SUNOCO PIPELINE
An ENERGY TRANSFER Company

535 Fritztown Road
Sinking Spring, PA 19608

April 30, 2019

Via Electronic Mail
Mr. Scott R. Williamson
Program Manager, Waterways & Wetlands Program
Southcentral Regional Office
Pennsylvania Department of Environmental Protection
909 Elmerton Avenue
Harrisburg, PA 17110-8200

Re: Responses to DEP Comments for Hydrogeological Re-evaluation Report
Locust Creek/Graham Creek 16-Inch Horizontal Directional Drill Location (S2-0170-16)
Permit No. E21-449
Lower Frankford Township, Cumberland County

Dear Mr. Williamson:

In compliance with the Corrected Stipulated Order dated August 10, 2017 a Re-evaluation Report on the above-referenced horizontal directional drill ("HDD") was submitted to the Department on February 11, 2019. In a letter dated March 19, 2019, the Department requested further information. Please accept this letter as a response. Your requests are bolded below followed by the response.

1. As the re-evaluation report acknowledges, two of the IR's occurred in water resources that are in close proximity to the entry and exit pits during HDD activities for the 20-inch pipeline. We request that SPLP further develops the discussion within the re-evaluation about how the relatively minor increase in HDD profile length and depth in the re-designed, proposed 16-inch bore path will act to minimize the potential for IR's to the water resources adjacent to the proposed entry and exit pit locations.

The Inadvertent Return (IR) information shown on Figures 1 and 2 in Attachment 2 presents the plan and cross section views of the IR events occurring during the 2017 - 2018 pilot hole drilling, reaming, and completion of the 20-inch HDD. These figures presents the IR locations of IRs in relation to the drilled profile and land surface which allows for correlation to geologic data collected during drilling. The geologic information was compared against the 2017 vertical geotechnical data presented in Attachment 1 of the Re-evaluation Report.

Three IRs occurred during the completion of this HDD. Two IRs occurred during tool entry or "punch in", one during the pilot tool entry at the east end of the profile, and one during the reaming tool entry at the west end of the profile. The third IR occurred during the pilot phase, initiated by a Loss of Circulation with the pilot tool at 1,880 feet (ft.) from entry and mud circulation during pull back of the tool pushed drilling fluids through weathered bedrock and overburden to the land surface.

The two tool entry IRs are easily identified to be the result of drilling fluid movements within the overburden above bedrock near the soil/bedrock interface. The IR at 1,880 ft. from entry resulted from the shallow depth of profile. Review of the profile and tool location compared to the 2017 veridical geotech data indicates that the pilot tool was within weathered and fractured shale.

SPLP utilized all the foregoing information, and daily drilling reports prepared by the monitoring geologist during the drilling of the 20-inch HDD in our internal assessment and redesign of the 16-inch HDD profile as revised.

To minimize the potential for "punch in" and "punch out" IRs, the entry and exit angles have been increased, as limited by the surface topography, and allowable pipe stress at each point to accelerate tool entry and exit into and out of bedrock and reduce drilling time through overburden. Both the HDD entry and exit were extended to relocate the entry and exit further from the wetland boundary. As stated in the Reevaluation Report, these steps may or may not prevent an IR, but if an IR occurs during entry or exit, these adjustments should result in the IR occurring within the Limits of Disturbance (LOD) in uplands and within the LOD perimeter erosion and sedimentation controls.

The increased depth of the redesigned 16-inch HDD horizontal run will enable the boring to advance through more competent material in an effort to reduce the potential for IRs. The depth of the redesigned profile places the horizontal run a minimum of 30 ft. of depth into bedrock having RQD values of 52 – 90, and core recoveries of 76 – 100%.

2. Relating to the consideration of geologic strength at profile depth: The geologic report refers to core borings at two locations near the HDD profile. The geologic report is limited in interpretation/discussion of the core samples in relation to geologic strength at profile depth. RQD ranges are listed along with descriptions stating that bedrock is highly weathered and broken. The report does not utilize core sample data in interpreting the likelihood of intercepting fractures during drilling activities. Please provide further discussion about how the use of this information was considered as part of the re-evaluation and selection of the 16" pipeline bore path.

