



**pennsylvania**

DEPARTMENT OF ENVIRONMENTAL  
PROTECTION

March 13, 2018

Mr. Matthew Gordon  
Sunoco Logistics, L.P.  
535 Fritztown Road  
Sinking Spring, PA 19608

Re: Hydrogeological Re-Evaluation Report  
Strasburg Road/Bow Tree Drive, Horizontal Directional Drill (HDD)  
Location (S3-0520)  
PA DEP Permit No. E15-862  
East Goshen Township  
Chester County

Dear Mr. Gordon:

The Department of Environmental Protection (DEP) has reviewed the HDD reevaluation analysis (Report) submitted on January 23, 2018, for the Strasburg Road/Bow Tree Drive Horizontal Directional Drill Location (S3-0520), DEP Permit No. E15-862, along with supplemental information provided by Sunoco's (Sunoco's or SPLP's) hydrogeologist, GES, on February 12, 2018. The Report is composed of the report titled "Horizontal Directional Drill Analysis Strasburg Road/Bow Tree Drive Crossing," (First Report or Sunoco Report) and the other was produced by GES, Inc. (GES), in January 2018 (GES Report). Collectively, the First Report and GES Report are referred to as the Report, for the purposes of this letter. The initial submission was posted on DEP's Mariner East II pipeline portal's webpage on January 23, 2018, and public comments were received.

This analysis for HDD 0520 was for the installation of both the 16-inch and 20-inch diameter pipelines. Sunoco is proposing a revised design for pipeline installation along the original HDD S3-0520 alignment which will increase the drill depth of the 20" pipe by 31 feet, and the depth of the 16" pipe by 16 feet, in order to reduce the risk of drilling fluid loss, inadvertent returns (IRs), and water supply impacts.

This review of the redesign of HDD No. S3-0520 has been completed in accordance with paragraphs 4 and 5 of the August 10, 2017, Corrected Stipulated Order (Order) under Environmental Hearing Board Docket No. 2017-009-L. The 20-inch HDD is No. 25 on the list of HDDs included on Exhibit 2. The 16-inch HDD is No. 19 on the list of HDDs included on Exhibit 3. Collectively, these HDDs are referred to herein as HDD S3-0520. The 20-inch HDD pilot hole was initiated and then suspended for further evaluation before the issuance of the Order.

IRs occurred during the initial pilot hole of phase of the 20-inch pipeline. Two IRs of approximately 100 and 70 gallons occurred when the pilot drill bit was at approximately 1,776 ft from entry (on June 7, 2017) and 2,686 ft from entry (on July 11, 2017), respectively. Losses of returns (LORs) also occurred in these same areas during tripping-in operations. The fracture trace analysis indicates possible zones of fracture concentration intersecting at these locations along the HDD profile and the soil overburden above the original HDD profile in these locations area is relatively thin. Sunoco has redesigned the HDD profile for the 16- and 20-inch pipelines and determined that the original design profiles for the 16- and 20-inch HDDs could be improved to lower the risk of drilling fluid loss, IRs, and water supply impacts from HDD construction. Sunoco completed additional geologic investigations to assist in the redesign of the planned HDD. The redesign adjusts the HDD profile deeper to place the HDD pathway through bedrock, which will provide better structural integrity than the originally designed shallower profile.

DEP has the following comments and questions that need to be addressed.

1. There are two reports included in the Report. The First Report is titled "Horizontal Directional Drill Analysis Strasburg Road/Bow Tree Drive Crossing," and the other (the GES Report) was produced by GES, Inc. (GES), in January 2018. While the GES Report is sealed and signed by a Pennsylvania-Licensed Professional Geologist (P.G.), it is not clear who produced the First Report. The First Report appears to represent Sunoco's plans and intentions. The GES Report is signed and sealed and makes some recommendations not committed to in the First Report. A Pennsylvania-Licensed Professional Geologist and Engineer will have to sign and seal the First Report as well.
2. Two small IRs were already reported associated with the reaming of the 20-inch pilot hole. Fracture trace analysis suggests that there is a subsurface structure in this area that may facilitate IRs. DEP believes that the previous IRs will likely reappear when drilling resumes. Recommendations made by the P.G. in the GES Report should be followed to minimize the risk of future IRs. Please indicate whether Sunoco intends to follow those recommendations.
3. The Report mentions that fracturing in the rock along the pipe run has areas of very close fracturing. However, it makes no mention of any predominant strike and dip of fractures and joints. Downhole geophysics were not performed. Geophysical techniques, including, but not limited to, caliper tests and ATV should be employed to determine fracture dips and strikes to determine a predominant fracture trace in a resubmitted Report. This will provide data that will assist in determining the direction of groundwater flow and likely paths of drilling fluids in the subsurface.

