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PennEast PIPELINE

HDD Inadvertent Returns and Contingency Plan - Pennsylvania

PennEast Pipeline Project

December 17, 2018

PennEast Pipeline Project
353754-HMM-E-E-004 RevD

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Appendix A – HDD Summary Table

Appendix B – Inadvertent Return Risk Assessment Table

Appendix C - Inadvertent Return Report Form

Acronyms

ANSI/NSF	American National Standards Institute/National Science Foundation International
EI	Environmental Inspector
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
FERC Procedures	FERC Wetland and Waterbody Construction and Mitigation Procedures
HDD	horizontal directional drill
IR Report	Inadvertent Return Report
PADEP	Pennsylvania Department of Environmental Protection
PennEast	PennEast Pipeline Company, LLC
PPG	pounds per gallon
Project	PennEast Pipeline Project
ROW(s)	right(s)-of-way
SPCC	Spill Prevention, Control, and Countermeasure Plan
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

1 Introduction and Purpose

PennEast Pipeline Company, LLC (PennEast) is proposing to construct the PennEast Pipeline Project (Project). The Project facilities include a 36-inch diameter, mainline pipeline, extending from Luzerne County, Pennsylvania, to Mercer County, New Jersey. The Project will extend from various receipt point interconnections in the eastern Marcellus region to various interconnections. The Project is designed to provide a direct and flexible path for transporting natural gas produced in the Marcellus Shale production region in eastern Pennsylvania to growing natural gas markets in eastern and southeastern Pennsylvania, New Jersey and surrounding states.

PennEast will utilize horizontal directional drilling (HDD) and/or conventional bore construction methods to minimize surface impacts to aquatic or other resources at designated crossing locations. This document has been prepared to satisfy the Federal Energy Regulatory Commission (FERC) requirements for an HDD Inadvertent Returns Plan, in accordance with Section V.B.6.d of the FERC's Wetland and Waterbody Construction and Mitigation Procedures (Procedures) as stated below, and to support federal and state permit applications. This document will continue to be updated as additional information is obtained, such as newly surveyed well data and modifications in response to landowner input. Updates to this plan may extend beyond the permit application submittals for the Project.

For each HDD, PennEast will file with the FERC Secretary for review and written approval by the FERC Executive Director, a HDD Plan that includes:

- site-specific construction diagrams that show the location of mud pits, pipe assembly areas, and all areas to be disturbed or cleared for construction;
- justification that disturbed areas are limited to the minimum workspace identified on the drawings and needed to construct the crossing;
- identification of any aboveground disturbance or clearing between the HDD entry and exit workspaces during construction;
- a description of how an inadvertent release of drilling mud would be contained and cleaned up; and
- a contingency plan for crossing waterbodies or wetlands in the event an HDD is unsuccessful and how the abandoned drill hole would be sealed, if necessary.

A summary table of all HDDs for the Project, location information, Pennsylvania Department of Environmental Protection (PADEP) region, wetland/surface water classification, sensitive resource(s) crossed, and whether a drill crosses a sensitive resource or within 450 feet of a public or private well is provided in Appendix A. Water source monitoring will be performed in accordance with the PennEast Well Monitoring Plan and Well Testing Data Form.

Crossing-specific drawings will be provided in advance of construction. These drawings are also included in the state-specific permit package for Pennsylvania. These drawings depict entry and exit locations, access roads, and other workspaces. The pipeline for the HDD pull will be assembled within the FERC certificated workspaces. A summary table of the inadvertent return risk assessments discussed within these reports is provided in Appendix C. Generalized risks and proposed mitigation(s) are presented in the table below.

Table 1: Inadvertent Return Risk Factors and Mitigations

Inadvertent Return Risk Factor	Mitigation
High elevation differences between entry and crossing features (>100ft)	Increase depth of cover underneath crossing feature
Historical mining operations	Locate the drill outside of areas of known mining operations Develop grouting plans and loss of circulation plans prior to construction of drill
Karst features	Locate the drill outside of areas of known Karst features Develop grouting plans and loss of circulation plans prior to construction of drill
Changing lithology	Develop grouting plans and loss of circulation plans prior to construction of drill
Low rock quality designation (RQD) zones (<40%)	Develop grouting plans and loss of circulation plans prior to construction of drill
High required downhole drilling fluid pressures	Implement drill and intersect construction techniques
Soils containing high percentage of gravels and cobbles	Implement casing at entry and/or exit locations

For all HDD installations, hydrofracture/hydraulic fracture evaluations will be completed to define allowable drilling fluid pressures based on the strength of the overlaying geotechnical materials and required drilling fluid pressures necessary to facilitate HDD operations. Contractor will also be required to monitor downhole drilling fluid pressures during all pilot bore operations. In addition, Contractor will be required to visually monitor drilling fluid returns during the entire drilling operation. If preferential drilling fluid flow pathways are encountered during the course of drilling, the Contractor will implement a loss circulation recovery plan. This plan can include pumping of loss-circulation materials, swabbing the bore, and/or grouting of the flow pathway. Requirements for this plan are further detailed in the PennEast HDD Construction Specification (Schedule A-10)

The locations of mud pits, storage areas and mud pumps will be field-located within the permitted limits of disturbance by the HDD contractor prior to construction. PennEast will consider options for the beneficial use/recycling of used HDD drilling mud and/or cuttings for agricultural soil amendment, right-of-way (ROW) stabilization, or fill, depending on the availability of suitable receiving locations in the HDD vicinity at the time of construction and receipt of applicable regulatory approvals. PennEast is also considering the option of using contractors to separate drilling fluid, cuttings and water for the purpose of disposal and recycling throughout the project upon completion of the HDD installation. PennEast may haul drilling mud to a pre-approved facility for disposal, provided that there is no inter-basin transfer of water.

As stated above, the drill-end workspace has been designed to accommodate the necessary materials and equipment to complete the HDD, containment barriers, and erosion and sediment controls. Size and length of the access roads have been minimized by utilizing existing roads and/or selecting the shortest practicable route from the nearest public road.

No aboveground mechanized disturbances are planned between the HDD entry and exit locations during construction. Disturbances will be limited to foot traffic for placement and use of any required sensor/transmitter/guidance system equipment.

2 HDD Inadvertent Return and Surface Spill Contingency Plan

2.1 Purpose and Objectives

The purpose of an inadvertent return plan is to identify operational procedures and responsibilities for the prevention, containment, and clean-up of drilling fluids that have ponded on the ground surface or within a waterbody during HDD operations. This plan complies with the requirements set forth in 25 Pa. Code Section 78a.68a and Section 102.5(l), and the PADEP Guidelines for the Development and Implementation of Emergency Response Plans. This plan defines methodologies to control and minimize the impacts to sensitive resources from inadvertent returns of drilling fluids associated with the proposed HDDs. The objectives of this plan are to:

- minimize the potential for an inadvertent return event;
- enable the timely detection of an inadvertent return event;
- provide for environmental protection of wetlands, waterbodies and other sensitive resources, in the event an inadvertent return occurs,
- establish response procedures to address containment and clean-up of an inadvertent return event; and
- establish notification protocols with the applicable parties and regulatory agencies, in the event an inadvertent return occurs.

The following discusses the role of drilling fluids during HDD installation, summarizes the inadvertent return risk for the proposed Project HDDs and presents an inadvertent return contingency plan.

2.2 Drilling Fluid Composition and Processing

Raw drilling fluids consist of a mixture of water, bentonite, and polymers (additives). The raw mixture has a unit weight slightly higher than that of fresh water. A typical bentonite-based drilling fluid contains up to five percent bentonite and has a mud weight between 8.6 to 8.8 pounds per gallon (PPG) in comparison to fresh water with a mud weight of 8.34 PPG. Bentonite is a naturally occurring, non-toxic, inert substance that meets American National Standards Institute/National Science Foundation International (ANSI/NSF) Standard 60 Drinking Water Additive Standards and is frequently used for drilling potable water wells. Material safety data sheets for the bentonite and additives will be submitted by the Contractor for acceptance by PennEast prior to the start of construction. The safety data sheets will be maintained onsite and available for review.

