.44	94 73	2,099 6	-7 1	36.0	-20 3	0.02
2,200.0	0.99	118 88	2,199.6	-7.6	38.0	-21 6	0.67
2,300.0	1.49	77.14	2,299 6	-7 7	40 0	-22 5	1.00
2,400.0	0 94	123 33	2,399.6	-7 9	42.0	-23.4	1.08
2,500.0	0.76	155 17	2,499.6	-8.9	43.0	-24.7	0.50
2,600 0	1 03	117 46	2,599.6	-10 0	44 0	-26.1	0 63
2,700.0	1.79	127.52	2,699.5	-11 3	46.1	-28 1	0.80
2,800 0	1 72	103 95	2,799 5	-12 6	48.8	-30.3	0 72
2,900.0	0.50	139 12	2,899 5	-13 3	50.5	-31.6	1.34
3,000.0	0 65	130.09	2,999.5	-14.0	51 2	-32.6	0.17
3,100 0	0 60	131.64	3,099.4	-14.7	52 1	-33 5	0.05
3,200.0	0.89	125.72	3,199 4	-15 5	53.1	-34 7	0 30
3,300.0	1.03	118 72	3,299 4	-16 4	54.5	-36 0	0.18
3,400 0	0.91	121.70	3,399.4	-17.3	56.0	-37.4	0.13
3,500.0	0 95	118.02	3,499.4	-18.1	57 4	-38.7	0.07
3,600 0	0 89	127.82	3,599.4	-18 9	58.7	-40 0	0 17
3,700.0	0 76	110.88	3,699 4	-19.7	59 9	-41 1	0.27
3,800 0	0.83	127 54	3,799 4	-20 3	61 1	-42.2	0 24
3,900.0	0.46	133 61	3,899 4	-21 1	62 0	-43.2	0.38
4,000.0	0.37	144 05	3,999.4	-21 6	62.5	-43.9	0 12
4,100.0	1.75	154.39	4,099.3	-23 2	63.3	-45 7	1.39
4,200.0	0.30	167 62	4,199 3	-24 9	64.1	-47.5	1.36
4,300 0	0 34	186.50	4,299 3	-25.4	64.1	-48.0	0.44
4,400.0	0 38	209.70	4,399 3	-26.0	63.9	-48.5	0.15
4,500 0	0 39	184 73	4,499.3	-26.6	63 7	-49 0	0.17
4,600 0	0 42	134.05	4,599.3	-27.2	63.9	-49 6	1.35
4,700.0	0.28	184.65	4,699 3	-27 7	64.2	-50.2	0.32
4,800 0	0.30	177.34	4,799 3	-28 2	64.2	-50.6	0.04
4,900 0	1.00	89 01	4,899.3	-28.5	65 0	-51.2	1 04
5,000.0	0.33	159 70	4,999.3	-28.7	66 0	-51 8	0 94
5,100.0	0 35	138.53	5,099.3	-29 2	66.3	-52.4	0.13
5,200 0	0 28	143.13	5,199.3	-29 6	66.7	-52 9	0.07
5,300.0	0.72	126 41	5,299 3	-30 2	67 3	-53.7	0 46
5,400.0	0.74	148 04	5,399 3	-31 1	68.2	-54.8	0.27

Scientific Drilling International

Survey Completion Report

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 2H - Slot 2
Project:	Washington County Pennsylvania	**TVD Reference:**	2H @ 1175.0ft
Site:	Hopkins Pad	**MD Reference:**	2H @ 1175.0ft
Well:	Hill Unit 2H	**North Reference:**	Grid
Wellbore:	Horizontal Hill Unit 2H	**Survey Calculation Method:**	Minimum Curvature
Design:	Horizontal Hill Unit 2H	**Database:**	EDMOKC

Survey

MD (ft)	Inc (°)	Azi (azimuth) (°)	TVD (ft)	N/S (ft)	E/W (ft)	V. Sec (ft)	DLeg (°/100ft)
5,500 0	0.68	143.45	5,499.3	-32.2	68.9	-56.1	0 08
5,600.0	0.63	150.54	5,599 3	-33.1	69.5	-57 2	0 10
5,700 0	0 69	135.50	5,699.3	-34.0	70 2	-58.3	0 18
5,800 0	0 64	129.93	5,799.3	-34.8	71 0	-59.3	0.08
5,900 0	0.53	124.04	5,899.2	-35 4	71 8	-60.2	0.13
6,000.0	0.88	110.33	5,999.2	-36 0	72.9	-61 1	0 39
6,032.0	0.72	120.47	6,031.2	-36.1	73 3	-61 5	0 67
6,129.0	1.10	351.90	6,128 2	-35.5	73.7	-61 0	1.70
6,193 0	1.80	330 10	6,192 2	-34.0	73.2	-59.4	1.37
6,231 0	2 30	332.36	6,230.2	-32 9	72 5	-58.1	1.33
6,294 0	4 00	328.50	6,293.1	-29 9	70 8	-54.7	2 72
6,389.0	7 30	320.40	6,387 6	-22 4	65.2	-45.6	3.57
6,484.0	9 70	320 70	6,481.6	-11.5	56 3	-32.2	2.53
6,579 0	12.10	318.10	6,574.8	2.1	44.5	-15 1	2 58
6,641.0	14 20	314.70	6,635.2	12 3	34.8	-2.0	3.61
6,736.0	17 30	315 40	6,726 6	30 5	16.6	21 8	3 27
6,831.0	19 50	319 40	6,816 8	52 6	-3.6	50 0	2.67
6,926.0	22.70	320 70	6,905 4	78.8	-25 6	82 6	3.40
7,021.0	26.06	319 22	6,991.9	108.8	-50.8	120 0	3.59
7,114.0	28.70	320 30	7,074 5	141 5	-78 4	160.7	2 89
7,209.0	31 60	318.90	7,156 6	177 8	-109 4	206 1	3.14
7,341 0	32 10	320.05	7,268.8	230 8	-154.6	272 4	0.60
7,435.0	30.42	318 94	7,349.1	267.9	-186.3	318 8	1.89
7,528 0	29.52	318.86	7,429.7	302.9	-216.8	362.8	0.97
7,529 0	29 53	318.87	7,430.5	303.2	-217 2	363.3	1.05
Tully							
7,612.0	30 19	320.02	7,502.5	334 6	-244 0	402.5	1 05
7,644 0	32 74	322 16	7,529 8	347 6	-254.5	418.6	8.70
7,676 0	34.92	322.28	7,556.4	361.7	-265.4	435 8	6.82
7,708 0	37.08	322.75	7,582.3	376.6	-276 9	453.9	6 80
7,740.0	40 27	323.47	7,607 3	392 6	-288 9	473.3	10.07
7,771.0	44 37	324.76	7,630 2	409 5	-301 1	493.6	13.52
7,797.0	47.75	325 49	7,648.2	424.9	-311.8	511 9	13.16
7,834.0	52 32	327 98	7,672 0	448.6	-327.3	539.7	13.38
7,841 0	53.22	328 42	7,676.2	453.3	-330 3	545.2	13.81
Marcellus							
7,866 0	56.45	329.91	7,690.6	470.9	-340.7	565.4	13.81
7,893.0	59.96	331 63	7,704 8	490 9	-351.9	588.2	14.08
7,895.9	60 28	331.71	7,706.3	493 1	-353.1	590 7	11.43
Landing Pt 2H							
7,929 0	63.98	332.62	7,721.8	519.0	-366 8	619.9	11 43
7,961 0	68.19	332.86	7,734.7	545.0	-380.2	649.0	13.17
7,987.0	71.79	332 60	7,743 6	566 7	-391 4	673 3	13 88
8,024.0	73 76	332 84	7,754.6	598.1	-407.6	708.6	5.36
8,056.0	73.95	333 16	7,763 5	625 5	-421 5	739.2	1.13

Scientific Drilling International

Survey Completion Report

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 2H - Slot 2
Project:	Washington County Pennsylvania	**TVD Reference:**	2H @ 1175.0ft
Site:	Hopkins Pad	**MD Reference:**	2H @ 1175.0ft
Well:	Hill Unit 2H	**North Reference:**	Grid
Wellbore:	Horizontal Hill Unit 2H	**Survey Calculation Method:**	Minimum Curvature
Design:	Horizontal Hill Unit 2H	**Database:**	EDMOKC

Survey

MD (ft)	Inc (°)	Azi (azimuth) (°)	TVD (ft)	N/S (ft)	E/W (ft)	V. Sec (ft)	DLeg (°/100ft)
8,082.0	76.04	333.56	7,770.2	648.0	-432.8	764.3	8.17
8,118.0	79.95	333.40	7,777.7	679.5	-448.5	799.4	10.87
8,149.0	82.30	333.53	7,782.5	706.9	-462.2	829.9	7.59
8,176.0	82.99	333.61	7,785.9	730.8	-474.1	856.6	2.57
8,213.0	83.20	333.89	7,790.4	763.8	-490.3	893.3	0.94
8,245.0	85.39	333.94	7,793.6	792.4	-504.3	925.1	6.85
8,271.0	88.15	333.98	7,795.0	815.7	-515.7	951.0	10.62
8,340.0	89.20	335.60	7,796.6	878.1	-545.1	1,019.9	2.80
8,367.0	89.50	335.79	7,796.9	902.7	-556.2	1,046.9	1.32
8,435.0	89.34	336.33	7,797.6	964.9	-583.8	1,114.8	0.83
8,461.0	89.26	336.22	7,797.9	988.7	-594.3	1,140.8	0.52
8,530.0	89.96	336.50	7,798.4	1,051.9	-621.9	1,209.8	1.09
8,557.0	90.30	336.67	7,798.3	1,076.6	-632.7	1,236.8	1.41
8,651.0	90.47	336.53	7,797.7	1,162.9	-670.0	1,330.8	0.23
8,746.0	90.27	335.83	7,797.1	1,249.8	-708.4	1,425.8	0.77
8,841.0	90.54	336.46	7,796.4	1,336.7	-746.8	1,520.7	0.72
8,937.0	90.54	336.26	7,795.5	1,424.6	-785.3	1,616.7	0.21
9,033.0	90.27	337.52	7,794.8	1,512.9	-823.0	1,712.7	1.34
9,128.0	90.10	338.23	7,794.5	1,600.9	-858.7	1,807.7	0.77
9,224.0	90.03	338.13	7,794.4	1,690.1	-894.4	1,903.7	0.13
9,319.0	89.93	338.58	7,794.5	1,778.4	-929.5	1,998.7	0.49
9,412.0	90.17	338.62	7,794.4	1,864.9	-963.4	2,091.7	0.26
9,506.0	90.40	338.78	7,793.9	1,952.5	-997.5	2,185.6	0.30
9,601.0	89.13	337.75	7,794.3	2,040.8	-1,032.7	2,280.6	1.72
9,695.0	89.23	337.62	7,795.6	2,127.7	-1,068.4	2,374.6	0.17
9,790.0	89.43	337.31	7,796.8	2,215.5	-1,104.8	2,469.6	0.39
9,885.0	89.73	337.27	7,797.4	2,303.1	-1,141.5	2,564.6	0.32
9,980.0	89.66	337.83	7,798.0	2,390.9	-1,177.8	2,659.6	0.59
10,075.0	89.97	338.17	7,798.3	2,479.0	-1,213.4	2,754.6	0.48
10,169.0	90.17	337.98	7,798.1	2,566.2	-1,248.5	2,848.6	0.29
10,264.0	90.20	337.53	7,797.8	2,654.1	-1,284.4	2,943.6	0.47
10,359.0	90.74	337.49	7,797.1	2,741.9	-1,320.8	3,038.6	0.57
10,453.0	89.50	338.02	7,796.9	2,828.9	-1,356.3	3,132.6	1.43
10,548.0	88.69	337.96	7,798.4	2,916.9	-1,391.9	3,227.6	0.85
10,643.0	88.86	337.65	7,800.4	3,004.9	-1,427.8	3,322.6	0.37
10,738.0	89.16	337.51	7,802.0	3,092.7	-1,464.0	3,417.5	0.35
10,833.0	89.36	337.08	7,803.3	3,180.3	-1,500.7	3,512.5	0.50
10,928.0	89.33	336.50	7,804.3	3,267.6	-1,538.1	3,607.5	0.61
11,022.0	89.60	336.33	7,805.2	3,353.8	-1,575.8	3,701.5	0.34
11,117.0	89.83	336.46	7,805.7	3,440.8	-1,613.8	3,796.5	0.28
11,211.0	88.96	336.36	7,806.7	3,527.0	-1,651.4	3,890.5	0.93
11,306.0	86.91	336.66	7,810.1	3,614.0	-1,689.3	3,985.4	2.18
11,400.0	87.65	336.79	7,814.6	3,700.3	-1,726.4	4,079.3	0.80
11,494.0	87.01	337.29	7,819.0	3,786.7	-1,763.0	4,173.1	0.86