4. A borehole geophysical suite should be performed in geotechnical borings to verify the fracture trace analysis and determine if any local fracture sets that exist. This may help determine preferential pathways of groundwater and potential drilling fluids.
5. Five geotechnical borings were drilled along the pipe run to depths of 56 to 105 feet bgs. No analysis was provided describing depths of what could be considered "competent" bedrock in each of the borings. In fact, the borings only encountered highly fractured bedrock down to a depth of 105 feet. The Report suggests that bedrock competency values are poor in some areas of the pipe run. An analysis describing the depths of what could be considered "competent" bedrock should be completed.
6. Surface geophysics should be employed to provide evidence of the top of bedrock along the whole run of the pipeline. The six geotechnical borings installed, while very useful in determining fracture density and lithology, are insufficient to determine the top of bedrock outside of their sample locations.
7. Specific points of potential weak bedrock and soils were not individually identified. This should be done. Predetermined areas of weakness should be addressed by a description of the prescriptive approach Sunoco will use when drilling.
8. The implementation of an early detection groundwater monitoring program using domestic wells was not incorporated. A map of wells along with a time frame of drilling activities should be presented in such a monitoring plan.
9. The Report contains limited site-specific information. Specifically, items such as pilot bore and reaming diameters, annular pressures, mud viscosities, action levels, and specific IR response actions should be included.
10. The Report states that loss control materials (LCM) can be used to manage the loss of fluids during the pilot hole phase. As bedrock is generally highly fractured to 65 or more feet below the existing ground surface, the use of LCMs during drilling appears appropriate. The discussion also states that loss of fluids may be managed by grouting. A discussion of the timing of the potential grouting program is not provided. Grouting of highly fractured zones of rock or fracture traces as a preventative measure may be prudent, whereas, grouting after an inadvertent return (IR) already occurs may not be desirable. If grouting is necessary, it may be better to identify and remediate the zones along the alignment that should be grouted prior to drilling the pilot holes. A conceptual description of the proposed grouting program, if any, should be provided.

11. IR prevention typically includes linking the respective proposed HDD geometry with site-specific geotechnical data. This approach will allow the HDD designer and driller to understand what specific HDD station ranges will be most vulnerable to IRs. Questions regarding the linking of the proposed HDD geometry and the site-specific geotechnical data for this specific bore include the following:
  - a. Has the possibility of IRs via weak subsurface soil/weathered rock/fill zones at existing utility trenches (if present) been considered?
  - b. The Report explicitly states that "SPLP will mandate rotational drilling of the pilot hole until competent bedrock is reached." Based on the test boring results, there is little competent bedrock along the alignments and weathering of bedrock along the majority of the HDD appears to be very deep and highly variable. Has a preliminary station number been assigned where the rotational drilling will terminate?
12. Page 2 of the Terracon Report (Attachment 2 of GES Report) states: "When laboratory soil testing results are available, we will submit a complete data report for the subject crossing." This report appears to be preliminary, and an update may be available by now. Any final report from Terracon should be offered as part of the Report.
13. This plan is to address a specific HDD bore at a specific location. Previous history with IRs in this area suggests that soil cover alone may not provide sufficient resistance to prevent future IRs and that a profile that penetrates sound rock may be more appropriate. As a result, discussion regarding sufficient depth of soil cover versus maximum allowable mud pressure should be included for portions of the HDD where the HDD path does not penetrate rock (as may be the case for the entirety of the 16-inch HDD).
14. The Report states: "No geophysical studies were recommended or performed for the reevaluation of HDD S3-0520 as the alignment is not in a karst area." Geophysical surveys should not be limited to karst environments, as they may be useful and provide valuable data in this instance. Specifically, a geophysical survey could be helpful to interpolate between geotechnical boring points, identifying areas of soft soils, confirming the top of rock configuration, and in delineating/characterizing the fractures identified by GES.
15. Evaluation of water levels should be performed prior to initiating the HDD bore to provide information regarding potential diminution of flow issues and the ability to determine if any future potential impact is related to head differentials or plugging of a potential water-bearing zone.