The exact mixture of fluids is determined based on the anticipated and actual geologic materials encountered within the bore path as the drilling process progresses. Additives (polymers) are commonly used to modify the drilling fluid properties to enhance performance of the drill. Raw drilling fluids are produced by adding small amounts of bentonite and/or polymers to fresh water. The fluids are mixed and maintained within a holding tank. The drilling fluids are only used once the desired fluid properties have developed.

The raw drilling fluid is pumped into the bore through the drill pipe. As the drilling fluid exits the down-hole tooling within the bore, it mixes with the soil and/or rock cuttings generated by the down-hole tooling to create "flowable" slurry. This mixture flows under an induced fluid pressure

gradient generated by the injection of additional drilling fluids into the bore. Flow of the drilling fluid/slurry mixture follows the path of least resistance. When properly designed and executed, the drilling fluid/slurry mixture flows toward either the drill rig entry or exit locations depending on which stage of the installation process is being completed and the location of the point in question within the bore.

When these fluids return to the ground surface, they are transferred to a separation plant for processing. A typical separation plant consists of vibrating screens and sand and silt hydrocyclones. Sometimes a centrifuge unit is also used to process the returning fluids. The slurry is processed through the separation plant to remove the entrained cuttings. The processed water is then recycled into storage tanks to be combined with additional bentonite, and polymers for reuse. Recycling of the drilling fluids is very important in large diameter installations, like this Project, where large volumes of drilling fluids are required to facilitate the installation process.

The separated soil and rock cuttings are referred to as spoil and will be removed from the site as storage space becomes limited. The equipment incorporated into the separation plant must be matched to the anticipated geotechnical materials and production rates to avoid delays associated with the drilling process.

Drilling solely with fresh water is not ideal for an HDD installation, as water is not capable of suspending and transporting the cuttings produced from the bore and provides little to no capacity to stabilize the bore. If the generated cuttings cannot be removed, then a fluid-filled bore cannot be properly developed and maintained and the product pipe cannot be installed.

2.3 Drilling Fluid Functions

Drilling fluids serve several functions to support an HDD installation. The primary functions include:

- cooling and lubrication of drilling tools, drill pipe, and the product pipe;
- rotation of the drill bit (in bedrock installations);
- suspension of cuttings within the drilling fluid/slurry mixture;
- removal of soil/bedrock cuttings from the bore during each phase of the installation process. A volume of cuttings at least equal to the volume of the product pipe must be removed to facilitate the production pipe installation process;
- counterbalance of natural ground water formation pressures; and
- stabilization of the bore and prevention of raveling of surrounding soil/bedrock materials. Stabilization of the bore is provided from the combination of developing a low-permeability bentonite filter cake along the bore walls and applying a positive fluid pressure to the surrounding bore walls. This supporting pressure is derived from the presence of the column of drilling fluid within the bore.

2.4 Controlling and Maintaining Drilling Fluid Circulation/Flow

Drilling fluid flow follows the path of least resistance. If the bore is designed to provide sufficient depths of cover above the HDD alignment and the HDD contractor follows good construction practices, maintaining drilling fluid flows within the bore should not be an issue. Proper

characterization of the site soils and bedrock materials coupled with proper depths of cover and good construction practices are crucial to maintaining slurry flow within the HDD bore.

If a bore is designed with insufficient depth of cover, the overlying soil/bedrock materials may not provide sufficient strength to resist the induced fluid pressure within the bore. When this occurs, the slurry may find an alternate preferential flow pathway to the ground surface or to a waterway. Hydrofracture, frac-out, or drilling fluid losses are descriptors given to the condition where the drilling fluids/slurry mixture leave the bore and migrate outwards away from the bore through the overlying bedrock fracture networks or surrounding soils. The term inadvertent return is used to describe an event that results in ponding of the drilling fluids/slurry mixture at the ground surface or within a surface water at a location away from the HDD rig or exit locations.

The introduction of drilling fluids into the HDD bore under pressure causes the drilling fluid/slurry mixture to flow. The magnitude of the required drilling fluid pressure necessary to induce flow is a function of several factors including:

- encountered geotechnical materials and their properties;
- volume of drilling fluids pumped downhole during each stage of the installation process;
- density and viscosity of the drilling fluids injected into the bore and of the returning slurry;
- annular space between the drilling equipment and the excavated bore that is available for fluid flow;
- length of the HDD installation; and
- elevation difference between the HDD entry/exit ground surface and the particular point in question along the bore path.

Overall, greater fluid pressures are required for heavier drilling fluids/slurry, greater depths, increased installation length, and problematic geotechnical materials where bore stability is difficult to maintain. Loss of drilling fluids represents an environmental concern, especially for a bedrock installation where the required pumping rate is on the order of 300 to 600 gallons per minute. At these flow rates, it is critical to the installation that drilling fluid returns are maintained within the bore.

The highest risk of an inadvertent return occurs during the pilot bore, where a complete flow path has yet to be constructed. The areas of greatest probability of occurrence include areas near the HDD entry and exit locations.

At the entry location of an HDD, there is a higher risk of drilling fluid returns due to the shallow depth of cover while the drill bit is initially advanced into the subsurface. To accommodate for this risk, a setback distance from drill rig to the closest waterbody or other sensitive feature has been established to achieve a sufficient depth of cover in these locations.

There is also an increased risk of drilling fluid returns near the exit location during the pilot bore operation, as the drill bit is steered upwards and the installation is completed. This risk is associated with the long flow path for drilling fluid flow back to the drill rig/entry location and the ever-decreasing depth of cover (and strength/resistance offered by the overlying geotechnical materials) above the HDD installation in the immediate vicinity of the exit location. Eventually, the required fluid pressure for drilling fluid flow back to the drill rig cannot be contained by the overlying geotechnical materials resulting in the potential for a surface release near the exit location. These types of releases often occur over the centerline of the HDD installation and within approximately

50 to100 feet of the exit location. To mitigate these risks for the proposed HDD installations, the setback distance of the exit location has been established away from any waterbodies and/or sensitive resource areas to avoid drilling fluid release during exiting of the drill bit.

2.5 Minimization of Environmental Impacts Associated with Drilling Fluid Flow

The most effective way to minimize environmental impacts associated with HDD installations and specifically with drilling fluids begins with designing the HDD installations within favorable geotechnical materials with sufficient depths of cover along the alignment and determining the required and allowable drilling fluid pressures for the installation. Prior to construction, minimization of environmental impacts is afforded by PennEast review of HDD contractor work plans and scrutinizing contingency plans and procedures. In construction, environmental impacts are minimized by controlling downhole annular pressures, reacting to occurrences of higher than anticipated pressures, visual observations of the volume of returning fluids, and maintaining drilling fluid flow/circulation within the HDD bore during the entire drilling process.