ANTERO RESOURCES

Scientific Drilling International

Survey Completion Report

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 2H - Slot 2
Project:	Washington County Pennsylvania	**TVD Reference:**	2H @ 1175 0ft
Site:	Hopkins Pad	**MD Reference:**	2H @ 1175 0ft
Well:	Hill Unit 2H	**North Reference:**	Grid
Wellbore:	Horizontal Hill Unit 2H	**Survey Calculation Method:**	Minimum Curvature
Design:	Horizontal Hill Unit 2H	**Database:**	EDMOKC

Survey

MD (ft)	Inc (°)	Azi (azimuth) (°)	TVD (ft)	N/S (ft)	E/W (ft)	V. Sec (ft)	DLeg (°/100ft)
11,575 0	87 28	337.24	7,823.0	3,861.3	-1,794.2	4,254 0	0 34
11,624 0	87 28	337.24	7,825.3	3,906 5	-1,813 2	4,303 0	0 00
Terminus TGT Hill Unit 2H							

Design Annotations

Measured Depth (ft)	Vertical Depth (ft)	Local Coordinates +N/-S (ft)	Local Coordinates +E/-W (ft)	Comment
7,529 0	7,430.5	303.2	-217 2	Tully
7,841.0	7,676 2	453 3	-330.3	Marcellus

Checked By: _____ Approved By: _____ Date: _____

JUN 18 2010

DEP. SOUTHWEST REGION OIL & GAS

5500-FM-OG0004 Rev. 1/2010

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
OIL AND GAS MANAGEMENT PROGRAM

Well Record and Completion Report

Deviated

DEP USE ONLY	
Site ID	Primary Fac ID
Client Id	Subfacility Id

Well Operator	DEP ID#	Well API # (Permit / Reg)	Project Number	Acres
Antero Resources Appalachian Corp.	266637	37125-23880-00		

Address	Well Farm Name	Well #	Serial #
1625 17th Street	Hill Unit	2H	

City	State	Zip Code	County	Municipality
Denver	CO	80202	Washington	West Pike Run

Phone	Fax	USGS 7.5 min. quadrangle map
303-357-7310	303-357-7315	California

Check all that apply: ☒ Original Well Record ☐ Original Completion Report ☐ Amended Well Record ☐ Amended Completion Report

WELL RECORD

Well Type ☒ Gas ☐ Oil ☐ Combination Oil & Gas ☐ Injection ☐ Storage ☐ Disposal

Drilling Method ☒ Rotary – Air ☒ Rotary – Mud ☐ Cable Tool

Date Drilling Started	Date Drilling Completed	Surface Elevation	Total Depth – Driller	Total Depth - Logger
3/29/2010	5/12/2010	1196' ft.	11,624' MD ft.	11,583' MD ft.

Casing and Tubing

Cement returned on surface casing? ☐ Yes ☒ No
Cement returned on coal protective casing? ☒ Yes ☐ No ☐ N/A

Hole Size	Pipe Size	Wt.	Thread / Weld	Amount in Well (ft)	*Material Behind Pipe* Type and Amount	*Packer / Hardware / Centralizers* Type	Size	Depth	Date Run
24"	20"	133#	STC	40'	109 sx Class H				3/30/10
17-1/2"	13-3/8"	48#	STC	485'	555 sx Class H				4/2/10
12-1/4"	9-5/8"	36"	LTC	1844'	670 sx Class H				4/4/10
					170 sx Class H	Cmt Plug	300'	7832'	4/16/10
8-1/2"	5-1/2"	20#	Buttress	11,624'	Lead 1250 sx, Tail 670 sx Class H				5/10/10

COMPLETION REPORT

Perforation Record

Date	Interval Perforated From	To

Stimulation Record

Date	Interval Treated	*Fluid* Type	*Fluid* Amount	*Propping Agent* Type	*Propping Agent* Amount	Average Injection Rate

SEP 23 2010
DEP, SOUTHWEST REGION
OIL & GAS

JUN 18 2010
DEP, SOUTHWEST REGION
OIL & GAS

Natural Open Flow	Natural Rock Pressure	Hours	Days
After Treatment Open Flow	After Treatment Rock Pressure	Hours	Days

Well Service Companies -- Provide the name, address, and phone number of all well service companies involved.

Name	Address	City - State – Zip	Phone
Bronco Drilling Company, Inc.	16217 N. May Ave.	Edmond, OK 73013	405-562-4128
Scientific Drilling	421 South Eagle Lane	Oklahoma City, OK 73128	405-787-3663

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SEP 14 2010
Dept. of Environmental Protection
California District Office

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LOG OF FORMATIONS

Well API#: 37-125-23880-00

(If you will need more space than this page, please photocopy the blank form before filling it in.)

Formation Name or Type	Top (feet)	Bottom (feet)	Gas at (feet)	Oil at (feet)	Water at (fresh / brine; ft.)	Source of Data
Sand and Shale (TVD)	7227'	7506'				MWD Gamma Ray
Shale	7506'	7529'				MWD Gamma Ray
Limestone	7529'	7586'				MWD Gamma Ray
Sand and Shale	7586'	7810'				MWD Gamma Ray
Shale	7810'	7969'				MWD Gamma Ray
Limestone	7969'	8019'				Mudlogging/Lithologic Sample Description
Horizontal Marcellus Top	7841'	MD				MWD Gamma
TD (Measured Depth)		11624'				

SEP 23 2010
DEP, SOUTHWEST REGION OIL & GAS

JUN 18 2010
DEP, SOUTHWEST REGION OIL & GAS

I do hereby certify to the best of my knowledge, information and belief that the well identified on this Well Record and Completion Report has been properly cased and cemented in accordance with the requirements of 25 Pa. Code Chapter 78 and any conditions contained in the permit for this well. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Well Operator's Signature: Ashley Mihalcin

Title: Permit Representative

Date: 6/15/2010

DEP USE ONLY

Reviewed by: [illegible]

Date: 9/22/10

Comments:

5500-FM-OG0004 Rev. 1/2010

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
OIL AND GAS MANAGEMENT PROGRAM

Well Record and Completion Report

Amended

DEP USE ONLY	
Site ID	Primary Fac ID
Client Id	Subfacility Id

Well Operator	DEP ID#	Well API # (Permit / Reg)	Project Number	Acres
Antero Resources Appalachian Corp	266637	37125-23879-00		

Address	Well Farm Name	Well #	Serial #
1625 17th Street	Hill Unit	3H	

City	State	Zip Code	County	Municipality
Denver	CO	80202	Washington	West Pike Run

Phone	Fax	USGS 7 5 min quadrangle map
303-357-7310	303-357-7315	California

Check all that apply: ☐ Original Well Record ☒ Original Completion Report ☐ Amended Well Record ☐ Amended Completion Report

WELL RECORD Also complete the Log of Formations Section (page 2)

Well Type: ☐ Gas ☐ Oil ☐ Combination Oil & Gas ☐ Injection ☐ Storage ☐ Disposal

Drilling Method: ☐ Rotary – Air ☐ Rotary – Mud ☐ Cable Tool

Date Drilling Started	Date Drilling Completed	Surface Elevation	Total Depth – Driller	Total Depth - Logger
		ft	ft	ft

Casing and Tubing

Cement returned on surface casing? ☐ Yes ☐ No

Cement returned on coal protective casing? ☐ Yes ☐ No ☐ N/A

Hole Size	Pipe Size	Wt	Thread / Weld	Amount in Well (ft)	*Material Behind Pipe* Type and Amount	*Packer / Hardware / Centralizers* Type	Size	Depth	Date Run

COMPLETION REPORT

Perforation Record

Date	Interval Perforated From	To
	Please see	Attachment

Stimulation Record

Date	Interval Treated	*Fluid* Type	Amount	*Propping Agent* Type	Amount	Average Injection Rate
	Please see Attachment					

OCT 2 1 2010

DEP, SOUTHWEST REGION
OIL & GAS

Natural Open Flow	Natural Rock Pressure	Hours	Days
After Treatment Open Flow	After Treatment Rock Pressure	Hours	Days

Well Service Companies -- Provide the name, address, and phone number of all well service companies involved

Name	Name	Name
Cal Frac Well Services Corp		
Address: 717 17th Street, Suite 1445	Address	Address
City - State – Zip: Denver, CO 80202	City - State – Zip	City - State – Zip
Phone: 303-293-2931	Phone	Phone

Hill Unit 3H (API# 37-125-23879-00)
Antero Resources Appalachian Corporation

COMPLETION REPORT ATTACHMENT

Perforation Record			Stimulation Record						
Date	*Interval Perforated* From	To	Date	Interval Treated	*Fluid* Type	Amount	*Propping Agent* Type	Amount	Average Injection Rate
7/30/2010	12708'	12940'	8/26/2010	Marcellus	Water/15% HCl	6313 bbl	Sand	1694#	12.7 bbl/min
8/27/2010	12054'	12613'	8/27/2010	Marcellus	Water/15% HCl	10081 bbl	Sand	111000#	62.8 bbl/min
8/28/2010	11400'	11959'	8/28/2010	Marcellus	Water/15% HCl	9567 bbl	Sand	384300#	70 bbl/min
8/29/2010	10746'	11305'	8/28/2010	Marcellus	Water/15% HCl	8861 bbl	Sand	286285#	64.3 bbl/min
8/30/2010	10092'	10651'	8/29/2010	Marcellus	Water/15% HCl	9010 bbl	Sand	276920#	68 bbl/min
9/2/2010	9765'	9997'	8/29/2010	Marcellus	Water/15% HCl	7313 bbl	Sand	350025#	55.6 bbl/min
9/4/2010	9438'	9670'	8/30/2010	Marcellus	Water/15% HCl	8790 bbl	Sand	368100#	64.8 bbl/min
9/5/2010	9111'	9343'	8/30/2010	Marcellus	Water/15% HCl	8730 bbl	Sand	385160#	55.9 bbl/min
9/6/2010	8457'	9016'	8/30/2010	Marcellus	Water/15% HCl	6870 bbl	Sand	10000#	62 3 bbl/min
9/7/2010	8130'	8362'	9/04/2010	Marcellus	Water/15% HCl	9659 bbl	Sand	391200#	61.8 bbl/min
			9/05/2010	Marcellus	Water/15% HCl	8992 bbl	Sand	312330#	58.5 bbl/min
			9/06/2010	Marcellus	Water/15% HCl	10255 bbl	Sand	115480#	55 bbl/min
			9/06/2010	Marcellus	Water/15% HCl	9220 bbl	Sand	377940#	69.7 bbl/min
			9/07/2010	Marcellus	Water/15% HCl	8463 bbl	Sand	381630#	70.2 bbl/min
			9/08/2010	Marcellus	Water/15% HCl	7840 bbl	Sand	384060#	68.8 bbl/min

Scientific Drilling International

Survey Report - Geographic

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 3H - Slot 3
Project:	Washington County Pennsylvania	**TVD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Site:	Hopkins Pad	**MD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Well:	Hill Unit 3H	**North Reference:**	Grid
Wellbore:	Horizontal Hill Unit 3H	**Survey Calculation Method:**	Minimum Curvature
Design:	Horizontal Hill Unit 3H	**Database:**	EDMOKC

Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (ft)	Map Easting (ft)	Latitude	Longitude
10,654 0	87 01	336 71	7,809 5	3,323 6	-826 6	14,563,128 86	1,926,451 97	40° 5' 50 374 N	79° 58' 37 970 W
10,749 0	87 31	336 09	7,814 2	3,410 5	-864 6	14,563,215 81	1,926,413 98	40° 5' 51 238 N	79° 58' 38 446 W
10,844 0	86 91	336 45	7,818 9	3,497 4	-902 8	14,563,302 67	1,926,375 80	40° 5' 52 101 N	79° 58' 38 925 W
10,938 0	86 30	336 44	7,824 5	3,583 4	-940 3	14,563,388 68	1,926,338 30	40° 5' 52 955 N	79° 58' 39 395 W
11,032 0	86 34	335 97	7,830 5	3,669 2	-978 1	14,563,474 51	1,926,300 45	40° 5' 53 808 N	79° 58' 39 869 W
11,095 0	86 47	335 96	7,834 5	3,726 7	-1,003 8	14,563,531 94	1,926,274 84	40° 5' 54 378 N	79° 58' 40 190 W
11,127 0	86 20	336 28	7,836 5	3,755 9	-1,016 7	14,563,561 14	1,926,261 92	40° 5' 54 668 N	79° 58' 40 352 W
11,190 0	86 81	336 69	7,840 4	3,813 5	-1,041 8	14,563,618 80	1,926,236 83	40° 5' 55 241 N	79° 58' 40 667 W
11,221 0	86 64	336 92	7,842 2	3,842 0	-1,054 0	14,563,647 25	1,926,224 64	40° 5' 55 524 N	79° 58' 40 819 W
11,316 0	87 21	337 26	7,847 3	3,929 4	-1,090 9	14,563,734 63	1,926,187 71	40° 5' 56 392 N	79° 58' 41 282 W
11,411 0	87 78	337 77	7,851 4	4,017 0	-1,127 2	14,563,822 32	1,926,151 41	40° 5' 57 263 N	79° 58' 41 736 W
11,505 0	87 45	337 12	7,855 3	4,103 8	-1,163 2	14,563,909 05	1,926,115 39	40° 5' 58 124 N	79° 58' 42 187 W
11,578 0	88 62	337 64	7,857 8	4,171 1	-1,191 3	14,563,976 40	1,926,087 33	40° 5' 58 793 N	79° 58' 42 538 W
11,600 0	88 92	337 33	7,858 3	4,191 4	-1,199 7	14,563,996 72	1,926,078 91	40° 5' 58 995 N	79° 58' 42 643 W
11,694 0	88 92	337 01	7,860 1	4,278 1	-1,236 2	14,564,083 34	1,926,042.44	40° 5' 59 855 N	79° 58' 43 100 W
11,757 0	89 40	337 20	7,861 0	4,336 1	-1,260 7	14,564,141 37	1,926,017 93	40° 6' 0 432 N	79° 58' 43 407 W
11,789 0	89 87	337 19	7,861 2	4,365 6	-1,273 1	14,564,170 87	1,926,005 53	40° 6' 0 725 N	79° 58' 43 562 W
11,884 0	89 29	335 12	7,861 9	4,452 5	-1,311 5	14,564,257 75	1,925,967 13	40° 6' 1 588 N	79° 58' 44 043 W
11,915 0	90 13	334 67	7,862 0	4,480 5	-1,324 6	14,564,285 82	1,925,953 98	40° 6' 1 867 N	79° 58' 44 209 W
11,947 0	91 21	335 27	7,861 7	4,509 5	-1,338 2	14,564,314 81	1,925,940 44	40° 6' 2 155 N	79° 58' 44 379 W
11,978 0	91 98	335 17	7,860 8	4,537 7	-1,351 1	14,564,342 95	1,925,927 45	40° 6' 2 434 N	79° 58' 44 542 W
12,010 0	92 12	335 29	7,859 7	4,566.7	-1,364 5	14,564,371 98	1,925,914 05	40° 6' 2 723 N	79° 58' 44 710 W
12,041 0	92 18	335 27	7,858 5	4,594 8	-1,377 5	14,564,400 12	1,925,901 10	40° 6' 3 003 N	79° 58' 44 872 W
12,073 0	91 85	335 52	7,857 4	4,623 9	-1,390 8	14,564,429 20	1,925,887 78	40° 6' 3 291 N	79° 58' 45 039 W
12,104 0	90 70	335 73	7,856 7	4,652 2	-1,403 6	14,564,457 43	1,925,874 99	40° 6' 3 572 N	79° 58' 45 200 W
12,136 0	90 66	335 49	7,856 3	4,681 3	-1,416 8	14,564,486 57	1,925,861 78	40° 6' 3 862 N	79° 58' 45 366 W
12,167 0	90 60	335 71	7,856 0	4,709 5	-1,429 6	14,564,514 80	1,925,848 97	40° 6' 4 142 N	79° 58' 45 526 W
12,199 0	90 48	335 58	7,855 7	4,738 7	-1,442 8	14,564,543 95	1,925,835 78	40° 6' 4 432 N	79° 58' 45 692 W
12,262 0	90 47	336 10	7,855 1	4,796 2	-1,468 6	14,564,601 43	1,925,809 99	40° 6' 5 003 N	79° 58' 46 015 W
12,325 0	89 70	335 80	7,855 0	4,853 7	-1,494 3	14,564,658 96	1,925,784 32	40° 6' 5 574 N	79° 58' 46 337 W
12,357 0	89 26	334 74	7,855 3	4,882 8	-1,507 7	14,564,688 02	1,925,770 93	40° 6' 5 863 N	79° 58' 46 505 W
12,388 0	89 36	335 35	7,855 7	4,910 9	-1,520 7	14,564,716 13	1,925,757 85	40° 6' 6 142 N	79° 58' 46 669 W
12,451 0	90 40	335 42	7,855 8	4,968 1	-1,547 0	14,564,773 40	1,925,731 61	40° 6' 6 712 N	79° 58' 46 999 W
12,483 0	90 81	335 97	7,855 5	4,997 3	-1,560 2	14,564,802 56	1,925,718 44	40° 6' 7 001 N	79° 58' 47 164 W
12,546 0	91 11	335 70	7,854 4	5,054 8	-1,585 9	14,564,860 04	1,925,692 66	40° 6' 7 572 N	79° 58' 47 487 W
12,640 0	90 40	334 93	7,853 2	5,140 2	-1,625 2	14,564,945 44	1,925,653 40	40° 6' 8 421 N	79° 58' 47 980 W
12,734 0	88 99	334 29	7,853 7	5,225 1	-1,665 5	14,565,030 35	1,925,613 10	40° 6' 9 265 N	79° 58' 48 486 W
12,829 0	90 00	334 62	7,854 5	5,310 8	-1,706 5	14,565,116 06	1,925,572 14	40° 6' 10 117 N	79° 58' 49 001 W
12,923 0	88 93	335 50	7,855 4	5,396 0	-1,746 1	14,565,201 29	1,925,532 50	40° 6' 10 964 N	79° 58' 49 498 W
13,003 0	88 93	335 50	7,856 9	5,468 8	-1,779 3	14,565,274 08	1,925,499 33	40° 6' 11 687 N	79° 58' 49 915 W
TGT Hill Unit 3H									

Survey Annotations

Measured Depth (ft)	Vertical Depth (ft)	Local Coordinates +N/-S (ft)	Local Coordinates +E/-W (ft)	Comment
7,710 0	7,595 0	618 9	243 6	Marcellus
7,860 0	7,670 5	740 3	199 4	Onondaga

Checked By: _____ Approved By: _____ Date: _____

Appendix H: 3H Well Completion Report

5500-FM-OG0004 Rev. 1/2010

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

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DEPARTMENT OF ENVIRONMENTAL PROTECTION
OIL AND GAS MANAGEMENT PROGRAM

LOG

Well Record and Completion Report

DEP USE ONLY	
Site ID	Primary Fac ID
Client Id	Subfacility Id

Well Operator	DEP ID#	Well API # (Permit / Reg)	Project Number	Acres
Antero Resources Appalachian Corp.	266637	37125-23879-00		

Address	Well Farm Name	Well #	Serial #
1625 17th Street	Hill Unit	3H	

City	State	Zip Code	County	Municipality
Denver	CO	80202	Washington	West Pike Run

Phone	Fax	USGS 7.5 min. quadrangle map
303-357-7310	303-357-7315	California

Check all that apply: ☒ Original Well Record ☐ Original Completion Report ☐ Amended Well Record ☐ Amended Completion Report

Well Type	☒ Gas	☐ Oil	☐ Combination Oil & Gas	☐ Injection	☐ Storage ☐ Disposal
Drilling Method	☒ Rotary – Air	☒ Rotary – Mud	☐ Cable Tool		

Date Drilling Started	Date Drilling Completed	Surface Elevation	Total Depth – Driller	Total Depth - Logger
1/25/2010	3/29/2010	1165' ft.	13,003' MD ft.	8003' MD ft.

Casing and Tubing

Cement returned on surface casing? ☐ Yes ☒ No
Cement returned on coal protective casing? ☐ Yes ☒ No ☐ N/A

Hole Size	Pipe Size	Wt.	Thread / Weld	Amount in Well (ft)	*Material Behind Pipe* Type and Amount	*Packer / Hardware / Centralizers* Type	Size	Depth	Date Run
24"	20"	133#	STC	40'	26 sacks Class H				1/25/10
17-1/2"	13-3/8"	48#	STC	479'	530 sacks Class H				2/12/10
12-1/4"	9-5/8"	36"	LTC	1834'	635 sacks Class A				2/15/10
					165 sacks Class H	Cmt Plug	300'	7507'	2/28/10
8-1/2"	5-1/2"	20#	Buttress	13003'	Lead 1290 sacks, Tail 860 Class H				3/27/10

Perforation Record

Date	Interval Perforated From	To

Stimulation Record

Date	Interval Treated	*Fluid* Type	Amount	*Propping Agent* Type	Amount	Average Injection Rate

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Natural Open Flow	Natural Rock Pressure	Hours	Days
After Treatment Open Flow	After Treatment Rock Pressure	Hours	Days

Well Service Companies -- Provide the name, address, and phone number of all well service companies involved.

Name	Address	City - State – Zip	Phone
Bronco Drilling Company, Inc.	16217 N. May Ave.	Edmond, OK 73013	405-562-4128
Weatherford Wireline Services	777 N. River Avenue	Weston, WV 26452	304-269-2009
Scientific Drilling	421 South Eagle Lane	Oklahoma City, OK 73128	405-787-3663

- 1 -

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LOG OF FORMATIONS

Well API#: 37-125-23879-00

(If you will need more space than this page, please photocopy the blank form before filling it in.)

Formation Name or Type	Top (feet)	Bottom (feet)	Gas at (feet)	Oil at (feet)	Water at (fresh / brine; ft.)	Source of Data
Sand (all tops in TVD)	1815'	1871'				Geophysical Log
Shale	1871'	1920'				Geophysical Log
Sand	1920'	1948'				Geophysical Log
Shale	1948'	1958'				Geophysical Log
Sand	1958'	2037'				Geophysical Log
Sand and Shale	2037'	2282'				Geophysical Log
Sand	2282'	2300'				Geophysical Log
Shale	2300'	2330'				Geophysical Log
Sand	2330'	2359'				Geophysical Log
Shale	2359'	2363'				Geophysical Log
Sand and Shale	2363'	2442'				Geophysical Log
Shale	2442'	2507'				Geophysical Log
Sand and Shale	2507'	2573'				Geophysical Log
Sand and Shale	2573'	2790'				Geophysical Log
Shale	2790'	2887'				Geophysical Log
Sand	2887'	2895'				Geophysical Log
Shale	2895'	2902'				Geophysical Log
Sand	2902'	2907'				Geophysical Log
Shale	2907'	3296'				Geophysical Log
Sand and Shale	3296'	3590'				Geophysical Log
Sand	3590'	3606'				Geophysical Log
Shale	3606'	3702'				Geophysical Log
Sand and Shale	3702'	3943'				Geophysical Log
Shale	3943'	4118'				Geophysical Log
Sand and Shale	4118'	4343'				Geophysical Log
Shale	4343'	4587'				Geophysical Log
Sand and Shale	4587'	4622'				Geophysical Log
Shale	4622'	4753'				Geophysical Log
Sand and Shale	4753'	4840'				Geophysical Log
Shale	4840'	5080'				Geophysical Log
Sand and Shale	5080'	5160'				Geophysical Log
Shale	5160'	5366'				Geophysical Log
Sand	5366'	5371'				Geophysical Log
Shale	5371'	5429'				Geophysical Log
Sand and Shale	5429'	5581'				Geophysical Log
Shale	5581'	6159'				Geophysical Log
Sand and Shale	6159'	6178'				Geophysical Log
Shale	6178'	6636'				Geophysical Log
Continued on 2nd Page						

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I do hereby certify to the best of my knowledge, information and belief that the well identified on this Well Record and Completion Report has been properly cased and cemented in accordance with the requirements of 25 Pa. Code Chapter 78 and any conditions contained in the permit for this well. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Well Operator's Signature	DEP USE ONLY
Ashley Mihalcin	Reviewed by: Date:
Title: Permit Representative	Date: 5/5/2010
	Comments:

Scientific Drilling International

Survey Report - Geographic

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 3H - Slot 3
Project:	Washington County Pennsylvania	**TVD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Site:	Hopkins Pad	**MD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Well:	Hill Unit 3H	**North Reference:**	Grid
Wellbore:	Horizontal Hill Unit 3H	**Survey Calculation Method:**	Minimum Curvature
Design:	Horizontal Hill Unit 3H	**Database:**	EDMOKC

Project	Washington County Pennsylvania, SW Pennsylvania		
Map System:	Universal Transverse Mercator (US Survey Fee	**System Datum:**	Mean Sea Level
Geo Datum:	NAD 1927 - Eastern US		
Map Zone:	Zone 17N (84 W to 78 W)		

Site	Hopkins Pad, Pad Center				
Site Position:		**Northing:**	14,559,794 17 ft	**Latitude:**	40° 5' 17 317 N
From:	Map	**Easting:**	1,927,276 73 ft	**Longitude:**	79° 58' 27 850 W
Position Uncertainty:	0 0 ft	**Slot Radius:**	0 "	**Grid Convergence:**	0 66 °

