



COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA PUBLIC UTILITY COMMISSION
P.O. BOX 3265, HARRISBURG, PA 17105-3265

IN REPLY PLEASE
REFER TO OUR FILE

April 27, 2018

Rosemary Chiavetta, Secretary
Pennsylvania Public Utility Commission
P.O. Box 3265
Harrisburg, PA 17105-3265

Re: In re: Sunoco Pipeline L.P. a/k/a Energy Transfer Partners
Petition of the Bureau of Investigation and Enforcement of
The Pennsylvania Public Utility Commission for the Issuance
of an Ex Parte Emergency Order
Docket No. P-2018-3000281

Dear Secretary Chiavetta:

Enclosed please find the Statement of the Bureau of Investigation and Enforcement of the Pennsylvania Public Utility Commission concurring with the request of Sunoco Pipeline L.P. a/k/a Energy Transfer Partners for reinstatement of transportation service on its Mariner East 1 pipeline.

Should you have any questions, please feel free to contact me.

Sincerely,

Richard A. Kanaskie
Director
PA Attorney ID No. 80409

cc: As per Certificate of Service

**BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

In re: Sunoco Pipeline L.P. a/k/a	:	
Energy Transfer Partners	:	
	:	
Petition of the Bureau of	:	Docket No. P-2018-3000281
Investigation and Enforcement of the	:	
Pennsylvania Public Utility Commission	:	
For the Issuance of an Ex Parte	:	
Emergency Order	:	

**STATEMENT OF THE BUREAU OF INVESTIGATION AND ENFORCEMENT
CONCURRING WITH THE REQUEST OF SUNOCO PIPELINE L.P. A/K/A ENERGY
TRANSFER PARTNERS FOR REINSTATEMENT OF TRANSPORTATION SERVICE
ON ITS MARINER EAST 1 PIPELINE**

AND NOW, comes the Bureau of Investigation and Enforcement of the Pennsylvania Public Utility Commission, pursuant to the Emergency Order executed by Commission Chairman Gladys M. Brown and entered on March 7, 2018, by its attorneys, and files this statement concurring with the request of Sunoco Pipeline L.P. a/k/a/ Energy Transfer Partners for reinstatement of transportation service on its Mariner East 1 pipeline.

I. Introduction

On March 7, 2018, the Bureau of Investigation and Enforcement (I&E) of the Pennsylvania Public Utility Commission (Commission) filed a Petition for Issuance of an *Ex Parte* Emergency Order (Petition), pursuant to 52 Pa. Code Section 3.2, seeking suspension of transportation service on the Mariner East 1 (ME1) pipeline of Sunoco Pipeline L.P. a/k/a/ Energy Transfer Partners (SPLP). Soil subsidence events, sometimes referred to as “sinkholes” occurred in the area of Lisa Drive, West Whiteland Township, Chester County. These subsidence events appeared to be related to the adjacent construction of SPLP’s ME2 and ME2x pipelines within SPLP’s right of way, partially exposing ME1 at one location. This exposure,

combined with the fact that ME1 was an active pipeline that was transporting hazardous liquids, that ME1 was in close proximity to residential dwellings in this area, and that the likelihood of additional soil subsidence events along the active ME1 pipeline as a result of continued construction was unknown, I&E's Safety Division (I&E-Safety) determined that there existed an immediate concern regarding the integrity of the ME1 pipeline and the safety of the public that necessitated the filing of I&E's Petition seeking the immediate suspension of transportation service on ME1. This confluence of factors supported the need for an investigation to ensure that these subsidence events had not compromised the integrity of the existing ME1 pipeline and, until that determination could be made, the prudent course of action was to immediately cease the transportation of product on ME1 until such line integrity concerns were addressed.

On March 7, 2018, an Emergency Order executed by Commission Chairman Gladys M. Brown was entered granting I&E's Petition, pursuant to the terms and conditions set forth therein (Emergency Order). The terms of the Emergency Order mandated, *inter alia*, that in order for SPLP to reinstate hazardous liquids transportation service on ME1, I&E must first be satisfied with "any corrective actions taken, or planned to be taken," by SPLP pursuant to Ordering Paragraphs 1a and 1b(i)-(iv) coupled with I&E's "concurrence with reinstatement of transportation service" on ME1. Emergency Order at 3. This reinstatement request is then "subject to Commission review and approval." The Emergency Order was ratified by the entire Commission at Public Meeting of March 15, 2018.

I&E provides herein a synopsis of the numerous actions taken by the SPLP and I&E to investigate and resolve I&E's concerns regarding the integrity of ME1 at the site of soil subsidence events in the Lisa Drive study area. As a result of our investigation, it is the position of I&E that the actions taken by SPLP and its consultants, in coordination with I&E and its

consultant, have sufficiently satisfied I&E's concerns regarding the integrity of ME1 in the Lisa Drive study area. This Statement is offered as a representation that the requirements of the Emergency Order have been met to the satisfaction of I&E.

II. Background

On March 5, 2018, I&E Engineers Sunil Patel and Kokou Apetoh accompanied by Safety Manager Paul Metro, visited Lisa Drive in West Chester, Pennsylvania, the site of SPLP's existing ME1 pipeline and ongoing construction of SPLP's ME2 and ME2x pipelines that has been the subject of three recent subsidence events. The first subsidence hole was discovered in November 2017 and was approximately 2 feet deep while the second one was found on March 1, 2018 and was 12 feet deep. The second subsidence hole is located 300 feet from Amtrak's tracks. The third subsidence hole was discovered on March 3, 2018 was approximately 15 feet deep and partially exposed ME1. All three subsidence holes had been filled and construction work on the ME2 and ME2x lines had ceased at the time of the visit by I&E-Safety although SPLP continued to perform surveys and other geological testing at the site.

Following the site visit, I&E-Safety along with a General Engineer/Pipeline Inspector from the federal Pipeline and Hazardous Materials Safety Administration (PHMSA), met with SPLP's officials in West Chester to discuss the Company's remediation plan to deal with the subsidence holes. This meeting included the Company's Vice President of Engineering, Vice President of Technical Services, Compliance Specialists, a Senior Project Manager and other Company employees. At this meeting, I&E-Safety and PHMSA requested that SPLP provide a written remediation plan. I&E-Safety stressed the importance of communication from the Company and demanded that the Company prove that the subsidence holes had not compromised the integrity of ME1.

