# SITE CHARACTERIZATION WORK PLAN

Sunoco Pipeline LP Twin Oaks-Newark 14” Diameter Pipeline Release
Upper Makefield Township, Bucks County, Pennsylvania

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# 1. Introduction and Purpose

This work plan was prepared by Verdantas LLC ("Verdantas") on behalf of Sunoco Pipeline LP ("Sunoco Pipeline") in relation to the release of petroleum products from the 14-inch diameter Twin Oaks – Newark Pipeline ("pipeline"). The location of the release is in the Mt. Eyre neighborhood of Upper Makefield Township ("Township"), Bucks County, Pennsylvania (the "Project Area"). A United States Geological Survey ("USGS") Topographic Map is provided as Figure 1 and Figure 2 is a Project Area Layout Map.

The purpose of the work plan is to detail the initial tasks planned to characterize the nature, extent, direction, rate of movement, volume, and composition of the petroleum products released from the pipeline. This work plan in intended to satisfy obligations established by the Administrative Order issued to Sunoco Pipeline by the Pennsylvania Department of Environmental Protection ("PADEP") on March 6, 2025. Specifically, this work plan addresses Paragraph 2(b)(i) of the Administrative Order and includes details of the planned report to address Paragraph 2(b)(ii) of the Administrative Order. These two obligations were also discussed as Items (i) and (ii) of the March 14, 2025, Proposed Implementation Schedule prepared by Sunoco Pipeline and submitted to the PADEP.

This work plan includes discussions of information previously provided to the PADEP in meetings, daily and weekly reports, the Interim Remedial Action Plan, and other submitted documents. This information is included in the work plan only to support the preliminary conceptual site model ("CSM") and selection of the planned characterization activities. This work plan is not intended to be a comprehensive report documenting the results of interim remedial actions.

This document was revised to address PADEP comments provided to Sunoco Pipeline in a Letter of Deficiency for Site Characterization Work Plan dated May 13, 2025, and public comments provided in the form of a letter from Berger Montague that Sunoco Pipeline received from PADEP via email on May 18, 2025. Separate responses to the PADEP and Berger Montague letters have been provided under separate cover. Additional revisions to the work plan were made to reflect ongoing work on the project including the completion or initiation of many tasks proposed in the original work plan.

# 2. Preliminary Source Characterization and Conceptual Site Model

The following information presents the CSM. The purpose of including the preliminary CSM in this work plan is to provide the current understanding of the site environmental system and the processes that appear to control the transport and movement of regulated substances through environmental media. This preliminary CSM has been prepared to organize the data collected during implementation of the interim remedial activities and will be refined as additional data are collected. A revised CSM will be presented in the interim site characterization report to be submitted to the PADEP by Sunoco Pipeline and the Act 2 Final Report will include the final CSM. As stated previously, this work plan is not intended to be a comprehensive report documenting the results of the interim remedial activities.

## 2.1 Release mechanism

A release of petroleum products from the pipeline was discovered on January 31, 2025. The pipeline predominantly transports jet fuel but occasionally transports unleaded gasoline and diesel fuel.

The release occurred from the pipeline in a location within the pipeline right-of-way at a property along Glenwood Drive near the intersection with Walker Road (“Release Location”) and is identified on Figures 2 and 3.

Impacted soils around the pipeline at the Release Location were excavated and properly disposed of at an off-site facility as documented in prior submissions to PADEP. Excavation of the impacted soils extended to or beneath the top of the weathered bedrock surface.

The pipeline was repaired, tested, and returned to service on February 2, 2025.

## 2.2 Estimated Volume of Release

Based on the observed leak rate, Sunoco Pipeline estimates that the volume of the released petroleum product to be 156 barrels (6,552 gallons). Petroleum products were recovered by the excavation of soil and are being recovered by ongoing well-bailing activities.

## 2.3 Soil impacts

Post-excavation soil samples collected on February 2 and February 10, 2025, were analyzed for the substances on the PADEP Short Lists of Petroleum Products (“Short Lists”). Analytical results indicate that low concentrations of certain regulated substances may remain in soil at the base of the excavation, which is within the weathered/rippable bedrock. See Figure 3 for post-excavation

sample locations. Penetrometer measurements of the excavation sidewalls and floor prior to backfilling support that the floor of the excavation was in weathered bedrock.