Well	Hill Unit 3H - Slot 3					
Well Position	**+N/-S**	0 0 ft	**Northing:**	14,559,805 27 ft	**Latitude:**	40° 5' 17 427 N
	+E/-W	0 0 ft	**Easting:**	1,927,278 60 ft	**Longitude:**	79° 58' 27 824 W
Position Uncertainty		0 0 ft	**Wellhead Elevation:**	1,196 0 ft	**Ground Level:**	1,170 0 ft

Wellbore	Horizontal Hill Unit 3H				
Magnetics	**Model Name**	**Sample Date**	**Declination (°)**	**Dip Angle (°)**	**Field Strength (nT)**
	IGRF2010	02/09/10	-9 08	67 74	53,130

Design	Horizontal Hill Unit 3H				
Audit Notes:					
Version:	1 0	**Phase:**	ACTUAL	**Tie On Depth:**	7,187 0
Vertical Section:	**Depth From (TVD) (ft)**	**+N/-S (ft)**	**+E/-W (ft)**	**Direction (°)**	
	0 0	0 0	0 0	336 12	

Survey Program **Date** 03/31/10

From (ft)	To (ft)	Survey (Wellbore)	Tool Name	Description
50 0	4,090 0	Survey #1 Gyro (Directional Pilot Hill Unit 1	GYD-GC-SS	Gyrodata gyro single shots
4,112 0	7,187 0	Survey #2 MWD (Directional Pilot Hill Unit	SDI MWD	SDI MWD/Gamma
7,246 0	13,003 0	Survey #1 MWD (Horizontal Hill Unit 3H)	SDI MWD	SDI MWD/Gamma

Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (ft)	Map Easting (ft)	Latitude	Longitude
7,187 0	12 10	37 70	7,144 3	405 3	307 2	14,560,210 53	1,927,585 79	40° 5' 21 398 N	79° 58' 23 811 W
7,246 0	11 95	37 50	7,202 0	415 0	314 7	14,560,220 27	1,927,593 29	40° 5' 21 493 N	79° 58' 23 713 W
7,278 0	11 87	28 75	7,233 3	420 5	318 3	14,560,225 78	1,927,596 89	40° 5' 21 547 N	79° 58' 23 665 W
7,310 0	12 66	15 57	7,264 6	426 8	320 8	14,560,232 05	1,927,599 41	40° 5' 21 609 N	79° 58' 23 632 W
7,342 0	14 78	0 08	7,295 7	434 2	321 8	14,560,239 51	1,927,600 36	40° 5' 21 683 N	79° 58' 23 619 W
7,373 0	17 67	348 23	7,325 5	442 8	320 8	14,560,248 07	1,927,599 41	40° 5' 21 767 N	79° 58' 23 630 W
7,405 0	20 61	341 60	7,355 7	452 9	318 0	14,560,258 18	1,927,596 64	40° 5' 21 868 N	79° 58' 23 664 W
7,437 0	23 59	337 87	7,385 3	464 2	313 8	14,560,269 46	1,927,592 45	40° 5' 21 980 N	79° 58' 23 716 W
7,468 0	27 24	335 33	7,413 3	476 4	308 5	14,560,281 65	1,927,587 15	40° 5' 22 101 N	79° 58' 23 782 W
7,499 0	30 95	333 82	7,440 4	490 0	302 1	14,560,295 26	1,927,580 67	40° 5' 22 236 N	79° 58' 23 864 W

Scientific Drilling International

Survey Report - Geographic

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 3H - Slot 3
Project:	Washington County Pennsylvania	**TVD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Site:	Hopkins Pad	**MD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Well:	Hill Unit 3H	**North Reference:**	Grid
Wellbore:	Horizontal Hill Unit 3H	**Survey Calculation Method:**	Minimum Curvature
Design:	Horizontal Hill Unit 3H	**Database:**	EDMOKC

Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (ft)	Map Easting (ft)	Latitude	Longitude
7,531 0	34 40	333 50	7,467 3	505 5	294 4	14,560,310 74	1,927,573 00	40° 5' 22 390 N	79° 58' 23 960 W
7,563 0	38 16	333 29	7,493 1	522 4	285 9	14,560,327 66	1,927,564 52	40° 5' 22 558 N	79° 58' 24 067 W
7,595 0	41 59	333 56	7,517 7	540 7	276 7	14,560,346 01	1,927,555 34	40° 5' 22 741 N	79° 58' 24 182 W
7,627 0	45 11	335 13	7,541 0	560 5	267 2	14,560,365 81	1,927,545 84	40° 5' 22 937 N	79° 58' 24 301 W
7,641 0	46 73	336 36	7,550 7	569 7	263 1	14,560,374 97	1,927,541 72	40° 5' 23 028 N	79° 58' 24 353 W
Landing Pt 3H									
7,658 0	48.72	337 78	7,562 1	581 3	258 2	14,560,386 57	1,927,536 82	40° 5' 23 144 N	79° 58' 24 415 W
7,690 0	51 35	339 09	7,582 7	604 1	249 2	14,560,409 37	1,927,527 81	40° 5' 23 370 N	79° 58' 24 527 W
7,710 0	52 95	339 14	7,595 0	618 9	243 6	14,560,424 13	1,927,522 18	40° 5' 23 517 N	79° 58' 24 597 W
Marcellus									
7,721 0	53 83	339 16	7,601 5	627 1	240 4	14,560,432 38	1,927,519 04	40° 5' 23 598 N	79° 58' 24 637 W
7,753 0	57 20	338 89	7,619 6	651 7	231 0	14,560,457 00	1,927,509 59	40° 5' 23 843 N	79° 58' 24 754 W
7,785 0	59 91	339 43	7,636 3	677 2	221 3	14,560,482 52	1,927,499 88	40° 5' 24 096 N	79° 58' 24 876 W
7,816 0	62 38	340 57	7,651 3	702 8	212 0	14,560,508 03	1,927,490 60	40° 5' 24 349 N	79° 58' 24 991 W
7,848 0	64 98	341 82	7,665 5	729 9	202 8	14,560,535 18	1,927,481 36	40° 5' 24 619 N	79° 58' 25 106 W
7,860 0	65 84	342 12	7,670 5	740 3	199 4	14,560,545 56	1,927,477 98	40° 5' 24 722 N	79° 58' 25 148 W
Onondaga									
7,880 0	67 27	342 61	7,678 4	757 8	193 8	14,560,563 04	1,927,472 43	40° 5' 24 895 N	79° 58' 25 217 W
7,912 0	68 97	343 01	7,690 4	786 1	185 1	14,560,591 41	1,927,463 65	40° 5' 25 177 N	79° 58' 25 326 W
7,944 0	69 47	343 22	7,701 7	814 8	176 4	14,560,620 04	1,927,454 96	40° 5' 25 461 N	79° 58' 25 433 W
7,976 0	71 21	343 15	7,712 5	843 6	167 6	14,560,648 88	1,927,446 24	40° 5' 25 747 N	79° 58' 25 541 W
8,008 0	73 64	342 74	7,722 1	872 8	158 7	14,560,678 04	1,927,437 30	40° 5' 26 036 N	79° 58' 25 652 W
8,040 0	76 24	342 70	7,730 4	902 3	149 5	14,560,707 55	1,927,428 12	40° 5' 26 329 N	79° 58' 25 766 W
8,072 0	78 70	342 79	7,737 4	932 1	140 3	14,560,737 38	1,927,418 85	40° 5' 26 625 N	79° 58' 25 881 W
8,104 0	81 28	342 66	7,742 9	962 2	130 9	14,560,767 47	1,927,409 50	40° 5' 26 923 N	79° 58' 25 997 W
8,136 0	85 21	342 43	7,746 7	992 5	121 4	14,560,797 78	1,927,399 96	40° 5' 27 224 N	79° 58' 26 115 W
8,186 0	88 09	341 09	7,749 6	1,039 9	105 7	14,560,845 18	1,927,384 34	40° 5' 27 694 N	79° 58' 26 309 W
8,282 0	87 05	338 19	7,753 7	1,129 8	72 4	14,560,935 09	1,927,350 98	40° 5' 28 587 N	79° 58' 26 725 W
8,346 0	88 90	338 83	7,756 0	1,189 3	49 0	14,560,994 60	1,927,327 55	40° 5' 29 178 N	79° 58' 27 017 W
8,378 0	89 06	338 96	7,756 5	1,219 2	37 4	14,561,024 45	1,927,316 03	40° 5' 29 474 N	79° 58' 27 161 W
8,473 0	89 43	339 08	7,757 8	1,307 9	3 4	14,561,113 14	1,927,282 02	40° 5' 30 355 N	79° 58' 27 586 W
8,569 0	88 89	337 32	7,759 2	1,397 0	-32 2	14,561,202 26	1,927,246 37	40° 5' 31 240 N	79° 58' 28 031 W
8,664 0	88 32	337 13	7,761 5	1,484 6	-69 0	14,561,289 83	1,927,209 61	40° 5' 32 109 N	79° 58' 28 492 W
8,759 0	88 93	337 80	7,763 8	1,572 3	-105 4	14,561,377 55	1,927,173 21	40° 5' 32 981 N	79° 58' 28.947 W
8,854 0	89 40	338 50	7,765 2	1,660 4	-140 7	14,561,465 71	1,927,137 86	40° 5' 33 856 N	79° 58' 29 389 W
8,950 0	89 29	337 79	7,766 3	1,749 5	-176 5	14,561,554 81	1,927,102 12	40° 5' 34 741 N	79° 58' 29 836 W
9,046 0	89 26	338 64	7,767.5	1,838 7	-212 1	14,561,643 94	1,927,066 50	40° 5' 35 626 N	79° 58' 30 281 W
9,141 0	89 50	338 82	7,768 5	1,927 2	-246 6	14,561,732 47	1,927,032 04	40° 5' 36 505 N	79° 58' 30 711 W
9,235 0	90 20	339 06	7,768 8	2,014 9	-280 3	14,561,820 19	1,926,998 26	40° 5' 37 376 N	79° 58' 31 133 W
9,328 0	88 96	337 88	7,769 4	2,101 4	-314 5	14,561,906 69	1,926,964 13	40° 5' 38 235 N	79° 58' 31 559 W
9,423 0	88 42	337 59	7,771 6	2,189 3	-350 5	14,561,994 59	1,926,928 15	40° 5' 39 108 N	79° 58' 32 009 W
9,518 0	88 56	337 07	7,774 1	2,276 9	-387 1	14,562,082 22	1,926,891 54	40° 5' 39 978 N	79° 58' 32 468 W
9,612 0	88 76	337 19	7,776 3	2,363 5	-423 6	14,562,168 80	1,926,855 02	40° 5' 40 838 N	79° 58' 32 925 W
9,707 0	88 99	337 44	7,778 2	2,451 2	-460 2	14,562,256 44	1,926,818 39	40° 5' 41 709 N	79° 58' 33 383 W
9,802 0	89 46	337 31	7,779 5	2,538 8	-496 8	14,562,344 12	1,926,781 85	40° 5' 42 579 N	79° 58' 33 841 W
9,897 0	89 83	338 01	7,780 1	2,626 7	-532 9	14,562,431 98	1,926,745 74	40° 5' 43 452 N	79° 58' 34 292 W
9,992 0	89 43	337 88	7,780 7	2,714 8	-568 5	14,562,520 03	1,926,710 07	40° 5' 44 326 N	79° 58' 34 738 W
10,087 0	89 09	336 98	7,781 9	2,802 5	-605 0	14,562,607 75	1,926,673 61	40° 5' 45 198 N	79° 58' 35 195 W
10,119 0	87 92	337 27	7,782 7	2,831 9	-617 4	14,562,637 22	1,926,661 17	40° 5' 45 490 N	79° 58' 35 350 W
10,182 0	87 48	337 56	7,785 3	2,890 1	-641 6	14,562,695 34	1,926,637 00	40° 5' 46 068 N	79° 58' 35 653 W
10,245 0	88 05	336 93	7,787 7	2,948 1	-665 9	14,562,753 39	1,926,612 65	40° 5' 46 644 N	79° 58' 35 958 W
10,276 0	87 75	337 61	7,788 8	2,976 7	-677 9	14,562,781 97	1,926,600 68	40° 5' 46 928 N	79° 58' 36 107 W
10,371 0	86 54	336 77	7,793 6	3,064 2	-714 7	14,562,869 42	1,926,563 90	40° 5' 47 797 N	79° 58' 36 568 W
10,465 0	86 84	336 22	7,799 0	3,150 2	-752 1	14,562,955 48	1,926,526 47	40° 5' 48 652 N	79° 58' 37 037 W
10,560 0	86 74	337 03	7,804 3	3,237 3	-789 8	14,563,042 55	1,926,488 84	40° 5' 49 517 N	79° 58' 37 508 W