The following construction requirements shall be placed upon each HDD contractor with respect to drilling fluid control:

- Instrumentation – The contractor shall provide and maintain instrumentation which accurately locates the pilot hole, measures drill string axial and torsional loads, and measures drilling fluid discharge rate and down-hole annular drilling fluid pressures. Down-hole annular pressures will be monitored as close to the drill bit as practical during the pilot bore phase of the installation process. The presence of a mudmotor, necessary to drill through bedrock materials, will dictate the achievable distance behind the drill bit where downhole annular pressures will be monitored. PennEast, or their designee, shall have access to all instruments and their readings at all times. Actual observed downhole annular drilling fluid pressures will be compared with anticipated values to determine if optimal drilling conditions are being maintained during the pilot bore installation process. A log of all recorded readings shall be maintained and will become a part of the “As-Built” information to be supplied by contractor to PennEast.
- Observation – Observations of drilling fluid returns at the HDD entry location will be continuously conducted for signs of reduced drilling fluid flow during the entire drilling process. Reduced drilling fluid return flow observations are often a first sign that drilling fluid losses may be occurring.
- Composition – The proposed composition of all drilling fluid components proposed for use shall be submitted to PennEast and applicable agencies for approval prior to use at any of the HDD installations.
- Recirculation – The contractor shall maximize recirculation of drilling fluid between downhole tooling and the returns pit located at the entry and exit locations. The contractor shall adequately size the pilot tool to provide annulus spacing around drilling pipe exits for good return flows during pilot drilling. The contractor shall provide containment, solids control and fluid cleaning equipment of a configuration and capacity that can process the returning drilling fluid volumes and clean the mud to an extent that allows for reuse. PennEast may specify standards for solids control and cleaning equipment performance or for treatment of excess drilling fluid and drilled spoil.
- Loss of Circulation – The contractor shall employ its best efforts to maintain full annular circulation of drilling fluids within the HDD bore at all times. Drilling fluid returns at locations

other than the entry and exit points shall be minimized. If annular circulation is lost, the contractor shall take one or more of the following steps to restore circulation:

- Size the hole frequently by advancing and retracting the drill string to keep the annulus clean and unobstructed (short-tripping).
- Establish circulation slowly further advancement, when drilling fluid flow has diminished or stopped.
- Minimize annular pressures by pumping sufficient quantities of drilling fluids downhole to clean the bore and minimize the density of the returning fluid. Viscosity should be minimal, consistent with bore cleaning and stabilization requirements.
- Control the balling of material on bits, reaming tools, and pipe to prevent a plunger effect from occurring. This tasks typically requires the introduction of special polymers to the drilling fluids. Material safety data sheets for all drilling fluids will be part of the HDD contractor's work plan and provided for PennEast approval prior to construction.
- Control penetration rates and travel speeds to prevent a plunger effect from occurring.
- Seal a zone of lost circulation using a high viscosity bentonite plug or lost circulation materials. All drilling fluid components including lost circulation materials will be approved by PennEast prior to use in the field.
- Suspend drilling activities for a period of six to eight hours.

2.6 Spill Prevention and Containment Measures

Protocols for preventing and responding to spills are outlined in the Spill Prevention, Control, and Countermeasure (SPCC) Plan. The HDD contractor is responsible for inspecting, establishing containment measures, and repairing equipment components to prevent release of any hazardous materials (i.e., hydraulic hoses, fuel tanks, etc.) prior to and upon arrival at the drill site. This equipment will also be inspected and maintained daily during all drilling operations to minimize the potential release of any materials.

Prior to initiating HDD operations, the HDD contractor will be responsible for staging their equipment and implementing a containment plan to prevent the migration of any fluids away from the site. At the drill rig entry location, a mud return pit would be excavated to contain and allow for processing of the drilling fluid returns. A similar pit would be excavated at the HDD exit location upon completion of the pilot bore operations.

Equipment-specific containment measures will be established around key equipment to capture and contain any potential fluids (including drilling fluids) during the installation process. For example, at the HDD rig, drilling fluids are expelled from the drill pipe each time a drill pipe is added or removed from the drill string. By establishing a containment barrier around the drill rig, these fluids are funneled into the mud return pit at the front of the drill rig where they are pumped to the separation plant for processing.

2.7 Inadvertent Return Prevention Measures

Preventing an inadvertent return events begins with designing the HDD bore within favorable materials and following good HDD construction practices during completion of the entire drilling process. Good HDD drilling practices includes monitoring the drilling fluid/slurry returns at the HDD rig locations. If the drilling fluid/slurry mixture is circulating through the bore and returning to either

of these locations, no inadvertent return is occurring. It is important to note that the volume of the returning fluids may not necessarily equal the volume of raw drilling fluids pumped into the bore as a small portion of the raw drilling fluid may be absorbed by the surrounding geotechnical materials as a filter cake develops along the newly exposed bore walls. In addition, circulation of drilling fluids/slurry can be temporarily lost if the drilling equipment encounters a high permeability zone. As drilling continues through this material, circulation of drilling fluids within the bore can redevelop with full returns restored once the flow pathway has been plugged with drill cuttings. Drilling fluid lost in this manner rarely migrates to the overlying ground surface.

Proactive monitoring to prevent a drilling fluid inadvertent return consists of continuously monitoring the circulation of drilling fluid/slurry returns at the HDD rig or exit locations, monitoring of the fluid properties of both the raw drilling fluids and the returning fluids, and monitoring of the downhole annular pressure during pilot bore drilling. The HDD contractor's mud technician is responsible for sampling, testing, and recording the fluid properties of the raw and returning drilling fluid during drilling operations. Typical monitored drilling fluid properties include viscosity, fluid density (or mud weight), and sand content. Viscosity and fluid density are the easiest and most important properties to monitor during the drilling process. The monitoring frequency of the drilling fluid properties varies depending on the conditions of the work and the encountered geotechnical materials.

The properties of the returning fluids provide an indication of what is occurring within the HDD bore. If monitoring indicates that one of the fluid properties of the returning fluids is not ideal for the encountered geotechnical materials, the mud technician can modify or adjust the fluid properties of the raw drilling fluids injected into the bore to then adjust the fluid properties of the returning slurry mixture. The mud technician may also inform the HDD rig operator to slow their advance rate to accomplish lower returns with lower mud weights and hence, lower required fluid pressures within the bore.

A slow down or sudden loss of drilling fluids/slurry circulation at the HDD rig or exit locations can provide an early indication that the down-hole fluid pressures within the bore are increasing and that a hydraulic fracture event is about to occur. It may also indicate that the drilling equipment has encountered a coarse granular soil with open pore spaces between soil particles that are filling with the injected drilling fluid or highly fractured or karst bedrock conditions. In the event circulation slows, the HDD rig operator may swab back to clean the bore and/or remove/pullback several drill pipes to re-establish full slurry returns at the HDD rig entry or exit locations. If returns are re-established, the drilling process continues. In the event returns are not re-established, additional drill pipes are removed to clean out any blockage within the bore. This could mean tripping completely out of the bore, retooling and/or recommencing drilling/reaming operations. Loss circulation material could also be mixed into the drilling fluid and injected into the bore. This material is designed to help plug or pack off an open flow channel, thereby increasing the ability to re-establish slurry flow within the HDD bore.

The cuttings produced by the drilling equipment in combination with the bentonite particles within the drilling fluid are capable of naturally sealing fractures or voids as the drilling process advances. Often the time required to stop and document or clean-up an inadvertent return is sufficient for the sealing of the preferential flow path and further flow does not occur.

The drill rig operator can also monitor the potential for inadvertent return events by monitoring the drilling fluid pressures within the drill pipe. Any presence of back pressure within the drill pipe when the drill pipe is disconnected (to remove or add the next drill pipe) can be a warning of a

plugged annulus, which could lead to a bore pressure build-up event and eventually an inadvertent return.

Special down-hole monitoring equipment can also be used to monitor the down-hole annular fluid pressure within the HDD bore as close as practical to the drill bit. This equipment provides real time monitoring of fluid pressures allowing for quicker reaction times to make adjustments (such as those described above) when increased fluid pressures are observed.

If an inadvertent return event is suspected, drilling operations will cease and the crew will be sent out to walk the alignment to visually inspect for inadvertent returns of drilling fluids ponding on the ground surface or potential discharge to waterway.

3 HDD Contractor Responsibilities

The HDD Contractor has overall responsibility for implementing this Plan. Responsibilities shall include:

- Verify that all workers are properly trained and familiar with the necessary procedures for response to an inadvertent return, prior to commencement of drilling operations.
- Maintain constant communication with construction personnel when a suspected inadvertent return occurs.
- Verify that all drilling equipment is in working order, including annular pressure monitoring equipment.
- Be responsible that the proper site personnel are informed of the inadvertent return, coordinating personnel, response, clean-up, regulatory agency notification and verify all waste materials are properly containerized, labelled, and removed from the site to an approved disposal facility by personnel experienced in the removal, transport and disposal of drilling mud.
- Confirm that drilling mud/spoils/cuttings associated with the crossings would be managed and disposed of at an Environmental Protection Agency (USEPA) approved facility if contaminated soil is encountered.
- Be familiar with all aspects of the drilling activity, the contents of this Plan and the conditions of approval under which the activity is permitted to take place.
- Have the authority to stop work and commit the resources (personnel and equipment) necessary to implement this plan.
- Verify that a copy of this plan is available (onsite) and accessible to all construction personnel.