Other interim investigation activities conducted to date provide additional lines of evidence to support preliminary CSM related to soil impacts. These additional lines of evidence are:

- The pipeline inspection conducted between January 20, 2025, and January 27, 2025, including over 1,000 photo-ionization detector ("PID") measurements along the pipeline, did not identify widespread petroleum impact along the pipeline.
- The advancement of eight direct-push borings along Glenwood Drive (understood to be downgradient from the release location) did not identify widespread petroleum impacts in soil.
- The preliminary results of the passive soil gas survey conducted between March 13 and March 20, 2025, do not support the existence of widespread petroleum impacts to soils in the area of the survey.

## 2.4 Bedrock Geology

According to Pennsylvania Geologic Survey mapping of the area, the bedrock formation beneath the Project Area is the Triassic-aged Lockatong Formation. The Lockatong Formation is described in Geyer and Wilshusen (1982) as dark gray to black argillite having some zones of black shale and locally, thin layers of impure calcareous shale. The primary porosity and permeability of the weathered and un-weathered rock in the Lockatong Formation are described as low with joint openings providing secondary porosity.

The depth to bedrock based on observations and direct-push refusal is between four and seven feet below the ground surface. The boring log from the first recovery well installed at a property on Spencer Drive described the bedrock as argillite. Bedrock was encountered at approximately 11 feet below ground surface during the recovery well boring advancement. Bedrock was encountered between three and five feet during the installation of the three recovery wells along Glenwood Drive near the Release Location.

## 2.5 Depth to Groundwater and Hydrogeology

Ongoing gauging of domestic water supply wells and the recovery well indicates that the depth to water in the water supply wells is variable based on water usage (e.g., pumping of the well). Recently measured depths to water in the water supply wells generally range from approximately 25 feet to 70 feet below ground surface. Observed variations in the depth to water may be attributed to topography, construction, seasonality, and operation of the well. Groundwater was not encountered during the interim remedial excavation of impacted soils or direct-push activities described above.

As stated above, bedrock has been encountered in borings at depths between three and eleven feet below ground surface. Therefore, groundwater in the Project Area is located within the bedrock unit and there does not appear to be a hydraulically saturated unconsolidated (soil) interval.

Water supply wells are used as the potable water supply in vicinity of the release. Reported water supply well depths are generally between 100 and 700 feet below ground surface (Pennsylvania Groundwater Well Information System ("PAGWIS")). The depth of the water supply wells relative to the depth to water appears to provide borehole storage for the water supply due to the relatively low formation yields in the area.

Regional groundwater flow is expected to be generally eastward. Based on preliminary observations from investigation and interim remedial actions conducted in water supply wells and the recovery wells, fracture/joint porosity appears to be the major source of groundwater yield in water supply wells and appears to be the predominant factor for shallow groundwater flow. Surficial and borehole geophysical logging and imaging have confirmed this general interpretation.

## 2.6 Extent of Separate-Phase Liquid

Sampling of private water supply wells conducted to date has indicated the presence of floating separate phase liquid (light non-aqueous phase liquid ("LNAPL")) at five locations. These are:

- Two properties on Glenwood Drive, including the Release Location and a property northeast of the Release Location;
- One property on Walker Road, adjoining and to the east of the Release Location;
- Two properties on Spencer Road, approximately 1,000 feet east-northeast of the Release Location.

LNAPL was also observed at an additional property on Spencer Road, but the LNAPL did not appear to be jet fuel based on the visual appearance and odor of the recovered LNAPL. Rather the LNAPL appears to be a different petroleum product. Also, LNAPL at that location has not been observed since January 29, 2025. Figure 4 depicts the locations of water supply wells and LNAPL observations.

## 2.7 Extent of Groundwater Impacts

The analytical results for the samples collected from water supply wells as of April 2, 2025, are depicted on Figure 5. Water supply well sample results where dissolved phase volatile organic compounds were detected at concentrations greater than the Statewide health standard ("SHS")

medium-specific concentrations ("MSCs") for Organic Regulated Substances in Groundwater, Residential, Used Aquifers (TDS ≤ 2500) are also depicted on Figure 5.