On March 6, 2018, I&E-Safety referred its concerns to I&E-Enforcement. Due to the uncertainty of the impact of the soil subsidence events on the integrity of SPLP's operating ME1 pipeline, it was determined that concerns regarding the safety of the public, as well as the environment, warranted the preparation and filing of a Petition for Emergency Order with the Commission seeking to immediately shut down ME1 until it could be confirmed that the soil subsidence events had not compromised the integrity of that active pipeline.

I&E's Petition for *Ex Parte* Emergency Order seeking a temporary shutdown of ME1 was filed on March 7, 2018. I&E's Petition sought, *inter alia*, that service be suspended on ME1, that the product in the line be purged from the Lisa Drive study area, that an in-line inspection (ILI) tool be run through ME1 in the study area and that SPLP conduct geophysical testing, including at minimum resistivity, seismic and gravity tests, to the satisfaction of I&E. I&E and SPLP participated in multiple conference calls wherein SPLP agreed, even prior to entry of the Emergency Order, to voluntarily suspend transportation service on ME1 pending the collection of geophysical data that it would then provide to I&E for its review. The data was expected to be provided to I&E within 10 to 14 days.

Later that same day, the Sunoco Pipeline Emergency Order at Docket No. P-2018-3000281 was entered and served. The Emergency Order directed that SPLP suspend transportation service but did not direct SPLP to purge product from the line as sought in the I&E Petition. This was based on SPLP's explanation that the product was required to be in the pipe in order for the ILI tool to be run. Accordingly, the Order directed SPLP to conduct the ILI Tool run within 24 hours of the entry of the Emergency Order "from a point at least one mile upstream from the Lisa Drive location to a point at least 1 mile downstream from Lisa Drive." Emergency Order at 2. Suspension of service was to take place within 12 hours after completion

of the ILI Tool run. SPLP was then to commence geophysical testing in the HDD area as described in the Petition (study area). This testing was to include, at a minimum, resistivity, seismic and gravity tests with the option of I&E to agree that SPLP need not conduct the resistivity testing. The parties were then expected to meet and discuss the findings of that geophysical testing.

III. Chronology of Events

On March 8, 2018, following the entry of the Commission's Emergency Order, the parties, SPLP and I&E, immediately initiated communications in order to schedule a technically-oriented meeting or conference call to coordinate compliance with the Emergency Order. A conference call was also held to update the ILI Tool work.

On March 9, 2018, a call was held to provide a further update on the pigging (ILI) tool, whether the tool had been retrieved, the amount of time needed to know data was gathered, and amount of time needed before ME1 is suspended. The following topics were also addressed:

- Types of geophysical testing to be conducted
- Discussion of resistivity
- Date and time ILI Tool findings will be shared
- Date and time geo findings will be shared
- Date and time of in-person meeting
- Discussion of strain gauges
- Request for weekly update of daily pressure readings
- Purge discussion
- Discussion of facilities and coordination with other utilities

Also on March 9, 2018, an internal discussion took place regarding expertise to adequately review and analyze the geophysical data to be retrieved from SPLP's testing in the Lisa Drive study area. I&E concluded that the retention of a geological consultant would be prudent to provide the necessary expertise to assist in the review of SPLP's geophysical testing data.

On March 10, 2018, the ILI Tool data report was received. On March 12, 2018, a conference call provided updates on ILI, shutdown, strain gauges, resistivity testing, and discussion on purging the product from ME1 (which although not mandated by the Order, was still a preferred action by I&E for the safety of the public). The initial review of the ILI tool data report took place. An ME1 pressure data report from pump stations system wide was received from SPLP. On March 13, 2018, I&E-Safety met with ARM Group Inc. (ARM) at its Hershey office to discuss I&E's desire to retain ARM as a geological and geophysical consultant in this matter. Also on this date, emails were received from SPLP in further support of the perceived challenges of resistivity testing.

On March 14, 2018, ARM was officially retained by I&E as a geophysical consultant for this matter. I&E served an initial investigation letter on SPLP, and now with the professional assistance of ARM, included a request for the following data:

1. Full geophysical survey work scope including detailed descriptions of the following:
 - a) The locations of all seismic lines, and gravity stations (coordinates and/or maps).
 - b) The seismic data collection parameters such as seismic source type and size, anticipated seismic shot locations, spacing between shots, geophone type / spacing / locations, sampling rate, sample collection time.
 - c) Seismic processing parameters including type of processing (e.g., refraction, reflection, MASW, etc.).
 - d) Type & model of gravimeter, gravity measurement time for each data point, method used to determine gravity measurement coordinates and elevations, gravity data processing methods and corrections, drift calculation method, and any other types of gravity data processing.
 - e) Detailed descriptions of any other geophysical survey methods.

2. All field notes and driller's logs from the HDD borings.
3. Field notes describing sinkhole location / width / depth, onsite photos of sinkholes, other field observations.

Also on March 14, 2018, ARM was on site at the Lisa Drive location. Preliminary confidential responses to I&E/ARM's March 14, 2018, information requests were received. Drilling reports were provided later that day.

On March 15, 2018, I&E received the final ILI Tool run report. An all-day SPLP/I&E off-site meeting was held, including SPLP and ETP representatives, SPLP geophysical consultants, I&E-Safety, counsel for both parties and a representative of PHMSA. On March 16, 2018, I&E held a conference call with ARM finalizing the retention of ARM as I&E's geophysical expert. Terms were reached between SPLP and I&E to conduct resistivity testing, and for the purging of product from a portion of ME1 (including the Lisa Drive section) in order for SPLP to complete other projects on ME1 while it was out of service pursuant to the Emergency Order. On March 19, 2018, electrical resistivity (ER) scope of work was discussed between the geophysical consultants for SPLP and I&E. On March 20, 2018, a call was held between counsel with further information requests to SPLP. On this date, SPLP's geophysical consultant provided ARM with a map of the HDD right-of-way, including survey points for use in placing the resistivity grid. ARM shared files for the proposed ER Plan with SPLP. On March 22, 2018, SPLP provided I&E with a copy of its filed Construction Notice Letter regarding the unrelated projects to be completed on ME1 while service was suspended. On March 23, 2018, SPLP advised that the purge of product from ME1 had been initiated. I&E requested that SPLP provide additional ER field data.

