This Geotechnical Data Report is for informational purposes only and is not considered part of the contract. The Contractor shall have no claim for additional compensation or for an extension of time for any reason resulting from actual site conditions differing from those described in this report.

GEOTECHNICAL DATA REPORT

Frontier Gas Pipeline
NCDOT R-2915A
Near Deep Gap, North Carolina
S&ME Project No. 1358-14-070

Prepared For:

MA Engineering Consultants, Inc.
598 East Chatham Street, Suite 137
Cary, North Carolina 27511

Prepared By:

8646 West Market Street, Suite 105
Greensboro, North Carolina 27409
NC PE Firm License No. F-0176

January 6, 2015

January 6, 2015

MA Engineering Consultants, Inc.
598 East Chatham Street, Suite 137
Cary, North Carolina 27511

Attention: Mr. Kevin C. Zdeb, P.E.

Reference: **GEOTECHNICAL DATA REPORT**
Frontier Gas Pipeline
NCDOT R-2915A
Near Deep Gap, North Carolina
S&ME Project No. 1358-14-070

Dear Mr. Zdeb:

S&ME, Inc. (S&ME) has completed the field exploration and laboratory testing for the above referenced project. The purpose was to explore and characterize subsurface conditions for use in the relocation of existing 6 and 10-inch diameter gas transmission lines due to conflicts with a proposed NCDOT roadway construction project (R-2915A) near Deep Gap, North Carolina. Our work was performed in general accordance with S&ME Proposal No. 13-1400635 dated November 5, 2014 and the terms and conditions of the Subcontractor's Agreement between MA Engineering Consultants Inc. and S&ME, Inc. dated November 7, 2014.

S&ME appreciates the opportunity to provide geotechnical exploration and testing services for this project. If you have questions or need additional information in regard to this report, please call us at (336) 288-7180.

Respectfully,
S&ME, Inc.

NORTH CAROLINA PROFESSIONAL SEAL 030944 ENGINEER MATT MOLER

Brian Ladd, P.E.
Senior Engineer

Matt Moler, P.E.
Senior Engineer/Project Manager

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FIGURES

APPENDICES

1.0 PROJECT INFORMATION

Project information has been obtained from the following:

- E-mails from Kevin Zdeb, P.E. with MA Engineering Consultants (MAEC) to Matt Moler, P.E. with S&ME on October 29 and 30, 2014.
- Review of provided NCDOT Preliminary Plan Sheets (prepared by Vaughn & Melton) and Microstation design files provided by MAEC.
- Telephone conversations between Kevin Zdeb and Matt Moler on November 4 and December 18, 2014.
- Review of Google Earth images of the site.

MA Engineering Consultants (MAEC) is assisting Frontier Natural Gas, LLC with relocation of existing 6 and 10-inch diameter gas transmission lines due to conflicts with a proposed NCDOT roadway construction project (R-2915A) near Deep Gap, North Carolina. The relocation includes a new station location and two proposed road crossings along the alignment. The crossing of US 221 at the intersection of US 421 will be performed using horizontal directional drilling (HDD) and the crossing of US 221 adjacent to the Belco gas station will be performed using Bore and Jack pipe installation procedures. Figure 1 presents a Site Vicinity Plan of the project.

MAEC requested that S&ME conduct six soil test borings along the proposed road crossings and the new station location, and perform laboratory testing on selected soil samples. The information obtained from these borings was to be used for the preparation of a geotechnical data report for the road crossings and geotechnical design recommendations for the new station. Design of the crossings and station will be performed by others.

2.0 GEOLOGY

According to the *1985 Geologic Map of North Carolina*, the site is located within the Blue Ridge Physiographic Province of North Carolina. The province is typified by northeasterly trending belts of igneous and metamorphic rock with occasional, deeply incised, and broad river valleys, with overlying alluvial materials. Many of the highest land elevations east of the Mississippi River occur within the Blue Ridge province. Typical rock types found include biotite gneiss, metasandstone, quartzite, and schist.

The site is underlain by the Alligator Back Formation and is described as finely laminated to thin layered gneiss. The gneiss is locally massive and contains micaceous granule conglomerate and includes schist, phyllite, and amphibolite. Soils typically encountered within this formation represent the in-place chemical decomposition of parent rock and contain considerable amounts of mica. These soils become progressively coarser with depth, representing progressively less advanced weathering of the parent material.

Based on our experience with Horizontal Directional Drilling (HDD) and the area geology, we have the following comments relative to HDD natural geologic hazards associated with borings B-3 and B-4 at the subject site.

HDD GEOLOGIC HAZARD	COMMENTS
Cohesionless sand, gravel, cobbles, or boulders with little to no fines.	Inconsistent with site geology.
Horizontal zones of gravel, cobbles, or boulders in soil matrix.	Not encountered in borings B-3 or B-4 but consistent with the site geology. Gravel seam encountered in boring B-6 from a depth of 7 to 13.5 feet.
Near vertical zones of gravel, cobbles, or boulders in soil matrix.	Not encountered in borings but consistent with the site geology.
Voids or preferential seepage paths potentially resulting in loss of drilling fluid return.	Inconsistent with site geology.
Very loose sand or very soft silt/clay.	Inconsistent with site geology.
Peat, organic soil.	Inconsistent with site geology.
Material with sufficient potential swell upon exposure to water to reduce borehole diameter.	Inconsistent with site geology.
Continuous strata of hard material requiring rock drilling techniques to penetrate.	Encountered in borings B-3 and B-4 at depths of 13 and 16.5 feet, respectively, and consistent with the site geology.
Artesian groundwater conditions.	Inconsistent with site geology.

3.0 EXPLORATION PROCEDURES

3.1 Field

Six soil test borings (labeled B-1 through B-6) were conducted for the gas transmission line relocation. The locations of these borings are shown on the Boring Location Plans (Figures 2 and 5). The GPS coordinates of the planned boring locations were provided by MAEC. S&ME used GPS equipment to field locate the planned borings in the field. Borings were offset as necessary to provide access for drilling equipment and to avoid conflicts with underground and overhead utilities. Ground surface elevations at the borings locations were interpolated from provided topographic information and should be considered approximate.

Borings B-1 and B-2, which were located within the planned station area, were conducted using hand augering equipment to depths of 5 and 3.5 feet, respectively, below the ground surface. Dynamic Cone Penetration (DCP) testing was performed in general accordance with ASTM STP-399 at varying depths to measure soil consistency. The test consists of driving a 1½-inch diameter, 60° hardened steel conical point in three increments using a 15-pound weight falling 20 inches. The number of hammer blows to

drive the cone each 1¾-inch increments is recorded, with the DCP reading taken as the average of the last two values.

Borings B-3 through B-6 were conducted using a track-mounted D-50 drill rig equipped with an autohammer. Hollow stem, continuous flight augers were used to advance the borings to refusal depths of 16 and 16.5 feet at borings B-3 and B-4 and to termination depths of 20 and 25 feet at borings B-5 and B-6. Standard Penetration Tests (SPT) were performed in the borings at 2.5-foot intervals in the top 10 feet, then at 5-foot intervals thereafter, in general accordance with ASTM D1586 to provide an index for estimating strength parameters and relative consistency of subsurface soils. In borings B-3 and B-4, rock coring was performed using an NQ-size core barrel below auger refusal to depths of 30 and 30.5 feet, respectively.

Groundwater measurements were attempted after drilling was completed in each of the test borings. Twenty four hour water level measurements were performed in borings B-3, B-4, and B-6 through temporary PVC pipe installed in the boreholes. Boring B-5 was immediately backfilled after boring completion due to its location within an active drive lane. The drilled borings were tremie grouted up to the ground surface with a cement-bentonite mix. Hand augur borings B-1 and B-2 were backfilled with soil cuttings compacted to the ground surface.

Boring logs containing soil descriptions, SPT N-values, and drilling observations were prepared by a geotechnical professional, and are attached in Appendix A. Stratification lines shown on boring logs are intended to represent approximate depths of changes in soil types. Naturally, transitional changes in soil types are often gradual and cannot be defined at exact depths. Photographs of the retrieved rock cores are provided in Appendix B.

3.2 Laboratory

Samples were returned to our laboratory where a geotechnical staff professional visually examined each soil sample to assess the distribution of grain sizes, plasticity, organic content, moisture condition, color, presence of lenses and seams, and apparent geological origin. A staff geologist visually examined each rock core sample to determine rock type, color, hardness, recovery, Rock Quality Designation (RQD), weathering, and documentation of fractures. The results of the classifications are presented on the individual boring logs. The contact lines represent approximate boundaries between the soil and rock types. The actual boundaries between the soil and rock types in the field may vary in both the horizontal and vertical directions.

Classification tests were performed on selected soil samples obtained during the field exploration. Laboratory testing included:

- Atterberg Limits (ASTM D 4318)
- Grain Size Distribution (#200 wash) (ASTM D 422)
- Moisture Content (ASTM D 2216)

A Deluxe Hardness Pick Set and Mineral Identification Kit manufactured by Mineralab, LLC was used by a staff geologist to estimate the Moh's Hardness Number of the rock core samples. The Moh's Hardness Numbers are presented on the boring logs. For the rock encountered, the Moh's Hardness Number ranged from 1.5 to 7.

Unconfined compressive tests were performed on four selected rock core samples in general accordance with ASTM D7012. Rock core compressive strengths ranged from 1,430 psi to 5,341 psi (average of 3,243 psi).

Results of the laboratory testing are presented in Appendix C. A Summary of Laboratory Test Data is also included in Appendix C.

4.0 SUBSURFACE CONDITIONS AND RECOMMENDED HDD GEOTECHNICAL PARAMETERS (BORINGS B-3 AND B-4)

The tables below summarize relevant subsurface information with respect to gas pipeline subsurface road crossing conditions. Soils with similar characteristics were grouped into strata based on visual soil classification, laboratory classification tests, consistencies inferred from standard penetration resistance values, and geologic origin. The strata contacts and composition may vary between the borings and should be considered approximate.

The tables below present soil descriptions and recommended geotechnical parameters for input into the HDD design software used by MAEC. The strength parameters and unit weights presented are based on local experience with USCS soil types. Shear modulus is based on correlation with soil parameter in NAVFAC DM 7.01. Soil reaction modulus and resilient modulus values are correlations based on soil types and in-situ relative densities.

Figure 4 presents the Generalized Subsurface Profile for the proposed HDD crossing. Imposed on the profile are the interpreted stratigraphy and "soil characteristics" for input into the API 1102 – Gas Pipeline Crossing portion of the HDD design software, and "soil classification" for input into the settlement analysis portion of the software. Note that the soil descriptions given on the profiles were assigned based on the nomenclature of the HDD software and may not be the same as the soil descriptions contained on the boring logs.

Soil Strata Summary

STRATA	DESCRIPTION	PERCENT OF MATERIAL			USCS	SPT (blows/ft)
		GRAVEL	SAND	SILT/CLAY		
I	FILL AND RESIDUALSOILS Predominately Medium-Dense to Dense Silty SAND	0 to 20	60 to 80	10 to 40	SM, SW	8 to 37
Ia	FILL SOIL Firm Sandy SILT	0	10 to 25	75 to 90	ML	2 to 5
II	PARTIALLY WEATHERED ROCK Sampled as Silty SAND with gravel and mica.	5 to 30	50 to 80	15 to 25	SM	50/1”
III	BEDROCK: Gneiss. Unconfined Compressive Strengths of 1,430 psi to 5,341 psi.	--	--	--	--	--

Notes:
1. USCS – Unified Soil Classification System, visual classification.
2. SPT – Standard Penetration Test "N" value. Tests performed with an autohammer.
3. The information presented above is a generalization of predominant subsurface conditions encountered. The material descriptions, percentages of materials, USCS, and SPT values presented are estimated based on visual classification, laboratory testing, field testing, and experience.

Geotechnical Parameters

Stratum	Soil Characterization		Friction Angle	Cohesion	Unit Weight		Shear Modulus	Modulus of Soil Reaction	Resilient Modulus	Soil Friction Coeff.
	API 1102	Settlement			Total	Effective				
I	Dense Sands	Dense Sand	30^{o}	0 psf	120 pcf	58 pcf	600 ksf	2.0 ksi	15 ksi	0.36
Ia	Soft to Medium Silt w/ low plasticity	Soft Firm Clay	20^{o}	100 psf	110 pcf	48 pcf	60 ksf	0.6 ksi	4 ksi	0.24
II	PWR	PWR	40^{o}	0 psf	140 pcf	78 pcf	2,000 ksf	4.0 ksi	6.5 ksi	0.30
III	Rock	Rock	---	---	155 pcf	93 pcf	Unconfined Strength = 3,200 psi			

5.0 JACK AND BORE (BORINGS B-5 AND B-6)

Bore and jack methods are planned for installing the utility below US 221 at the Belco gas station, just north of Church Hill Street. Jack and bore methods generally consist of excavating a pit adjacent to the pipe alignment, horizontally boring and hydraulically pushing sections of pipe or casing along the alignment. After installation of the first section of casing, additional sections of casing are subsequently welded to the previous section of casing and advanced. A receiving pit is constructed at the opposite end of the horizontal bore to receive the casing. Earth removal is generally accomplished by mechanical means such as augers or boring equipment.

The casing is advanced forward using a hydraulic installation system. Horizontal forces induced by the installation are resisted by the pit sidewalls or support system. It is

necessary to provide a relatively uniform distribution of load around the pipe or casing periphery to prevent localized stress concentrations. This is typically accomplished by using a cushion material between the pipe sections and installation system. Where extreme pressures are anticipated due to long distances or where excessive friction forces are anticipated, additional pipe casing thickness may be required.

The pipe or casing section should be designed by a registered structural engineer with regard to the anticipated overburden, hydrostatic, and anticipated installation pressures.

5.1 Subsurface Conditions

Above a depth of about 8 feet below existing grades, horizontal drilling and pipe jacking will generally extend through silty sand. Below this depth PWR, was from about 7 to 18 feet below existing grade in boring B-5 and a gravel layer (77% gravel) was encountered in boring B-6 from about 7 to 13 feet below existing grade. Groundwater was not encountered in borings B-5 or B-6 to the depths explored. The groundwater level typically fluctuates during the year due to seasonal and climatic changes and could be perched just above the PWR in the typically wetter winter months. A graphical depiction of the jack and bore crossing profile is shown in Figure 6.

5.2 Horizontal Boring Pits

Excavations should be sloped or shored in accordance with local, state, and federal regulations, including OSHA excavation safety standards (29 CFR Part 1926). All excavated soils should be placed away from the top edges of the excavation, at a distance equaling or exceeding the depth of the excavation. This information is provided only as a service, and under no circumstance is S&ME to be responsible for construction site safety. The selection and design of the temporary lateral support system should be the responsibility of the general contractor who is solely responsible for site safety. Each excavation should be observed and soils classified by an OSHA-defined competent person.

Where required, lateral support could be provided by sheet piles, soldier piles and wood lagging, or a soil nailed system. The temporary retaining system used to support the excavation faces can be designed to resist “active” lateral earth pressures if some lateral wall movement is acceptable. Additional lateral loads should be applied as necessary to account for surcharge from temporary construction loads and adjacent roadways. A detailed design of the lateral support system should be provided by the contractor and designed by a professional engineer registered in the State of North Carolina.

For the boring pits, the back of the pit should be able to provide adequate resistance against the thrust generated by the jack and bore operation. Some displacement of the rear pit wall will be necessary to develop the passive resistance of the soils. The following lateral earth pressure parameters can be used in design of temporary excavation support of boring pits.