A fracture trace analysis along with an electrical resistivity imaging ("ERI") survey in the Mt. Eyre neighborhood were completed between February 20 and March 7, 2025, and results were provided to the PADEP. Supplemental ERI survey activities were completed between May 8 and June 25, 2025. The ERI survey was conducted to detect and delineate underground electrically conductive semi-planar features that could represent water-bearing fractures or bedding plane partings. These assessments along with literature reviews, LNAPL gauging, and analytical results led to the development of Figure 6, which depicts inferred water-bearing fractures along with LNAPL observations[1]. Fracture sets are interpreted to strike approximately North 50° and south dipping, greater than 60°. As shown on this figure, an inferred fracture passes very close to two wells on Spencer Road where LNAPL has been observed. Extrapolation of this feature captures the property on Walker Road where LNAPL was also observed, and the property on Glenwood Drive (Release Location).

## 2.8 Summary of Preliminary CSM

The preliminary CSM is that petroleum products released from the pipeline migrated primarily downward through a thin layer of soil beneath the pipeline to the bedrock surface at approximately eight to eleven feet below ground surface in the vicinity of the release. Impacted soil material beneath the pipeline at the Release Location was removed during the interim remedial excavation. There is no evidence of residual petroleum products in soils at the Release Location except for potential low-level concentrations at the base of the interim remedial excavation in weathered bedrock.

The released petroleum products migrated downward through the weathered bedrock and into bedrock fractures. Downward migration continued to the (unconfined) water table at a depth of approximately 25 to 35 feet. The variable pumping of domestic water supply wells in the Project Area creates dynamic hydraulic gradients in the water-bearing bedrock fractures which are the predominant pathways for groundwater movement. Separate- and dissolved-phase petroleum has migrated along the bedrock fractures in response to these gradients and the general eastwardly regional groundwater gradient.

A schematic cross-section illustrating the preliminary CSM is included as Figure 7. This figure is provided as a general illustration of the CSM and is not intended to represent a scaled cross-section or actual conditions at a specific location within the Project Area.

[1] Note that the supplemental ERI survey data was completed on June 25, 2025, and therefore, that data is not included on Figure 6.

# 3. Proposed Site Characterization Tasks

Site characterization is an iterative process with the results of each characterization activity being used to refine and shape the scope of future activities. As such, the scope of characterization work presented in this work plan represents the most-likely initial site characterization activities based on the preliminary CSM. Changes to the planned activities and the performance of additional activities are expected. These changes will be communicated to the PADEP in the required 90-day updates or other written communications.

Planned activities are located in public rights-of-way to the greatest extent possible to minimize disruption to local residents and simplify the logistics of property access. Activities planned on public and private property not owned by Sunoco Pipeline will require permission for access from the property owners. Sunoco Pipeline may request assistance from the PADEP during access discussions with property owners.

Standard operating procedures ("SOPs") are not included in this work plan. Existing SOPs will be used if applicable and new SOPs will be prepared as necessary. SOPs will account for conditions associated with negotiated access to properties. These SOPs will be identified or prepared and provided to the PADEP prior to the performance of characterization activities. It is not possible to include specific SOPs for all tasks described in this work plan as the procedures that will be used are being reviewed and refined as new data is obtained. General information regarding the anticipated methods to be used to conduct proposed activities is included with the description of each task below.

As stated in Section 1 of this work plan, many activities proposed in the original work plan have been completed or initiated. This plan has been revised to reflect the continued characterization and interim remedial progress.

## 3.1 Compile Available Property Information

Publicly available and observable information regarding the location and construction of the water supply wells, septic systems and sand mounds, and sub-grade structures (basements and crawl spaces, sumps, and radon systems) in the Project Area will be reviewed and compiled. The review will include the PAGWIS, County and Township land development and property records, and information obtained by visual observation from public rights-of-way. Sunoco Pipeline's consultants will also obtain additional property-specific data and information during field activities at private properties in the Project Area as permitted by property owners. This information will be used to refine the CSM specifically related to potential shallow groundwater flow and vapor intrusion preferential pathways.