Numerous additional discussions and meetings and communications took place from March 26, 2018 to the present, including substantial direct communications between the

geophysical consultants. On April 11, 2018, I&E met with ARM at its Hershey office to discuss preliminary findings from data provided by SPLP. On April 12, 2018, representatives from SPLP and I&E convened at the office of SPLP counsel. On April 19, 2018, I&E met again at the office of its consultant to continue the review of its geological findings. On April 23, 2018, I&E and SPLP conducted a second all day off-site meeting, including an afternoon session with representatives from the Department of Environmental Protection to discuss the status of the investigation and to finalize any remaining information requests posed by I&E and its consultant.

As this synopsis is intended to represent, I&E-Safety, its counsel, and/or representatives from ARM, its geophysical consultant, have maintained extensive contact with representatives of SPLP, ETP, its attorneys, its geophysical consultant, GES, and/or many other Company personnel throughout the entire period of this investigation. I&E-Safety engineers logged over 150 hours on-site at Lisa Drive during the course of this investigation. Similarly, ARM personnel were on-site over 110 hours. These logged hours represent on-site observation and consultation time only, and do not include the hundreds of office hours spent reviewing data and analyzing data outputs.

I&E, with the expert assistance of its geophysical consultant, has participated in a coordinated and exhaustive extraction of data and thorough analyses of those data outputs using multiple disciplines, in order to render a professional opinion as to whether the on-going pipeline construction in the Lisa Drive study area has compromised the integrity of the existing ME1 pipeline. This professional review of the technical aspects of I&E's investigation is designated the "ARM Summary Report" and is attached hereto. The ARM Summary Report identifies the tasks completed by SPLP and its geophysical consultants, the tasks completed by ARM and concludes with ARM's opinion regarding the integrity of the ME1 pipeline. Moreover, I&E

notes that ongoing monitoring of ME1 will continue both visually by SPLP and I&E-Safety personnel through completion of SPLP's grouting program as well as post-grout monitoring via continued strain gauge and pipeline elevation monitoring for a period of six months after construction activity in the Lisa Drive area has concluded.

IV. Conclusion

This comprehensive investigation, culminating in the study performed by ARM, was intended to answer the uncertainties that led I&E to file its Petition seeking to stop the flow of product on ME1 until I&E was satisfied that the integrity of that active pipeline had not been compromised by the recent subsidence events. Having considered the corrective action taken by SPLP, as well as the corrective action planned to be taken, I&E avers that those concerns have been adequately addressed.

WHEREFORE, based on its investigation and the technical evaluation conducted by its geophysical consultant, ARM Group Inc., as set forth in the ARM Summary Report attached hereto, the Bureau of Investigation and Enforcement is of the opinion that the integrity of the ME1 pipeline has not been compromised by the soil subsidence events that triggered this investigation and consequently, I&E does not oppose SPLP's request to resume transportation service on its ME1 pipeline.

Respectfully submitted,



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Dated: April 27, 2018



ARM Group Inc.

Earth Resource Engineers and Consultants

April 27, 2018

Mr. Michael L. Swindler
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RE: Sunoco Pipeline, L.P./
Energy Transfer Partners
Mariner East HDD Support
Summary Report
PUC Docket No. P-2018-3000281
ARM Project No. 180281

Dear Mr. Swindler:

ARM Group Inc. (ARM) is pleased to provide this summary letter report to document the scope of services completed by ARM and our resulting conclusions. On March 14, 2018, the Pennsylvania Public Utility Commission (PUC) Bureau of Investigation and Enforcement (I&E) contracted with ARM to provide technical support associated with the Sunoco Pipeline, L.P. (SPLP) horizontal directional drill (HDD) boring project in the vicinity of Lisa Drive in Exton, Chester County, Pennsylvania (Figure 1). Specifically, I&E requested ARM's support by providing the following:

- On-site meeting to review the I&E's concerns;
- Review SPLP's HDD program;
- Advise I&E engineers regarding geophysical techniques being used by SPLP;
- Monitor the geophysical tests performed by SPLP;
- Monitor SPLP's soil boring program implementation;
- Review all of SPLP's geophysical testing results and soil boring program results;
- Render an opinion regarding the integrity of the ME1 pipeline.

This report describes the background of the project, the tasks completed by SPLP's geological and geophysical consultants, the tasks completed by ARM, and ARM's opinion regarding the integrity of the ME1 pipeline.

BACKGROUND

According to Groundwater & Environmental Services, Inc. (GES), SPLP's geological and geotechnical consultant, SPLP is working on a horizontal directional drill project in the vicinity of Lisa Drive in Exton, Chester County, Pennsylvania. In November 2017 a ground surface subsidence feature occurred at the location of the pilot drill inadvertent return (IR) of the Mariner East (ME-2X) pipeline for HDD S3-0400 (ME-2X HDD). Subsequently, PADEP issued an Emergency Order on January 3, 2018, which halted drilling of the ME-2X pipeline, as the HDD was nearing completion of its final ream for installation of the 16-inch ME-2X pipe. The borehole remained open and uncompleted for approximately 45 days before approval to re-start was received and the bore completed and pipe installed. The final ME-2X pipe pullback occurred on March 3, 2018 with two additional subsidence features (one located 400 feet south of the IR location adjacent to the 491 Lisa Drive Property and the other located approximately 20 feet north of the IR location (toward the Amtrak property), both developing within 48 hours following the pipe pullback. ME-2X HDD S3-0400 lies within the adjoining right-of-way (ROW) to the ME1 pipeline and crosses beneath the ME1 pipeline approximately 30 feet south of the subsidence location near the 491 Lisa Drive property.

As noted in GES's April 12, 2018 Geotechnical Report, SPLP introduced flowable fill material into each hole such that each hole was leveled to the ground surface. SPLP also began an integrity evaluation program on the ME1 pipeline, which included:

- Exposing the ME1 pipeline at intervals between the Amtrak property to the north and south toward Lynetree Drive for visual inspection of the pipeline;
- Installing strain gauges at intervals along the ME1 pipeline in the same locations;
- Deactivating the pipeline operation and implementing internal pipeline integrity testing via caliper tool runs; and,
- Continued appropriate maintenance activities.

On March 7, 2018, the PUC suspended operations of the SPLP Mariner East 1 (ME1) pipeline after a ground surface subsidence feature exposed the pipeline in the area behind the home located at 491 Lisa Drive in Exton, Chester County, Pennsylvania. Figure 1 shows the location of this area.