16. Given the developed nature of this area and proximity of residential groundwater supply wells, further discussion is warranted regarding this topic. Potential actions could include the following:
  - a. Evaluate and project water well depths, casing depths, and water-level depths (based on a water-level survey) on cross sections/profile views.
  - b. The GES Report identifies the fractures on a plan view. The Report should also identify potential zones of fractures or fracture trace intercepts on the profile views, along with residential water supply well locations.
  - c. At least 10 properties have private water supply wells within 450 feet of the proposed HDD. Two additional properties have private water-supply wells located just beyond the identified 450-ft boundary. An additional 13 properties are located within 450 feet of the proposed HDD and may or may not have private water supply wells. The Report should include a specific plan for temporary supply replacements, as the bedrock is highly fractured, even at depth, and residential water supply wells are located as close as 55 feet from the planned bore path. To limit potential impact on residential water well users, there should be a well-conceived response plan in place and ready to execute.
17. The Report indicates Sunoco will monitor downhole pressures, viscosities, mud loss, and nearby water wells. However, there are no specific values or action levels such as how often mud loss is calculated or what viscosity would be maintained during the bore or at what point an IR contingency plan would be implemented (i.e., if there is X pressure increase or X mud loss, an IR contingency plan would be started). The specific viscosities and action values and pressures should be defined and documented to facilitate prompt actions during the HDD bore.
18. The Report discusses potential changes in water quality, but should also discuss potential changes to water quantity, as the potential exists for the HDD bore to adversely impact the yield of private water supply wells.
19. In the Report, Sunoco encourages private well owners to make arrangements for alternative water supplies due to the risk of an IR. Sunoco should supply water to these residents prior to drilling, as a precautionary measure, as recommended in the GES Report and provided for in the February 6, 2018, HDD Inadvertent Return Assessment, Preparedness, Prevention and Contingency Plan (Inadvertent Return PPC Plan) incorporated into the February 8, 2018, Consent Order and Agreement entered into between Sunoco and DEP.

20. The Report should designate, based on the geotechnical data, the depth at which full mud pressure can be used to power the motor without blowing out the soils and/or the low RQD weathered rock above the HDD.
21. Although the drilling practices are intended to minimize the risk of an IR occurring, there is a possibility that an IR could reach the ground surface. Given the highly developed nature of this area and the close proximity to residential water supply wells, the Report should reference the February 6, 2018, Inadvertent Return PPC Plan.
22. The terms pressure, fluid pressure, drilling pressure, and mud pressure may refer to either the injection pressure of the drilling fluid (mud) inside the drill string or to the pressure outside the drill string but within the borehole. Most HDD drillers measure the injection pressure of the mud/drilling fluid within the drill string and do not measure the pressure of the bore outside the drill string but within the borehole. The Report should clarify which pressure values are being monitored as part of this proposed HDD bore.
23. When applying the cavity expansion model, maximum allowable mud pressures in soil will likely be exceeded near the exit point (and possibly at other locations) due to the length of the bore through which cuttings must be transported. The Report should consider options for lowering mud pressures to help minimize the risk of IRs. For example, perhaps the pilot holes could be initiated from both ends.
24. The Report indicates the 16-inch HDD will be deeper than originally planned and it is shown that way on the revised profile. However, the summary text of Sunoco's discussion indicates the maximum depth of cover has not changed. The summary text of Sunoco's discussion of the original design provides the average depth of cover for both the 20-inch HDD and the 16-inch HDD. However, the revised design does not provide the average depth of cover for either HDD bore. These discrepancies should be clarified.
25. The Report should provide details regarding the proximity of the original 20-inch pilot bore to the revised HDDs and how the original 20-inch pilot bore will be decommissioned/abandoned. The Report should also detail what steps will be taken to minimize the potential for IRs associated with the original pilot bore.
26. The revised profile shows the 16-inch bore has been deepened slightly, apparently along the soil/bedrock interface. This is typically not a desired location for an HDD bore, as drilling along the soil/rock interface will likely result in difficult drilling conditions (in and out of bedrock) and an increase in the risk of an IR, especially in the areas where the fracture zones intersect the HDDs.

27. Sunoco's Report states that the HDD "could affect individual well use during active drilling for wells located within 150 linear ft." Sunoco needs to explain why it focuses only on wells located within 150', and must address whether other water supplies outside of 150' could be affected. Please provide justification sealed by a Pennsylvania-Licensed Professional Geologist that wells outside of the 150' profile will not be impacted.
28. With regard to water supplies that might be impacted by these HDD activities, Sunoco must address those impacts in an acceptable manner. Sunoco has the option to enter into written agreements with all private water supply owners whose water supplies may be impacted by this Drill, regardless of their location from the Drill, as part of this reevaluation, and in advance of commencing the HDD. Under the agreements, Sunoco must provide short and long-term replacement potable water supplies adequate in quantity and quality for the purposes served, to the satisfaction of all potentially affected water supply owners. The agreements should provide for Sunoco to conduct water quality and quantity testing of each potentially affected water supply prior to, during, and after the HDD activities. Sunoco needs to provide proof of these agreements to DEP with a response to this letter.
29. In the alternative, if Sunoco chooses not to pursue these agreements with the private water supply owners, it must provide a discussion of actions to be taken by Sunoco to prevent water supply impacts from occurring. Sunoco needs to demonstrate how, in the absence of the agreements described above, Sunoco will avoid impacts to all water supplies. Sunoco's approach should include the utilization of technical and nontechnical measures to avoid such impacts, including, but not limited to, the conversion of the HDD to a trench installation, use of other trenchless construction methods, the use of NSF-60 approved gels or other approved additives that could prevent such impacts from the Drill, or some combination of all of the above. To the extent Sunoco proposes to use any ANSI/NSF 60 certified HDD additives, consistent with Special Condition NN contained in DEP Permit No. E15-862, Sunoco will only be able to use the additives in the manner indicated in the certification of the proposed additive. The manner in which the proposed additive is to be used, as indicated in its ANSI/NSF 60 certification, should be submitted with your response. In addition, Sunoco should indicate whether it will be following all conditions included as part of the additive's certification or, if not, provide an explanation as to why it is not and why that deviation is acceptable.
30. The Report discusses potential changes in water quality, but also needs to discuss potential changes to water quantity, as the potential exists for the HDD bore to adversely impact the yield of private water supply wells. Please describe how this will be done consistent with applicable provisions of the latest versions (February 6, 2018) of the IR PPC Plan, and the Operations Plan (January 2018).