## 3.2 Additional Surficial Geophysical Investigations

As stated above, ERI has been used in the Project Area during interim remedial and initial investigation activities. A supplemental ERI survey and a seismic refraction survey are planned to provide additional information regarding the inferred bedrock fractures and the nature of the soil/bedrock interface. The remaining planned geophysical work will be completed by RETTEW of Lancaster, Pennsylvania, by early July (weather permitting).

### 3.2.1 Supplemental ERI Survey

A supplemental ERI survey was conducted in the area to the west and east of the previous ERI survey area to facilitate mapping of inferred fracture traces across the segment of the pipeline where the release occurred. The location of the supplemental ERI survey is depicted on Figure 8.

The ERI survey was performed with an Advanced Geosciences, Inc. SuperSting™ R-8 with sectional 112-electrode (rollable) system. Fully reciprocal dipole-dipole readings was collected with ten-foot dipole width and a dipole separation up to N=10. The data collection and storage was fully automated and digital. The field data from the supplemental ERI survey are being processed using EarthImager2D.

### 3.2.2 Seismic Refraction Survey

A seismic refraction survey is being conducted in the area of the original and planned supplemental ERI survey. The purpose of the seismic refraction survey is to refine the understanding of the depth to, and nature of, the soil/bedrock interface within the survey area. The location of the seismic refraction survey is depicted on Figure 8. As of the writing of this report, seismic refraction data collection is almost complete.

The seismic refraction survey is being performed with a Geometrics, Inc. Geode with a sectional 48-geophone (rollable) system equipped with Marks Products 3.5 hertz geophones. The seismic source is a 32-pound slide hammer. A 10-foot geophone spacing and a 30-foot shot spacing are being used and the data collection and storage was fully automated and digital. The data are being recorded with no filters. The seismic refraction survey data are being processed using SeisImager.

## 3.3 Soil Characterization

Soil characterization was conducted in the vicinity of the Release Location to delineate the horizontal and vertical extent of petroleum impact including the identification and delineation of soil or LNAPL that may be a potential vapor intrusion source or a potential continued source of dissolved-phase groundwater contamination. As stated above, results from sampling at the extent of the interim remedial excavation showed relatively low concentrations of PADEP Short

List substances. However, laboratory reporting limits for some PADEP Short List substances were elevated above the PADEP SHS MSCs and/or soil vapor intrusion screening values.

Twelve soil borings were proposed in the April 18, 2025, work plan. The proposed locations of the soil borings are shown on Figure 9. On June 17, 2025, fourteen direct-push borings were advanced within the Sunoco Pipeline right-of-way in the area around the interim remedial excavation. The locations of the fourteen soil borings installed in this area are in the process of being surveyed.

Borings were advanced to direct-push refusal within the weathered bedrock. Recovered soil was screened with a PID using a headspace technique which can minimize variability in PID responses due to differences in grain size and soil moisture. Recovered soil was also scanned with ultraviolet light to screen for the presence of separate-phase petroleum products.

Borings were advanced with a track-mounted direct-push drilling rig operated by Parratt-Wolff, Inc. of East Syracuse, New York (with an office in Watsontown, Pennsylvania).

At least one laboratory analytical sample was collected from each soil boring. The depth of the sampling interval was based on the preliminary CSM and observations made during the boring advancement. Samples were generally collected at the interval with the greatest PID response or the interval identified as containing petroleum products by ultraviolet light scanning. If there were no indications of petroleum impact, the laboratory analytical sample was collected from the deepest soil interval recovered from the boring.

The laboratory analytical samples are being analyzed for the PADEP Short List substances by Pace Analytical Laboratory for the analytes using analytical methods identified by the PADEP and published in Table III-5 of the Pennsylvania Land Recycling Program Technical Guidance Manual ("TGM"). Sunoco Pipeline and its contractors have worked with the analytical laboratory to attempt to obtain laboratory reporting limits that are below the SHS MSCs and SHS soil vapor intrusion screening values.

Logs for each soil boring will be prepared by, or under the direct supervision of a professional geologist licensed in the Commonwealth of Pennsylvania using a standard classification system (e.g., Unified Soil Classification System or modified Burmister).