In response to the PUC Order, SPLP conducted geophysical surveys which were followed by a corresponding geotechnical boring program to assess subsurface soils and related geology beneath and immediately adjacent to the ME1 pipeline. An electrical resistivity survey was also conducted and field data were provided to ARM for their analysis and interpretation.



SPLP GEOPHYSICAL INVESTIGATIONS

In March 2018, SPLP contracted Quantum Geophysics (via a subcontract through GES) to conduct a geophysical investigation between the Amtrak railroad property and Lynetree Drive, along the ME1 pipeline. The full geophysical report was provided to ARM on April 12, 2018. The investigation included a microgravity survey, a seismic multi-channel analysis of surface waves (MASW) survey, and an electrical resistivity (ER) survey to identify subsurface conditions potentially related to recent ground subsidence. As noted by GES, the purpose of the geophysical investigation was to detect and delineate low-density zones that might represent solution channels or deeply weathered fracture zones beneath the ME1 pipeline in the area of Lisa Drive.

Gravity Survey

GES reported that the results of the microgravity survey in the area of ME1 identified sixteen potential areas of concern in the study area. Two (2) of the areas of concern are located in the vicinity of the two repaired subsidence features near the IR location and two (2) are located on either side of the repaired subsidence at 491 Lisa Drive.

Seismic MASW Survey

According to the GES report, the MASW survey identified thirteen (13) potential areas of concern in the study area. GES reported that the majority of the areas of concern were observed within approximately 10-feet of the ground surface and west of 487 Lisa Drive where they coincide with areas of concern observed from the microgravity survey. Two (2) of the MASW survey areas of concern coincide with two (2) of the microgravity survey areas of concern that are located near the repaired subsidence at 491 Lisa Drive.

Electrical Resistivity Survey

On March 20, 2018, ARM provided Quantum Geophysics with a work plan and the data acquisition command files for collecting two (2) three-dimensional ER data grids between the Amtrak railroad property and the ME-2X HDD entry/exit point located south of Lynetree Drive. Quantum Geophysics collected the ER data on March 23 and 24, 2018 and provided the ER data and GPS locations of the ER electrodes to ARM on April 2, 2018.

The geophysical results confirm the presumed connection between the HDD bore that was completed and the three subsidence features that formed. This observation suggests that additional HDD activities in this area would likely result in additional subsidence features being formed and/or an expansion of the three subsidence features that formed during the initial HDD bore. It is ARM's opinion that SPLP has mitigated this concern by changing the next pipeline installation in this area from an HDD installation to a trenching/direct burial installation. The connection between the HDD bore that was completed and the three subsidence features that formed could provide a preferential pathway for further soil loss if not properly addressed in the grouting program. It is ARM's opinion that SPLP has satisfactorily addressed this area of concern in their grouting program as noted below.



Based on ARM's review of the data provided by SPLP, the geophysical surveys were completed in a manner consistent with industry standard techniques and were designed to properly screen the area of interest for potential areas of concern within the right of way (ROW) and to guide the soil boring investigation.

SPLP DRILLING PROGRAM

Upon completion of the geophysical surveys described above, SPLP contracted with Directional Project Support (DPS) to develop and implement a 'Remedial Scope of Work' (RSW). The RSW was dated April 4, 2018 and provide to ARM on April 5, 2018. The RSW written by Directional Project Support (DPS) on behalf of SPLP, DPS states: *"The purpose of the geophysical work was to identify any additional areas of 'weak soils and/or bedrock' that may facilitate any additional subsidence along the ME 1 pipeline. These areas, in turn, would be further investigated via borings to validate whether they pose a risk for future subsidence or ground instability."*

The DPS RSW notes a boring program will be completed and the boring program would include three parts described as follows:

"The boring program consists of three (3) parts:

- (1) Soil sample collection at the location of the ME1 pipeline, from land surface to refusal, to assess the density and strength of soils supporting the ME1 pipeline in areas identified by the geophysical data as "low shear wave velocity" and exhibiting "low gravity signatures;"*
- (2) Determination of the depth to bedrock, rock type and relative competency to determine bedrock structure and the soil bedrock interface, along with groundwater levels; and*
- (3) Delineation of the magnitude and extent of the existing subsidence locations sufficient for planning and remediation compaction grouting."*

On April 3, 2018, the soil boring investigation was initiated, and the soil boring program was completed on April 23, 2018. The drilling program included the installation of 41 borings via industry-standard techniques. DPS and GES reported that the soil boring data establish that the top 10-16 feet consist of overburden soils (silt, sandy silt, silty sand, and some gravel). The overburden is underlain by saprolite and split spoon refusal on saprolite was encountered at depths ranging from 24 to 48 feet. Minimal weathered schist fragments were observed within the saprolite. The average depth to water observed in the soil borings ranged from 18 feet to 35 feet below ground surface (bgs).

As previously noted, the soil boring program was conducted to assess the density and strength of soils in areas identified by the geophysical surveys as areas of potential concern. The soil boring program was also used to delineate the existing subsidence locations to support the planning of the remediation compaction grouting program.



GES summarized the drilling results by noting: “Results from the boring program targeted to the 16 specific locations near the ME1 pipeline indicate soil profiles in all samples ranging from 2-10 SPT-N (blow counts/foot) in shallow soils and saprolite (< 6 feet bgs and 11-100 SPT-N units at soil depths of 8 to 48 feet bgs). The results of the soil boring program confirm that medium-dense to very dense compacted soils and saprolite are present at all of the targeted locations, and also confirm the absence of any loose zones (< 10 SPT-N) or voids beneath ME1 pipeline to the boring program refusal depth of 24 to 48 feet bgs. The geotechnical soil boring investigation confirmed that subsurface conditions consist primarily of saprolite and weathered schist, which is underlain by the Octoraro Schist.”

On April 16, 2018, ARM met with four members of the GES technical team to discuss the project results to date, including the following:

- Review of the ER data output provided by ARM to GES
- Review of ARM comment letter issued by I&E at the 4-12-18 meeting
- Review and response to ARM questions on the ‘ME 1 Adjoining Ground Subsidence Evaluation & Remedial Recommendations Report’

During the April 16, 2018 meeting, GES noted they had discovered a zone of soft soils near the north end of the ME1 line in the area of investigation (behind the residences at 475 & 479 Lisa Drive, see Figure 2). ARM requested two additional soil borings to complete the delineation of the extent of the soft zone and one additional soil boring to address the potential area of concern to the south of boring A-4.