Lateral Earth Pressure Parameters for Boring Pits

Parameter	Value
Soil Friction Angle (ϕ)	30^o
At-Rest Earth Pressure Coefficient (K_o)	0.5
Active Coefficient Earth Pressure (K_a)	0.33
Passive Earth Pressure Coefficient (K_p)	3.0
Moist Unit Weight of Backfill	120 pcf
Friction Coefficient b/w Foundation and Bearing Soil	0.36

Surface water must be directed away from the pit areas and sumps with pumps should be available to drain the pits if necessary. The boring pits should be backfilled immediately after pipe installation is complete and all slopes repaired, as required.

6.0 NEW STATION LOCATION (BORINGS B-1 AND B-2)

6.1 Subsurface Conditions

Hand auger borings B-1 and B-2 were located within an existing horse pasture. These borings encountered 4 to 6 inches of organic laden topsoil at the ground surface. Residual soil existing from the in-place weathering of bedrock was encountered beneath the topsoil extending to boring termination. Residual soils were classified as low plasticity silt, silty sand, and clayey sand with respective USCS designations of ML, SM, and SC. DCP blow counts were 7 and 11 blows per increment (bpi) indicating firm to stiff soil consistencies for silt soils and loose consistencies for silty and sandy clay soils. No groundwater was encountered in the borings to the depths explored. Hand auger refusal was encountered in boring B-2 at a depth of 3.5 feet below the ground surface. Generalized subsurface conditions are provided in Figure 3.

6.2 Subgrade Evaluation and Preparation

The site should be stripped of topsoil containing vegetative and root matter. An average stripping depth of approximately 6 inches is estimated for the new station area. Topsoil may be stockpiled on site and reused in landscaped areas. Topsoil should not be used as structural fill beneath structures or areas to be gravel surfaced.

Exposed subgrade soils should be evaluated by the Geotechnical Engineer by observing proof rolling with a fully loaded tandem-axle dump truck. Areas that are loose or soft, or that are observed to rut, pump, or deflect excessively during the proof rolling process should be repaired. Possible repair measures could include undercutting to stable soils and backfilling with well-compacted, low plasticity materials, discing of in-situ soils to dry to proper moisture content and then re-compacting, placement of geotextile stabilization fabric on unsuitable materials and placement of crushed stone, or some combination of these. The most practical repair measure will be influenced by the depth

of soil instability, soil water content, depth of fill, soil type, and weather conditions. Actual repair measures should be determined in the field at the time of construction.

Site grading will be difficult during periods of extended rainfall that generally occur during the winter months. Exposed subgrade soils will tend to pump and rut under rubber-tired traffic and provide poor support for foundations and pavements. Exposed subgrades should be sloped and sealed at the end of each day to promote runoff and reduce infiltration from rainfall.

6.3 Structural Fill

On-site soils (excluding topsoil) with USCS classifications of ML, SM, and SC are suitable for re-use as structural fill, provided that any debris, organics, and particles greater than 3 inches in diameter are removed prior to placement. Depending on weather conditions and the existing moisture content of on-site soils, water content adjustment of the on-site soils may be necessary prior to compaction. Drying may be accomplished by spreading and discing to maximize exposure to sun and wind during favorable weather conditions.

Off-site fill materials, if required, should consist of a clean and low plasticity material with a maximum particle size no larger than 3 inches, and a maximum dry density of at least 100 pcf as determined by the Standard Proctor Compaction test (ASTM D698). Soils with USCS classifications of SP, SP-SM, SC, SM, and ML typically meet the noted requirements. The contractor should submit samples of proposed imported fill for evaluation by S&ME prior to fill placement.

Structural fill should be placed in maximum 8-inch loose lifts and compacted to a minimum of 95% of its Standard Proctor maximum dry density at a water content within 3% of optimum. The relative compaction should be increased to 98% within the upper 12 inches of the design subgrade elevation.

6.4 Foundation Support

Shallow foundations can be designed for a net allowable bearing pressure of 2,500 psf. Footings should bear a minimum of 18 inches below finished grade for frost protection and protective embedment.

The bottom of footing excavations should be evaluated by the project Geotechnical Engineer or senior soil technician working under the direction of the Geotechnical Engineer using a DCP to gauge the consistency of the subgrade soils. Subgrades that appear unstable or exhibit DCP blow counts less than those reported on the enclosed Hand Auger Boring Logs should be lowered to adequate bearing materials. Foundation overexcavations could be backfilled with aggregate base course (ABC stone) or lean concrete up to design bearing level. The use of washed stone (No. 57) is not recommended because fluctuations in the water levels could allow fines (i.e. silt and clay) to migrate into the stone resulting in a softening/loosening of adjacent bearing soils.

6.5 Gravel Drive Area

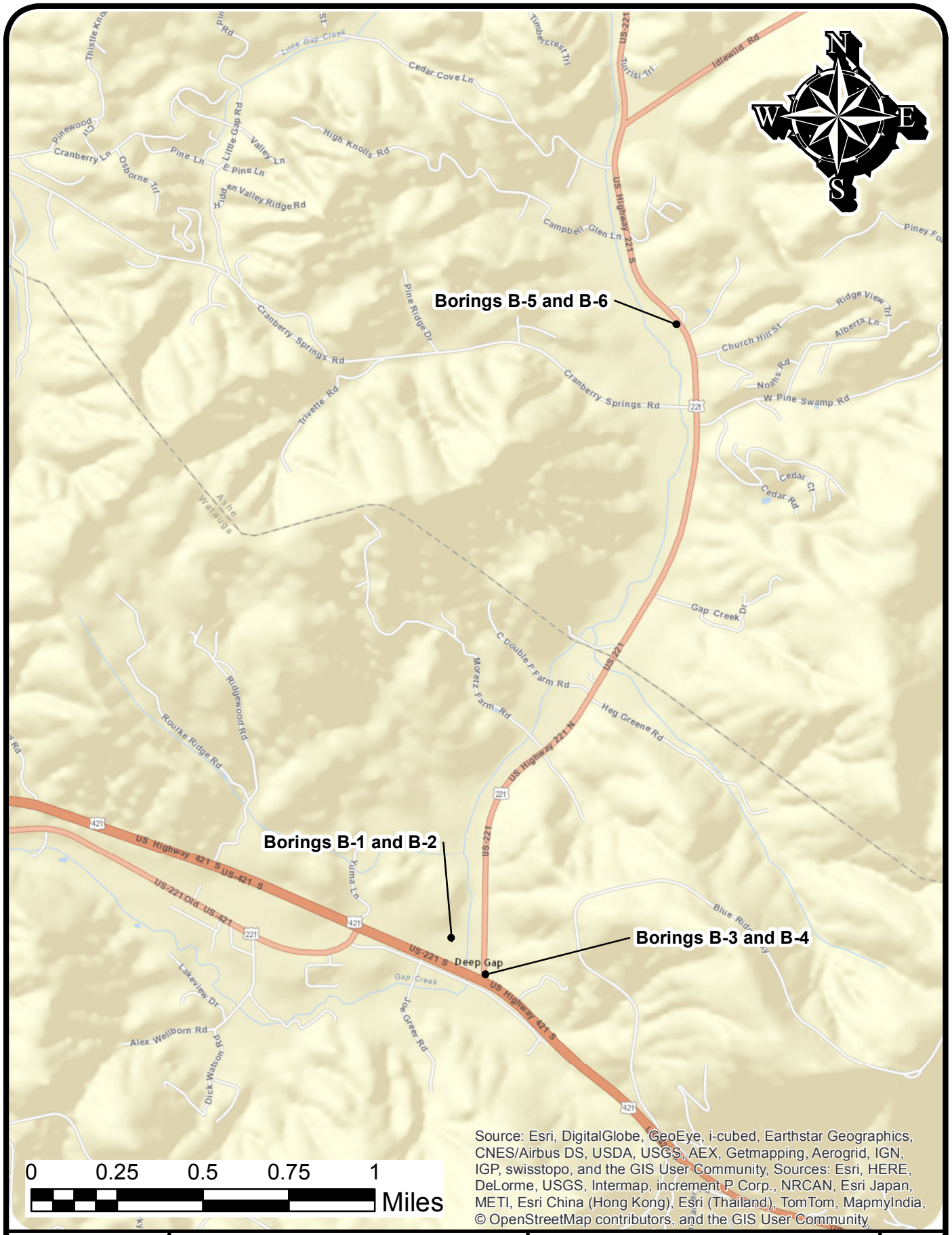
Access to the new station location will be provided by a gravel surfaced driveway. The driveway is anticipated to support heavy loads from tractor trailers. To support these loads, the driveway should be covered with a 14-inch thick layer of compacted aggregate base course (NCDOT ABC stone). Alternatively, the thickness of the ABC stone layer can be reduced to 8 inches if it is underlain by a non-woven geotextile that is placed over the subgrade soil. The geotextile helps protect the stone from becoming contaminated by the subgrade soils due to truck traffic loading. Once contaminated, the stone will deteriorate and lose strength with time.

7.0 QUALIFICATIONS

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions contained in this report were based on the applicable standards of the engineering profession at the time this report was prepared. No other warranty, express or implied, is made.

The nature and extent of variations between borings may not become evident until construction. If variations appear evident, then it will be necessary to reevaluate the applicability of the information obtained with this exploration and laboratory testing program. Environmental services were beyond the scope of this report.

FIGURES



SCALE:	AS SHOWN
DATE:	DEC 2014
DRAWN BY:	SDK
PROJECT NO:	1358-14-070

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SITE VICINITY PLAN

Frontier Gas Pipeline
NCDOT R-2915A
Deep Gap, North Carolina

FIGURE NO.
1

SCALE:	As Shown
DATE:	DEC. 2014
DRAWN BY:	SDK
PROJECT NO:	1358-14-070

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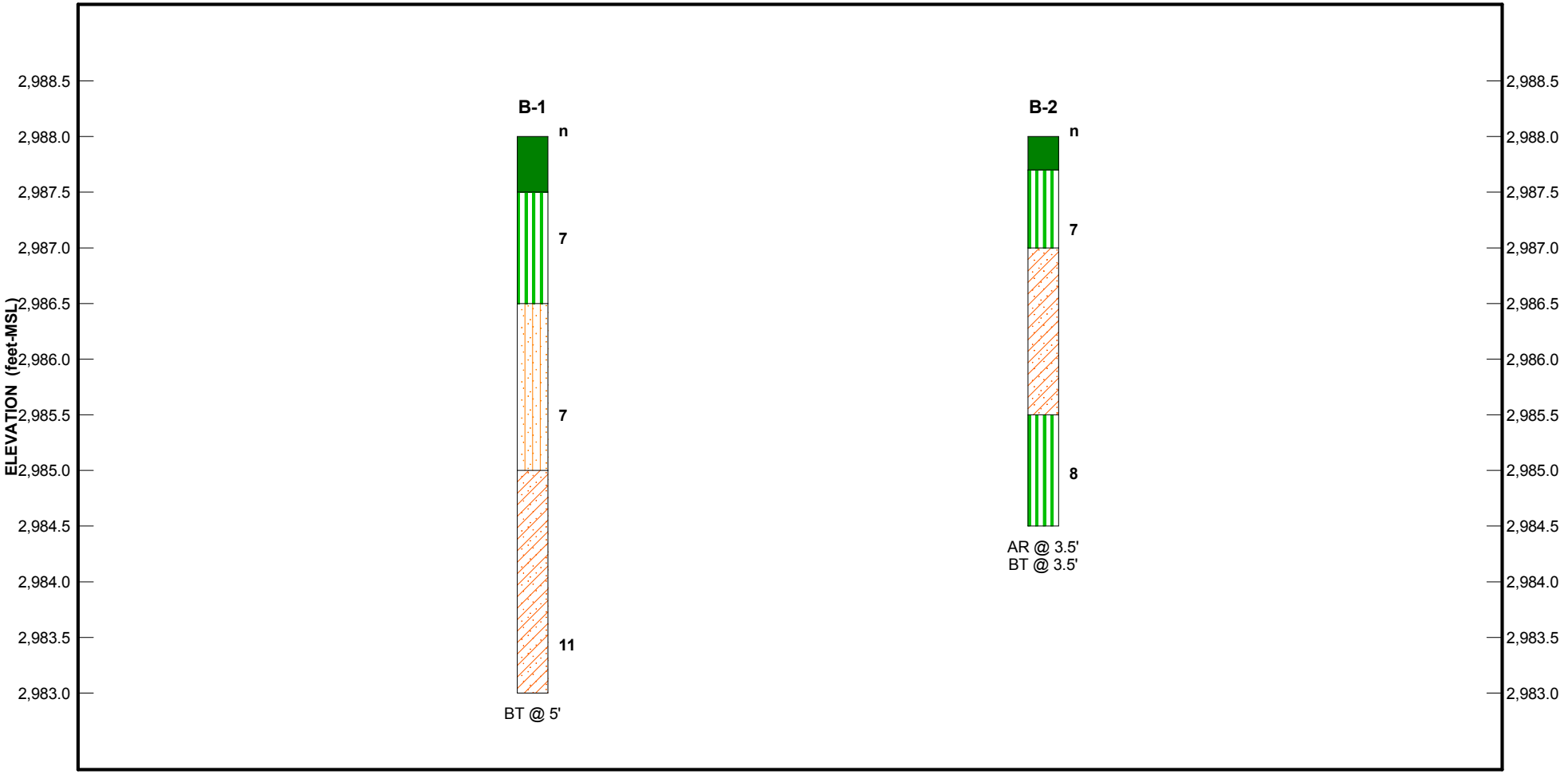
BORING LOCATION PLAN