## 3.4 Groundwater Characterization

Installation and sampling of groundwater monitoring wells is planned to delineate the horizontal and vertical extent of petroleum impacts to groundwater including the identification and delineation of groundwater and LNAPL that may be a potential vapor intrusion source. As stated above, the preliminary CSM is that the water table is within the fractured bedrock system beneath the Project Area. Results of water sampling conducted in water supply wells and recovery wells identified wells with LNAPL and dissolved-phase concentrations of PADEP Short List substances

greater than the SHS MSCs. The planned location of the monitoring wells is based on the locations of identified LNAPL and dissolved-phase concentrations greater than the SHS MSCs and the distribution of fracture traces identified by the ERI surveys.

The locations of the planned monitoring wells may be adjusted based on the results of the currently ongoing and planned interim remedial activities including the ongoing recovery well installation and sampling, continued water supply well monitoring, and the location of underground utilities. Results from the surface geophysics and soil characterization will also be evaluated and used to modify the locations of the planned monitoring wells. Additional monitoring wells may be required to complete the groundwater characterization. Installation of the planned monitoring wells requires the granting of access by the Township and/or the other owners of the properties where the well installations are planned.

### 3.4.1 Monitoring Well Installation

Seven groundwater monitoring well locations are planned at locations primarily along the inferred traces of bedrock fractures shown on Figures 6 and 8 that have indications of impact based on interim remedial activities. The locations of these monitoring wells are depicted on Figure 10. Recovery wells recently installed near the Release Location are being used to preliminarily characterize groundwater adjacent to the Release Location.

Two completion procedures are being evaluated for the monitoring well installations. These different procedures are being evaluated because of the hydrogeological setting described in the preliminary CSM. The well completion procedure will be selected from these methods based on results of the ongoing interim remedial actions including recovery well installation and sampling and the reconnaissance well water sampling. In this hydrogeologic setting, it can be difficult to install monitoring wells at different locations that monitor the same aquifer interval and also have sufficient water for monitoring and sampling.

- The first completion procedure is to install two monitoring wells at each location. The first well will be installed to a total depth of approximately 75 feet with the screened interval extending from approximately 50 feet below ground surface to approximately 75 feet below ground surface. Solid casing may be used to isolate the screened interval from the overlying interval in these deep wells. The second well at each location would be installed with a screened interval from approximately 20 to 40 feet below ground surface. The two wells may be constructed within the same boring if sufficient isolation of the monitored intervals can be obtained.

- The alternative completion technique is to install a boring to approximately 75 feet and perform borehole geophysics on the open borehole. The completion of the well will be determined by the results of the geophysics and may include the use of multi-level monitoring materials (e.g., Solinst® Flute or Waterloo Multilevel system) or the completion of two conventional monitoring wells within the same boring if sufficient isolation of the

monitored intervals can be obtained. If multiple monitoring wells or multi-level monitoring materials are not used, two monitoring wells may be installed at each identified location.

The methodology for monitoring well installation will evolve as additional information is obtained during successive phases of investigation activities including observations from recent recovery well installations. Initial monitoring well installations will likely involve the use of borehole geophysical techniques.

The SOP for the advancement of the monitoring well borings and completion of the monitoring wells will be developed after the procedure is selected based on the results of the recovery well installation and sampling. The SOP will be provided to the PADEP for review prior to the initiation of the monitoring well installation activities. Monitoring wells will be installed and developed in general accordance with the current TGM. Logs for the monitoring well borings will be prepared by, or under the direct supervision of, a professional geologist licensed in the Commonwealth of Pennsylvania. The top of casing for each monitoring well will be professionally surveyed by a surveyor licensed in the Commonwealth of Pennsylvania to allow for the calculation of water level elevations and the preparation of a potentiometric surface or water table contour map. Survey measurements will be referenced to North American Datum ("NAD") 83 (2011) as the horizontal datum and North American Vertical Datum ("NAVD") 88 (2018) as the vertical datum.

Monitoring of nearby water supply wells will be conducted during monitoring well drilling activities using procedures similar to those used during recovery well installation activities. The water supply well monitoring procedures will be included in the SOPs for the monitoring well installation.

Investigation derived waste generated during monitoring well installation activities, including drilling cuttings and recovered groundwater, will be contained and handled in accordance with Sunoco Pipeline's waste management procedures.