GES completed the three additional soil borings as requested and provided the results from the two borings in the vicinity of the IR to ARM on April 18, 2018. The results from the boring south of 491 Lisa Drive were provided to ARM by GES on April 26, 2018 and GES noted that no soft zones were encountered in the boring.

Based on ARM’s review of the data provided by SPLP, the soil borings were completed in a manner consistent with industry standard techniques. The soil borings in the area near 491 Lisa Drive, when combined with the geophysical results, have adequately delineated the extent of this area of concern (see Figure 3).

The soil borings generally delineated the extent of areas of concern (i.e., soft zones) to support the planning of the remediation compaction grouting program in the areas of the two observed surface subsidence features behind 475 & 479 Lisa Drive. The eastern extent of the soft zone was not completed by SPLP due to access limitations. However, SPLP has addressed this potential data gap by including this area in the compaction grouting program. SPLP will complete ten (10) compaction grout borings spaced five-feet apart in a line parallel to and east of ME1 to provide assurances that the structural integrity of ME1 remains intact.

At I&E’s request, ARM has been providing a scientist to conduct on-site observations of the drilling program activities. The table below provides a summary of the drilling activities as observed by ARM through April 24, 2018.



Date	Activities Completed on Site	ARM Observations/Comments
3/14/18	Gravity & MASW data collection	ARM's 1 st day on site. Geophysical data collection had begun on Monday, 3/12/18.
3/15/18	Gravity & MASW data collection	Microgravity being collected along with MASW. Multiple MASW lines oriented along LOD.
3/16/18	Gravity & MASW data collection	Microgravity being collected along with MASW near Lynetree Drive.
3/19/18	Gravity & MASW data collection	Original scope of MASW and microgravity completed. Additional microgravity points added around 491 Lisa Drive.
3/23/18	Resistivity survey	Two U-shaped grids were completed.
3/26/18	Surveying	No geophysics or groundwork activities. Subcontractors and surveyors onsite to complete routine/weekly monitoring and mark out microgravity and pot-hole locations.
4/9/18	Drilling & Surveying	SPT drilling & coring being completed North of Lynetree Drive. Four holes observed being drilled.
4/10/18	Drilling	SPT drilling & coring being completed North of Lynetree Drive. Four holes observed being drilled around features at the Northern end of the site.
4/11/18	Drilling	SPT drilling & coring being completed North of Lynetree Drive. Three holes observed being drilled around features at the Northern end of the site. An additional one from the previous day was grouted.
4/16/18	Site Walk & Surveying	No drilling being done due to heavy rains. Survey crews staking out points.
4/17/18	Drilling	SPT drilling & coring being completed behind 487 Lisa Drive at the northern end of the site. Three holes observed being drilled.
4/18/18	Drilling	Hole drilled by the shed behind 487 Lisa Drive at the northern end was cored and grouted.
4/23/18	Grout Preparation	Site being prepared for implementing grout plan.
4/24/18	Grout Preparation	Drilling initiated through flowable fill at subsidence behind 491 Lisa Drive.



ME1 ELEVATION & STRAIN GAUGE MONITORING PROGRAM

The DPS RSW suggests that Part 1 of the boring program would address the stability of the ME1 pipeline as follows: *“DPS proposes to initially establish baseline data on the location of the ME1 pipeline and follow up monitoring survey of tell-tails placed on the ME1 pipe to account for any vertical pipe movement.”*

In order to assess the vertical movement of the ME1 pipeline, SPLP contracted with LW Survey Company (LWS) to monitor the elevation of the ME1 pipeline on a regular basis. SPLP also installed and has been monitoring 10 strain gauge stations along the ME1 pipeline in the project area. On April 17 and April 25, 2018, ARM received information from SPLP/GES regarding the elevation measurements and strain gauge data. ARM’s review of the top of pipe elevation monitoring data indicated a maximum variation at one of the stations (ME1-2) of 0.522-feet (6.2 inches).

During a meeting between I&E, SPLP, GES, DPS, and ARM on April 23, 2018, SPLP noted that the pipeline elevation monitoring data point in question (where the 6.2-inch variability was noted) was an error and that SPLP used multiple methods to determine the stability of the pipeline, including GPS, laser levels, total stations, and strain gauges. SPLP also noted that the strain gauges recorded data on a regular basis.

The strain gauge data were provided to ARM on April 25, 2018 and included an evaluation of the data by Kiefner and Associates, Inc. (Kiefner). Kiefner provided an evaluation of the monitoring data and an assessment of the ME1 pipeline integrity from their analysis of the strain gauge data. Kiefner closes their report by stating: “In essence, the current stresses indicate acceptable stress levels at all the 10 monitoring locations. There have been no indications of ground movement due to sinkhole formation within this portion of the pipeline since the monitoring began on March 13, 2018.” In addition, during the April 20, 2018 meeting, SPLP indicated that the total pipeline elevation monitoring and strain gauge data set indicated the pipeline was stable and not undergoing any stress due to movement.

Based on ARM’s understanding that Kiefner is an authority in pipeline engineering, ARM believes the Kiefner report describes a strain gauge monitoring program that is consistent with the requirements in the PUC Order.

GROUTING PROGRAM

ARM received SPLP’s grouting program from GES on April 18, 2018. The grouting program was developed by DPS with input from Hayward Baker (HB), a subcontractor to DPS. ARM reviewed the grout plan and discussed with I&E during our April 19, 2018 meeting. On April 20, 2018, I&E submitted another data request to SPLP regarding the grout plan.

During the April 23, 2018 meeting between I&E, SPLP, GES, DPS, and ARM, SPLP noted that the grout plan would be revised to address all of I&E’s requests, and later on April 23, 2018, ARM received the revised grout plan. On April 24, 2018, I&E provided additional comments to



SPLP regarding the supplemental grout plan. ARM received responses to the April 24, 2018 comments from SPLP on April 25, 2018, which indicated SPLP installed a soil boring through the flowable fill within the ground surface subsidence feature behind 491 Lisa Drive on April 23, 2018 to confirm no void existed beneath the flowable fill. Upon completion of the boring, SPLP grouted the boring by placing cement grout into the boring. Since no settlement of the grout was observed 18 hours after grouting, GES determined the grouting successfully solidified the loose soils beneath the flowable fill material and extended well into the competent soil horizon beneath the ground surface subsidence feature.