Frontier Gas Pipeline
NCDOT R-2915A
Near Deep Gap, North Carolina

FIGURE NO. **2**

Hand Auger Borings B-1 and B-2



Topsoil

ML, Low Plasticity Silt

SM, Silty Sand

SC, Clayey Sand

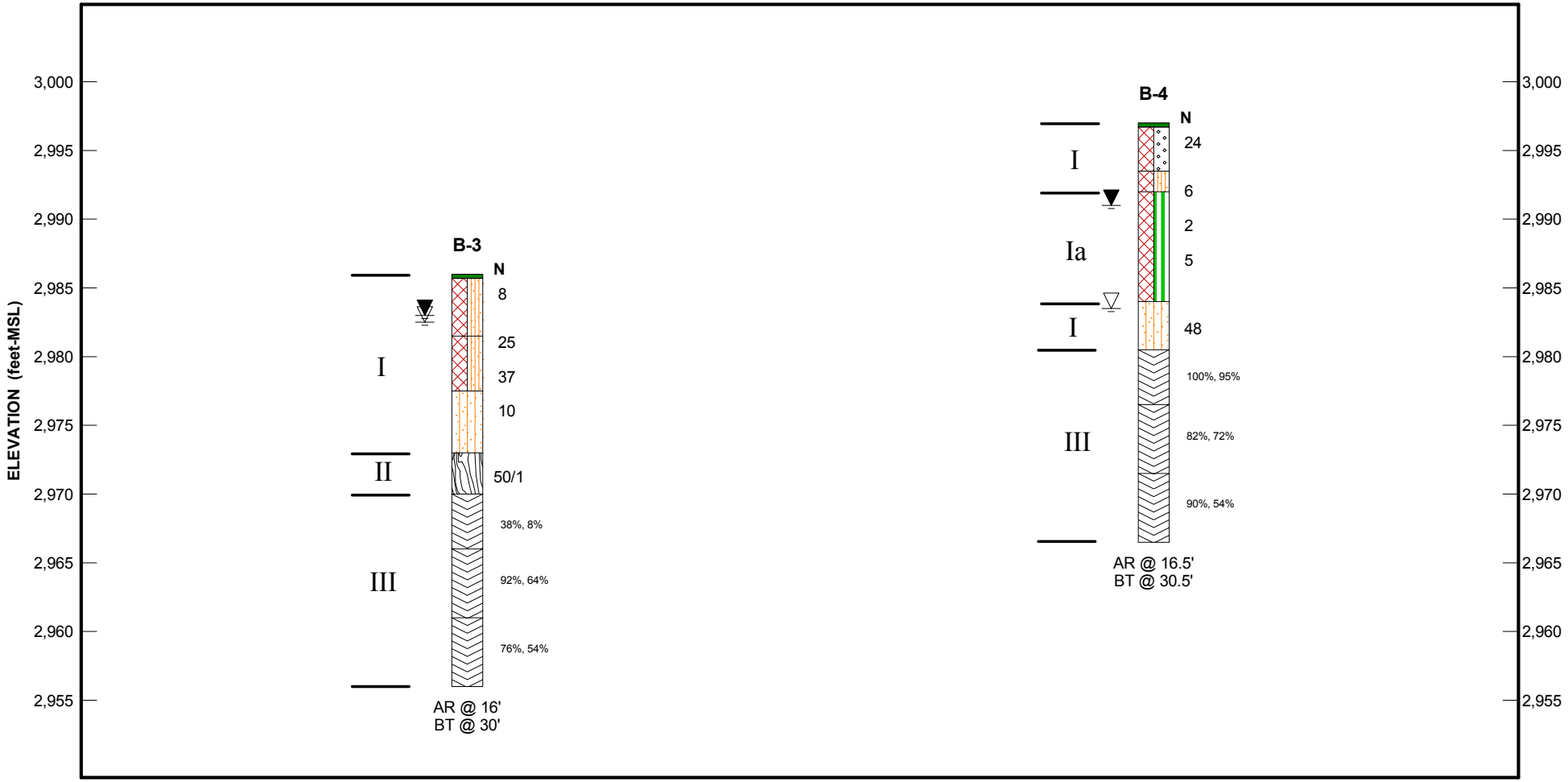
AR - Auger Refusal

BT - Boring Terminated

n = dynamic cone penetration resistance (blows/1.75 inches)

JOB NO: 1358-14-070	S&ME	8646 West Market Street, Suite 105 Greensboro, North Carolina 27409	Diagram: Generalized Subsurface Profile Project: Frontier Gas Pipeline Location: Deep Gap, North Carolina	Figure 3
DATE: 12/18/14				

Borings B-3 and B-4



SM, Silty Sand

SW, Well-graded Sand

Gneiss Rock

Topsoil

ML, Low Plasticity Silt

III - Stratum Designation

Partially Weathered Rock

Fill

- Groundwater after 24 Hours

- Groundwater at Termination of Boring

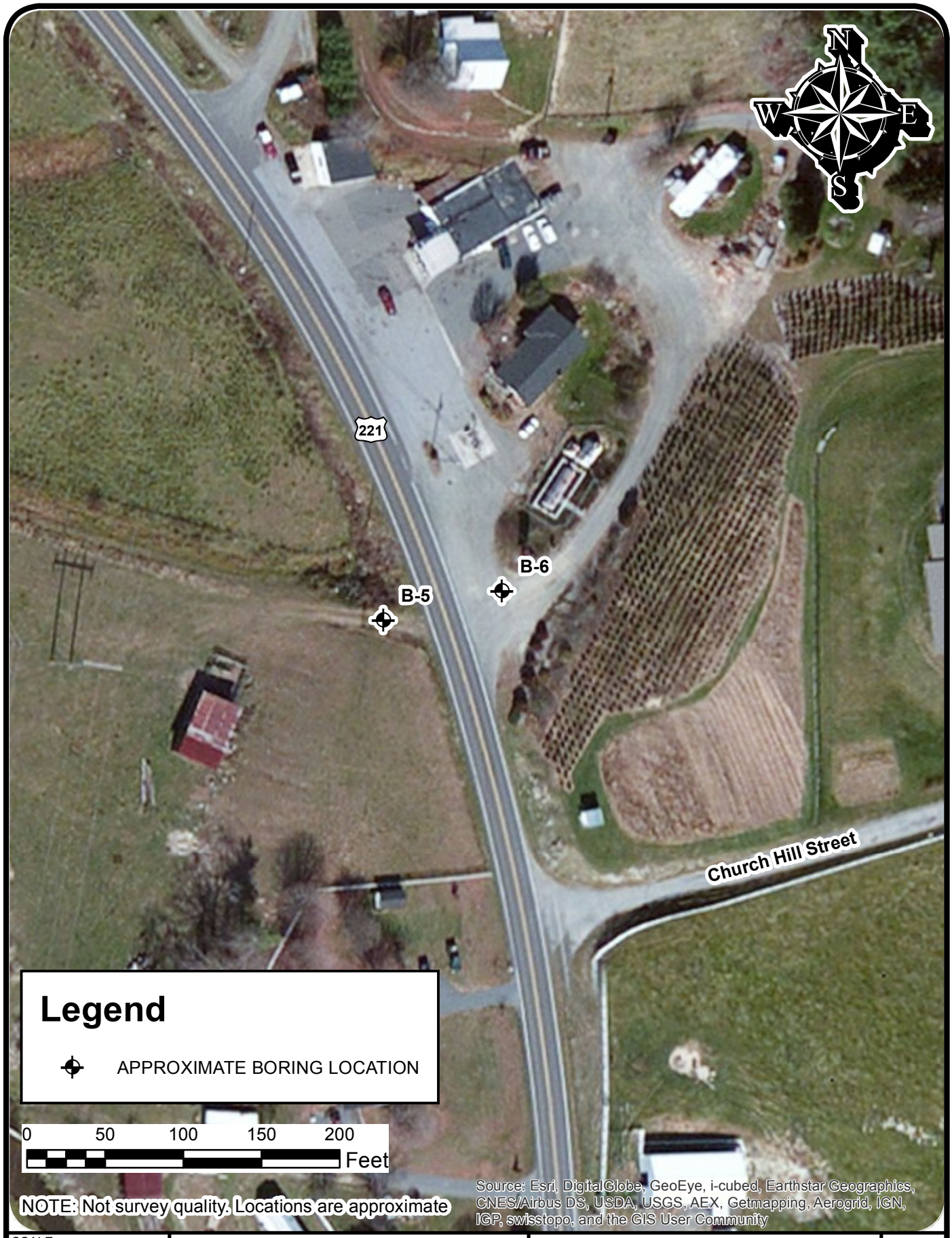
AR - Auger Refusal

BT - Boring Terminated

97%, 31% - Rock Core Recovery, Rock Core RQD

N = Standard Penetration Test resistance value (blows per foot). The depicted stratigraphy is shown for illustrative purposes only. The actual subsurface conditions will vary between boring locations.

JOB NO: 1358-14-070 DATE: 12/18/14	S&ME	8646 West Market Street, Suite 105 Greensboro, North Carolina 27409	Diagram: Generalized Subsurface Profile Project: Frontier Gas Pipeline Location: Deep Gap, North Carolina	Figure 4



SCALE:	As Shown
DATE:	DEC. 2014
DRAWN BY:	SDK
PROJECT NO:	1358-14-070

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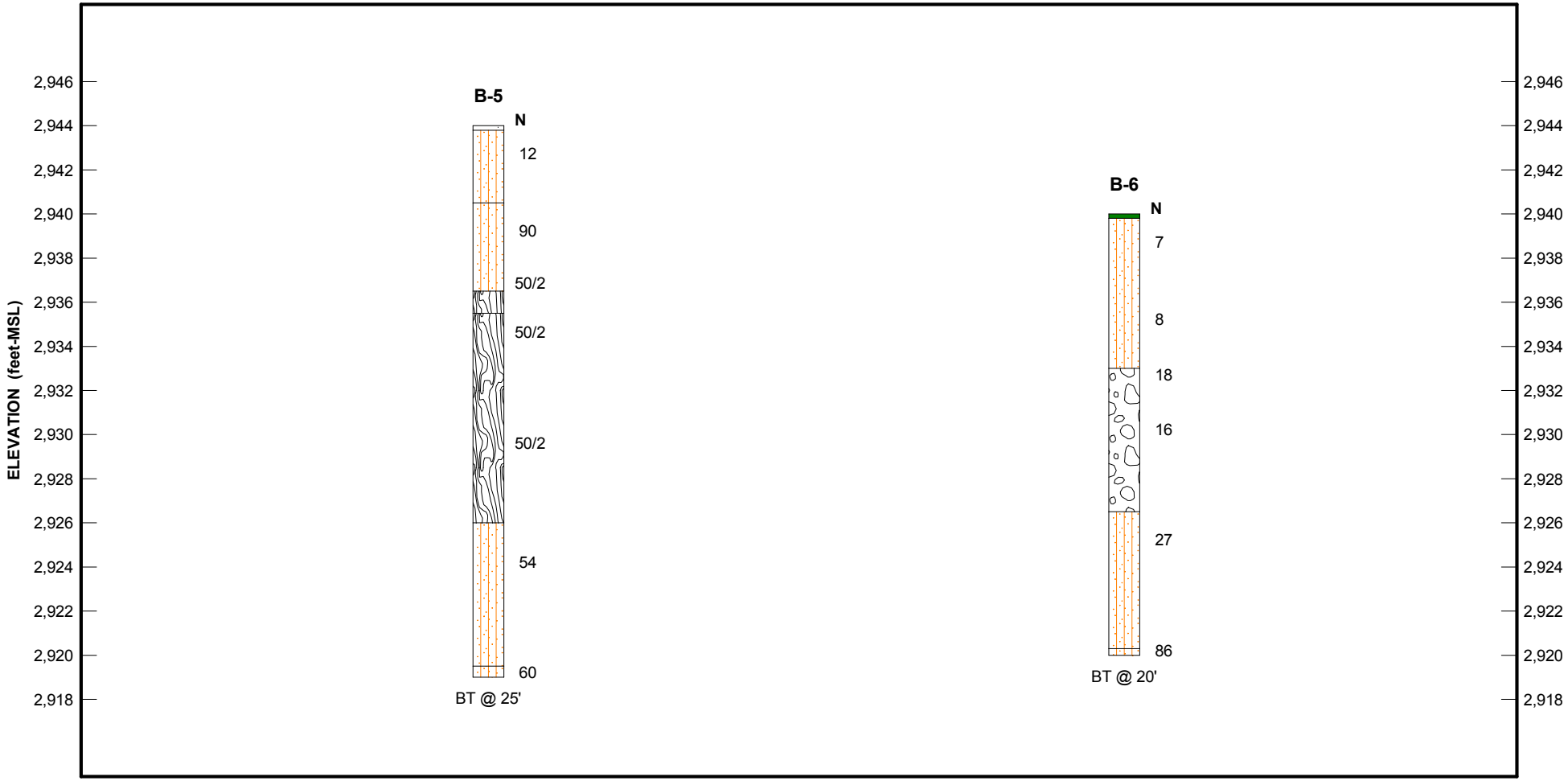
BORING LOCATION PLAN

Frontier Gas Pipeline
NCDOT R-2915A
Near Deep Gap, North Carolina

FIGURE NO. 5

Borings B-5 and B-6



Gravel

GP, Poorly-Graded Gravel

SM, Silty Sand

Topsoil

III - Stratum Designation

Partially Weathered Rock

AR - Auger Refusal

BT - Boring Terminated

N = Standard Penetration Test resistance value (blows per foot). The depicted stratigraphy is shown for illustrative purposes only. The actual subsurface conditions will vary between boring locations.

JOB NO: 1358-14-070	S&ME	8646 West Market Street, Suite 105 Greensboro, North Carolina 27409	Diagram: Generalized Subsurface Profile Project: Frontier Gas Pipeline Location: Deep Gap, North Carolina	Figure 6
DATE: 12/18/14				

APPENDICES

Appendix A
Legend to Soil Classification and Symbols
Hand Auger Boring Logs (B-1 and B-2)
Boring Logs (B-3 through B-6)

Appendix B
Rock Core Pictures

Appendix C
Summary of Laboratory Test Data
Laboratory Test Results (15 pages)

LEGEND TO SOIL CLASSIFICATION AND SYMBOLS

SOIL TYPES

(Shown in Graphic Log)


Fill


Asphalt


Concrete


Topsoil


Partially Weathered Rock


Cored Rock


GW — WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES


GP — POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES


GM — SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES


GC — CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES


SW — WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES


SP — POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES


SM — SILTY SANDS, SAND - SILT MIXTURES


SC — CLAYEY SANDS, SAND - CLAY MIXTURES


ML — INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY


CL — INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS


OL — ORGANIC SILTS AND ORGANIC CLAYS OF LOW PLASTICITY


MH — INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS, ELASTIC SILTS


CH — INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS


OH — ORGANIC SILTS AND ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY

WATER LEVELS

(Shown in Water Level Column)

▽ = Water Level At Termination of Boring
▼ = Water Level Taken After 24 Hours
◄ = Loss of Drilling Water
HC = Hole Cave

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	STD. PENETRATION RESISTANCE BLOWS/FOOT
Very Soft	0 to 2
Soft	3 to 4
Firm	5 to 8
Stiff	9 to 15
Very Stiff	16 to 30
Hard	31 to 50
Very Hard	Over 50

RELATIVE DENSITY OF COHESIONLESS SOILS

RELATIVE DENSITY	STD. PENETRATION RESISTANCE BLOWS/FOOT
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	Over 50

SAMPLER TYPES

(Shown in Samples Column)


Shelby Tube


Split Spoon


Rock Core


No Recovery

TERMS

Standard Penetration Resistance – The Number of Blows of 140 lb. Hammer Falling 30 in. Required to Drive 1.4 in. I.D. Split Spoon Sampler 1 Foot. As Specified in ASTM D 1586.

REC – Total Length of Rock Recovered in the Core Barrel Divided by the Total Length of the Core Run Times 100%.

RQD – Total Length of Sound Rock Segments Recovered that are Longer Than or Equal to 4" (mechanical breaks excluded) Divided by the Total Length of the Core Run Times 100%.

S&ME
ENGINEERING • TESTING
ENVIRONMENTAL SERVICES

PROJECT: **Frontier Gas Pipeline**
Deep Gap, North Carolina
1358-14-070

HAND AUGER BORING LOG: B-1

DATE STARTED: **11/14/14** DATE FINISHED: **11/14/14**

SAMPLING METHOD: **3" Open Bucket HA** PERFORMED BY: **D. Keatts**

WATER LEVEL: **Dry at TOB**

NOTES:
- **Soil excavated with a 3" open bucket HA.**
- **Boring terminated at 5'.**
- **Soil backfilled and compacted into borehole.**
- **Northing: 914706.0 Easting: 1259729.0**

Depth (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	WATER LEVEL	DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.) 10 20 30 60 80	DCP VALUE
		Topsoil - 6 inches thick				
1		**RESIDUAL: CLAYEY SILT (ML)** brown, moist, with sand	2987.00			7
2		**SILTY SAND (SM)** brown tan, moist, with gravel	2986.00			
3		**CLAYEY SAND (SC)** tan, moist	2985.00			7
4			2984.00			
5		Boring terminated at 5 ft	2983.00			11

1. PENETRATION RESISTANCE IS THE NUMBER OF BLOWS OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE 1.75 IN.

PROJECT: **Frontier Gas Pipeline**
Deep Gap, North Carolina
1358-14-070

HAND AUGER BORING LOG: B-2

DATE STARTED: **11/14/14** DATE FINISHED: **11/14/14**

SAMPLING METHOD: **3" Open Bucket HA** PERFORMED BY: **D. Keatts**

WATER LEVEL: **Dry at TOB**

NOTES:
- **Soil excavated with a 3" open bucket HA.**
- **Boring terminated at 5'.**
- **Soil backfilled and compacted into borehole.**
- **Northing: 914666.8 Easting: 1259723.0**

Depth (feet)	MATERIAL DESCRIPTION	ELEVATION (feet)	DCP VALUE
	Topsoil - 4 inches thick		
1	**RESIDUAL: CLAYEY SILT (ML)** brown, moist	2987.00	7
2	**SILTY SAND (SM)** tan brown, fine, moist	2986.00	
3	**SILTY SAND (SM)** black, fine, moist, with clay	2985.00	8
	Boring terminated at 3.5 ft due to auger refusal		

DYNAMIC CONE PENETRATION RESISTANCE (blows/1.75 in.)
10 20 30 60 80

S&ME

1. PENETRATION RESISTANCE IS THE NUMBER OF BLOWS OF A 10.1 LB HAMMER FALLING 22.6 IN., DRIVING A 0.79 IN. O.D. 60 DEGREE CONE 1.75 IN.