4 Environmental Inspection and Training

An Environmental Inspector (EI), experienced in HDD and associated environmental protection measures, shall verify that the proper equipment and materials are available on-site and that this Plan's procedures are followed. Prior to the start of construction, the Drilling Contractor shall verify that a training session is conducted with key HDD contractors, drilling and inspection personnel. Such personnel will be thoroughly trained in the applicable inadvertent return contingency plan

items. On-site safety and environmental protection meetings will provide ongoing communications and awareness measures regarding prevention, mitigation, and response associated with potential inadvertent return events. The training session will include the following:

- The provisions of this Plan, equipment maintenance and site-specific permit and monitoring requirements.
- Inspection procedures for release prevention and containment equipment and materials.
- Contractor/crew obligation to stop the drilling operation upon identifying an inadvertent return and to report any release.
- Operation of release prevention and control equipment and the location of release control materials, as necessary and appropriate.
- Protocols for communication with agency representatives who might be on-site during the clean-up effort.

Visual observation along the HDD alignment shall be completed regularly throughout the drilling program. The frequency of these observations will be greatest during the pilot bore and initial reaming passes where the probability of an inadvertent return event occurring is the highest.

5 HDD Alignment Monitoring and Inadvertent Return Protocols

Monitoring of the HDD alignment for an inadvertent return is an integral component of this plan. Monitoring frequency will vary depending upon the following drilling fluid operational conditions:

- Condition 1: Full drilling fluid circulation
- Condition 2: Partial loss of drilling fluid circulation
- Condition 3: Inadvertent returns of drilling fluid

5.1 Monitoring Protocol for Condition 1 – Full Drilling Fluid Circulation

When HDD operations are in progress and full drilling fluid circulation is being maintained at one or both of the HDD endpoints, the following monitoring protocol will be implemented.

- The presence of drilling fluid returns at the HDD entry/exit points will be periodically documented.
- Land-based portions of the drilled alignment will be periodically walked and visually inspected for signs of inadvertent drilling fluid returns as well as surface heaving and settlement. Waterways will be visually inspected from the banks for a visible drilling fluid plume. Where practicable and with agency approval, boats may be employed for additional monitoring.
- Drilling fluid products present at the jobsite will be documented.

If an inadvertent return of drilling fluid is detected during routine monitoring, the monitoring protocol associated with Condition 3 will be implemented.

5.2 Monitoring Protocol for Condition 2 – Partial Loss of Drilling Fluid Circulation

When HDD operations are in progress and drilling fluid circulation to the HDD entry/exit points is notably lost or diminished, the following monitoring protocol will be implemented.

- HDD operations will be halted and the EI notified of lost or diminished drilling fluid.
- The EI will then immediately perform a walkthrough inspection along the drill alignment for an inadvertent return. The EI will notify the spread's Lead EI that drilling fluid circulation to the HDD endpoints has been partially lost or diminished.
- The EI will document steps taken by the HDD contractor to restore circulation. Should the contractor fail to comply with the requirements of this Plan, the EI will notify the spread's Lead EI so that appropriate actions can be taken.
- If circulation is regained, the EI will inform the spread's Lead EI and resume the monitoring protocol associated with Condition 1.
- If circulation is not re-established, the EI will increase the frequency of visual inspection along the drilled path alignment as appropriate. Additionally, the EI will document periods of contractor downtime (during which no drilling fluid is pumped) and the contractor's drilling fluid pumping rate in case it should become necessary to estimate lost circulation volumes.

5.3 Monitoring Protocol for Condition 3 – Inadvertent Returns of Drilling Fluid

If an inadvertent return of drilling fluids is detected, the following monitoring and operational protocol will be implemented.

- Immediately upon discovery, drilling operations will be suspended and containment measures will be implemented by the contractor. Documentation of any containment measures employed will be provided by the EI.
- The HDD contractor shall notify the Lead EI, EI, Chief Inspector, appropriate PennEast representative, and Drilling Contractor. Upon notification, PennEast will perform external notifications per Section 7 of this plan.
- The EI shall document the location, approximate area impacted, approximate volume, and potential for aquatic resource to be impacted by the return.
- The EI will periodically monitor and document both the inadvertent return and the effectiveness of the containment measures. Periods of contractor downtime and the contractor's drilling fluid pumping rate will also be documented in case it should become necessary to estimate inadvertent return volumes. Drilling will resume upon receipt of agency approvals.

6 Response to Inadvertent Returns

If an inadvertent return is observed, the HDD contractor will take immediately take measures to eliminate, reduce, or control the inadvertent return. The actions to be taken will depend on the location of the inadvertent return, site specific geologic conditions, and the volume of the inadvertent return. Cleanup activities outside of the approved construction workspace will not

proceed prior to agency notifications. All inadvertent returns, regardless of location, will be reported in accordance with Section 7.

6.1 General Conditions

- This Plan must be onsite during drilling operations and made available to regulatory agencies;
- PADEP is to be notified at least 24 hours prior to the beginning of each HDD under waters of the Commonwealth. Notice may be made electronically;
- All required permits and Material Safety Data Sheets must be onsite and made available to PADEP;
- Drilling fluid additives other than bentonite and water shall be approved by PennEast prior to use;
- When an inadvertent return occurs that is not near the entry or exit locations, or when continued losses of drilling fluid circulation are observed following implementation of contingency measures to retract several lengths of drill pipe (short-tripping) and restore drilling fluid flows, the loss or discharge shall be reported to applicable agencies; and,
- Any water supply complaints received by PennEast will be reported to applicable agencies within 24 hours.

PennEast notes that it is common for returns to slow and then be fully re-established when a blockage behind the drill bit develops and is then cleared.

PennEast will provide full-time inspection for HDD construction. Inspection documentation will include the following data:

- Summary of Shift Production
- Drill time per pipe joint (min)
- Steering Inputs
- Axial thrust (psi)
- Torque (psi)
- Pump Flow Rate (gal/min)
- Pipe Pressure (psi)
- Downhole Annular Pressure (psi)
- General Site Activities
- Descriptions of cuttings/spoils at separation plant
- Drilling fluid properties (mud weight and viscosity)

6.2 Inadvertent Returns in Upland Areas

If an inadvertent return is identified within the HDD alignment construction ROW, within upland areas and without potential to impact aquatic resources (i.e., wetlands, ditches, streams, rivers,

ponds, etc.), then notification, containment, and clean-up will be carried out as necessary. If an inadvertent return were to occur over wooded or mountainous terrain, typical responses to this event would include foot-traffic to setup pumps with small hoses to transfer the returns from the location of the inadvertent return back to an accessible location. Construction of new access roads outside of permitted locations are not anticipated as the mitigation equipment can generally be hand carried. The Chief Inspector and EI will work closely to determine the best course of action for inadvertent returns occurring within upland areas. Applicable agencies and affected landowners (private or public) will be notified. The HDD contractor will take appropriate actions to reduce, eliminate, or control the return. The actions may include:

- Constructing a small pit or sandbag coffer around the return point, installing a section of silt fence and/or straw bales to trap as much drilling fluids as possible, and placing a pump hose in the pit to pump the drilling fluid back to the bore site or temporary holding area or vessels (i.e., vac truck);
- Reducing drilling fluid pressures; and/or
- Adding pre-approved loss circulation materials to the fluid mixture. These additives will be identified by the HDD Contractor in their work plan with the appropriate Material Safety Data Sheets, and will be submitted to PennEast for approval prior to construction and use in the field.

Drilling fluid may be recovered, recycled, and reused to the extent practical. All waste drilling fluid will be properly managed and disposed.