31. The recommendations of Section 4.2 of the GES Report should be fully integrated into the redesign plan and resubmitted Report. Presently, only a portion of these appear to have been included.
32. The IRs Discussion in the Summary Report discusses bedrock near the southeast entry point as being poor throughout the entire depth of core to 70 ft. No rock coring was conducted on B6-7E. Please revise the narrative to explain the conclusion regarding the rock strength at the southeast end of the profile.
33. The 150- to 175-foot “impact area” relied upon in the geologic report and the Adjacent Features Analysis does not appear to be supported by site-specific Geologic or Hydrologic data or other competent data. Provide the basis for this determination.
34. Please revise the appropriate sections of the reevaluation document to consider the presence of the abandoned July 2017, 2600+ ft long pilot bore. Please discuss the potential for this drill hole to facilitate and or transmit an IR and the methods to prevent or minimize this potential.
35. The following best management practices (BMPs) should be incorporated into the Report. If Sunoco feels it is inappropriate to include any of these BMPs, Sunoco should provide an explanation as to why it is inappropriate to do so.
  - a. Sunoco will provide the drilling crew and company inspectors the location(s) data on potential zones of higher risk for fluid loss and IRs, including the area related to previous IRs, and potential zones of fracture concentration identified by the fracture trace analysis along the drill path so that monitoring can be enhanced when drilling through these locations.
  - b. Sunoco will mandate rotational drilling of the pilot hole until competent bedrock is reached, such that the initial drilling at entry is performed at fluid pressures less than those required to operate the mud motor drive.
  - c. Sunoco will mandate the use of annular pressure monitoring during the drilling of the pilot hole, which assists in immediate identification of pressure changes indicative of loss of return flows or over pressurization of the annulus, managing development pressures that can induce an IR.
  - d. Sunoco inspectors will ensure that an appropriate diameter pilot tool, relative to the diameter of the drilling pipe, is used to ensure adequate “annulus spacing” around the drilling pipe exits to allow good return flows during the pilot drilling.



- e. Sunoco will mandate short-tripping of the drilling tools to ensure an open annulus is maintained to manage the potential inducement of IRs.
  - f. Sunoco will require monitoring of the drilling fluid viscosity, such that fissures and fractures in the subsurface are sealed during the drilling process.
  - g. If necessary, the pilot hole and reaming phases at the point of entry for the HDD may utilize casing, hammered into the substrate down to structurally better rock, to prevent vertical or lateral movement of drilling fluids at shallow depths.
  - h. During the reaming phase, the use of LCMs can be implemented if indications of a potential IR are noted or an IR is observed.
  - i. If LCMs prove ineffective to mitigate loss of returns or IRs, then grouting of the pilot hole may be implemented.
36. DEP requests that Sunoco provide the following information related to the project's potential effect on well production zones and water supplies:
- a. An analysis of private water supply well production zones and how the proposed HDD activities will interact with them (listing the depths of wells and pumps is insufficient).
  - b. A map showing all the private water supplies in the correct, surveyed locations.
  - c. A description of the following: if there is short tripping of the tooling during the HDD, what are the chances of a plunger-effect occurring during either the drilling or reaming phases or during pipe pullback, and could this affect private water supplies?
  - d. Water quality sample results of the private water supplies that may be affected.
  - e. Water quantity test results (pump yield tests) of the private water supplies that may be affected.

Based on the technical review of the information submitted in the subject Report and the related comments listed above, it has been determined that the requirements regarding geologic information and geologic analysis detailed in the Order **have not** been met. DEP looks forward to the receipt of information addressing the above concerns and questions with the Report.

If you have additional questions, please contact me at 454.250.5171.

Sincerely,



John Hohenstein, P.E.  
Chief, Dams and Waterways Section  
Waterways and Wetlands

cc: Mr. Mulray, P.G. - GES  
Mr. Wardrop, P.G. - GES  
Mr. Sofranko - Chester County Conservation District  
Re 30 (GJS18WAW)72-4