PROJECT: **Frontier Gas Pipeline**
Deep Gap, North Carolina
S&ME Project No. 1358-14-070

BORING LOG **B-3**

DATE DRILLED: **12/4/14**	ELEVATION: **2986.0 ft**
DRILL RIG: **Track D-50**	BORING DEPTH: **30.0 ft**
DRILLER: **H. Herd**	WATER LEVEL: **3.5' ATD, 3' 24 hr**
HAMMER TYPE: **Autohammer**	LOGGED BY: **D. Keatts/L. Butler**
SAMPLING METHOD: **Split Spoon, Rock Core**	NORTHING: **914488.64** / EASTING: **1259926.95**
DRILLING METHOD: **3¼" H.S.A., NQ Core**	

NOTES:
- **Soil excavated with a 3 1/4" HSA to refusal at 16'.**
- **Water level measurement was attempted.**
- **Rock cored with an NQ diamond core bit to 30'.**
- **PVC inserted for borehole support.**
- **Stabilized water level measurement taken at 24 hours.**
- **Borehole tremie grouted to the ground surface.**

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet)	SAMPLE NO.	1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	N VALUE
	Topsoil - 4 inches thick						
	FILL: SILTY SAND (SM) loose to medium dense, brown black, fine, moist, with gravel		SS-1	2	3	5	8
			SS-2	2	6	19	25
5	**FILL: SILTY SAND (SM)** dense, brown gray, medium to coarse, wet, with gravel	2981.0	SS-3	12	20	17	37
	RESIDUUM: SILTY SAND (SM) loose, olive gray, fine, moist to wet, with mica		SS-4	8	5	5	10
10		2976.0					
	PARTIALLY WEATHERED ROCK (SM) olive white, moist, sampled as silty sand with gravel		SS-5	12	50	50/1	50/1
15		2971.0					
	GNEISS: light gray and yellowish orange, soft, incompetent, very poor rock quality, severe weathering, course to medium grained, weathered high angle fractures, weathered mid-angle fracture from 19.6 to 20 feet, Moh's Hardness 1.5		RC-1		38%	8%	

STANDARD PENETRATION TEST DATA (blows/ft) / REMARKS — 10 20 30 60 80

WATER LEVEL

S&ME BORING LOG 1358-14-070 FRONTIER GAS PIPELINE.GPJ S&ME.GDT 1/6/15

NOTES:

1. ***THIS LOG IS ONLY A PORTION OF A REPORT PREPARED FOR THE NAMED PROJECT AND MUST ONLY BE USED TOGETHER WITH THAT REPORT.***
2. ***BORING, SAMPLING AND PENETRATION TEST DATA IN GENERAL ACCORDANCE WITH ASTM D-1586.***
3. ***STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.***
4. ***WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.***

S&ME

PROJECT: **Frontier Gas Pipeline**
Deep Gap, North Carolina
S&ME Project No. 1358-14-070

BORING LOG **B-3**

DATE DRILLED: **12/4/14**
ELEVATION: **2986.0 ft**
DRILL RIG: **Track D-50**
BORING DEPTH: **30.0 ft**
DRILLER: **H. Herd**
WATER LEVEL: **3.5' ATD, 3' 24 hr**
HAMMER TYPE: **Autohammer**
LOGGED BY: **D. Keatts/L. Butler**

NOTES:
- **Soil excavated with a 3 1/4" HSA to refusal at 16'.**
- **Water level measurement was attempted.**
- **Rock cored with an NQ diamond core bit to 30'.**
- **PVC inserted for borehole support.**
- **Stabilized water level measurement taken at 24 hours.**
- **Borehole tremie grouted to the ground surface.**

SAMPLING METHOD: **Split Spoon, Rock Core**
NORTHING: **914488.64**
EASTING: **1259926.95**

DRILLING METHOD: **3¼" H.S.A., NQ Core**

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA 1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	STANDARD PENETRATION TEST DATA (blows/ft) / REMARKS 10 20 30 60 80	N VALUE
		GNEISS: light gray, moderately soft, continuous, fair rock quality, slight weathering, course to medium grained, intersecting horizontal and mid-angle fractures from 21.1 to 21.4 feet and approximately 24.5 to 25 feet, high angle weathered fracture from approximately 23.5 to 24 feet, Moh's Hardness 2.5			RC-2			92%	64%		
25		GNEISS: yellowish orange to light gray, moderately soft to moderately hard, fairly continuous, fair rock quality, moderately severe to very slight weathering, course to medium grained, intersecting horizontal and weathered vertical fractures from 25 to approximately 27 feet, Moh's Hardness 2.5 (23' to 27'), 4.5 (27' to 29'), and 3.5 (29' to 30')		2961.0	RC-3			76%	54%		
30		Auger refusal at 16 ft Boring terminated at 30 ft		2956.0							

S&ME BORING LOG 1358-14-070 FRONTIER GAS PIPELINE.GPJ S&ME.GDT 1/6/15

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3. ***STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.***
4. ***WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.***

S&ME

PROJECT: **Frontier Gas Pipeline**
Deep Gap, North Carolina
S&ME Project No. 1358-14-070

BORING LOG **B-4**

DATE DRILLED: **12/4/14**	ELEVATION: **2997.0 ft**
DRILL RIG: **Track D-50**	BORING DEPTH: **30.5 ft**
DRILLER: **H. Herd**	WATER LEVEL: **13.5' ATD, 6' 24 hr**
HAMMER TYPE: **Autohammer**	LOGGED BY: **D. Keatts/L. Butler**
SAMPLING METHOD: **Split Spoon, Rock Core**	NORTHING: **914389.38** / EASTING: **1260171.94**
DRILLING METHOD: **3¼" H.S.A., NQ Core**	

NOTES:
- Soil excavated with a 3 1/4" HSA to refusal at 16.5'.
- Water level measurement was attempted.
- Rock cored with an NQ diamond core bit to 30.5'.
- PVC inserted for borehole support.
- Stabilized water level measurement taken at 24 hours.
- Borehole tremie grouted to the ground surface.

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet)	SAMPLE NO.	1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	N VALUE
	Topsoil - 4 inches thick						
	FILL: GRAVELLY SAND (SW) medium dense, brown gray, fine, dry, well graded		SS-1	5	14	10	24
	FILL: SILTY SAND (SM) loose, orange tan, fine, damp, with mica		SS-2	2	3	3	6
5	**FILL: SANDY SILT (ML)** very soft to firm, dark brown, moist, with mica	2992.0	SS-3	2	1	1	2
			SS-4	2	2	3	5
10		2987.0					
	RESIDUUM: SILTY SAND (SM) dense, white orange, fine to medium, moist		SS-5	5	10	38	48
15		2982.0					
	GNEISS: light gray, moderately hard, continuous, excellent rock quality, fresh to very slight weathering, course to medium grained, mid-angle weathered fractures from 19.1 to 19.3 feet, Moh's Hardness 7 to 6		RC-1		100%	95%	

STANDARD PENETRATION TEST DATA (blows/ft) / REMARKS — 10 20 30 60 80

S&ME BORING LOG 1358-14-070 FRONTIER GAS PIPELINE.GPJ S&ME.GDT 1/6/15

NOTES:

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4. ***WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.***

PROJECT: **Frontier Gas Pipeline**
Deep Gap, North Carolina
S&ME Project No. 1358-14-070

BORING LOG **B-4**

DATE DRILLED: **12/4/14**
ELEVATION: **2997.0 ft**
DRILL RIG: **Track D-50**
BORING DEPTH: **30.5 ft**
DRILLER: **H. Herd**
WATER LEVEL: **13.5' ATD, 6' 24 hr**
HAMMER TYPE: **Autohammer**
LOGGED BY: **D. Keatts/L. Butler**

NOTES:
- **Soil excavated with a 3 1/4" HSA to refusal at 16.5'.**
- **Water level measurement was attempted.**
- **Rock cored with an NQ diamond core bit to 30.5'.**
- **PVC inserted for borehole support.**
- **Stabilized water level measurement taken at 24 hours.**
- **Borehole tremie grouted to the ground surface.**

SAMPLING METHOD: **Split Spoon, Rock Core**
NORTHING: **914389.38**
EASTING: **1260171.94**

DRILLING METHOD: **3¼" H.S.A., NQ Core**

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA 1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	STANDARD PENETRATION TEST DATA (blows/ft) / REMARKS 10 20 30 60 80	N VALUE
		GNEISS: light gray to yellowish orange, moderately soft, fairly continuous, fair rock quality, slight to moderate weathering, course to medium grained, low angle weathered fractures at approximately 20.7, 22.0, and 24.6 feet, Moh's Hardness 5 to 4			RC-2			82%	72%		
25				2972.0							
		GNEISS: light gray and yellowish orange, soft, continuous, fair rock quality, slight to moderate weathering, course to medium grained, multiple low-angle weathered fractures from approximately 27 to 28.5 feet, Moh's Hardness 4 to 3			RC-3			90%	54%		
30				2967.0							
		Auger refusal at 16.5 ft Boring terminated at 30.5 ft									

S&ME BORING LOG 1358-14-070 FRONTIER GAS PIPELINE.GPJ S&ME.GDT 1/6/15

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S&ME

PROJECT: **Frontier Gas Pipeline**
Deep Gap, North Carolina
S&ME Project No. 1358-14-070

BORING LOG **B-5**

DATE DRILLED: **12/3/14**	ELEVATION: **2944.0 ft**
DRILL RIG: **Track D-50**	BORING DEPTH: **25.0 ft**
DRILLER: **H. Herd**	WATER LEVEL: **Dry at TOB.**
HAMMER TYPE: **Autohammer**	LOGGED BY: **D. Keatts**
SAMPLING METHOD: **Split spoon**	NORTHING: **924104.08** EASTING: **1263235.13**
DRILLING METHOD: **3¼" H.S.A.**	

NOTES:
- **Soil excavated with a 3 1/4" HSA to termination at 25'.**
- **Water level measurement was attempted.**
- **Borehole tremie grouted to the ground surface immediately after drilling completion.**

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA 1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	STANDARD PENETRATION TEST DATA (blows/ft) / REMARKS	N VALUE
	Gravel Driveway Surface - 2 inches thick								
	POSSIBLE RESIDUUM: SILTY SAND (SM) medium dense, tan brown, fine, damp, with mica		SS-1		3	7	5		12
	RESIDUUM: SILTY SAND (SM) very dense, gray tan, fine, damp, with mica		SS-2		14	45	45		90
5		2939.0	SS-3		12	38	50/2		50/2
	PARTIALLY WEATHERED ROCK (SM) gray brown, damp, sampled as silty sand with mica		SS-4		15	50/2			50/2
	PARTIALLY WEATHERED ROCK (SM) tan gray, damp, sampled as silty sand with mica								
10		2934.0							
			SS-5		15	50/2			50/2
15		2929.0							
	SILTY SAND (SM) very dense, tan gray, fine, damp, with mica		SS-6		8	22	32		54

STANDARD PENETRATION TEST DATA (blows/ft) / REMARKS: 10 20 30 60 80

S&ME BORING LOG 1358-14-070 FRONTIER GAS PIPELINE.GPJ S&ME.GDT 1/6/15

NOTES:

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3. ***STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.***
4. ***WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.***

S&ME

PROJECT: **Frontier Gas Pipeline**
Deep Gap, North Carolina
S&ME Project No. 1358-14-070

BORING LOG **B-5**

DATE DRILLED: **12/3/14**
ELEVATION: **2944.0 ft**
DRILL RIG: **Track D-50**
BORING DEPTH: **25.0 ft**
DRILLER: **H. Herd**
WATER LEVEL: **Dry at TOB.**
HAMMER TYPE: **Autohammer**
LOGGED BY: **D. Keatts**

NOTES:
- **Soil excavated with a 3 1/4" HSA to termination at 25'.**
- **Water level measurement was attempted.**
- **Borehole tremie grouted to the ground surface immediately after drilling completion.**

SAMPLING METHOD: **Split spoon**
NORTHING: **924104.08**
EASTING: **1263235.13**

DRILLING METHOD: **3¼" H.S.A.**

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA 1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	STANDARD PENETRATION TEST DATA (blows/ft) / REMARKS	N VALUE
		SILTY SAND (SM) very dense, tan gray, fine, damp, with mica *(continued)*									
					SS-7		15	22	38		60
25		**SILTY SAND (SM)** very dense, orange brown, medium, damp		2919.0							
		Boring terminated at 25 ft									

S&ME BORING LOG 1358-14-070 FRONTIER GAS PIPELINE.GPJ S&ME.GDT 1/6/15

NOTES:

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3. ***STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.***
4. ***WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.***

PROJECT: **Frontier Gas Pipeline**
Deep Gap, North Carolina
S&ME Project No. 1358-14-070

BORING LOG **B-6**

DATE DRILLED: **12/3/14**	ELEVATION: **2940.0 ft**
DRILL RIG: **Track D-50**	BORING DEPTH: **20.0 ft**
DRILLER: **H. Herd**	WATER LEVEL: **Dry at 24 hrs.**
HAMMER TYPE: **Autohammer**	LOGGED BY: **D. Keatts**
SAMPLING METHOD: **Split spoon**	NORTHING: **924112.43** EASTING: **1263289.26**
DRILLING METHOD: **3¼" H.S.A.**	

NOTES:
- **Soil excavated with a 3 1/4" HSA to termination at 20'.**
- **Water level measurement was attempted.**
- **PVC inserted for borehole support.**
- **Stabilized water level measurement taken at 24 hours.**
- **Borehole tremie grouted to the ground surface.**

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA 1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	STANDARD PENETRATION TEST DATA (blows/ft) / REMARKS	N VALUE
	Topsoil - 2 inches thick								
	RESIDUUM: SILTY SAND (SM) loose, brown, fine, moist, with mica		SS-1		3	3	4		7
			SS-2		2	3	5		8
5		2935.0							
			SS-3		9	12	6		18
	GRAVEL (GP) medium dense, gray white, dry, with sand, poorly graded		SS-4		15	10	6		16
10		2930.0							
	SILTY SAND (SM) medium dense to dense, gray brown, fine, moist, with sand and mica		SS-5		7	13	14		27
15		2925.0							
			SS-6		10	38	48		86
20	**SILTY SAND (SM)** very dense, white, fine, dry	2920.0							
	Boring terminated at 20 ft								

STANDARD PENETRATION TEST DATA (blows/ft) / REMARKS: 10 20 30 60 80

S&ME BORING LOG 1358-14-070 FRONTIER GAS PIPELINE.GPJ S&ME.GDT 1/6/15

NOTES:

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S&ME

Rock Core Pictures
Frontier Gas Pipeline
Deep Gap, North Carolina
Project #: 1358-14-070
Sheet 1 of 2

S&ME
8646 West Market Street, Suite 105
Greensboro, NC 27409

Photo 1

Date: 12/16/14

Photographer: D. Keatts

Boring	B-3: RC-1 and RC-2
Remarks	Depth = 16 to 25 feet (Elev. = 2970' to 2961') UCS test performed from 22.2 to 22.8 feet (2963.8' to 2963.2') = 3,672 psi

Photo 2

Date: 12/16/14

Photographer: D. Keatts

Boring	B-3: RC-3
Remarks	Depth = 25 to 30 feet (Elev. = 2961' to 2956') UCS test performed from 28 to 28.7 feet (2958' to 2957.3') = 5,341 psi

Rock Core Pictures
Frontier Gas Pipeline
Deep Gap, North Carolina
Project #: 1358-14-070
Sheet 2 of 2

S&ME
8646 West Market Street, Suite 105
Greensboro, NC 27409

Photo 3

Date: 12/16/14

Photographer: D. Keatts

Boring	B-4: RC-1 and RC-2
Remarks	Depth = 16.5 to 25.5 feet (Elev. = 2980.5' to 2971.5') UCS test performed from 22.8 to 23.3 feet (2974.2' to 2973.7') = 1,430 psi

Photo 4

Date: 12/16/14

Photographer: D. Keatts

Boring	B-4: RC-3
Remarks	Depth = 25.5 to 30.5 feet (Elev. = 2971.5' to 2966.5') UCS test performed from 28.4 to 29 feet (2968.6' to 2968') = 2,528 psi

SUMMARY OF LABORATORY TEST DATA
Frontier Gas Pipeline
NCDOT R-2915A
Deep Gap, North Carolina
S&ME Project No. 1358-14-070

SAMPLE LOCATION				Sample Type	USCS Classification	Atterberg Limits			Natural Moisture Content	Diameter (millimeters)				% Silt and Clay	% Sand			% Gravel	Unconfined Compressive Strength (psi)
Boring	Sample #	Depth (ft)	Strata			LL	PL	PI	%	D_{100}	D_{60}	D_{30}	D_{10}		Fine	Medium	Coarse		
B-3	SS-4	8.5 - 10	I	SS	SM	NP	NP	NP	26.0	--	--	--	--	--	--	--	--	--	--
	SS-5	13.5-14.6	II	SS	SM	--	--	--	11.2	18.00	1.30	0.15	--	22.0	23.5	20.1	7.5	26.9	--
	RC-2	22.2-22.8	III	RC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3,672
	RC-3	28-28.7	III	RC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5,341
B-4	SS-3	6-7.5	Ia	SS	ML	NP	NP	NP	30.4	--	--	--	--	--	--	--	--	--	--
	SS-5	13.5-15	I	SS	SM	--	--	--	12.2	19.00	1.30	0.26	--	14.0	26.0	29.7	9.5	20.8	--
	RC-2	22.8-23.3	III	RC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,430
	RC-3	28.4-29	III	RC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,528
B-5	SS-3	6-7.2	--	SS	SM	NP	NP	NP	10.5	--	--	--	--	--	--	--	--	--	--
	SS-5	13.5-14.2	--	SS	SM	--	--	--	6.4	11.00	0.35	0.17	--	14.9	52.7	20.0	4.6	7.9	--
	SS-6	18.5-20	--	SS	SM	--	--	--	10.0	1.80	0.27	0.13	--	21.0	71.1	7.5	0.4	0.0	--
B-6	SS-3	6-7.5	--	SS	SM	NP	NP	NP	5.9	--	--	--	--	--	--	--	--	--	--
	SS-4	8.5-10	--	SS	GP	--	--	--	2.6	38.00	22.20	8.20	0.37	3.5	7.2	6.8	5.0	77.4	--
	SS-5	13.5-15	--	SS	SM	NP	NP	NP	13.4	--	--	--	--	--	--	--	--	--	--
	SS-6	18.5-20	--	SS	SM	--	--	--	10.6	9.50	0.50	0.19	--	15.0	40.5	28.9	9.4	6.2	--

LEGEND
SS - Split Spoon Soil Sample
RC - Rock Core
LL - Liquid Limit
PL - Plastic Limit
PI - Plasticity Index
NP- Non-Plastic

UNCONFINED COMPRESSION
(ASTM D7012 Method C)

S&ME, Inc. - Knoxville 1413 Topside Road, Louisville, TN 37777

Project Name: Frontier Gas Pipeline
Project Number: 1358-14-070

Report Date: December 22, 2014
Reviewed By: Jason B. Burgess

Sample No.	Sample Id	Depth (ft)	Dimensions, in.		Shape (See Key)	Area (in^2)	Unit Weight (lbs/ft^3)	Loading Rate (psi/sec)	Maximum Load (lbs)	Strength (psi)	Moisture (%)
			Length	Diameter							
RC-2	B-3	22' 2" - 22' 9"	4.33	1.96	D	3.02	156.5	52	11,090	3,672	0.1
RC-3	B-3	28' - 28' 9"	4.33	1.98	D	3.08	158.4	59	16,450	5,341	0.2
RC-2	B-4	22' 9" - 23' 4"	4.22	1.96	C	3.02	149.6	36	4,320	1,430	0.2
RC-3	B-4	28' 5" - 29'	4.27	1.95	D	2.99	153.9	60	7,560	2,528	0.1

NOTES: Effective (as received) unit weight as determined by RTH 109-93.
Loading rates were selected to target reaching failure between 2 and 15 minutes.

SHAPE KEY

ASTM D4543-08 *Standard Practice for Preparing Rock Core as Cylindrical Test Specimens and Verifying Conformance to Dimensional and Shape Tolerance* Section 1.2 - "Rock is a complex engineering material that can vary greatly as a function of lithology, stress history, weathering, moisture content and chemistry, and other natural geologic processes. As such, it is not always possible to obtain or prepare rock core specimens that satisfy the desirable tolerances given in this practice. Most commonly, this situation presents itself with weaker, more porous, and poorly cemented rock types and rock types containing significant or weak (or both) structural features. For these and other rock types which are difficult to prepare, all reasonable efforts shall be made to prepare a specimen in accordance with this practice and for the intended test procedure. However, when it has been determined by trial that this is not possible, prepare the rock specimen to the closest tolerances practicable and consider this to be the best effort and report it as such and if allowable or necessary for the intended test, capping the ends of the specimen as discussed in this practice is permitted."

A Test specimen measurements met the desired shape tolerances of ASTM D4543-08 (side straightness, end flatness & parallelism, and end perpendicularity to axis)

B Test specimen measurements met the desired shape tolerances of ASTM D4543-08 for end flatness & parallelism, and end perpendicularity to axis. Specimen did not meet the desired tolerance for side straightness. Specimen prepared to closest tolerances practicable.

C Test specimen measurements met the desired shape tolerances of ASTM D4543-08 for end flatness & parallelism. Specimen did not meet the desired tolerances for side straightness and end perpendicularity to axis. Specimen prepared to closest tolerances practicable.

D Test specimen measurements met the desired shape tolerances of ASTM D4543-08 for end flatness. Specimen did not meet the desired tolerances for side straightness, parallelism and end perpendicularity to axis. Specimen prepared to closest tolerances practicable.

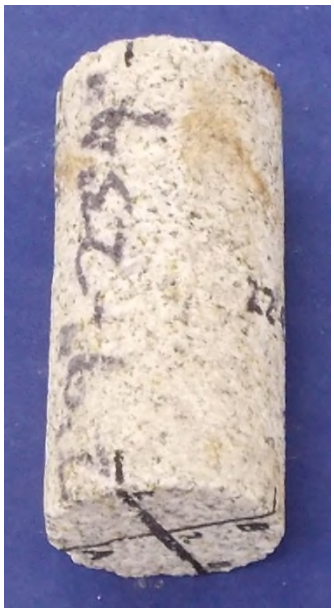
E Test specimen measurements met the desired shape tolerances of ASTM D4543-08 for end flatness and end perpendicularity to axis. Specimen did not meet the desired tolerance for side straightness and parallelism. Specimen prepared to closest tolerances practicable.

S&ME
1413 Topside Road
Louisville, TN 37777

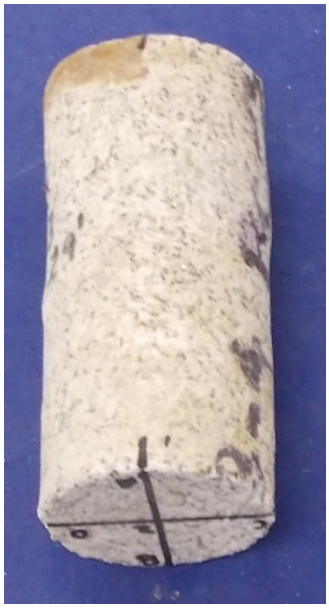
1	**Specimen ID**	B-3, RC-2 (22’ 2” – 22’ 9”)
	Remarks	Unconfined Compression of Rock Specimen Before/After Test (ASTM D7012, Method C)

2	**Specimen ID**	B-3, RC-3 (28’ – 28’ 9”)
	Remarks	Unconfined Compression of Rock Specimen Before/After Test (ASTM D7012, Method C)

S&ME
1413 Topside Road
Louisville, TN 37777



3	**Specimen ID**	B-4, RC-2 (22’ 9” – 23’ 4”)
	Remarks	Unconfined Compression of Rock Specimen Before/After Test (ASTM D7012, Method C)



4	**Specimen ID**	B-4, RC-3 (28’ 5” – 29’)
	Remarks	Unconfined Compression of Rock Specimen Before/After Test (ASTM D7012, Method C)

Form No: TR-D2216-T265-2
Revision No. 0
Revision Date: 02/22/08

Laboratory Determination of Water Content

ASTM D 2216 ☑ *AASHTO T 265* ☐ ***Quality Assurance***

S&ME, Inc. - Greensboro 8646 West Market St., Suite 105 Greensboro NC 27409

Project #:	**1358-14-070**	Report Date:	12-17-14
Project Name:	Frontier Gas Pipeline	Test Date(s):	12-12-14
Client Name:	MA Engineering Consultants, Inc.		
Client Address:	598 East Chatham Street, Suite 137 Cary NC		
Sample by:	H. Herd	Sample Date(s):	12/3-4/14
Sampling Method:	Hand Auger	Drill Rig :	

Method: **A (1%)** ☐ **B (0.1%)** ☑ *Balance ID.* ***5544*** *Calibration Date:* ***8-10-14***

Boring No.	Sample No.	Sample Depth	Tare #	Tare Weight	Tare Wt.+ Wet Wt	Tare Wt. + Dry Wt	Water Weight	Percent Moisture
		ft. or m.		grams	grams	grams	grams	%
B-3	SS-4	8.5'-10.0'	B-2	7.90	70.46	57.54	12.92	**26.0%**
	SS-5	13.5'-14.6'	8	139.72	292.95	277.49	15.46	**11.2%**
B-4	SS-3	6.0'-7.5'	3	8.18	73.05	57.92	15.13	**30.4%**
	SS-5	13.5'-15.0'	11	126.32	363.79	338.03	25.76	**12.2%**
B-5	SS-3	6.0'-7.2'	30	9.38	72.80	66.76	6.04	**10.5%**
	SS-5	13.5'-14.2'	13	120.19	332.18	319.40	12.78	**6.4%**
	SS-6	18.5'-20.0'	14	295.67	579.57	553.81	25.76	**10.0%**
B-6	SS-3	6.0'-7.5'	22	9.31	73.02	69.45	3.57	**5.9%**
	SS-4	8.5'-10.0'	16	291.94	493.15	488.07	5.08	**2.6%**
	SS-5	13.5'-15.0'	20	9.33	71.98	64.60	7.38	**13.4%**
	SS-6	18.5'-20.0'	17A	11.46	242.61	220.45	22.16	**10.6%**

Notes / Deviations / References

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Jimmy Thomasson		Nicet 119392	
Technician Name	*Signature*	*Certification Type / No.*	*Date*
David Keatts, PE		Project Engineer	
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D4318-T89-90
Revision No. 0
Revision Date: 11/20/07

Liquid Limit, Plastic Limit, and Plastic Index

Another code *ASTM D 4318* ☒ *AASHTO T 89* ☐ *AASHTO T 90* ☐ ***Quality Assurance***

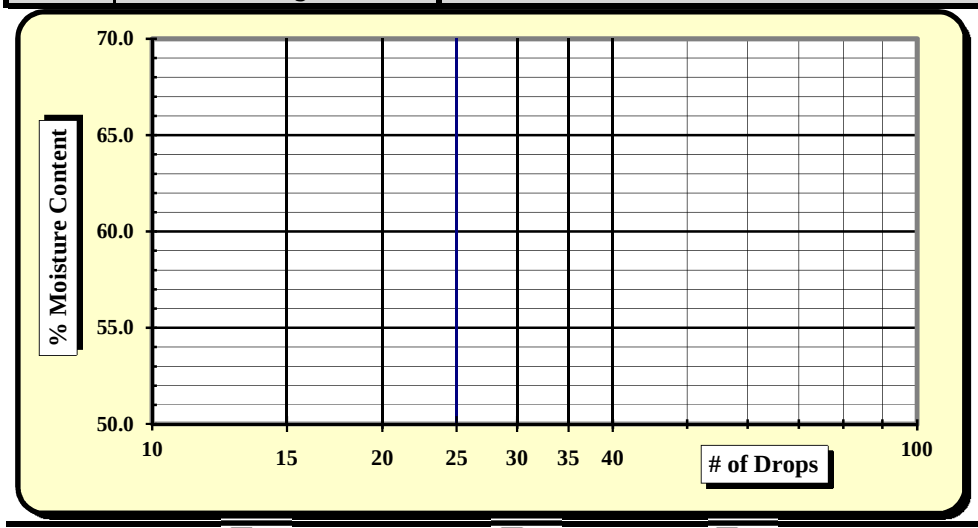
S & ME, Inc.- Greensboro 8646 West Market St. Suite 105, Greensboro NC 27409

Project #:	**1358-14-070**	Report Date:	12-17-14
Project Name:	Frontier Gas Pipeline	Test Date(s)	12-16-14
Client Name:	MA Engineering Consultants, Inc.		
Client Address:	598 East Chatham Street, Suite 137 Cary NC		

Boring #:	B-3	Sample #: SS-4		Sample Date: 12/3-4/14	
Location:	NA	Offset: NA		Elevation: 8.5'-10.0'	
Sample Description:	Olive Gray Silty SAND (SM)				

Type and Specification	*S&ME ID #*	*Cal Date:*	*Type and Specification*	*S&ME ID #*	*Cal Date:*
Balance (0.01 g)	5544	8/10/2014	Grooving tool	5575	10/11/2014
LL Apparatus	5571	4/19/2014	Grooving tool		
Oven	5470	12/1/2014	Grooving tool		

Pan #		Liquid Limit						Plastic Limit		
	Tare #:			32	4	5	6			9
A	Tare Weight			15.96						
B	Wet Soil Weight + A			25.34						
C	Dry Soil Weight + A			22.68						
D	Water Weight (B-C)	#######	#######	2.66				#######	#######	
E	Dry Soil Weight (C-A)	#######	#######	6.72				#######	#######	
F	% Moisture (D/E)*100			39.6%						
N	# OF DROPS			14				*Moisture Contents determined by ASTM D 2216*		
LL	LL = **F** * FACTOR									
Ave.	*Average*							**#DIV/0!**		



One Point Liquid Limit			
N	**Factor**	**N**	**Factor**
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic ☒
Liquid Limit ######
Plastic Limit ######
Plastic Index ######
Group Symbol **SM**

Multipoint Method ☑
One-point Method ☐

Wet Preparation ☐ Dry Preparation ☐ Air Dried ☑

Notes / Deviations / References: Not rollable.