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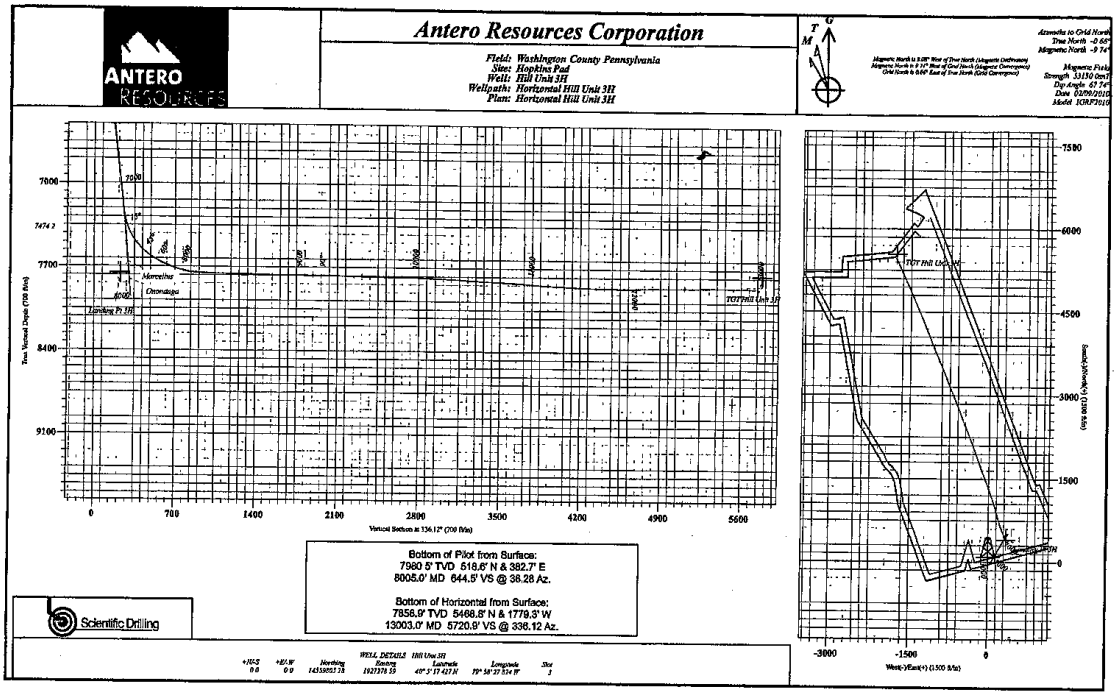

5500-FM-OG0004 Rev. 1/2010

LOG OF FORMATIONS

Well API#: 37-125-23879-00

(If you will need more space then this page, please photocopy the blank form before filling it in.)

Formation Name or Type	Top (feet)	Bottom (feet)	Gas at (feet)	Oil at (feet)	Water at (fresh / brine; ft.)	Source of Data
Sand and Shale	6636'	6640'				Geophysical Log
Shale	6640'	7000'				Geophysical Log
Sand and Shale	7000'	7207'				Geophysical Log
Shale	7207'	7212'				Geophysical Log
Sand and Shale	7212'	7401'				Geophysical Log
Shale	7401'	7420'				Geophysical Log
Limestone	7420'	7468'				Geophysical Log
Sand and Shale	7468'	7659'				Geophysical Log
Shale	7659'	7808'				Geophysical Log
Limestone	7808'	7822'				Geophysical Log
Chert	7822'					Geophysical Log
Horizontal Marcellus Top	7835'	MD				Geophysical Log
TD (Measured Depth)		13003'				

RECEIVED
MAY 19 2010
DEP, SOUTHWEST REGION
OIL & GAS

I do hereby certify to the best of my knowledge, information and belief that the well identified on this Well Record and Completion Report has been properly cased and cemented in accordance with the requirements of 25 Pa. Code Chapter 78 and any conditions contained in the permit for this well. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Well Operator Signature	DEP USE ONLY
Ashley Mihalcin	Reviewed by: Date:
Title: Permit Representative Date: 5/5/2010	Comments:

ANTERO RESOURCES

Scientific Drilling International

Survey Report

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 3H - Slot 3
Project:	Washington County Pennsylvania	**TVD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Site:	Hopkins Pad	**MD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Well:	Hill Unit 3H	**North Reference:**	Grid
Wellbore:	Directional Pilot Hill Unit 3H	**Survey Calculation Method:**	Minimum Curvature
Design:	Directional Pilot Hill Unit 3H	**Database:**	EDMOKC

Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
5,001 0	8 00	31 30	4,993 2	76 4	105 2	123 8	1 28	-1 26	-1 26
5,095 0	9 30	30 80	5,086 1	88 5	112 5	137 9	1 39	1 38	-0 53
5,285 0	9 90	35 00	5,273 4	115 1	129 7	169 5	0 49	0 32	2 21
5,476 0	8 70	27 20	5,461 9	141 4	145 7	200 2	0 91	-0 63	-4 08
5,663 0	9 00	31 60	5,646 7	166 4	159 8	228 7	0 40	0 16	2 35
5,854 0	9 60	32 30	5,835 2	192 6	176 2	259 5	0 32	0 31	0 37
6,045 0	9 00	30 60	6,023 7	218 9	192 3	290 3	0.35	-0 31	-0 89
6,233 0	10 40	31 00	6,209 0	246 1	208 5	321 8	0 75	0 74	0 21
6,424 0	10 40	31 00	6,396 8	275 7	226 3	356 1	0.00	0 00	0 00
6,614 0	10 50	28 80	6,583 7	305 5	243 5	390 4	0 22	0 05	-1 16
6,805 0	12 10	33 00	6,771 0	337 6	262 7	427 6	0 94	0 84	2 20
6,997 0	12 40	31 30	6,958 6	372 1	284 4	468 2	0 24	0 16	-0 89
7,187 0	12 10	37 70	7,144 3	405 3	307 2	508 5	0 73	-0 16	3 37
7,283 0	11 10	36 70	7,238 3	420 6	318 9	527 8	1 06	-1 04	-1 04
7,378 0	10 30	34 60	7,331 7	434 9	329 2	545 4	0 94	-0 84	-2 21
7,568 0	8 90	32 20	7,519 0	461 4	346 6	577 0	0 77	-0 74	-1 26
7,710 0	8 90	32 20	7,659 3	480 0	358 3	599 0	0 00	0 00	0 00
Marcellus									
7,752 7	8 90	32 20	7,701 5	485 6	361 9	605 5	0 00	0 00	0 00
Onondoga Target 3H									
7,860 0	8 90	32 20	7,807 5	499 6	370 7	622 1	0 00	0 00	0 00
Onondaga									
8,005 0	8 90	32 20	7,950 8	518 6	382 7	644 5	0 00	0 00	0 00

Survey Annotations

Measured Depth (ft)	Vertical Depth (ft)	Local Coordinates +N/-S (ft)	Local Coordinates +E/-W (ft)	Comment
7,710 0	7,659 3	480 0	358 3	Marcellus
7,860 0	7,807 5	499 6	370 7	Onondaga

Checked By: _____ Approved By: _____ Date: _____

Antero Resources Corporation

Washington County Pennsylvania
Hopkins Pad
Hill Unit 3H - Slot 3

Horizontal Hill Unit 3H

Survey: Survey #1 MWD

Standard Survey Report

31 March, 2010

Scientific Drilling

ANTERO RESOURCES

Antero Resources Corporation

Washington County Pennsylvania
Hopkins Pad
Hill Unit 3H - Slot 3

Directional Pilot Hill Unit 3H

Design: Directional Pilot Hill Unit 3H

Survey Report - Geographic

31 March, 2010

Scientific Drilling

Scientific Drilling International

Survey Report - Geographic

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 3H - Slot 3
Project:	Washington County Pennsylvania	**TVD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Site:	Hopkins Pad	**MD Reference:**	WELL @ 1196.0ft (Original Well Elev)
Well:	Hill Unit 3H	**North Reference:**	Grid
Wellbore:	Directional Pilot Hill Unit 3H	**Survey Calculation Method:**	Minimum Curvature
Design:	Directional Pilot Hill Unit 3H	**Database:**	EDMOKC

Project	Washington County Pennsylvania, SW Pennsylvania		
Map System:	Universal Transverse Mercator (US Survey Fee	**System Datum:**	Mean Sea Level
Geo Datum:	NAD 1927 - Eastern US		
Map Zone:	Zone 17N (84 W to 78 W)		

Site	Hopkins Pad, Pad Center				
Site Position:		**Northing:**	14,559,794 17 ft	**Latitude:**	40° 5' 17 317 N
From:	Map	**Easting:**	1,927,276 73 ft	**Longitude:**	79° 58' 27 850 W
Position Uncertainty:	0 0 ft	**Slot Radius:**	0 "	**Grid Convergence:**	0 66 °

Well	Hill Unit 3H - Slot 3					
Well Position	**+N/-S**	0 0 ft	**Northing:**	14,559,805 27 ft	**Latitude:**	40° 5' 17 427 N
	+E/-W	0 0 ft	**Easting:**	1,927,278 60 ft	**Longitude:**	79° 58' 27 824 W
Position Uncertainty		0 0 ft	**Wellhead Elevation:**	1,196 0 ft	**Ground Level:**	1,170 0 ft

Wellbore	Directional Pilot Hill Unit 3H				
Magnetics	**Model Name**	**Sample Date**	**Declination (°)**	**Dip Angle (°)**	**Field Strength (nT)**
	IGRF2010	07/30/09	-9 07	67 79	53,195

Design	Directional Pilot Hill Unit 3H					
Audit Notes:						
Version:	1 0	**Phase:**	ACTUAL	**Tie On Depth:**		0 0
Vertical Section:	**Depth From (TVD) (ft)**	**+N/-S (ft)**	**+E/-W (ft)**	**Direction (°)**		
	0 0	0 0	0 0	36 28		

Survey Program **Date** 03/31/10

From (ft)	To (ft)	Survey (Wellbore)	Tool Name	Description
50 0	4,090 0	Survey #1 Gyro (Directional Pilot Hill Unit	GYD-GC-SS	Gyrodata gyro single shots
4,112 0	8,005 0	Survey #2 MWD (Directional Pilot Hill Unit	SDI MWD	SDI MWD/Gamma

Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (ft)	Map Easting (ft)	Latitude	Longitude
0 0	0 00	0 00	0 0	0 0	0 0	14,559,805 27	1,927,278 60	40° 5' 17 427 N	79° 58' 27 824 W
50 0	0 13	42 98	50 0	0 0	0 0	14,559,805 32	1,927,278 64	40° 5' 17 428 N	79° 58' 27 823 W
100 0	0 41	84 96	100 0	0 1	0 3	14,559,805 37	1,927,278 85	40° 5' 17 428 N	79° 58' 27 821 W
150 0	0 55	94 16	150 0	0 1	0 7	14,559,805 37	1,927,279 27	40° 5' 17 428 N	79° 58' 27 815 W
200 0	0 70	90 55	200 0	0 1	1 2	14,559,805 35	1,927,279 82	40° 5' 17 428 N	79° 58' 27 808 W
250 0	0 68	90 37	250 0	0 1	1 8	14,559,805 35	1,927,280 42	40° 5' 17 428 N	79° 58' 27 800 W
300 0	0 62	89 73	300 0	0 1	2 4	14,559,805 35	1,927,280 99	40° 5' 17 428 N	79° 58' 27 793 W
350 0	0 52	66 55	350 0	0 2	2 9	14,559,805 44	1,927,281 46	40° 5' 17 428 N	79° 58' 27 787 W
400 0	0 59	47 94	400 0	0 4	3 3	14,559,805 70	1,927,281 86	40° 5' 17 431 N	79° 58' 27 782 W
450 0	0 53	47 42	450 0	0 8	3 6	14,559,806 03	1,927,282 22	40° 5' 17 434 N	79° 58' 27 777 W
500 0	0 56	54 16	500 0	1 1	4 0	14,559,806 33	1,927,282 59	40° 5' 17 437 N	79° 58' 27 772 W

ANTERO RESOURCES

Scientific Drilling International

Survey Report Geographic

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 3H - Slot 3
Project:	Washington County Pennsylvania	**TVD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Site:	Hopkins Pad	**MD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Well:	Hill Unit 3H	**North Reference:**	Grid
Wellbore:	Directional Pilot Hill Unit 3H	**Survey Calculation Method:**	Minimum Curvature
Design:	Directional Pilot Hill Unit 3H	**Database:**	EDMOKC

Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (ft)	Map Easting (ft)	Latitude	Longitude
550 0	0 53	59 98	550 0	1 3	4 4	14,559,806 59	1,927,282 99	40° 5' 17 440 N	79° 58' 27 767 W
600 0	0 52	64 00	600 0	1 5	4 8	14,559,806 80	1,927,283 40	40° 5' 17 442 N	79° 58' 27 762 W
650 0	0 52	70 77	650 0	1 7	5 2	14,559,806 98	1,927,283 81	40° 5' 17 443 N	79° 58' 27 757 W
700 0	0 46	64 91	700 0	1 9	5 6	14,559,807 14	1,927,284 21	40° 5' 17 445 N	79° 58' 27 751 W
750 0	0 40	74 92	750 0	2 0	6 0	14,559,807 27	1,927,284 56	40° 5' 17 446 N	79° 58' 27 747 W
800 0	0 44	74 80	800 0	2 1	6 3	14,559,807 36	1,927,284 91	40° 5' 17 447 N	79° 58' 27 742 W
850 0	0 38	74 26	850.0	2 2	6 7	14,559,807 46	1,927,285 26	40° 5' 17 448 N	79° 58' 27 738 W
900 0	0 35	72 55	900 0	2 3	7 0	14,559,807 55	1,927,285 56	40° 5' 17 449 N	79° 58' 27 734 W
950 0	0 41	83 51	950 0	2 3	7 3	14,559,807 61	1,927,285 89	40° 5' 17 449 N	79° 58' 27 730 W
1,000 0	0 39	85 84	1,000 0	2 4	7 6	14,559,807 65	1,927,286 23	40° 5' 17 450 N	79° 58' 27 725 W
1,050 0	0 54	88 75	1,050 0	2 4	8 0	14,559,807 66	1,927,286 64	40° 5' 17 450 N	79° 58' 27 720 W
1,100 0	0 61	87 46	1,100 0	2 4	8 5	14,559,807 68	1,927,287 14	40° 5' 17 450 N	79° 58' 27 714 W
1,150 0	0 69	83 30	1,150 0	2 5	9 1	14,559,807 73	1,927,287 71	40° 5' 17 450 N	79° 58' 27 706 W
1,200 0	0 49	110 36	1,200 0	2 4	9 6	14,559,807 69	1,927,288 21	40° 5' 17 450 N	79° 58' 27 700 W
1,250 0	0 53	108 43	1,250 0	2 3	10 0	14,559,807 54	1,927,288 63	40° 5' 17 448 N	79° 58' 27 695 W
1,300 0	0 50	108 69	1,299 9	2 1	10 5	14,559,807 40	1,927,289 05	40° 5' 17 447 N	79° 58' 27 689 W
1,350 0	0 69	95 75	1,349 9	2 0	11 0	14,559,807 30	1,927,289 56	40° 5' 17 446 N	79° 58' 27 683 W
1,400 0	0 65	94 02	1,399 9	2 0	11 5	14,559,807 25	1,927,290 14	40° 5' 17 445 N	79° 58' 27 675 W
1,450 0	0 69	95 70	1,449 9	1 9	12 1	14,559,807 20	1,927,290 72	40° 5' 17 445 N	79° 58' 27 668 W
1,500 0	0 65	100 00	1,499 9	1 8	12 7	14,559,807 12	1,927,291 30	40° 5' 17 444 N	79° 58' 27 660 W
1,550 0	0 66	94 86	1,549 9	1 8	13 3	14,559,807 05	1,927,291 87	40° 5' 17 443 N	79° 58' 27 653 W
1,600 0	0 66	87 42	1,599 9	1 8	13 8	14,559,807 03	1,927,292 44	40° 5' 17 443 N	79° 58' 27 645 W
1,650 0	0 73	85 93	1,649 9	1 8	14 4	14,559,807 07	1,927,293 05	40° 5' 17 443 N	79° 58' 27 638 W
1,700 0	0 74	87 50	1,699 9	1 8	15 1	14,559,807 11	1,927,293 69	40° 5' 17 443 N	79° 58' 27 629 W
1,750 0	0 78	88 55	1,749 9	1 9	15 8	14,559,807 13	1,927,294 35	40° 5' 17 444 N	79° 58' 27 621 W
1,800 0	0 96	85 14	1,799 9	1 9	16 5	14,559,807 17	1,927,295 11	40° 5' 17 444 N	79° 58' 27 611 W
1,850 0	0 98	83 23	1,849 9	2 0	17 4	14,559,807 26	1,927,295 95	40° 5' 17 445 N	79° 58' 27 600 W
1,900 0	1 03	80 58	1,899 9	2 1	18 2	14,559,807 38	1,927,296 82	40° 5' 17 446 N	79° 58' 27 589 W
1,950 0	1 19	83 97	1,949 9	2 2	19 2	14,559,807 51	1,927,297 78	40° 5' 17 447 N	79° 58' 27 577 W
2,000 0	1 37	86 89	1,999 9	2 3	20 3	14,559,807 60	1,927,298 89	40° 5' 17 448 N	79° 58' 27 562 W
2,050 0	1 40	93 13	2,049 9	2 3	21 5	14,559,807 60	1,927,300 10	40° 5' 17 448 N	79° 58' 27 547 W
2,100 0	1 39	97 80	2,099 8	2 2	22 7	14,559,807 48	1,927,301 31	40° 5' 17 446 N	79° 58' 27 531 W
2,150 0	1 25	101 25	2,149 8	2 0	23 8	14,559,807 29	1,927,302 44	40° 5' 17 444 N	79° 58' 27 517 W
2,200 0	1 22	105 16	2,199 8	1 8	24 9	14,559,807 05	1,927,303 49	40° 5' 17 442 N	79° 58' 27 503 W
2,250 0	1 31	104 82	2,249 8	1 5	26 0	14,559,806 76	1,927,304 56	40° 5' 17 439 N	79° 58' 27 490 W
2,300 0	1 33	102 32	2,299 8	1 2	27 1	14,559,806 49	1,927,305 68	40° 5' 17 436 N	79° 58' 27 475 W
2,350 0	1 31	106 41	2,349 8	0 9	28 2	14,559,806 21	1,927,306 79	40° 5' 17 433 N	79° 58' 27 461 W
2,400 0	1 24	117 34	2,399 8	0 5	29 2	14,559,805 80	1,927,307 82	40° 5' 17 429 N	79° 58' 27 448 W
2,450 0	1 28	118 89	2,449 8	0 0	30 2	14,559,805 28	1,927,308 79	40° 5' 17 424 N	79° 58' 27 435 W
2,500 0	1 29	118 53	2,499 7	-0 5	31 2	14,559,804 74	1,927,309 78	40° 5' 17 418 N	79° 58' 27 423 W
2,550 0	1 44	118 28	2,549 7	-1 1	32 2	14,559,804 17	1,927,310 82	40° 5' 17 413 N	79° 58' 27 409 W
2,600 0	1 36	120 16	2,599 7	-1 7	33 3	14,559,803 58	1,927,311 89	40° 5' 17 407 N	79° 58' 27 396 W
2,650 0	1 25	124 10	2,649 7	-2 3	34 3	14,559,802 97	1,927,312 85	40° 5' 17 400 N	79° 58' 27 383 W
2,700 0	1 40	123 65	2,699 7	-2 9	35 2	14,559,802 33	1,927,313 81	40° 5' 17 394 N	79° 58' 27 371 W
2,750 0	1 41	124 63	2,749 7	-3 6	36 2	14,559,801 64	1,927,314 83	40° 5' 17 387 N	79° 58' 27 358 W
2,800 0	1 17	123 63	2,799 7	-4 3	37 2	14,559,801 01	1,927,315 76	40° 5' 17 381 N	79° 58' 27 346 W
2,850 0	1 00	133 54	2,849 7	-4 8	37 9	14,559,800 43	1,927,316 50	40° 5' 17 375 N	79° 58' 27 337 W
2,900 0	1 02	131 73	2,899 6	-5 4	38 6	14,559,799 83	1,927,317 15	40° 5' 17 369 N	79° 58' 27 329 W
2,950 0	0 98	121 65	2,949 6	-6 0	39 2	14,559,799 31	1,927,317 85	40° 5' 17 364 N	79° 58' 27 320 W
3,000 0	0 88	111 55	2,999 6	-6 3	40 0	14,559,798 94	1,927,318 57	40° 5' 17 360 N	79° 58' 27 310 W
3,050 0	1 01	117 39	3,049 6	-6 7	40 7	14,559,798 60	1,927,319 32	40° 5' 17 356 N	79° 58' 27 301 W
3,100 0	1 04	115 80	3,099 6	-7 1	41 5	14,559,798 20	1,927,320 12	40° 5' 17 352 N	79° 58' 27 291 W
3,150 0	0 90	115 14	3,149 6	-7 4	42 3	14,559,797 84	1,927,320 88	40° 5' 17 349 N	79° 58' 27 281 W
3,200 0	0 89	118 10	3,199 6	-7 8	43 0	14,559,797 49	1,927,321 58	40° 5' 17 345 N	79° 58' 27 272 W
3,250 0	0 98	116 77	3,249 6	-8 2	43 7	14,559,797 11	1,927,322 30	40° 5' 17 341 N	79° 58' 27 263 W

ANTERO RESOURCES

Scientific Drilling International

Survey Report - Geographic

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 3H - Slot 3
Project:	Washington County Pennsylvania	**TVD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Site:	Hopkins Pad	**MD Reference:**	WELL @ 1196.0ft (Original Well Elev)
Well:	Hill Unit 3H	**North Reference:**	Grid
Wellbore:	Directional Pilot Hill Unit 3H	**Survey Calculation Method:**	Minimum Curvature
Design:	Directional Pilot Hill Unit 3H	**Database:**	EDMOKC

Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (ft)	Map Easting (ft)	Latitude	Longitude
3,300 0	1 06	115 37	3,299 6	-8 6	44 5	14,559,796 72	1,927,323 10	40° 5' 17 337 N	79° 58' 27 252 W
3,350 0	1 05	114 72	3,349 6	-8 9	45 3	14,559,796 33	1,927,323 94	40° 5' 17 334 N	79° 58' 27 242 W
3,400 0	1 02	118 67	3,399 6	-9 3	46 1	14,559,795 92	1,927,324 74	40° 5' 17 329 N	79° 58' 27 231 W
3,450 0	0 99	114 97	3,449 6	-9 7	46 9	14,559,795 53	1,927,325 52	40° 5' 17 325 N	79° 58' 27 221 W
3,500 0	0 99	118 80	3,499 6	-10 1	47 7	14,559,795 14	1,927,326 29	40° 5' 17 321 N	79° 58' 27 212 W
3,550 0	0 95	115 39	3,549 5	-10 5	48 4	14,559,794 75	1,927,327 05	40° 5' 17 318 N	79° 58' 27 202 W
3,600 0	0 83	117 89	3,599 5	-10 9	49 1	14,559,794 41	1,927,327 74	40° 5' 17 314 N	79° 58' 27 193 W
3,650 0	0 84	113 87	3,649 5	-11 2	49 8	14,559,794 09	1,927,328 40	40° 5' 17 311 N	79° 58' 27 185 W
3,700 0	0 76	118 14	3,699 5	-11 5	50 4	14,559,793 78	1,927,329 02	40° 5' 17 308 N	79° 58' 27 177 W
3,750 0	0 78	111 18	3,749 5	-11 8	51 0	14,559,793 50	1,927,329 63	40° 5' 17 305 N	79° 58' 27 169 W
3,800 0	0 89	121 19	3,799 5	-12 1	51 7	14,559,793 18	1,927,330 28	40° 5' 17 302 N	79° 58' 27 161 W
3,850 0	0 76	125 50	3,849 5	-12 5	52 3	14,559,792 79	1,927,330 89	40° 5' 17 298 N	79° 58' 27 153 W
3,900 0	0 77	134 76	3,899 5	-12 9	52 8	14,559,792 36	1,927,331 39	40° 5' 17 293 N	79° 58' 27 146 W
3,950 0	0 81	132 39	3,949 5	-13 4	53 3	14,559,791 88	1,927,331 89	40° 5' 17 289 N	79° 58' 27 140 W
4,000 0	0 79	120 05	3,999 5	-13 8	53 9	14,559,791 47	1,927,332 45	40° 5' 17 285 N	79° 58' 27 133 W
4,050 0	0 81	128 25	4,049 5	-14 2	54 4	14,559,791 08	1,927,333 03	40° 5' 17 281 N	79° 58' 27 126 W
4,090 0	0 78	147 61	4,089 5	-14 6	54 8	14,559,790 67	1,927,333 40	40° 5' 17 277 N	79° 58' 27 121 W
4,112 0	0 41	153 35	4,111 5	-14 8	54 9	14,559,790 48	1,927,333 51	40° 5' 17 275 N	79° 58' 27 119 W
4,177 0	1 20	13 40	4,176 5	-14 3	55 2	14,559,790 93	1,927,333 77	40° 5' 17 279 N	79° 58' 27 116 W
4,239 0	3 10	14 30	4,238 4	-12 1	55 7	14,559,793 19	1,927,334 34	40° 5' 17 301 N	79° 58' 27 108 W
4,335 0	5 30	11 50	4,334 2	-5 2	57 3	14,559,800 05	1,927,335 86	40° 5' 17 369 N	79° 58' 27 088 W
4,431 0	5 70	23 60	4,429 7	3 5	60 1	14,559,808 76	1,927,338 66	40° 5' 17 455 N	79° 58' 27 051 W
4,527 0	7 80	27 50	4,525 1	13 6	65 0	14,559,818 91	1,927,343 57	40° 5' 17 554 N	79° 58' 26 986 W
4,622 0	9 30	34 00	4,619 0	25 7	72 2	14,559,830 99	1,927,350 84	40° 5' 17 673 N	79° 58' 26 890 W
4,717 0	9 50	33 70	4,712 7	38 6	80 9	14,559,843 88	1,927,359 49	40° 5' 17 799 N	79° 58' 26 777 W
4,906 0	9 20	32 50	4,899 2	64 3	97 7	14,559,869 60	1,927,376 26	40° 5' 18 052 N	79° 58' 26 558 W
5,001 0	8 00	31 30	4,993 2	76 4	105 2	14,559,881 65	1,927,383 77	40° 5' 18 170 N	79° 58' 26 459 W
5,095 0	9 30	30 80	5,086 1	88 5	112 5	14,559,893 77	1,927,391 06	40° 5' 18 289 N	79° 58' 26 364 W
5,285 0	9 90	35 00	5,273 4	115 1	129 7	14,559,920 33	1,927,408 29	40° 5' 18 550 N	79° 58' 26 138 W
5,476 0	8 70	27 20	5,461 9	141 4	145 7	14,559,946 63	1,927,424 31	40° 5' 18 808 N	79° 58' 25 928 W
5,663 0	9 00	31 60	5,646 7	166 4	159 8	14,559,971 67	1,927,438 44	40° 5' 19 054 N	79° 58' 25 742 W
5,854 0	9 60	32 30	5,835 2	192 6	176 2	14,559,997 86	1,927,454 78	40° 5' 19 311 N	79° 58' 25 528 W
6,045 0	9 00	30 60	6,023 7	218 9	192 3	14,560,024 18	1,927,470 90	40° 5' 19 569 N	79° 58' 25 317 W
6,233 0	10 40	31 00	6,209 0	246 1	208 5	14,560,051 38	1,927,487 12	40° 5' 19 836 N	79° 58' 25 104 W
6,424 0	10 40	31 00	6,396 8	275 7	226 3	14,560,080 94	1,927,504 88	40° 5' 20 126 N	79° 58' 24 871 W
6,614 0	10 50	28 80	6,583 7	305 5	243 5	14,560,110 81	1,927,522 05	40° 5' 20 419 N	79° 58' 24 646 W
6,805 0	12 10	33 00	6,771 0	337 6	262 7	14,560,142 85	1,927,541 34	40° 5' 20 734 N	79° 58' 24 393 W
6,997 0	12 40	31 30	6,958 6	372 1	284 4	14,560,177 34	1,927,563 01	40° 5' 21 072 N	79° 58' 24 109 W
7,187 0	12 10	37 70	7,144 3	405 3	307 2	14,560,210 53	1,927,585 79	40° 5' 21 398 N	79° 58' 23 811 W
7,283 0	11 10	36 70	7,238 3	420 6	318 9	14,560,225 90	1,927,597 46	40° 5' 21 549 N	79° 58' 23 658 W
7,378 0	10 30	34 60	7,331 7	434 9	329 2	14,560,240 22	1,927,607 75	40° 5' 21 689 N	79° 58' 23 523 W
7,568 0	8 90	32 20	7,519 0	461 4	346 6	14,560,266 64	1,927,625 23	40° 5' 21 948 N	79° 58' 23 295 W
7,710 0	8 90	32 20	7,659 3	480 0	358 3	14,560,285 23	1,927,636 94	40° 5' 22 131 N	79° 58' 23 141 W
Marcellus									
7,752 7	8 90	32 20	7,701 5	485 6	361 9	14,560,290 83	1,927,640 46	40° 5' 22 185 N	79° 58' 23 095 W
Onondoga Target 3H									
7,860 0	8 90	32 20	7,807 5	499 6	370 7	14,560,304 87	1,927,649 30	40° 5' 22 323 N	79° 58' 22 979 W
Onondaga									
8,005 0	8 90	32 20	7,950 8	518 6	382 7	14,560,323 85	1,927,661 26	40° 5' 22 509 N	79° 58' 22 822 W

ANTERO RESOURCES

Scientific Drilling International

Survey Report Geographic

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 3H - Slot 3
Project:	Washington County Pennsylvania	**TVD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Site:	Hopkins Pad	**MD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Well:	Hill Unit 3H	**North Reference:**	Grid
Wellbore:	Directional Pilot Hill Unit 3H	**Survey Calculation Method:**	Minimum Curvature
Design:	Directional Pilot Hill Unit 3H	**Database:**	EDMOKC

Design Annotations

Measured Depth (ft)	Vertical Depth (ft)	Local Coordinates +N/-S (ft)	Local Coordinates +E/-W (ft)	Comment
7,710 0	7,659 3	480 0	358 3	Marcellus
7,860 0	7,807 5	499 6	370 7	Onondaga

Checked By: _____ Approved By: _____ Date: _____

Antero Resources Corporation

Washington County Pennsylvania
Hopkins Pad
Hill Unit 3H - Slot 3

Horizontal Hill Unit 3H

Survey: Survey #1 MWD

Survey Report - Geographic

31 March, 2010

ANTERO RESOURCES

Antero Resources Corporation

Washington County Pennsylvania
Hopkins Pad
Hill Unit 3H - Slot 3

Directional Pilot Hill Unit 3H

Survey: Survey #2 MWD

Standard Survey Report

31 March, 2010

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OIL & GAS

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Scientific Drilling International

Survey Report

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 3H - Slot 3
Project:	Washington County Pennsylvania	**TVD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Site:	Hopkins Pad	**MD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Well:	Hill Unit 3H	**North Reference:**	Grid
Wellbore:	Directional Pilot Hill Unit 3H	**Survey Calculation Method:**	Minimum Curvature
Design:	Directional Pilot Hill Unit 3H	**Database:**	EDMOKC

Project	Washington County Pennsylvania, SW Pennsylvania		
Map System:	Universal Transverse Mercator (US Survey Fee	**System Datum:**	Mean Sea Level
Geo Datum:	NAD 1927 - Eastern US		
Map Zone:	Zone 17N (84 W to 78 W)		

Site	Hopkins Pad, Pad Center				
Site Position:		**Northing:**	14,559,794 17 ft	**Latitude:**	40° 5' 17 317 N
From:	Map	**Easting:**	1,927,276 73 ft	**Longitude:**	79° 58' 27 850 W
Position Uncertainty:	0 0 ft	**Slot Radius:**	0 "	**Grid Convergence:**	0 66 °

Well	Hill Unit 3H - Slot 3					
Well Position	**+N/-S**	0 0 ft	**Northing:**	14,559,805 27 ft	**Latitude:**	40° 5' 17 427 N
	+E/-W	0 0 ft	**Easting:**	1,927,278 60 ft	**Longitude:**	79° 58' 27 824 W
Position Uncertainty		0 0 ft	**Wellhead Elevation:**	1,196 0 ft	**Ground Level:**	1,170 0 ft

Wellbore	Directional Pilot Hill Unit 3H				
Magnetics	**Model Name**	**Sample Date**	**Declination (°)**	**Dip Angle (°)**	**Field Strength (nT)**
	IGRF2010	07/30/09	-9 07	67 79	53,195

Design	Directional Pilot Hill Unit 3H						
Audit Notes:							
Version:	1 0	**Phase:**	ACTUAL	**Tie On Depth:**			0 0
Vertical Section:	**Depth From (TVD) (ft)**	**+N/-S (ft)**	**+E/-W (ft)**	**Direction (°)**			
	0 0	0 0	0 0	36 28			

Survey Program	**Date** 03/31/10		
From (ft)	**To (ft)**	**Survey (Wellbore)**	**Tool Name**	**Description**
50 0	4,090 0	Survey #1 Gyro (Directional Pilot Hill Unit ;	GYD-GC-SS	Gyrodata gyro single shots
4,112 0	8,005 0	Survey #2 MWD (Directional Pilot Hill Unit	SDI MWD	SDI MWD/Gamma

Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
4,090 0	0 78	147 61	4,089 5	-14 6	54 8	20 7	0 00	0 00	0 00
4,112 0	0 41	153 35	4,111 5	-14 8	54 9	20 6	1 70	-1 68	26 09
4,177 0	1 20	13 40	4,176 5	-14 3	55 2	21 1	2 36	1 22	-215 31
4,239 0	3 10	14 30	4,238 4	-12 1	55 7	23 2	3 06	3 06	1 45
4,335 0	5 30	11 50	4,334 2	-5 2	57 3	29 7	2 30	2 29	-2 92
4,431 0	5 70	23 60	4,429 7	3 5	60 1	38 4	1 28	0 42	12 60
4,527 0	7 80	27 50	4,525 1	13 6	65 0	49 4	2 24	2 19	4 06
4,622 0	9 30	34 00	4,619 0	25 7	72 2	63 5	1 88	1 58	6 84
4,717 0	9 50	33 70	4,712 7	38 6	80 9	79 0	0 22	0 21	-0 32
4,906 0	9 20	32 50	4,899 2	64 3	97 7	109 6	0 19	-0 16	-0 63

Scientific Drilling International

Survey Report

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 3H - Slot 3
Project:	Washington County Pennsylvania	**TVD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Site:	Hopkins Pad	**MD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Well:	Hill Unit 3H	**North Reference:**	Grid
Wellbore:	Horizontal Hill Unit 3H	**Survey Calculation Method:**	Minimum Curvature
Design:	Horizontal Hill Unit 3H	**Database:**	EDMOKC

Project	Washington County Pennsylvania, SW Pennsylvania		
Map System:	Universal Transverse Mercator (US Survey Fee	**System Datum:**	Mean Sea Level
Geo Datum:	NAD 1927 - Eastern US		
Map Zone:	Zone 17N (84 W to 78 W)		

Site	Hopkins Pad, Pad Center				
Site Position:		**Northing:**	14,559,794 17 ft	**Latitude:**	40° 5' 17 317 N
From:	Map	**Easting:**	1,927,276 73 ft	**Longitude:**	79° 58' 27 850 W
Position Uncertainty:	0 0 ft	**Slot Radius:**	0 "	**Grid Convergence:**	0 66 °

Well	Hill Unit 3H - Slot 3					
Well Position	**+N/-S**	0 0 ft	**Northing:**	14,559,805 27 ft	**Latitude:**	40° 5' 17 427 N
	+E/-W	0 0 ft	**Easting:**	1,927,278 60 ft	**Longitude:**	79° 58' 27 824 W
Position Uncertainty		0 0 ft	**Wellhead Elevation:**	1,196 0 ft	**Ground Level:**	1,170 0 ft

Wellbore	Horizontal Hill Unit 3H				
Magnetics	**Model Name**	**Sample Date**	**Declination (°)**	**Dip Angle (°)**	**Field Strength (nT)**
	IGRF2010	02/09/10	-9 08	67 74	53,130

Design	Horizontal Hill Unit 3H						
Audit Notes:							
Version:	1 0	**Phase:**	ACTUAL	**Tie On Depth:**			7,187 0
Vertical Section:	**Depth From (TVD) (ft)**		**+N/-S (ft)**	**+E/-W (ft)**	**Direction (°)**		
	0 0		0 0	0 0	336 12		

Survey Program **Date** 03/31/10

From (ft)	To (ft)	Survey (Wellbore)	Tool Name	Description
50 0	4,090 0	Survey #1 Gyro (Directional Pilot Hill Unit :	GYD-GC-SS	Gyrodata gyro single shots
4,112 0	7,187 0	Survey #2 MWD (Directional Pilot Hill Unit	SDI MWD	SDI MWD/Gamma
7,246 0	13,003 0	Survey #1 MWD (Horizontal Hill Unit 3H)	SDI MWD	SDI MWD/Gamma

Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
7,187 0	12 10	37 70	7,144 3	405 3	307 2	246 2	0 00	0 00	0 00
7,246 0	11 95	37.50	7,202 0	415 0	314 7	252 1	0 26	-0 25	-0 34
7,278 0	11 87	28 75	7,233 3	420 5	318 3	255 7	5 64	-0 25	-27 34
7,310 0	12 66	15 57	7,264 6	426 8	320 8	260 4	9 07	2 47	-41 19
7,342 0	14 78	0 08	7,295 7	434 2	321 8	266 8	13 20	6 63	-48 41
7,373 0	17 67	348 23	7,325 5	442 8	320 8	275 0	14 13	9 32	-38 23
7,405 0	20 61	341 60	7,355 7	452 9	318 0	285 4	11 41	9 19	-20 72
7,437 0	23 59	337 87	7,385 3	464 2	313 8	297 4	10 29	9 31	-11 66
7,468 0	27 24	335 33	7,413 3	476 4	308 5	310 7	12 29	11 77	-8 19