Based on all of the Grouting Program information provided by SPLP, ARM understands the Grouting Program for the area of concern behind 475 and 479 Lisa Drive is as follows:

- The post-grout monitoring plan will be completed by SPLP via continued strain gauge and pipeline elevation monitoring for a period of six-months following construction activities, which is defined as the date on which the PADEP provides written concurrence regarding the closure of SPLP's Chapter 102 permit.
- The grout mix was designed by Hayward Baker and will meet industry standard specifications for compaction grouting applications.
- The grout plan includes compaction grout interval thresholds and cumulative thresholds for action, including cessation of grouting. The grout injection interval refusal thresholds include ground heave, grout volume, and grout injection pressure.
- SPLP will continuously monitor the ground elevation in the area of each grout injection point, the ground elevation in the area of ME1, the pipeline elevation, and the strain gauge data throughout the grout program implementation. SPLP will cease grout injection when any movement is detected.

SUMMARY & CONCLUSIONS

ARM has reviewed the following documentation provided by SPLP:

- Geophysical surveys,
- Soil boring data,
- ME1 pipeline elevation monitoring & strain gauge data, and
- Grouting Program.



Based on ARM’s review of the information provided, ARM has developed the following conclusions as presented in the summary table below:

Table 1: Conclusions Summary

Work Scope Item	Conclusions
<p>Geophysical Surveys</p>	<p>The geophysical surveys completed by SPLP included:</p> <ul style="list-style-type: none"> • Gravity, • Seismic MASW, and • Electrical resistivity (ER) surveys. <p>The geophysical surveys were completed in a manner consistent with industry standard techniques and were designed to screen for areas of concern within the ROW and to guide the soil boring investigation.</p>
<p>Soil Boring Investigation</p>	<p>The soil borings were completed in a manner consistent with industry standard techniques. The soil borings in the area near 491 Lisa Drive, when combined with the geophysical results, have adequately delineated the extent of this area of concern.</p> <p>The soil borings generally delineated the extent of areas of concern (i.e., soft zones) to support the planning of the remediation compaction grouting program in the areas of the two observed surface subsidence features behind 475 & 479 Lisa Drive. The eastern extent of the soft zone was not completed by SPLP due to access limitations. However, SPLP has addressed this potential data gap by including this area in the compaction grouting program. SPLP will complete ten (10) compaction grout borings spaced five-foot apart in a line parallel to and east of ME1 to provide assurances that the structural integrity of ME1 remains intact.</p>



Table 1: Conclusions Summary (continued)

Work Scope Item	Conclusions
<p>Pipeline Elevation & Strain Gauge Monitoring</p>	<p>SPLP’s pipeline integrity expert (Kiefner) closes their report by stating: “In essence, the current stresses indicate acceptable stress levels at all the 10 monitoring locations. There have been no indications of ground movement due to sinkhole formation within this portion of the pipeline since the monitoring began on March 13, 2018.” In addition, during the April 20, 2018 meeting, SPLP indicated that the total pipeline elevation monitoring and strain gauge data set indicated the pipeline was stable and not undergoing any stress due to movement.</p> <p>Based on ARM’s understanding that Kiefner is an authority in pipeline engineering, ARM believes the Kiefner report describes a strain gauge monitoring program that is consistent with the requirements in the PUC Order.</p>
<p>Grout Plan</p>	<p>SPLP placed flowable fill within the ground surface subsidence feature behind 491 Lisa Drive and installed a soil boring to confirm no void existed beneath the flowable fill. SPLP then grouted the soil boring by placing cement grout into the boring. Since no settlement of the grout was observed 18 hours after grouting, GES determined the grouting successfully solidified the loose soils beneath the flowable fill material and extended well into the competent soil horizon beneath the ground surface subsidence feature.</p> <p>For the Grouting Program in the area of concern behind 475 and 479 Lisa Drive, SPLP will continuously monitor the ground elevation in the area of each grout injection point, the ground elevation in the area of ME1, the pipeline elevation, and the strain gauge data throughout the grout program implementation. SPLP will cease grout injection when any movement is detected.</p> <p>Considering all of the documents provided to ARM for review and the discussions held with SPLP and its contractors as described herein, it is ARM’s opinion that the corrective actions taken and planned to be taken by SPLP (grouting and post-grouting monitoring program) as described herein will be sufficient to mitigate the risk to the integrity of the ME1 pipeline.</p>



LIMITATIONS

Based on the inherent variability in geologic conditions, actual conditions could vary from those estimated based on the SPLP-provided data as outlined within this document. All conclusions and recommendations presented in this report are based on the assumption that the subsurface conditions do not deviate appreciably from those disclosed within the information provided to ARM by SPLP. ARM's data review and conclusions are intended to render an opinion regarding the stability of the ME1 pipeline, but no guarantee or warrantee against sinkhole development and pipeline stability-related issues, either express or implied, is made by ARM through the issuance of this report. No additional representations are made as to matters not specifically addressed within this report. Any additional facts or circumstances in existence but not described or considered within this report may change the analysis, outcomes and representations made in this report.

CLOSING

Considering all of the documents provided to ARM for review and the discussions held with SPLP and its contractors as described herein, it is ARM's opinion that the corrective actions taken and planned to be taken by SPLP (grouting and post-grouting monitoring program) as described herein will be sufficient to mitigate the risk to the integrity of the ME1 pipeline.

ARM appreciates the opportunity to provide these services to I&E on this project. If you have any questions regarding this report, please feel free to contact either of the undersigned.