ASTM D 4318: Liquid Limit, Plastic Limit, & Plastic Index of Soils

Jimmy Thomasson — *Technician Name* — *Date*
David Keatts, PE — *Technical Responsibility* — *Date*

Form No: TR-D422-WH-1Ga
Revision No. 0
Revision Date: 07/14/08

Sieve Analysis of Soils

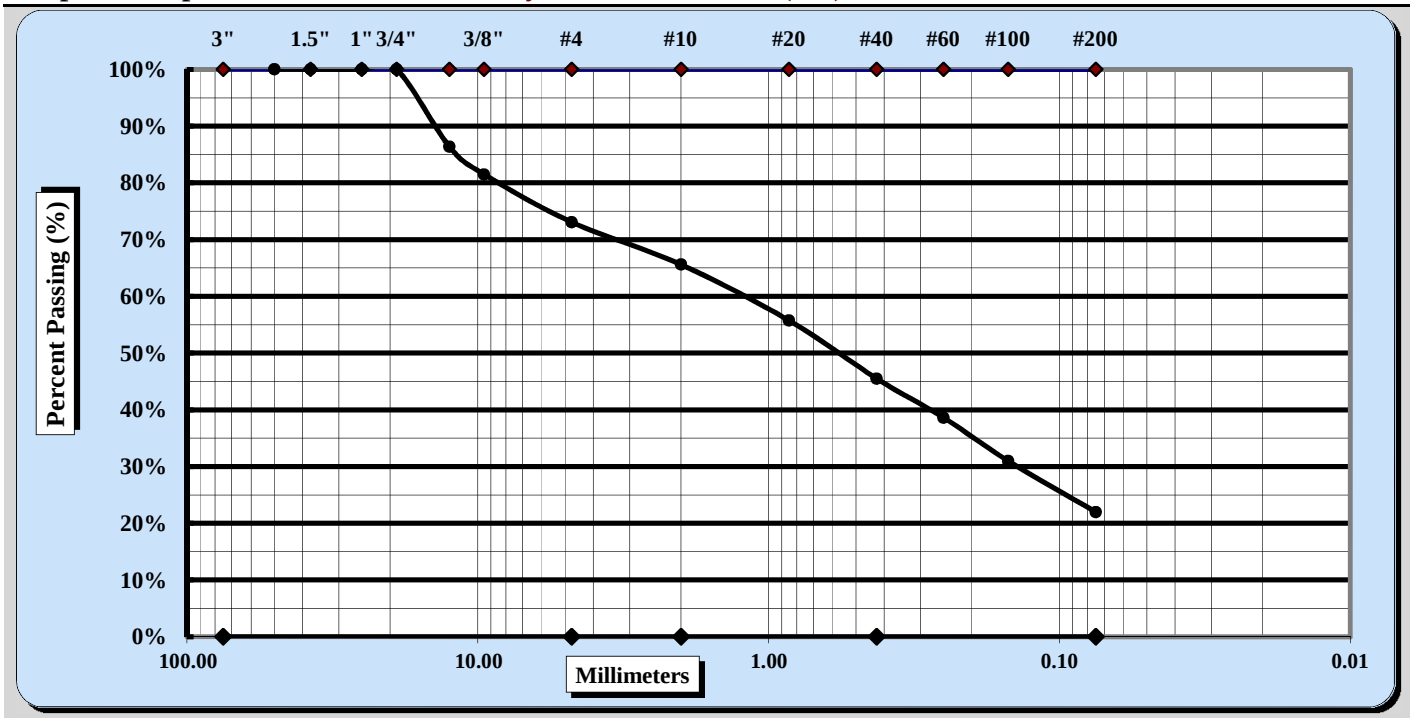
ASTM D 422

Quality Assurance

S&ME, Inc. - Greensboro 8646 west market St. Suite 105 Greensboro NC 27409

Project #:	**1358-14-070**	Report Date:	12-17-14
Project Name:	Frontier Gas Pipeline	Test Date(s):	12-16-14
Client Name:	MA Engineering Consultants		
Client Address:	598 East Chatham Street Suite 137 Cary NC		
Sample Id. B-3	Type: NA	Sample Date:	12/3-4/14
Location: NA	Sample: SS-5	Elevation:	13.5'-14.6'

Sample Description: Olive White Silty SAND with Gravel (SM)



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 4.75 mm (#4)	Silt	< 0.075 and > 0.005 mm
Coarse Sand	< 4.75 mm and >2.00 mm (#10)	Clay	< 0.005 mm
Medium Sand	< 2.00 mm and > 0.425 mm (#40)	Colloids	< 0.001 mm

Maximum Particle Size	3/4"	Coarse Sand	7.5%	Fine Sand	23.5%
Gravel	26.9%	Medium Sand	20.1%	Silt & Clay	22.0%
Liquid Limit		Plastic Limit		Plastic Index	
Specific Gravity		**Cc =** ######	**Cu =** ######	Moisture Content	

Coarse Sand	7.5%	Medium Sand	20.1%	Fine Sand	23.5%

Description of Sand & Gravel Particles: Rounded ☐ Angular ☐
Hard & Durable ☐ Soft ☐ Weathered & Friable ☐

Notes / Deviations / References:

David Keatts, PE — *Technical Responsibility*
_____ — *Signature*
Project Engineer — *Position*
_____ — *Date*

Form No. TR-D4318-T89-90
Revision No. 0
Revision Date: 11/20/07

Liquid Limit, Plastic Limit, and Plastic Index

Another code *ASTM D 4318* ☒ *AASHTO T 89* ☐ *AASHTO T 90* ☐ ***Quality Assurance***

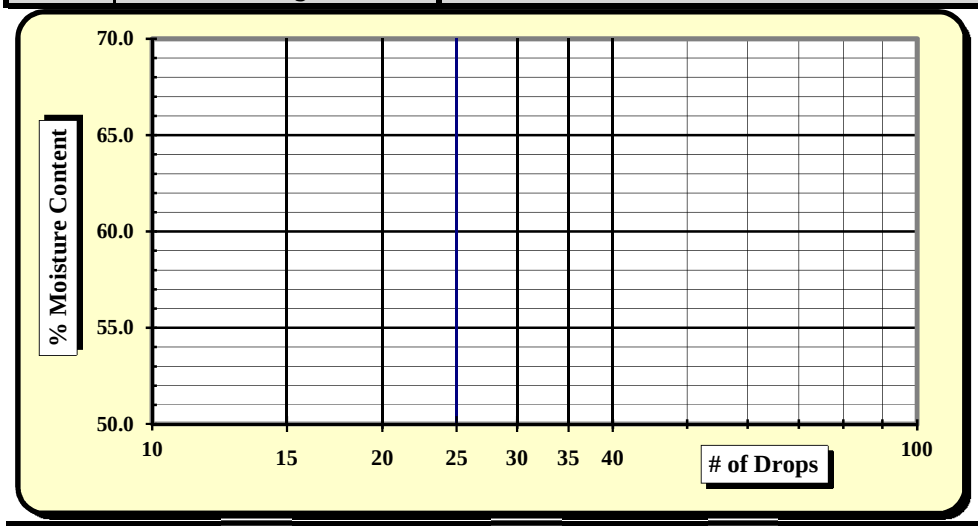
S & ME, Inc.- Greensboro 8646 West Market St. Suite 105, Greensboro NC 27409

Project #:	**1358-14-070**	Report Date:	12-17-14
Project Name:	Frontier Gas Pipeline	Test Date(s)	12-16-14
Client Name:	MA Engineering Consultants, Inc.		
Client Address:	598 East Chatham Street, Suite 137 Cary NC		

Boring #:	B-4	Sample #: SS-3		Sample Date: 12/3-4/14	
Location:	NA	Offset: NA		Elevation: 6.0'-7.5'	
Sample Description:	Dark Brown Sandy SILT (ML)				

Type and Specification	*S&ME ID #*	*Cal Date:*	*Type and Specification*	*S&ME ID #*	*Cal Date:*
Balance (0.01 g)	5544	8/10/2014	Grooving tool	5575	10/11/2014
LL Apparatus	5571	4/19/2014	Grooving tool		
Oven	5470	12/1/2014	Grooving tool		

Pan #		Liquid Limit						Plastic Limit		
	Tare #:			9	4	5	6			9
A	Tare Weight			15.87						
B	Wet Soil Weight + A			25.11						
C	Dry Soil Weight + A			22.42						
D	Water Weight (B-C)	#######	#######	2.69				#######	#######	
E	Dry Soil Weight (C-A)	#######	#######	6.55				#######	#######	
F	% Moisture (D/E)*100			41.1%						
N	# OF DROPS			11				*Moisture Contents determined by ASTM D 2216*		
LL	LL = **F** * FACTOR									
Ave.	*Average*							**#DIV/0!**		



One Point Liquid Limit			
N	**Factor**	**N**	**Factor**
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic ☒
Liquid Limit ######
Plastic Limit ######
Plastic Index ######
Group Symbol **ML**

Multipoint Method ☑
One-point Method ☐

Wet Preparation ☐ Dry Preparation ☐ Air Dried ☑

Notes / Deviations / References: Not rollable.

ASTM D 4318: Liquid Limit, Plastic Limit, & Plastic Index of Soils

Jimmy Thomasson — *Technician Name* — *Date*
David Keatts, PE — *Technical Responsibility* — *Date*

Form No: TR-D422-WH-1Ga
Revision No. 0
Revision Date: 07/14/08

Sieve Analysis of Soils

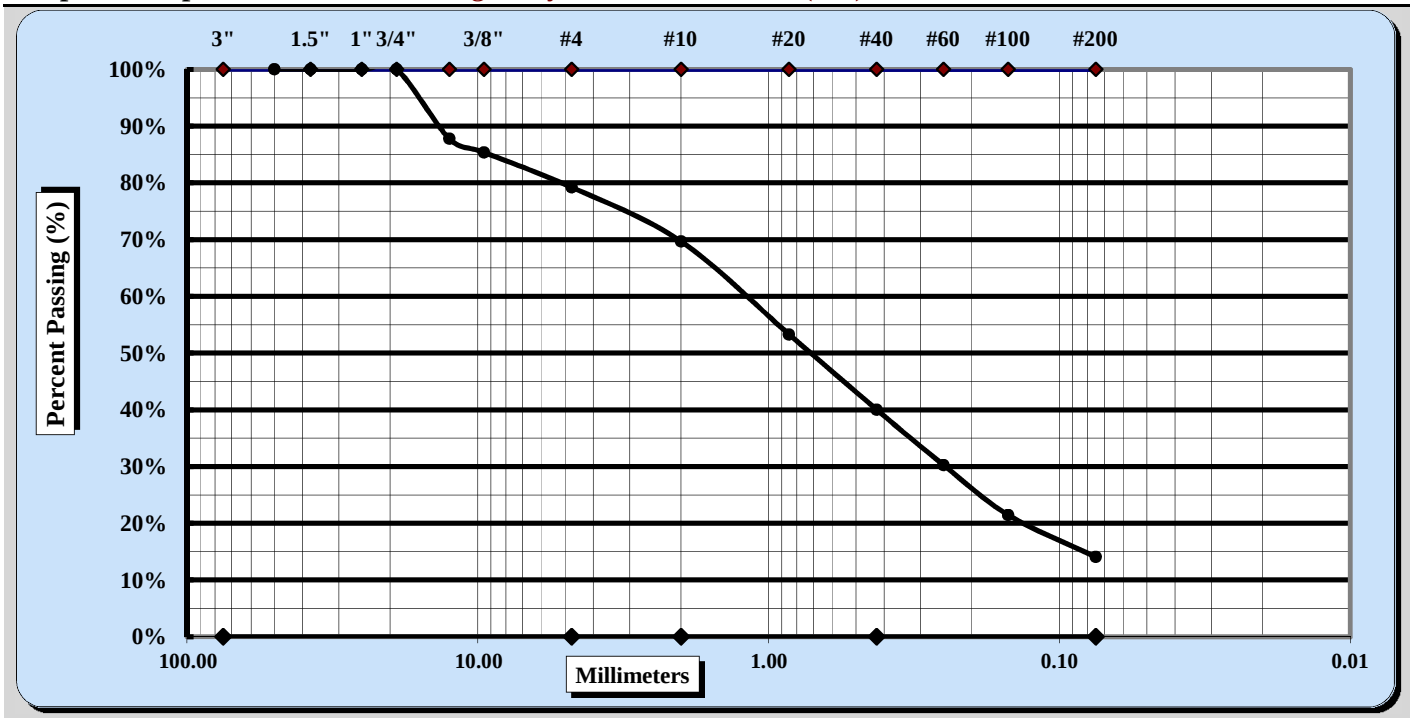
ASTM D 422

Quality Assurance

S&ME, Inc. - Greensboro 8646 west market St. Suite 105 Greensboro NC 27409

Project #:	**1358-14-070**	Report Date:	12-17-14
Project Name:	Frontier Gas Pipeline	Test Date(s):	12-16-14
Client Name:	MA Engineering Consultants		
Client Address:	598 East Chatham Street Suite 137 Cary NC		
Sample Id. B-4	Type: NA	Sample Date:	12/3-4/14
Location: NA	Sample: SS-5	Elevation:	13.5'-15.0'

Sample Description: White Orange Silty SAND with Gravel (SM)



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 4.75 mm (#4)	Silt	< 0.075 and > 0.005 mm
Coarse Sand	< 4.75 mm and >2.00 mm (#10)	Clay	< 0.005 mm
Medium Sand	< 2.00 mm and > 0.425 mm (#40)	Colloids	< 0.001 mm

Maximum Particle Size	3/4"	Coarse Sand	9.5%	Fine Sand	26.0%
Gravel	20.8%	Medium Sand	29.7%	Silt & Clay	14.0%
Liquid Limit		Plastic Limit		Plastic Index	
Specific Gravity		**Cc =** ######	**Cu =** ######	Moisture Content	

Coarse Sand	9.5%	Medium Sand	29.7%	Fine Sand	26.0%

Description of Sand & Gravel Particles: Rounded ☐ Angular ☐
Hard & Durable ☐ Soft ☐ Weathered & Friable ☐

Notes / Deviations / References:

David Keatts, PE — *Technical Responsibility*
_____ — *Signature*
Project Engineer — *Position*
_____ — *Date*

Form No. TR-D4318-T89-90
Revision No. 0
Revision Date: 11/20/07

Liquid Limit, Plastic Limit, and Plastic Index

Another code *ASTM D 4318* ☒ *AASHTO T 89* ☐ *AASHTO T 90* ☐ ***Quality Assurance***