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 3H - Slot 3
Project:	Washington County Pennsylvania	**TVD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Site:	Hopkins Pad	**MD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Well:	Hill Unit 3H	**North Reference:**	Grid
Wellbore:	Horizontal Hill Unit 3H	**Survey Calculation Method:**	Minimum Curvature
Design:	Horizontal Hill Unit 3H	**Database:**	EDMOKC

Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
7,499 0	30 95	333 82	7,440 4	490 0	302 1	325 8	12 20	11 97	-4 87
7,531 0	34 40	333 50	7,467 3	505 5	294 4	343 0	10 79	10 78	-1 00
7,563 0	38 16	333 29	7,493 1	522 4	285 9	361 9	11 76	11 75	-0 66
7,595 0	41 59	333 56	7,517 7	540 7	276 7	382 4	10 73	10 72	0 84
7,627 0	45 11	335 13	7,541 0	560 5	267 2	404 4	11 50	11 00	4 91
7,641 0	46 73	336 36	7,550 7	569 7	263 1	414 4	13 21	11 59	8 83
Landing Pt 3H									
7,658 0	48 72	337 78	7,562 1	581 3	258 2	427 0	13 21	11 69	8 32
7,690 0	51 35	339 09	7,582 7	604 1	249 2	451 5	8 80	8 22	4 09
7,721 0	53 83	339 16	7,601 5	627 1	240 4	476 1	8 00	8 00	0 23
7,753 0	57 20	338 89	7,619 6	651 7	231 0	502 4	10 55	10 53	-0 84
7,785 0	59 91	339 43	7,636 3	677 2	221 3	529 7	8 59	8 47	1 69
7,816 0	62 38	340 57	7,651 3	702 8	212 0	556 8	8 59	7 97	3 68
7,848 0	64 98	341 82	7,665 5	729 9	202 8	585 3	8 85	8 13	3 91
7,880 0	67 27	342 61	7,678 4	757 8	193 8	614 4	7 50	7 16	2 47
7,912 0	68 97	343 01	7,690 4	786 1	185 1	643 9	5 44	5 31	1 25
7,944 0	69 47	343 22	7,701 7	814 8	176 4	673 6	1 68	1 56	0 66
7,976 0	71 21	343 15	7,712 5	843 6	167 6	703 5	5 44	5 44	-0 22
8,008 0	73 64	342 74	7,722 1	872 8	158 7	733 8	7 69	7 59	-1 28
8,040 0	76 24	342 70	7,730 4	902 3	149 5	764 5	8 13	8 13	-0 13
8,072 0	78 70	342 79	7,737 4	932 1	140 3	795 5	7 69	7 69	0 28
8,104 0	81 28	342 66	7,742 9	962 2	130 9	826 8	8 07	8 06	-0 41
8,136 0	85 21	342 43	7,746 7	992 5	121 4	858 4	12 30	12 28	-0 72
8,186 0	88 09	341 09	7,749 6	1,039 9	105 7	908 1	6 35	5 76	-2 68
8,282 0	87 05	338 19	7,753 7	1,129 8	72 4	1,003 8	3 21	-1 08	-3 02
8,346 0	88 90	338 83	7,756 0	1,189 3	49 0	1,067 7	3 06	2 89	1 00
8,378 0	89 06	338 96	7,756 5	1,219 2	37 4	1,099 7	0 64	0 50	0 41
8,473 0	89 43	339 08	7,757 8	1,307 9	3 4	1,194 5	0 41	0 39	0 13
8,569 0	88 89	337 32	7,759 2	1,397 0	-32 2	1,290 4	1 92	-0 56	-1 83
8,664 0	88 32	337 13	7,761 5	1,484 6	-69 0	1,385 4	0 63	-0 60	-0 20
8,759 0	88 93	337 80	7,763 8	1,572 3	-105 4	1,480 3	0 95	0 64	0 71
8,854 0	89 40	338 50	7,765 2	1,660 4	-140 7	1,575 3	0 89	0 49	0 74
8,950 0	89 29	337 79	7,766 3	1,749 5	-176 5	1,671 2	0 75	-0 11	-0 74
9,046 0	89 26	338 64	7,767 5	1,838 7	-212 1	1,767 1	0 89	-0 03	0 89
9,141 0	89 50	338 82	7,768 5	1,927 2	-246 6	1,862 0	0 32	0 25	0 19
9,235 0	90 20	339 06	7,768 8	2,014 9	-280 3	1,955 9	0 79	0 74	0 26
9,328 0	88 96	337 88	7,769 4	2,101 4	-314 5	2,048 8	1 84	-1 33	-1 27
9,423 0	88 42	337 59	7,771 6	2,189.3	-350 5	2,143 8	0 65	-0 57	-0 31
9,518 0	88 56	337 07	7,774 1	2,276 9	-387 1	2,238 7	0 57	0 15	-0 55
9,612 0	88 76	337 19	7,776 3	2,363 5	-423 6	2,332 7	0 25	0 21	0 13
9,707 0	88 99	337 44	7,778 2	2,451 2	-460 2	2,427 6	0 36	0 24	0 26
9,802 0	89 46	337 31	7,779 5	2,538 8	-496 8	2,522 6	0 51	0 49	-0 14
9,897 0	89 83	338 01	7,780 1	2,626 7	-532 9	2,617 6	0 83	0 39	0 74

ANTERO RESOURCES

Scientific Drilling International

Survey Report

Scientific Drilling

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 3H - Slot 3
Project:	Washington County Pennsylvania	**TVD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Site:	Hopkins Pad	**MD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Well:	Hill Unit 3H	**North Reference:**	Grid
Wellbore:	Horizontal Hill Unit 3H	**Survey Calculation Method:**	Minimum Curvature
Design:	Horizontal Hill Unit 3H	**Database:**	EDMOKC

Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
9,992 0	89 43	337 88	7,780 7	2,714 8	-568 5	2,712 5	0 44	-0 42	-0 14
10,087 0	89 09	336 98	7,781 9	2,802 5	-605 0	2,807.5	1 01	-0 36	-0 95
10,119 0	87 92	337 27	7,782 7	2,831 9	-617 4	2,839 5	3 77	-3 66	0 91
10,182 0	87 48	337 56	7,785 3	2,890 1	-641 6	2,902 4	0 84	-0 70	0 46
10,245 0	88 05	336 93	7,787 7	2,948 1	-665 9	2,965 3	1 35	0 90	-1 00
10,276 0	87 75	337 61	7,788 8	2,976 7	-677 9	2,996 3	2 40	-0 97	2 19
10,371 0	86 54	336 77	7,793 6	3,064 2	-714 7	3,091 2	1 55	-1 27	-0 88
10,465 0	86 84	336 22	7,799 0	3,150 2	-752 1	3,185 0	0 67	0 32	-0 59
10,560 0	86 74	337 03	7,804 3	3,237 3	-789 8	3,279 9	0 86	-0 11	0 85
10,654 0	87 01	336 71	7,809 5	3,323 6	-826 6	3,373 7	0 45	0 29	-0 34
10,749 0	87 31	336 09	7,814 2	3,410 5	-864 6	3,468 6	0 72	0 32	-0 65
10,844 0	86 91	336 45	7,818 9	3,497 4	-902 8	3,563 5	0 57	-0 42	0 38
10,938 0	86 30	336 44	7,824 5	3,583 4	-940 3	3,657 3	0 65	-0 65	-0 01
11,032 0	86 34	335 97	7,830 5	3,669 2	-978 1	3,751 1	0 50	0 04	-0 50
11,095 0	86 47	335 96	7,834 5	3,726 7	-1,003 8	3,814 0	0 21	0 21	-0 02
11,127 0	86 20	336 28	7,836 5	3,755 9	-1,016 7	3,845 9	1 31	-0 84	1 00
11,190 0	86 81	336 69	7,840 4	3,813 5	-1,041 8	3,908 8	1 17	0 97	0 65
11,221 0	86 64	336 92	7,842 2	3,842 0	-1,054 0	3,939 7	0 92	-0 55	0 74
11,316 0	87 21	337 26	7,847 3	3,929 4	-1,090 9	4,034 6	0 70	0 60	0 36
11,411 0	87 78	337 77	7,851 4	4,017 0	-1,127 2	4,129 5	0 80	0 60	0 54
11,505 0	87 45	337 12	7,855 3	4,103 8	-1,163 2	4,223 4	0 77	-0 35	-0 69
11,578 0	88 62	337 64	7,857 8	4,171 1	-1,191 3	4,296 3	1 75	1 60	0 71
11,600 0	88 92	337 33	7,858 3	4,191 4	-1,199 7	4,318 3	1 96	1 36	-1 41
11,694 0	88 92	337 01	7,860 1	4,278 1	-1,236 2	4,412 3	0 34	0 00	-0 34
11,757 0	89 40	337 20	7,861 0	4,336 1	-1,260 7	4,475 2	0 82	0 76	0 30
11,789 0	89 87	337 19	7,861 2	4,365 6	-1,273 1	4,507 2	1 47	1 47	-0 03
11,884 0	89 29	335 12	7,861 9	4,452 5	-1,311 5	4,602 2	2 26	-0 61	-2 18
11,915 0	90 13	334 87	7,862 0	4,480 5	-1,324 6	4,633 2	3 07	2 71	-1 45
11,947 0	91 21	335 27	7,861 7	4,509 5	-1,338 2	4,665 2	3 86	3 38	1 88
11,978 0	91 98	335 17	7,860 8	4,537 7	-1,351 1	4,696 2	2 50	2 48	-0 32
12,010 0	92 12	335 29	7,859 7	4,566 7	-1,364 5	4,728 2	0 58	0 44	0 38
12,041 0	92 18	335 27	7,858 5	4,594 8	-1,377 5	4,759 2	0 20	0 19	-0 06
12,073 0	91 85	335 52	7,857 4	4,623 9	-1,390 8	4,791 1	1 29	-1 03	0 78
12,104 0	90 70	335 73	7,856 7	4,652 2	-1,403 6	4,822 1	3 77	-3 71	0 68
12,136 0	90 66	335 49	7,856 3	4,681 3	-1,416 8	4,854 1	0 76	-0 13	-0 75
12,167 0	90 60	335 71	7,856 0	4,709 5	-1,429 6	4,885 1	0 74	-0 19	0 71
12,199 0	90 48	335 58	7,855 7	4,738 7	-1,442 8	4,917 1	0 55	-0 38	-0 41
12,262 0	90 47	336 10	7,855 1	4,796 2	-1,468 6	4,980 1	0 83	-0 02	0 83
12,325 0	89 70	335 80	7,855 0	4,853 7	-1,494 3	5,043 1	1 31	-1 22	-0 48
12,357 0	89 26	334 74	7,855 3	4,882 8	-1,507 7	5,075 1	3 59	-1 38	-3 31
12,388 0	89 36	335 35	7,855 7	4,910 9	-1,520 7	5,106 1	1 99	0 32	1 97
12,451 0	90 40	335 42	7,855 8	4,968 1	-1,547 0	5,169 1	1 65	1 65	0 11
12,483 0	90 81	335 97	7,855 5	4,997 3	-1,560 2	5,201 1	2 14	1 28	1 72
12,546 0	91 11	335 70	7,854 4	5,054 8	-1,585 9	5,264 1	0 64	0 48	-0 43

Scientific Drilling International

Survey Report

Company:	Antero Resources Corporation	**Local Co-ordinate Reference:**	Well Hill Unit 3H - Slot 3
Project:	Washington County Pennsylvania	**TVD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Site:	Hopkins Pad	**MD Reference:**	WELL @ 1196 0ft (Original Well Elev)
Well:	Hill Unit 3H	**North Reference:**	Grid
Wellbore:	Horizontal Hill Unit 3H	**Survey Calculation Method:**	Minimum Curvature
Design:	Horizontal Hill Unit 3H	**Database:**	EDMOKC

Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
12,640 0	90 40	334 93	7,853 2	5,140 2	-1,625 2	5,358 1	1 11	-0 76	-0 82
12,734 0	88 99	334 29	7,853 7	5,225 1	-1,665 5	5,452 0	1 65	-1 50	-0 68
12,829 0	90.00	334 62	7,854 5	5,310 8	-1,706 5	5,547 0	1 12	1 06	0 35
12,923 0	88 93	335 50	7,855 4	5,396 0	-1,746 1	5,641 0	1 47	-1 14	0 94
13,003 0	88 93	335 50	7,856 9	5,468 8	-1,779 3	5,720 9	0 00	0 00	0 00
TGT Hill Unit 3H									

Checked By: _____ Approved By: _____ Date: _____