6.3 Inadvertent Returns in Aquatic Resources

The environmental impacts of a return of drilling fluid into a water body include a temporary increase in local turbidity until drilling fluid dissipates with the current and/or settles to the bottom. In the immediate vicinity of a return, benthic organisms may be impacted if sufficient quantities of bentonite settle upon them.

If the return is identified within or is determined to have potential to flow into an aquatic resource, drilling operations will be suspended to allow the EI to appropriately quantify the return, document its location, photograph the return, assess the potential to impact to the resource(s), and report the incident to the Lead EI, Chief Inspector, PennEast Construction Manager, and Drilling Contractor. Information about the return will be recorded and updated as necessary as a running report on the Inadvertent Return (IR) Report form provided in Appendix C. The Drilling Contractor is responsible for completion of the IR Report form with the assistance of the EI and environmental compliance contractor. Each IR Report form will be updated as new information is learned about the return and as activities to restore the area occur. The general reporting will be “Initial”, “Interim”, and then “Final”. The initial, interim, and final reports will comprehensively document the return from initial discovery/notification through final restoration. All inadvertent returns in wetlands and waterbodies, regardless of size, are to be reported to the appropriate agencies in accordance with the notification section below.

Clean-up and restoration activities that would require the installation of construction matting, placement of materials in the wetland or waterbody, or the entry of construction vehicles and equipment are not allowed without prior agency notifications. If upon reporting the incident, and under further consultation with the agencies, the return is determined to be significant enough to warrant containment, clean-up, and restoration via mechanical methods, then the following procedures will be followed:

- Draft restoration plan, outlining the limits, types, and duration of disturbances, will be provided to the PADEP/ USACE for review. FERC will be notified for instances where work outside of FERC-certificated workspace is involved.
- Appropriate aquatic resource encroachment permits will be applied for depending on levels and types of disturbances required to clean up the material.
- Approved activities would only be implemented under the close, full-time supervision of the assigned EI.
- Drilling operations will resume when the return is contained and successfully remediated. The return area will continue to be monitored during the daily inspection.

One exception to ceasing drilling operations would be a return of drilling fluids during the pipe pullback process. Ceasing operations would pose significant risk of causing the pulled pipe to be stuck and not able to resume.

6.4 Inadvertent Returns in Sensitive Aquatic Resources

If an inadvertent return is identified within sensitive resource wetlands and/or streams, drilling operations will be suspended to allow the EI to appropriately quantify the return, document its location, photograph the return, assess potential to impact aquatic resource(s), and report the incident to the Lead EI, Chief Inspector, and Drilling Contractor. Information about the return will be recorded and updated as necessary on the IR Report form provided in Appendix C.

All inadvertent returns in, or with potential to flow into, aquatic resources occupied by sensitive resources are to be reported to the appropriate agencies in accordance with Section 7 and additional notifications provided below.

Clean-up and restoration activities that would require the installation of construction matting, placement of materials in the wetland or waterbody, or the entry of construction vehicles and equipment are not allowed without prior agency notifications. If upon reporting the incident, and under further consultation with the agencies, the return is determined to be significant enough to warrant containment, clean-up, and restoration via mechanical methods, then the following procedures will be followed:

- Draft restoration plan, outlining the limits, types, and duration of disturbances, will be provided to the PADEP/ USACE for review. FERC will be notified for instances where work outside of FERC-certificated workspace is involved.
- Appropriate aquatic resource encroachment permits will be applied for depending on levels and types of disturbances required to clean up the material.
- Approved activities would only be implemented under the close, full-time supervision of the assigned EI.
- Drilling operations will resume when the return is contained and successfully remediated. The return area will continue to be monitored during the daily inspection.

One exception to ceasing drilling operations would be a return of drilling fluids during the pipe pullback process. Ceasing operations would pose significant risk of causing the pulled pipe to be stuck and not able to resume.

6.5 Sensitive Resource Additional Notifications

Notifications will be conducted in accordance with procedures identified in Section 7 of this Plan; however, additional agency notifications are required for inadvertent returns with potential to impact aquatic or other sensitive resources. All inadvertent returns, in or with potential to flow into, aquatic or sensitive resources will also be reported to the additional agencies per Section 7.

6.6 Containment & Clean-Up Materials and Equipment

The HDD contractor will be required to have the necessary containment and clean-up equipment on-site, at the boring location and readily available for use. The following material and equipment should be on site and in ample supply depending on the extent of sensitive areas:

- Spill sorbent pads and booms
- Compost filter socks
- Weighted filter socks
- Straw bales (certified weed-free)
- Wood stakes
- Sledge hammers
- Sand bags
- Silt fence
- Plastic sheeting
- Corrugated plastic pipe
- Shovels, push brooms, and squeegees
- Leak-free hoses
- Several five-gallon buckets
- Centrifugal, trash and sump pumps
- Vacuum truck (located within a 0.5-hour of the site)
- Rubber tired or wide track back hoe
- Timber mats
- Bobcat (if needed on a site-specific basis)
- Storage tanks (if needed on a site-specific basis)
- Floating Type I turbidity curtains may be considered for standing water; whereas, floating Type II turbidity curtains may be considered for use on large streams with flow conditions exceeding 2.5 f/s. Should turbidity curtains be deemed necessary this will be denoted on the site-specific notes of the crossing drawing.

If necessary, a 24-hour outside emergency response company may be called in for assistance.

6.7 Clean-up within a Waterway

Upon containment and control of an inadvertent return within a waterway, PennEast will engage with the applicable agency(s) regarding the appropriate course of action for cleanup activities as discussed in Section 6.3.

In-stream clean-up measures will be evaluated based on the extent and accessibility of the accumulated residue and the potential environmental effects associated with clean-up operations. In certain cases, recovery and clean-up of drilling mud inadvertently released into flowing water will not be practical as recovery measures have potentially greater impact to the environment than allowing the inert, water soluble drilling mud to dissipate naturally.

If in-stream clean-up measures are deemed necessary, PennEast will coordinate with the affected agencies. The measure may include, but are not limited to:

- Deployment of divers with suction hoses to remove pooled bentonite from floor of waterbody
- Deployment of boats with mechanical/skimming equipment as needed
- Hand-removal of bentonite in sensitive areas
- Deployment of secondary turbidity curtains
- Deployment of sediment collectors

Resuspension of the bentonite and controlling the in-situ turbidity of the waterbody will be primary considerations. Removed material will be handled per Section 9.

6.8 Response Close-out Procedures

When the release has been contained and cleaned up, response closeout activities will be reviewed by PennEast. Implementation of the clean-up is to be conducted at the direction of the Drilling Contractor, with oversight by the EI and shall include the following:

- The recovered drilling fluid will either be recycled or hauled to an approved facility for disposal. No recovered drilling fluids will be discharged into streams, storm drains or any other water source.
- All inadvertent return excavation and clean-up sites will be returned to pre-project contours using clean fill as necessary.
- All containment measures (fiber rolls, straw bale, etc.) will be removed, unless otherwise specified by the Drilling Contractor. It may be beneficial to keep the containment measures in place for the remainder of drilling operations.

6.9 Construction Re-Start

Following an inadvertent release of drilling fluid, and after containment is achieved, drilling operations may continue if the root cause of the return is determined and a plan is developed to reduce or eliminate the risk of reoccurrence. This will take place under the supervision of a PE or PG, who will inspect and report back to PADEP.

Construction activities will not restart without prior approval from PADEP and PennEast.

7 Notification

Landowners impacted by an inadvertent return will be promptly notified. In addition, PennEast will immediately notify a landowner with a water supply within 450 feet of an HDD of any discharge of pollution associated with the project. In the event of an inadvertent return, of any volume, the Drilling Contractor will be responsible for notifying PennEast personnel who will then notify the resource agencies. Agency notifications will occur within 24 hours and proper documentation will be submitted in a timely and complete manner. The notifications will initially be via phone to the PADEP Emergency Response numbers listed below and then to the appropriate agency personnel via submittal of an initial IR Report form located in Appendix B. USACE will be notified of all inadvertent releases of drilling fluids on USACE property or within waters of the United States. In addition, USACE's on-call representative will be notified of any release which occurs on holidays or weekends.