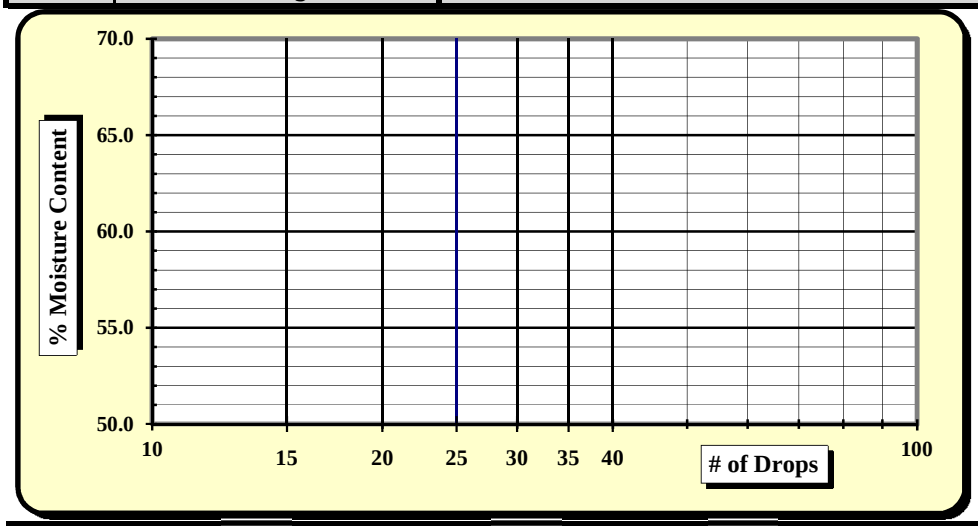
S & ME, Inc.- Greensboro 8646 West Market St. Suite 105, Greensboro NC 27409

Project #:	**1358-14-070**	Report Date:	12-17-14
Project Name:	Frontier Gas Pipeline	Test Date(s)	12-16-14
Client Name:	MA Engineering Consultants, Inc.		
Client Address:	598 East Chatham Street, Suite 137 Cary NC		

Boring #:	B-5	Sample #: SS-3		Sample Date: 12/3-4/14	
Location:	NA	Offset: NA		Elevation: 6.0'-7.2'	
Sample Description:	Gray Tan Silty SAND (SM)				

Type and Specification	*S&ME ID #*	*Cal Date:*	*Type and Specification*	*S&ME ID #*	*Cal Date:*
Balance (0.01 g)	5544	8/10/2014	Grooving tool	5575	10/11/2014
LL Apparatus	5571	4/19/2014	Grooving tool		
Oven	5470	12/1/2014	Grooving tool		

Pan #		Liquid Limit						Plastic Limit		
	Tare #:			24	4	5	6			9
A	Tare Weight			13.92						
B	Wet Soil Weight + A			23.00						
C	Dry Soil Weight + A			20.56						
D	Water Weight (B-C)	#######	#######	2.44				#######	#######	
E	Dry Soil Weight (C-A)	#######	#######	6.64				#######	#######	
F	% Moisture (D/E)*100			36.7%						
N	# OF DROPS			14				*Moisture Contents determined by ASTM D 2216*		
LL	LL = **F** * FACTOR									
Ave.	*Average*							**#DIV/0!**		



One Point Liquid Limit			
N	**Factor**	**N**	**Factor**
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic ☒
Liquid Limit ######
Plastic Limit ######
Plastic Index ######
Group Symbol **SM**

Multipoint Method ☑
One-point Method ☐

Wet Preparation ☐ Dry Preparation ☐ Air Dried ☑

Notes / Deviations / References: Not rollable.

ASTM D 4318: Liquid Limit, Plastic Limit, & Plastic Index of Soils

Jimmy Thomasson — *Technician Name* — *Date*
David Keatts, PE — *Technical Responsibility* — *Date*

Form No: TR-D422-WH-1Ga
Revision No. 0
Revision Date: 07/14/08

Sieve Analysis of Soils

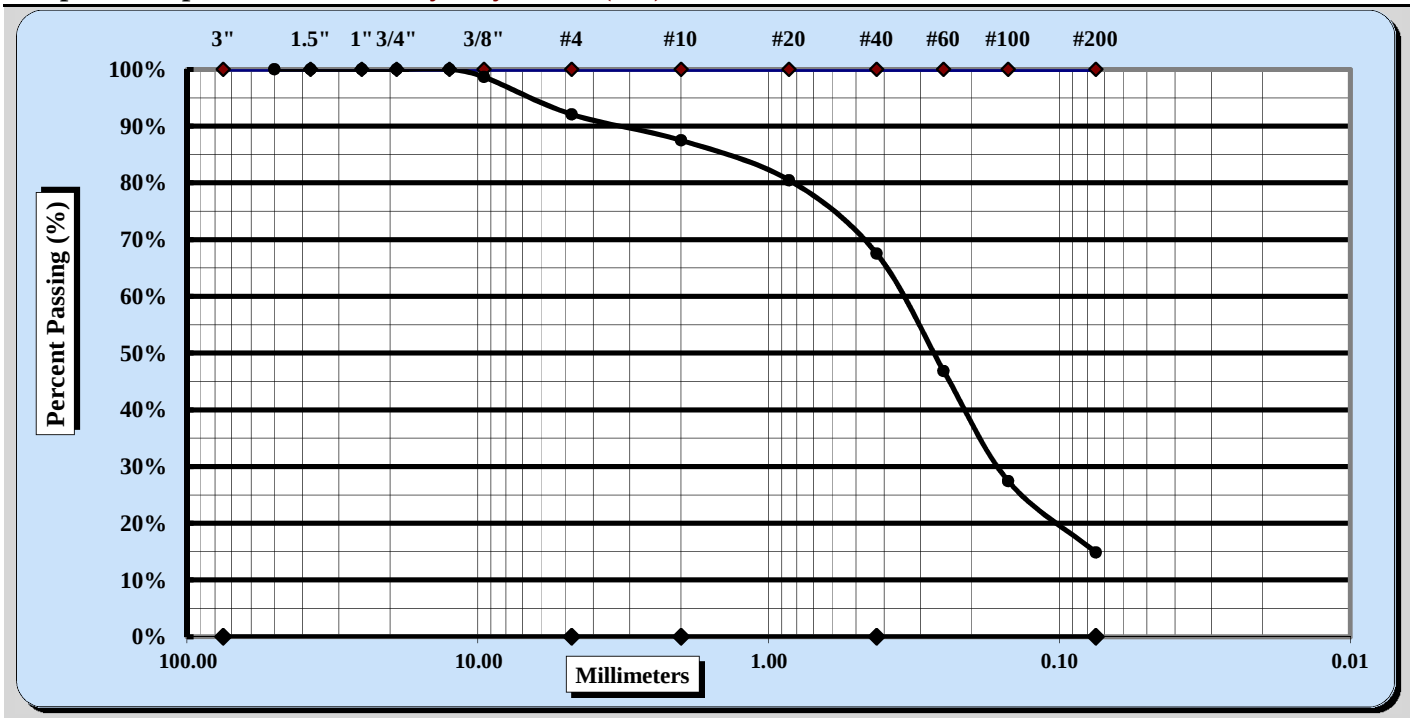
ASTM D 422

Quality Assurance

S&ME, Inc. - Greensboro 8646 west market St. Suite 105 Greensboro NC 27409

Project #:	**1358-14-070**	Report Date:	12-17-14
Project Name:	Frontier Gas Pipeline	Test Date(s):	12-16-14
Client Name:	MA Engineering Consultants		
Client Address:	598 East Chatham Street Suite 137 Cary NC		
Sample Id. B-5	Type: NA	Sample Date:	12/3-4/14
Location: NA	Sample: SS-5	Elevation:	13.5'-14.2'

Sample Description: Tan Gray Silty SAND (SM)



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 4.75 mm (#4)	Silt	< 0.075 and > 0.005 mm
Coarse Sand	< 4.75 mm and >2.00 mm (#10)	Clay	< 0.005 mm
Medium Sand	< 2.00 mm and > 0.425 mm (#40)	Colloids	< 0.001 mm

Maximum Particle Size	1/2"	Coarse Sand	4.6%	Fine Sand	52.7%
Gravel	7.9%	Medium Sand	20.0%	Silt & Clay	14.9%
Liquid Limit		Plastic Limit		Plastic Index	
Specific Gravity		**Cc =** ######	**Cu =** ######	Moisture Content	

Coarse Sand	4.6%	Medium Sand	20.0%	Fine Sand	52.7%

Description of Sand & Gravel Particles: Rounded ☐ Angular ☐
Hard & Durable ☐ Soft ☐ Weathered & Friable ☐

Notes / Deviations / References:

David Keatts, PE — *Technical Responsibility*
_____ — *Signature*
Project Engineer — *Position*
_____ — *Date*

Form No: TR-D422-WH-1Ga
Revision No. 0
Revision Date: 07/14/08

Sieve Analysis of Soils

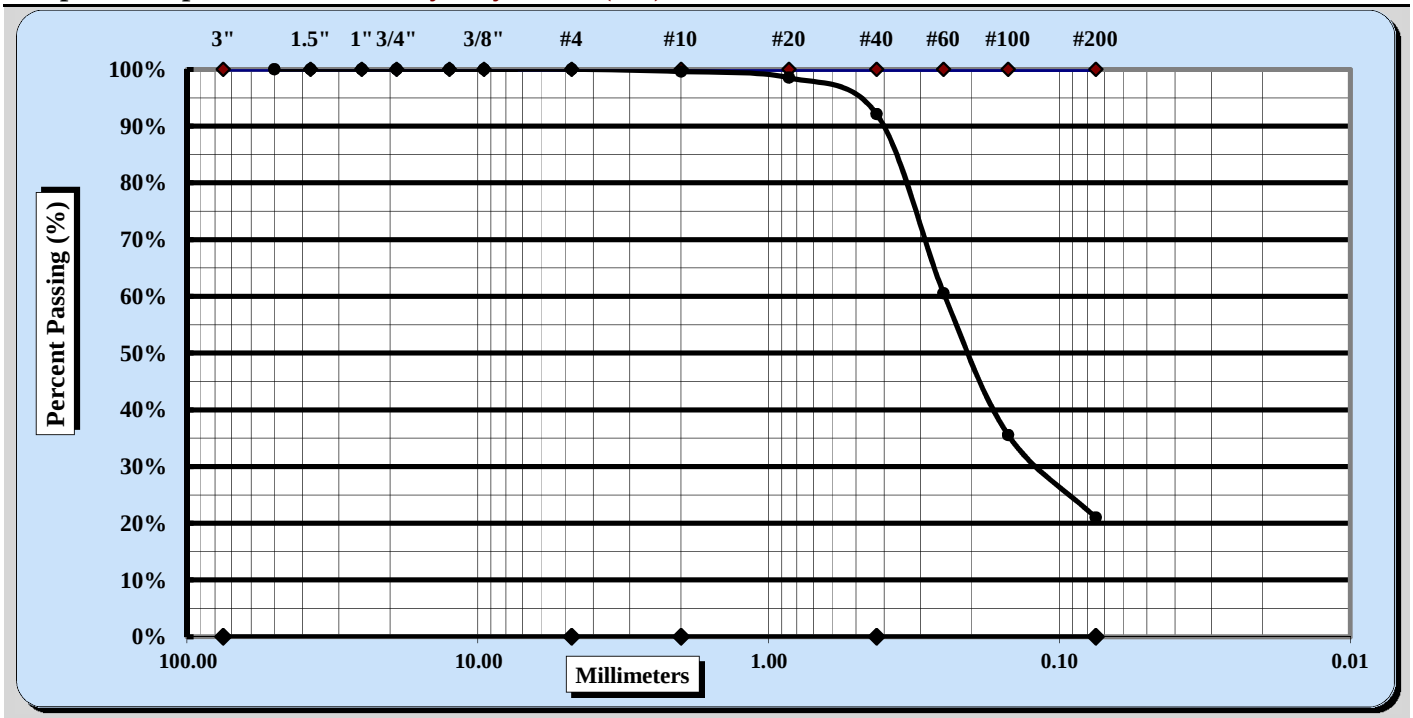
ASTM D 422

Quality Assurance

S&ME, Inc. - Greensboro 8646 west market St. Suite 105 Greensboro NC 27409

Project #:	**1358-14-070**	Report Date:	12-17-14
Project Name:	Frontier Gas Pipeline	Test Date(s):	12-16-14
Client Name:	MA Engineering Consultants		
Client Address:	598 East Chatham Street Suite 137 Cary NC		
Sample Id. B-5	Type: NA	Sample Date:	12/3-4/14
Location: NA	Sample: SS-6	Elevation:	18.5'-20.0'

Sample Description: Tan Gray Silty SAND (SM)



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 4.75 mm (#4)	Silt	< 0.075 and > 0.005 mm
Coarse Sand	< 4.75 mm and >2.00 mm (#10)	Clay	< 0.005 mm
Medium Sand	< 2.00 mm and > 0.425 mm (#40)	Colloids	< 0.001 mm

Maximum Particle Size	#4	Coarse Sand	0.4%	Fine Sand	71.1%
Gravel	0.0%	Medium Sand	7.5%	Silt & Clay	21.0%
Liquid Limit		Plastic Limit		Plastic Index	
Specific Gravity		**Cc =** ######	**Cu =** ######	Moisture Content	
Coarse Sand	0.4%	Medium Sand	7.5%	Fine Sand	71.1%

Description of Sand & Gravel Particles: Rounded ☐ Angular ☐
Hard & Durable ☐ Soft ☐ Weathered & Friable ☐

Notes / Deviations / References:

David Keatts, PE — *Technical Responsibility*
_____ — *Signature*
Project Engineer — *Position*
_____ — *Date*

Form No. TR-D4318-T89-90
Revision No. 0
Revision Date: 11/20/07

Liquid Limit, Plastic Limit, and Plastic Index

Another code *ASTM D 4318* ☒ *AASHTO T 89* ☐ *AASHTO T 90* ☐ ***Quality Assurance***

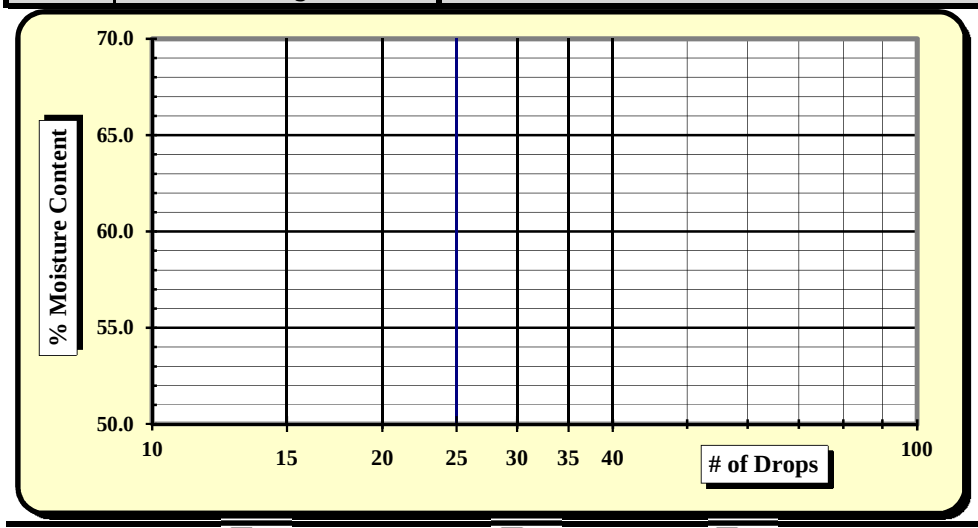
S & ME, Inc.- Greensboro 8646 West Market St. Suite 105, Greensboro NC 27409

Project #:	**1358-14-070**	Report Date:	12-17-14
Project Name:	Frontier Gas Pipeline	Test Date(s)	12-16-14
Client Name:	MA Engineering Consultants, Inc.		
Client Address:	598 East Chatham Street, Suite 137 Cary NC		

Boring #:	B-6	Sample #: SS-3		Sample Date: 12/3-4/14	
Location:	NA	Offset: NA		Elevation: 6.0'-7.5'	
Sample Description:	Brown Silty SAND (SM)				

Type and Specification	*S&ME ID #*	*Cal Date:*	*Type and Specification*	*S&ME ID #*	*Cal Date:*
Balance (0.01 g)	5544	8/10/2014	Grooving tool	5575	10/11/2014
LL Apparatus	5571	4/19/2014	Grooving tool		
Oven	5470	12/1/2014	Grooving tool		

Pan #		Liquid Limit						Plastic Limit		
	Tare #:			36	4	5	6			9
A	Tare Weight			15.80						
B	Wet Soil Weight + A			25.32						
C	Dry Soil Weight + A			22.79						
D	Water Weight (B-C)	#######	#######	2.53				#######	#######	
E	Dry Soil Weight (C-A)	#######	#######	6.99				#######	#######	
F	% Moisture (D/E)*100			36.2%						
N	# OF DROPS			12				*Moisture Contents determined by ASTM D 2216*		
LL	LL = **F** * FACTOR									
Ave.	*Average*							**#DIV/0!**		



One Point Liquid Limit			
N	**Factor**	**N**	**Factor**
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic ☒
Liquid Limit ######
Plastic Limit ######
Plastic Index ######
Group Symbol **SM**

Multipoint Method ☑
One-point Method ☐

Wet Preparation ☐ Dry Preparation ☐ Air Dried ☑

Notes / Deviations / References: Not rollable.