A truck or track-mounted drilling rig will be used to install the monitoring wells using hollow-stem-auger, air-rotary, and/or sonic drilling techniques. These activities will be performed by a licensed drilling contractor. Parratt-Wolff, Inc. of East Syracuse, New York (with an office in Watsontown, Pennsylvania), is anticipated to be the contractor for this work.

### 3.4.2 Groundwater Monitoring and Sampling

Two rounds of groundwater monitoring and sampling will be conducted. This will include the measurement of water levels in the monitoring and recovery wells, purging of the monitoring wells, and the collection of analytical samples from the monitoring wells. The first round of monitoring and sampling will occur at least two weeks after the monitoring wells are developed.

The depth of water will be measured in each monitoring and recovery well using an electronic conductance-type water level indicator capable of discerning LNAPL. If LNAPL is encountered, the depth to the LNAPL and the depth to water in the well will both be measured to allow for the

calculation of LNAPL thickness. The monitoring wells will then be purged in general accordance with Appendix A of the TGM using low-flow or standard volume purge methods that will be determined based on the characteristics and completions of the monitoring wells, and analytical samples will be collected for the PADEP Short List substances. Analytical samples are anticipated to be analyzed by Pace Analytical Laboratory using the analytical methods identified by the PADEP in Table III-5 of the TGM.

As stated previously, to the extent possible, existing SOPs will be used for groundwater monitoring and sampling activities. If necessary, alternative SOPs will be developed and provided to the PADEP prior to performance of the characterization activity, including SOPs for purging and sampling of monitoring wells with LNAPL. Quality assurance and quality control samples along with data validation procedures will be provided in the SOP for the groundwater sampling activities.

Investigation derived waste generated during groundwater monitoring and sampling activities, including purge water, will be contained and handled in accordance with Sunoco Pipeline's waste management procedures.

## 3.5 Evaluation of Potential Vapor Intrusion Pathways

Following completion of the planned soil and groundwater characterization work described above, potential vapor intrusion pathways from soil and groundwater impact (including LNAPL) will be evaluated in accordance with the current TGM. The first step in the evaluation will be the identification of potential vapor intrusion sources. There are two components that define a potential vapor intrusion source. The first component is the presence of soil or groundwater at concentrations above the applicable SHS screening value or the presence of LNAPL. The second component is that the location(s) identified in the first component are within a proximity distance of an inhabited space or a potential preferential vapor migration pathway.

Identified potential vapor intrusion sources will be further evaluated using either additional soil and groundwater sampling or vapor intrusion-specific sampling (near-source soil gas, sub-slab soil gas, or indoor air). Alternatively, mitigation of the potential vapor intrusion pathway may be implemented prior to vapor intrusion sampling in accordance with the current TGM.

Sub-slab soil gas sampling was conducted during the week of June 9 – 13, 2025. This sampling was performed in accordance with the Sub-Slab Soil Gas Sampling and Analysis Plan that was submitted to the PADEP on June 2, 2025. A second round of sub-slab soil gas sampling is preliminarily scheduled to occur in late July.

Existing SOPs for alternative vapor intrusion sampling will be used, or new SOPs will be created and provided to the PADEP prior to sampling. An SOP for mitigation will be prepared and provided to the PADEP prior to implementation of any mitigation measures.

# 4. Interim Site Characterization Report

An Interim Site Characterization Report (“ISCR”) that provides the results of the completed interim remedial and characterization activities will be prepared. In accordance with the obligations of the Administrative Order Paragraph 2(b)(ii), which established a Proposed Implementation Schedule of Act 2 deliverables, the ISCR will be submitted to the PADEP on or before September 2, 2025.

Neither the TGM or the 25 PA Code Chapter 250 Regulations reference or require a site characterization report or an ISCR. However, in accordance with the Administrative Order, the ICSR will describe the interim characterization of the nature, extent, direction, rate of movement, volume and composition of regulated substances released in the environment from the release in accordance with the SHS. The ISCR will present the data generated during the implementation of this work plan as well as the results of the interim activities undertaken and completed to address the release. The ISCR will include an updated CSM and additional characterization activities will be proposed, if appropriate.