Respectfully submitted,



Ryan A. Brandon
Project Hydrogeologist II



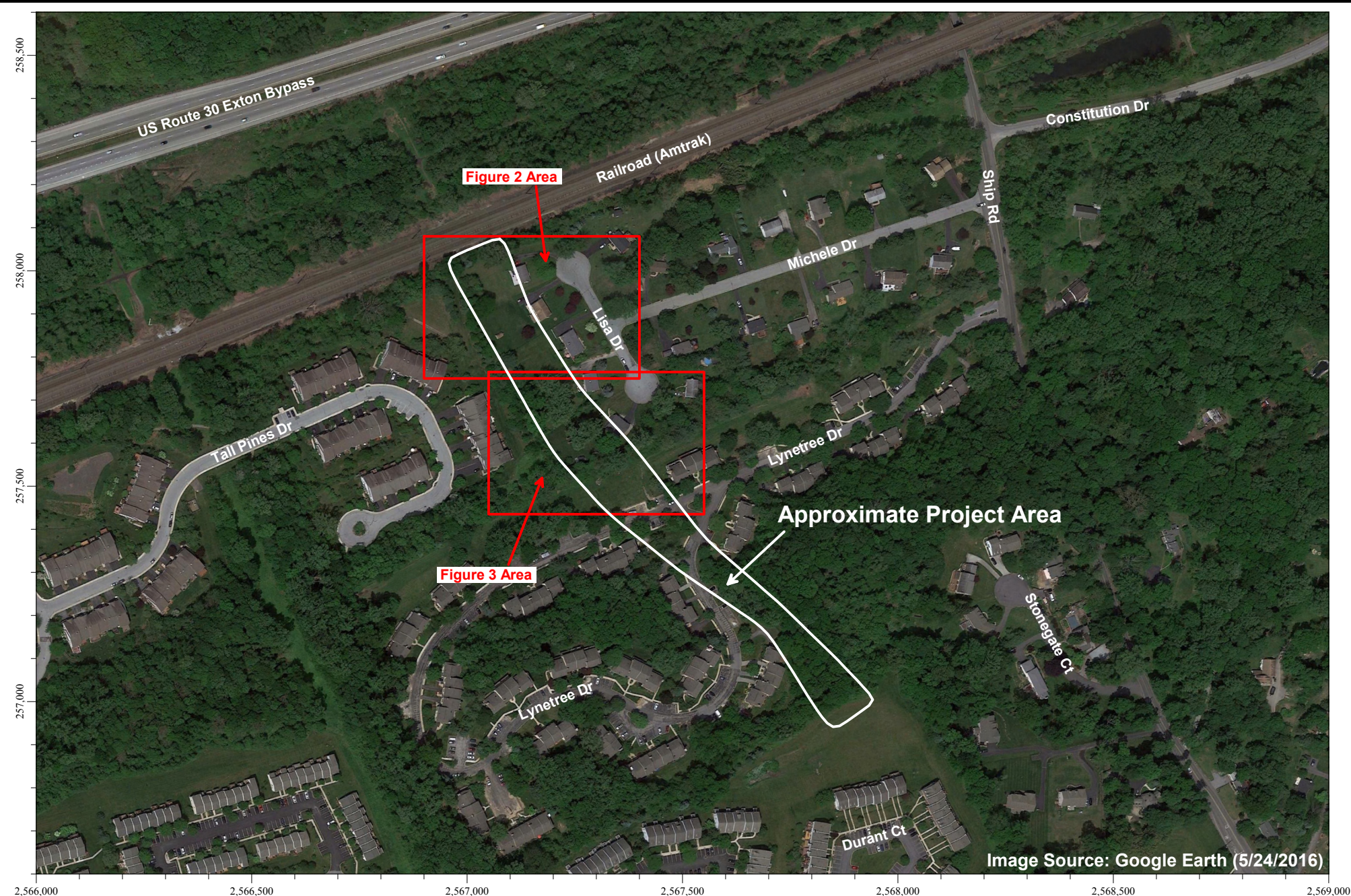
William J. Seaton, PhD., P.G.
Sr. Geophysicist



Scott A. Wendling, P.G.
Vice President, Sr. Project Manager

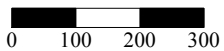
Attachments: Figures 1 - 3





2,566,000 2,566,500 2,567,000 2,567,500 2,568,000 2,568,500 2,569,000

Map Scale (ft)



PA State Plane South Coordinates
NAD83, US Survey Feet



ARM Group Inc.
Earth Resource Engineers
and Consultants

SITE MAP
PA PUC Mariner East Support

West Whiteland Township
Chester County, Pennsylvania

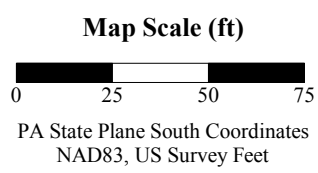
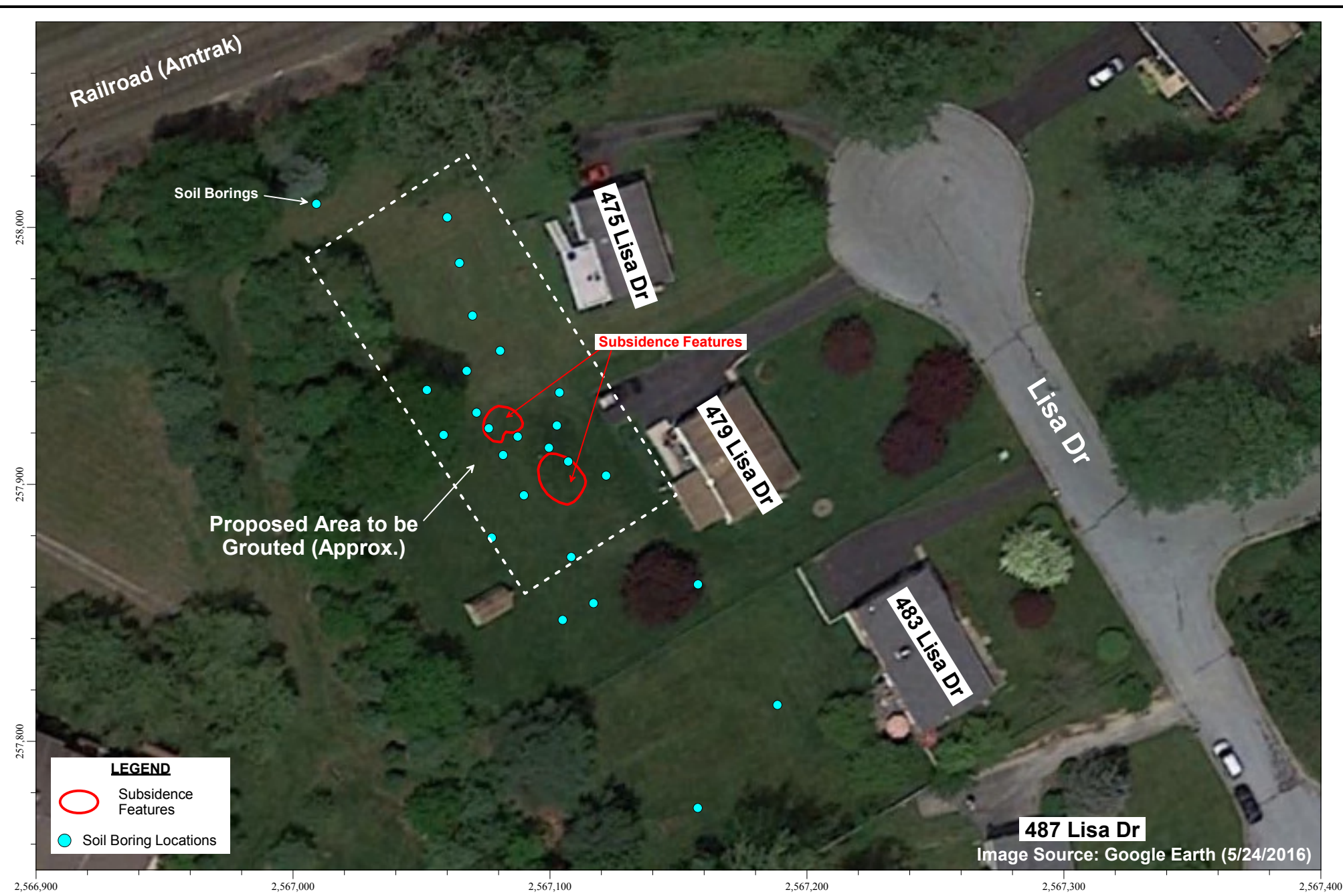
April 2018