ASTM D 4318: Liquid Limit, Plastic Limit, & Plastic Index of Soils

Jimmy Thomasson — *Technician Name* — *Date*
David Keatts, PE — *Technical Responsibility* — *Date*

Form No: TR-D422-WH-1Ga
Revision No. 0
Revision Date: 07/14/08

Sieve Analysis of Soils

ASTM D 422

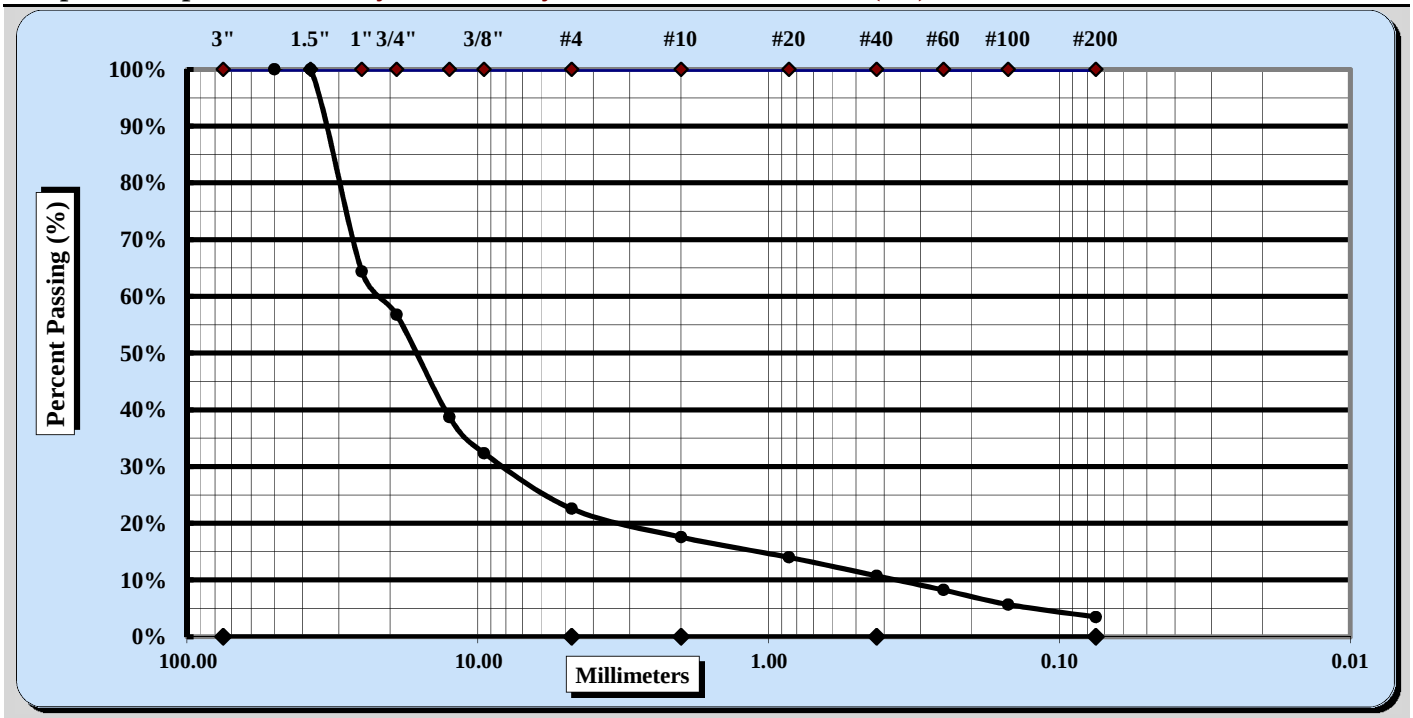
Quality Assurance

S&ME, Inc. - Greensboro 8646 west market St. Suite 105 Greensboro NC 27409

Project #:	**1358-14-070**	Report Date:	12-17-14
Project Name:	Frontier Gas Pipeline	Test Date(s):	12-16-14
Client Name:	MA Engineering Consultants		
Client Address:	598 East Chatham Street Suite 137 Cary NC		

Sample Id.	B-6	Type:	NA	Sample Date:	12/3-4/14
Location:	NA	Sample:	SS-4	Elevation:	8.5'-10.0'

Sample Description: Gray White Poorly Graded Gravel with Sand (GP)



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 4.75 mm (#4)	Silt	< 0.075 and > 0.005 mm
Coarse Sand	< 4.75 mm and >2.00 mm (#10)	Clay	< 0.005 mm
Medium Sand	< 2.00 mm and > 0.425 mm (#40)	Colloids	< 0.001 mm

Maximum Particle Size	1.5"	Coarse Sand	5.0%	Fine Sand	7.2%
Gravel	77.4%	Medium Sand	6.8%	Silt & Clay	3.5%
Liquid Limit		Plastic Limit		Plastic Index	
Specific Gravity		**Cc =** ######	**Cu =** ######	Moisture Content	

Coarse Sand	5.0%	Medium Sand	6.8%	Fine Sand	7.2%

Description of Sand & Gravel Particles: Rounded ☐ Angular ☐
Hard & Durable ☐ Soft ☐ Weathered & Friable ☐

Notes / Deviations / References:

David Keatts, PE — *Technical Responsibility*
_____ — *Signature*
Project Engineer — *Position*
_____ — *Date*

Form No. TR-D4318-T89-90
Revision No. 0
Revision Date: 11/20/07

Liquid Limit, Plastic Limit, and Plastic Index

Another code *ASTM D 4318* ☒ *AASHTO T 89* ☐ *AASHTO T 90* ☐ ***Quality Assurance***

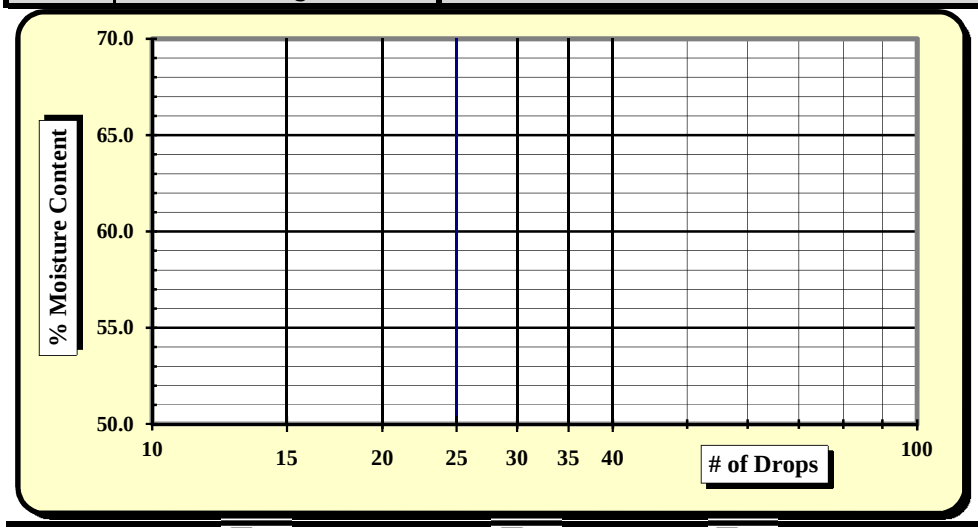
S & ME, Inc.- Greensboro 8646 West Market St. Suite 105, Greensboro NC 27409

Project #:	**1358-14-070**	Report Date:	12-17-14
Project Name:	Frontier Gas Pipeline	Test Date(s)	12-16-14
Client Name:	MA Engineering Consultants, Inc.		
Client Address:	598 East Chatham Street, Suite 137 Cary NC		

Boring #:	B-6	Sample #: SS-5		Sample Date: 12/3-4/14	
Location:	NA	Offset: NA		Elevation: 13.5'-15.0'	
Sample Description:	Gray Brown Silty SAND (SM)				

Type and Specification	*S&ME ID #*	*Cal Date:*	*Type and Specification*	*S&ME ID #*	*Cal Date:*
Balance (0.01 g)	5544	8/10/2014	Grooving tool	5575	10/11/2014
LL Apparatus	5571	4/19/2014	Grooving tool		
Oven	5470	12/1/2014	Grooving tool		

	Pan #	Liquid Limit						Plastic Limit		
	Tare #:			23	4	5	6			9
A	Tare Weight			15.83						
B	Wet Soil Weight + A			24.53						
C	Dry Soil Weight + A			22.23						
D	Water Weight (B-C)	#######	#######	2.30				#######	#######	
E	Dry Soil Weight (C-A)	#######	#######	6.40				#######	#######	
F	% Moisture (D/E)*100			35.9%						
N	# OF DROPS			14				*Moisture Contents determined by ASTM D 2216*		
LL	LL = **F** * FACTOR									
Ave.	*Average*							**#DIV/0!**		



One Point Liquid Limit			
N	**Factor**	**N**	**Factor**
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic ☒
Liquid Limit ######
Plastic Limit ######
Plastic Index ######
Group Symbol **SM**

Multipoint Method ☑
One-point Method ☐

Wet Preparation ☐ Dry Preparation ☐ Air Dried ☑

Notes / Deviations / References: Not rollable.

ASTM D 4318: Liquid Limit, Plastic Limit, & Plastic Index of Soils

Jimmy Thomasson — *Technician Name* — *Date*
David Keatts, PE — *Technical Responsibility* — *Date*

Form No: TR-D422-WH-1Ga
Revision No. 0
Revision Date: 07/14/08

Sieve Analysis of Soils

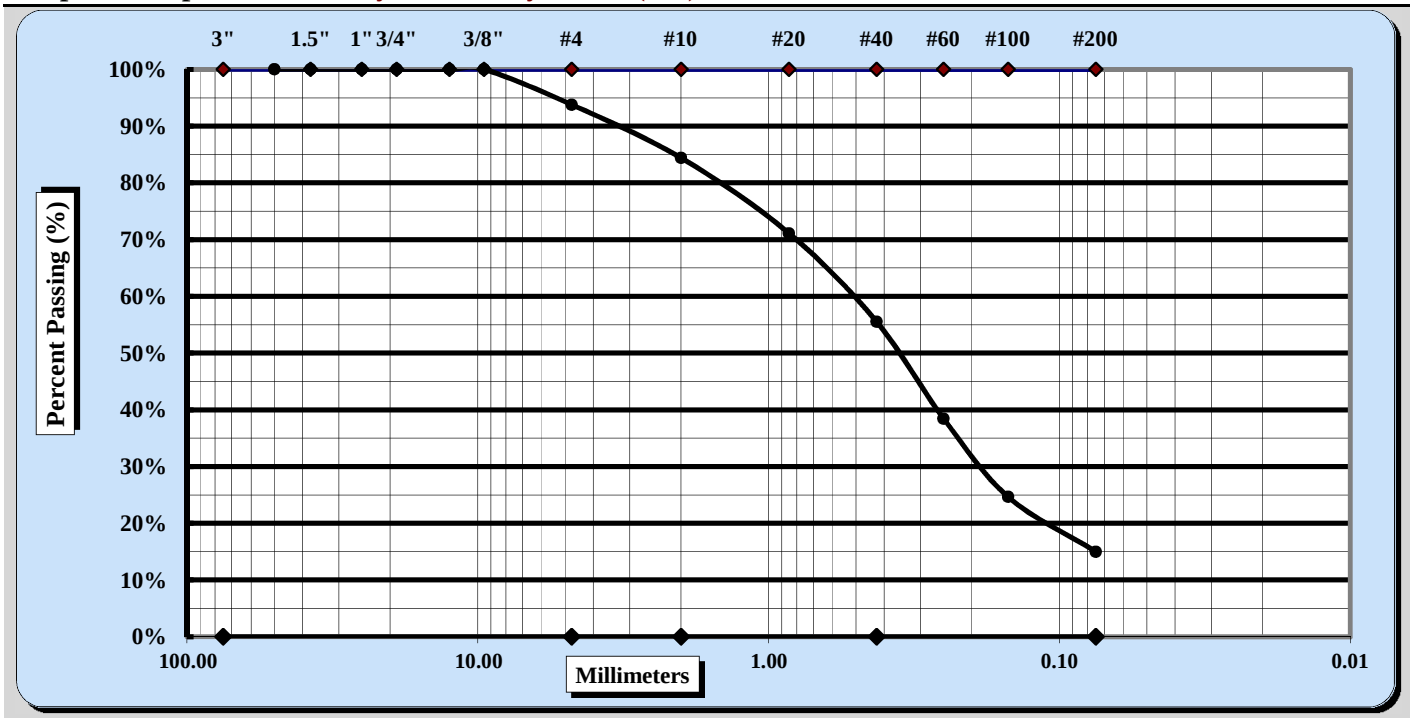
ASTM D 422

Quality Assurance

S&ME, Inc. - Greensboro 8646 west market St. Suite 105 Greensboro NC 27409

Project #:	**1358-14-070**	Report Date:	12-17-14
Project Name:	Frontier Gas Pipeline	Test Date(s):	12-16-14
Client Name:	MA Engineering Consultants		
Client Address:	598 East Chatham Street Suite 137 Cary NC		
Sample Id. B-6	Type: NA	Sample Date:	12/3-4/14
Location: NA	Sample: SS-6	Elevation:	18.5'-20.0'

Sample Description: Gray Brown Silty SAND (SM)



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 4.75 mm (#4)	Silt	< 0.075 and > 0.005 mm
Coarse Sand	< 4.75 mm and >2.00 mm (#10)	Clay	< 0.005 mm
Medium Sand	< 2.00 mm and > 0.425 mm (#40)	Colloids	< 0.001 mm

Maximum Particle Size	3/8"	Coarse Sand	9.4%	Fine Sand	40.5%
Gravel	6.2%	Medium Sand	28.9%	Silt & Clay	15.0%
Liquid Limit		Plastic Limit		Plastic Index	
Specific Gravity		**Cc =** ######	**Cu =** ######	Moisture Content	

Coarse Sand	9.4%	Medium Sand	28.9%	Fine Sand	40.5%

Description of Sand & Gravel Particles: Rounded ☐ Angular ☐
Hard & Durable ☐ Soft ☐ Weathered & Friable ☐

Notes / Deviations / References:

David Keatts, PE — *Technical Responsibility*
_____ — *Signature*
Project Engineer — *Position*
_____ — *Date*