Notifications will be made to FERC in compliance with certificate conditions.

The Pennsylvania Clean Streams Law regulations require that when any pollutant discharged into surface or groundwater, including sewers, drains and ditches, the person spilling the substance or the person owning the premises from which the substance is spilled must notify PADEP. Therefore, all returns in or flowing into an aquatic resource will require notification to the appropriate regional emergency number upon return discovery.

For the initial phone notification, the following information will be provided:

- Name and telephone number of person reporting.
- Location of the release.
- Date and time of release.
- Type and quantity, estimated size of release.
- How the release occurred.
- The type of activity that was occurring around the area of the inadvertent return.
- Description of any sensitive areas and their location in relation to the inadvertent return.
- Description of the methods used to clean up or secure the site.
- Listing of the current permits obtained for the project.

Following the initial phone notification to the appropriate emergency/regulatory numbers listed above, PennEast personnel will notify the following individuals via e-mail to include submittal of the IR Report form located in Appendix C. This email notification will document the initial phone reporting of the return and any open consultations with the applicable agencies. County Conservation Districts shall be notified depending on the county of occurrence. Additional consultations may be required regarding remediation approval, restoration approval, and the need for appropriate approval/permits. The IR Report form will be used to document the consultations and approvals and report final remediation/restoration.

See Table 2 for a listing of agencies/stakeholders, contact information, regulatory oversight and/or roles, and the applicable crossing(s).

Table 2: Agency/Stakeholder Notifications

Agency/Stakeholder	Contact Information	Regulatory Oversight/Role	Applicable Crossing(s)
US Army Corp of Engineers Baltimore District	Mike Dombroskie mike.dombroskie@nab02.usace.army.mil (814) 235-0571	Wetlands and Waterbodies (Clean Water Act Section 404, Rivers and Harbors Act Section 10)	I-81
US Army Corp of Engineers Philadelphia District	Glenn Weitknecht Glenn.R.Weitknecht@usace.army.mil (267) 284-6563	Wetlands and Waterbodies (Clean Water Act Section 404, Rivers and Harbors Act Section 10)	I-80, Pohopoco Creek, Lehigh, I-78, Delaware
US Army Corp of Engineers Philadelphia District	Bob Phillips Robert.W.Phillips@usace.army.mil (215) 656-6682	USACE Project/Owned Property (Section 408)	Pohopoco Creek
US Fish and Wildlife Service	Pam Shellenberger pamela_shellenberger@fws.gov (814) 234-4090 x7459	Threatened and Endangered Species	I-81
Pennsylvania Department of Environmental Protection Northeast Region	Mike Luciani mluciani@pa.gov (570) 830-3089	Wetlands and Watercourses (Chapter 102/105)	I-81, I-80, Pohopoco Creek, Lehigh, I-78
Pennsylvania Department of Environmental Protection Southeast Region	Abdel Nassani anassani@pa.gov (484) 250-5170	Wetlands and Watercourses (Chapter 102/105)	Delaware
Pennsylvania Fish and Boat Commission Bureau of Law Enforcement Northeast Region	(570) 477-5717	Watercourses	I-81, I-80, Pohopoco Creek
Pennsylvania Fish and Boat Commission Bureau of Law Enforcement Northeast Region	(717) 626-0228	Watercourses	Lehigh, I-78, Delaware
Pennsylvania Department of Natural Resources	Rebecca Bowen rebbowen@pa.gov (717) 772-0258	Threatened and Endangered Species	I-80
Pennsylvania Department of Natural Resources	David Mong damong@pa.gov (717) 783-7947	Beltzville State Park	Pohopoco Creek
Pennsylvania Historical and Museum Commission	Mark Shaffer mshaffer@pa.gov 717-787-3362	Cultural Resources	Lehigh, I-78, Delaware
Luzerne Conservation District	Heather Graham heather@luzcd.org (570) 674-7991 ext. 1	Erosion and Sediment Control	I-81
Carbon County Conservation District	Chris Storm carbmgr@ptd.net (610) 377-4894	Erosion and Sediment Control	I-80, Pohopoco Creek
Northampton County Conservation District	Sharon M. Pletchan SPletchan@northamptoncounty.org (610) 829-6284	Erosion and Sediment Control	Lehigh, I-78
Bucks County Conservation District	Rene Moyer rmoyer@bucksccd.org (215) 345-7577	Erosion and Sediment Control	Delaware

This list may be modified pending further discussions and consultation with agencies and stakeholders.

In addition, Table 3 lists the PennEast line list numbers for property owners that are to be notified in the event of an inadvertent return at each drill. These properties include those directly intersected by the drill as well as parcels that have a drinking water well within 450 feet of the HDD. The HDD Contractor shall coordinate with land team for specific landowner notifications.

Table 3: Landowner Notifications

HDD	MP begin	MP End	Line List #(s) Crossed
PA St. Route 315 / Interstate 81	10.2R2	10.6R2	PE-LU-A223.001, PE-LU-162.028-HWY, PE-LU-162.027-HWY, PE-LU-182.000, PE-LU-A229.000, PE-LU-A230.000, PE-LU-182.000
Interstate 80	26.8R2	27.6R2	PE-CA-012.001, PE-CA-012.000-HWY, PE-CA-012.000
Pohopoco Creek	43.2R3	44.4R3	PE-CA-149.000, PE-CA-151.000, PE-CA-152.000, PE-CA-154.000, PE-CA-155.000*
Lehigh River	70.9R3	71.5	PE-NO-206.000, PE-NO-206.000-HWY, PE-NO-207.000, PE-NO-208.000, PE-NO-209.000, PE-NO-209.000-RI, PE-NO-211.000, PE-NO-211.000-RI, PE-NO-212.000, PE-NO-213.000, PE-NO-214.000, PE-NO-215.000, HL-NO-034.000/PE-NO-216.000
Interstate 78	71.6	72.1	HL-NO-034.000/PE-NO-216.000, PE-NO-216.000-HWY, PE-NO-A336.000*, PE-NO-A336.000-MR, PE-NO-219.000, PE-NO-220.000, PE-NO-222.000, PE-NO-223.000, PE-NO-224.000
Delaware River	77.4	77.9	PE-BU-009.000, PE-BU-009.000-HWY, PE-BU-010.000, PE-BU-011.000, PE-BU-012.000, PE-BU-013.000, PE-BU-013.000-RI, PE-BU-013.001-RI, PE-BU-A026.000, PE-HU-001.000*, PE-HU-003.000, PE-HU-006.000, PE-HU-007.000, PE-HU-007.000-CR, PE-HU-009.000*

Note: An "*" denotes that a well or water supply is located on this property that is within 450 feet of the drill alignment.

8 Failed HDD Contingency

If an attempted HDD installation is unsuccessful, the proposed HDD alignment could be modified using the same HDD entry/exit locations to accommodate an additional HDD attempt, depending on the condition that resulted in the HDD failure. Prior to attempting a second HDD crossing, a risk mitigation workshop will be held with PennEast to determine the cause of the initial failure and any mitigation measures that could be adopted to reduce the risk(s) during the second HDD attempt. Based on the risk workshop, it will be determined whether a second HDD can be attempted.

Subsurface information obtained during the pilot hole phase is important to PennEast's decision making framework. Natural variations in stratigraphy encountered by the pilot hole could interfere with steering accuracy. Occasionally, large boulders and layers of weak soils could cause problems with maintaining compliance with the designed pipeline alignment. Depending on the cause and severity of the problem, and its potential consequences to the environment and/or pipeline crossing, the following actions could include:

- Accepting a new drill path.
- Adjusting the depth of the borehole path so that the drill could avoid the problematic stratum.
- Pulling out the drill pipe, moving the drill rig over (offset the alignment) and re-drilling the pilot hole.
- Abandoning the pilot hole and employing an alternative crossing method such as trenching with isolation.