1" = 300'

180281

Figure

1



475-487 LISA DRIVE
PA PUC Mariner East Support

West Whiteland Township
Chester County, Pennsylvania

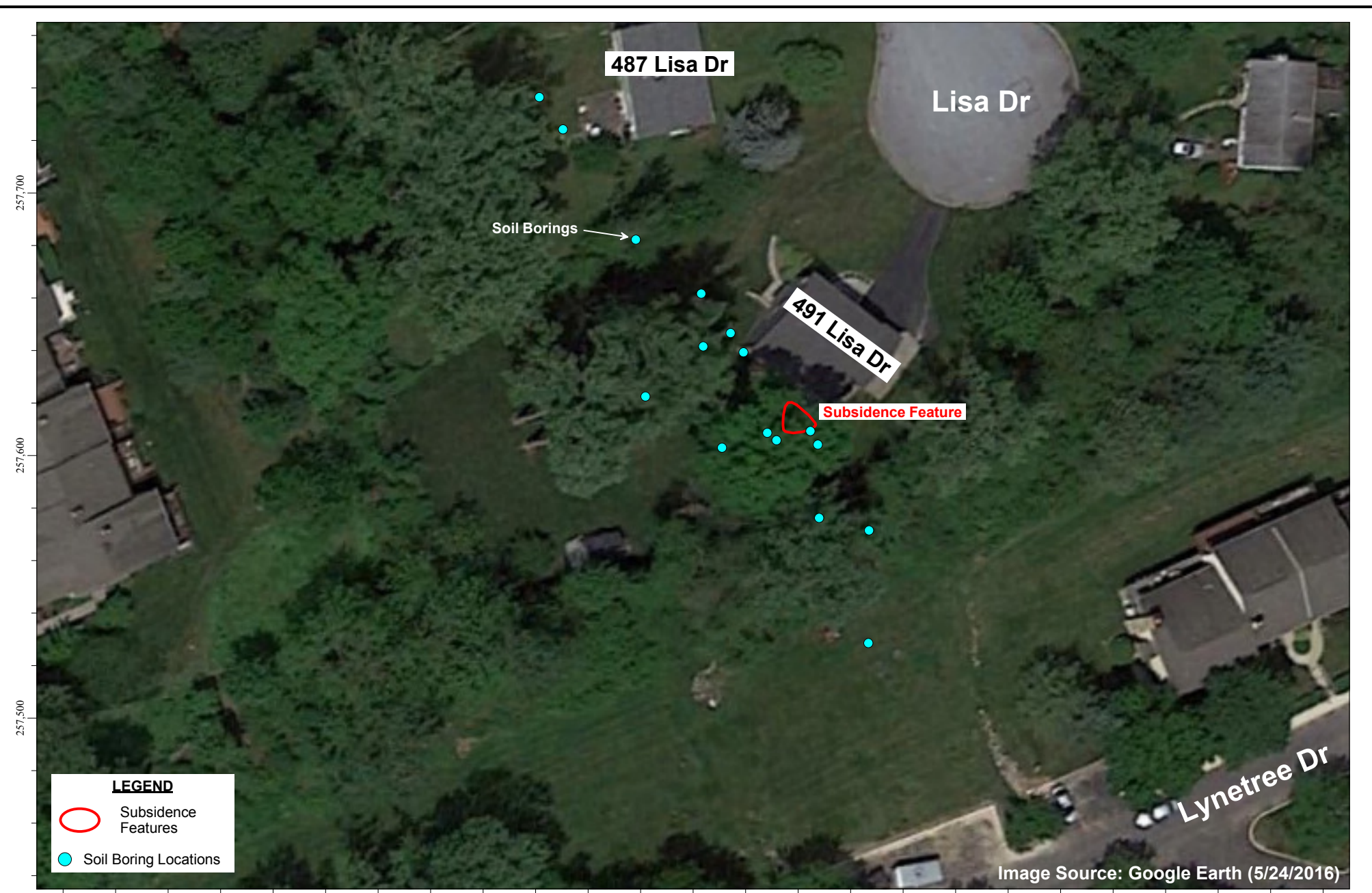
April 2018

1" = 50'



180281

Figure

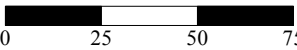
2



LEGEND

-  Subsidence Features
-  Soil Boring Locations

Map Scale (ft)



0 25 50 75

PA State Plane South Coordinates
NAD83, US Survey Feet




ARM Group Inc.
Earth Resource Engineers
and Consultants

487-491 LISA DRIVE
PA PUC Mariner East Support

West Whiteland Township
Chester County, Pennsylvania

April 2018

1" = 50'

180281

Figure

3

Sunoco Pipeline L.P. a/k/a Energy Transfer :
Partners :

Petition of the Bureau of Investigation and :
Enforcement of The Pennsylvania Public :
Utility Commission for the Issuance :
of an Ex Parte Emergency Order :

Docket No. P-2018-300281

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a true copy of the foregoing document, upon the parties, listed below, in accordance with the requirements of 52 Pa. Code §1.54 (relating to service by a party).

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Dated: April 27, 2018