Based upon the 2017 geotechnical core data, the pilot and reaming tools will intercept fractured, weathered, and broken layers within the bedrock until approximately 130 ft. of depth below the land surface is achieved. As discussed in the response to Item 1 above, the horizontal run is set at a general depth of 126 ft. below ground, which provides for a minimum of 20 ft. of competent rock above the profile to mitigate the potential for IRs to occur.

3. Relating to the consideration of Overburden Strength Analysis: The geologic report provides a description of soils underlying the site but does not include any analysis or discussion of the overburden strength. Please provide additional information/discussion to address the consideration of overburden strength analysis as per the requirements of paragraph 4 ii of the EHB corrected and stipulated order.

Results from the 2014 and 2017 geotechnical investigation identified the overburden as being a medium dense to very dense material that typically had a very stiff to hard consistency. The material identified in the split spoon samples ranged from clayey sands to fine to coarse grained sands and gravels. The silt and clay content showed a decreasing downward trend as the sampler approached the soil to bedrock interface. Based on these results, there is a higher potential for an IR to occur while the profile is approaching the soil/bedrock interface which supports the rationale for increasing the entry and exit angles to allow for the boring to be advanced more quickly through the overburden zone and into competent bedrock.

4. Relating to the consideration of Pipe Stress Radius: Provide further explanation of how the following statement applies to this HDD re-evaluation: "Pipe stress allowances are an integral part of the design calculations performed for each HDD."

For steel pipe the “pipe stress allowance” is the amount of curvature that a piece or length of pipeline can bend without resulting in damages such as a “kink” or “crimp” in the wall of the pipe. The innate curvature ability of pipe is termed the “free stress radius”. The stress allowances of the pipe is determined by the ductility of the steel, wall thickness, and the diameter of the pipe. An HDD design is limited by the horizontal distance between the points of entry and exit and the free stress radius of the pipe.

Ductility of the steel used for pipelines is determined by the percentage of carbon within the steel. Generally steel pipe is categorized as either “low carbon” having less than 0.3% carbon content within the steel, or “high carbon” having greater than 3% carbon within the steel. As the carbon content within the steel used to make the pipe increases, the flexibility (ductility) of the pipe is decreased. The X70 16-inch pipe utilized on the Mariner project is a low carbon (high ductility) steel pipe.

The design of an HDD profile accounts for the free stress radius of the pipeline segment to be pulled into the drilled entry, through the entry radius of curvature at maximum horizontal depth, out the exit radius leaving maximum depth, and out the drilled exit; therefore each HDD has a minimum of four (4) points of pipeline curvature to assess for pipeline stress. Additionally, a horizontally drilled profile is not a “perfect” pathway, especially when drilled through rock formations. The pilot tool cutting into the rock face has a larger cutting face than the drill stem pushing the tool forward, which results in flexibility of the tooling within the pilot hole, and as a result the pilot tool will drift in orientation as proceeding forward because the cutting tool will proceed easier into softer material while cutting due to natural variances in hardness of the materials being cut, whether they are soils or rock. Steering of the pilot tool is used to correct drifting as it occurs. As a result of this natural drifting during completion of the pilot hole, the entire length of the drilled pilot hole is assessed for stress allowances at three (3) joint intervals before reaming of the annulus is permitted. If errors during pilot drilling or reaming occur and a mid-point is identified that would breach the pipe stress allowance, then the use of an over-reamed annulus is assessed for breach of the stress allowance. In cases where an over-reamed annulus will not correct the stress problem, the HDD has to be re-drilled.

All of the information and the stress assessment procedures discussed above are incorporated into the profile design and implemented in analysis of the drilling profile to ensure the integrity of the pipeline as installed.

SPLP submits that we have been, and are, in complete compliance with the agreed terms and analysis requirements of the Order, as agreed to by the Department, and that no further analysis is required for the Department to consent to the start of this HDD. SPLP therefore requests that the Department approve the Reevaluation Report for Graham Creek Crossing Horizontal Directional Drill (S2-0170-16) as soon as possible.

Sincerely,

Larry J. Gremminger, CWB
Geotechnical Evaluation Leader
Vice-President – Environmental, Health & Safety
Energy Transfer Partners
Mariner East 2 Pipeline Project

Pertaining to the practice of geology and information conveyed.

Douglas J. Hess, P.G.
License No. PG-000186-G
Skelly and Loy, Inc.
Director of Groundwater
and Site Characterization
Geo-Environmental Services

04/30/2019
Date