- Fluid loss, including inadvertent returns is addressed in the previous sections of this plan in the context of monitoring and clean up. The following content addresses fluid loss in the context of remedial response leading to abandonment. Loss of circulation can occur during any of the phases of the HDD. If loss of circulation is encountered during any crossing installation phase, then PennEast's HDD contractor, construction manager and the engineering consultant will need to assess the extent of fluid loss, determine its likely cause and take the appropriate remedial action. These actions could include:
  - Deeming the fluid loss acceptable and continuing to drill/ream/pull.
  - Stopping the operation, re-establishing circulation and restarting the operation.
  - Abandoning the hole, moving over, and boring a new crossing path (re-drill).
  - Abandoning the hole and employing an alternative crossing method, such as trenching with isolation as applicable.
  - Drilling a relief well.
- If severe pipe damage or collapse is experienced during the pipeline pullback phase, then the HDD contractor, construction manager and engineering consultant will need to take the appropriate action to complete the crossing within specifications. After assessing the damage, determining its likely cause and appropriate remedial action, these actions could include:
  - Deeming the pipe section acceptable.
  - Removing the pipe from the bore, repairing or replacing the pipe, re-reaming the bore to the same or larger diameter and re-installing the pipe.
  - Abandoning the pipe, moving over, and boring a new crossing path (re-drill).
  - Abandoning the pipe and employing an alternative crossing method, such as trenching with isolation.
- If for any reason an HDD hole must be abandoned, the HDD contractor will fill the abandoned hole with grout. The upper five feet of the abandoned hole will be filled with compacted soil to allow vegetation to re-establish. If deemed necessary by PennEast, the USACE, or PADEP, the HDD contractor may be required to complete more extensive grouting to reduce the risk of ground subsidence and/or returns of inadvertent drilling fluid from adjacent HDD alignments, or to comply with applicable regulatory requirements or other project conditions.
- The grout mixture utilized to abandon a borehole will consist of either a cement grout or cement/bentonite grout mixture that can be pumped downhole through the drill pipe used to drill/ream the hole.
- The grout mix design (e.g., water/cement/bentonite ratios) will generally be suited for each HDD location based on the geologic formation(s) along the abandoned portion of the hole. Admixtures such as those used in structural concrete may be used to modify the flowability and/or set time of the grout. To grout the abandoned hole (including pipe section if the pipe cannot be pulled out), the HDD contractor will extract all cutting tools (e.g., reamer, cutting heads) from the hole, advance the drill pipe into the hole to the required grout depth and begin pumping the grout mixture while the drill pipe is being extracted from the hole. The

rate at which the drill pipe is extracted during grouting operations will be regulated to match the rate of grout placement.

Once the partially completed hole has been properly abandoned, new entry and exit locations will be evaluated. If the new entry and exit points are viable, a new drill can go forward. The new entry and exit locations should be offset from the original to avoid the point of release. Should the shifted alignment also fail, alternate methods, such as open-cut crossing, will be evaluated.

9 Project Completion and Clean-Up

The Drilling Contractor shall confirm the proper site clean-up is conducted. The clean-up will include the following:

- All materials and any rubbish-construction debris shall be removed from the construction zone at the end of each workday.
- Sump pits at the bore entry and exits will be filled and returned to natural grade.
- All protective measures (fiber rolls, straw bale, silt fence, etc.) will be removed unless otherwise specified by the Drilling Contractor.

Appendix A – HDD Summary Table

APPENDIX A

HDD SUMMARY TABLE

HDD ID	Resource(s) Crossed	MP Begin[1,2]	MP End[1,2]	Crossing Length (ft)[3]	County	PADEP Region	Wetland Resource Value Classification[4,6]	Surface Water Quality Classification[5,7]	Sensitive Resource[5]	Within 450ft of a Well/Water Supply[8]
Pennsylvania										
PA St. Route 315 / Interstate 81	PA St. Route 315 / Interstate 81	10.2R2	10.6R2	1,755	Luzerne	NE	N/A	Wild Trout Stream	Bat Hibernacula nearby	No
Interstate 80	Interstate 80 & emergent & forested wetlands	26.8R2	27.6R2	3,824	Carbon	NE	Exceptional	HQ-CWF and Wild Trout Stream	PA Rare Plants in Wetland	No
Pohopoco Creek (Beltzville Lake) / Wild Creek	Pohopoco Creek (Beltzville Lake) / Wild Creek, perennial and intermittent streams	43.2R3	44.4R3	6,100	Carbon	NE	Exceptional	EV Stream	State Park (DCNR) and USACE-owned property; BWA water line	Yes - S
Lehigh River	Lehigh River, Lehigh Canal, ephemeral stream	70.9R3	71.5	4,152	Northampton	NE	N/A	WWF	Historic Canal Archaeological Site 36BN0294	No
Interstate 78	Interstate 78, ephemeral stream	71.6	72.1	2,286	Northampton	NE	N/A	WWF	Archaeological Sites 36NM0346, 36NM0076	Yes - S
Pennsylvania/New Jersey										
Delaware River	Delaware River, Delaware Canal & forested and scrub-shrub wetlands	77.4	77.9	2,836	Bucks / Hunterdon	SE	Exceptional	WWF/DRBC	Historic Canal, Archaeological Site nearby, State Park (DCNR), Public Water Supply	Yes - S

Notes:

1. Begin/End MPs are at the approximate locations of HDD entry/exit points.
2. All route deviations implemented after the September 2015 FERC Filing are denoted with an "R" and indicate a milepost equation. Mileposts with an "R1" indicate route deviations implemented and provided to FERC prior to the issuance of the Draft Environmental Impact Statement. Mileposts with an "R2" indicate route deviations implemented as part of this September 2016 Supplemental Filing. Mileposts with an “R3 indicate route deviations implemented post-FERC certificate issuance. All mileposts without an "R" indicate that the route has not changed since the September 2015 Application.
3. Lengths are approximate and subject to field verification.
4. N/A – Not Applicable
5. HQ – High Quality, CWF – Cold Water Fishes, EV – Exceptional Value, DRBC – Delaware River Basin Commission, DCNR – Department of Conservation and Natural Resources, WWF – Warm Water Fishes, BWA – Bethlehem Water Authority
6. Anticipated Pennsylvania wetland resource value classification in accordance with 25 PA Code 105.17. PADEP makes the final determinations regarding resource values.
7. Source: Pennsylvania Chapter 93 Designated Use (PADEP, 2017), Pennsylvania Statewide Existing Use Classifications (PADEP 2017), Stream Sections that Support Wild Trout Production (PFBC, 2018), Class A Wild Trout Waters (PFBC, 2018), Trout Stocked Streams (PFBC, 2018), Delaware River Designation per Delaware River Basin Commission, (DRBC, 2015).
8. Well locations obtained a database of wells identified through public databases, civil survey, and landowner input. “- S” denotes the existence of a surveyed well or water supply. Well Data based on current survey data as of 12/2018. Table will be updated as additional survey information becomes available.

Appendix B – Inadvertent Return Risk Assessment Table

APPENDIX B

INADVERTENT RETURN RISK ASSESSMENT

HDD ID	Potential Contributing Factors to an Inadvertent Return	Mitigation/Discussion
Pennsylvania		
PA St. Route 315 / Interstate 81	Historical mining operations - It is possible that the drill will encounter preferential flow pathways or historical mining infrastructure, leading to loss of drilling fluids. Low RQD zones (<40%) - located in areas near soil/bedrock interface. Low RQD zones may lead to some bore instability.	Locating the drill outside of areas of known mining operations - HDD designed above known locations of mining operations to the extent practicable. Developing grouting plans and loss of circulation plans for implementation if preferential drilling fluid flow pathways are encountered - This will be a Contractor workplan requirement. Zones of low RQDs are limited in length and will be encountered on entry and exit tangents. Majority of drill located in bedrock materials with much higher RQD ratings. Hydrofracture/hydraulic fracture evaluations completed to define allowable drilling fluid pressures and required drilling fluid pressures. - the results will be verified by the Contractor as part of their workplan and used during construction to limit downhole drilling fluid pressures. Contractor required by contract documents to monitor downhole annular drilling fluid pressures during entire pilot bore.
Interstate 80	Soils containing high percentage of gravels and cobbles - During the geotechnical investigation, layers of loose gravel were observed at relatively shallow depths on the north side of I-80. The gravels were observed to a depth of approximately 18.5 feet below ground surface on the north side of the crossing. Low RQD zones (<40%) - located in areas near soil/bedrock interface and at various depths below. Low RQD zones may lead to some bore instability.	Implementation of casing - To support gravelly soils and mitigate the risks associated with such deposits, a temporary conductor casing is recommended on the north side of the HDD installation. Zones of low RQD have been avoided to the extent possible. Driller will need to design drilling fluids for this condition. Hydrofracture/hydraulic fracture evaluations completed to define allowable drilling fluid pressures and required drilling fluid pressures - The results will be verified by the Contractor as part of their workplan and used during construction to limit downhole drilling fluid pressures. Contractor required by contract documents to monitor downhole annular drilling fluid pressures during entire pilot bore.
Pohopoco Creek (Beltzville Lake) / Wild Creek	Elevation differences between entry and crossing features >100ft Soils containing high percentage of gravels and cobbles - During the geotechnical investigation, layers of gravel and decomposed rock fragments were observed with thicknesses of 13 to 15 feet on both sides of the Beltzville Lake Crossing. These soils represent a risk to the overall bore stability, raveling of gravel into the bore, potential damage to the pipe string, and increased pullback loads/stresses.	Locating the drill outside of areas of known Karst features - HDD designed to avoid known locations of Karst features. Developing grouting plans and loss of circulation plans Hydrofracture/hydraulic fracture evaluations completed to define allowable drilling fluid pressures and required pressures - The results will be verified by the Contractor as part of their workplan and used during construction to limit downhole drilling fluid pressures. Contractor required by contract documents to monitor downhole annular drilling fluid pressures during entire pilot bore Contractor to stage turbidity curtains for deployment in event of inadvertent return.

HDD ID	Potential Contributing Factors to an Inadvertent Return	Mitigation/Discussion
Lehigh River	Elevation differences between entry and crossing features >100ft High required downhole drilling fluid pressures Karst Features - There are possible Karst conditions on both the north and south sides of the proposed Lehigh River HDD crossing. The ERI survey on south side of the Lehigh River consisted of high resistivity zones within the proposed HDD crossing depths, which Hager-Richter indicated as potential karst features. Additional geotechnical borings were drilled evaluate these potential karstic areas. Voids were identified within the additional geotechnical borings.	Increased depth of cover underneath crossing feature - the drill has been designed to increase the depths under Lehigh River to the extent practicable. Implementation of casing - To support these soils and mitigate the risks associated with such deposits, a temporary conductor casing is recommended on both sides of the HDD installation. Hydrofracture/hydraulic fracture evaluations completed to define allowable drilling fluid pressures and required pressures - The results will be verified by the Contractor as part of their workplan and used during construction to limit downhole drilling fluid pressures. Contractor required by contract documents to monitor downhole annular drilling fluid pressures during entire pilot bore Developing grouting plans and loss of circulation plans
Interstate 78	Karst Features - Northwest of I-78, mapped Karst features include 20 surface depressions within 0.5 miles of the HDD alignment. On the southeast side of the interstate, Karst features include 6 surface depressions. Low RQD zones (<40%) - located in areas near soil/bedrock interface and at various depths below. Low RQD zones may lead to some bore instability.	Locating the drill outside of areas of known Karst features - HDD designed to avoid known locations of Karst features. Developing grouting plans and loss of circulation plans Hydrofracture/hydraulic fracture evaluations completed to define allowable drilling fluid pressures and required pressures - The results will be verified by the Contractor as part of their workplan and used during construction to limit downhole drilling fluid pressures. Contractor required by contract documents to monitor downhole annular drilling fluid pressures during entire pilot bore
Pennsylvania/New Jersey		
Delaware River	Changing lithology - changing geotechnical strata between western side (dolomite) and eastern side of the river (gneiss). Soils containing high percentage of gravels and cobbles - During the geotechnical Investigation, layers of gravel and isolated boulders were observed extending to various depths on both sides of the Delaware River. These soils represent a risk to the overall bore stability, raveling of gravel into the bore, potential damage to the pipe string, and increased pullback loads/stresses. Karst Features - Mapped Karst features include 4 surface depressions within 0.5 miles of the borings on the Pennsylvania side of the river.	Developing grouting plans and loss of circulation plans - This will be a Contractor workplan requirement. Implementation of casing -To support these soils and mitigate the risks associated with such deposits, a temporary conductor casing is recommended on the west side of the HDD installation. Locating the drill outside of areas of known Karst features - HDD designed to avoid known locations of Karst features. Drill and intersect methodology - The drill and intersect method was chosen to mitigate risks associated with the geotechnical data provided during the investigation, such as drilling through cobbles and gravel at the entry and exit points, and hydraulic fracture through the overburden materials above the alignment. Hydrofracture/hydraulic fracture evaluations completed to define allowable drilling fluid pressures and required pressures - The results will be verified by the Contractor as part of their workplan and used during construction to limit downhole drilling fluid pressures. Contractor required by contract documents to monitor downhole annular drilling fluid pressures during entire pilot bore

Appendix C - Inadvertent Return Report Form

MOTT MACDONALD

PennEast Pipeline Project - CP15-558-000
Inadvertent Return Report Form

PennEast PIPELINE

IR Report No.	Link	Filing Date	Status	Comments	Resources Effected	Milepost	Alignment Reference	Diagram Reference
	Link							
	Link							
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PennEast Pipeline Project - CP15-558-000

Inadvertent Return Report Form

IR Report No:		Report Date:	
PADEP Permit No:		Initial/Interim/Final:	
Resources Effected:		USACE Permit No:	
Milepost/Station No.:		Location/Coordinates:	
Alignment Sheet No:		Est. Quantity Released:	
Diagram Reference:		Photo Reference:	

Description of How Release Occured:	
Was IR within the FERC approved workspace?	☐ Yes ☐ No
If no, contact the FERC 3rd Party Monitor and PennEast staff.	
Was IR within an upland with no risk of flow into a wetland/waterbody?	☐ Yes ☐ No
If yes, follow procedures under Section 6.2 of the Plan.	
Was IR within a waterbody?	☐ Yes ☐ No
If yes, follow procedures under Section 6.3 of the Plan.	
Describe any sensitive areas (e.g., wetland, waterbody, cultural site, or other sensitive resource) in relation to the inadvertent return.	
Do the proposed clean-up activities require work within listed species habitat (federal, state, or agency)?	☐ Yes ☐ No
If yes, follow procedures under Section 6.4 of the Plan:	
Describe methods proposed to contain and clean-up the inadvertent return.	
Does the proposed clean-up activities require additional agency clearance (e.g., off-ROW, impacting sensitive resources not previously contemplated in project permits, etc.)?	☐ Yes ☐ No
If yes, follow variance request procedures outlined in the Implementation Plan.	
Have all appropriate agencies been notified?	☐ Yes ☐ No
If yes, document in Contact section below.	
Have all affected landowners been notified?	☐ Yes ☐ No
If yes, document in Contact section below.	

Attachments (include explanation if attachment is not needed)		
1. Figure illustrating extent/location of IR	☐ Yes ☐ No	
2. Photos of IR:	☐ Yes ☐ No	
3. Other	☐ Yes ☐ No	

Authorization and Signatures				
IR Form Completed by:	Name (print)	Signature	Date/Time:	

Contacts	Name (print)	Notification	Method (email/phone)	Date/Time:	Notes
1. Chief Inspector		☐ Yes ☐ No			
2. Site Supervisor/Foreman		☐ Yes ☐ No			
3. ROW Agent		☐ Yes ☐ No			
4. Lead Env. Inspector		☐ Yes ☐ No			
5. Env. Inspector		☐ Yes ☐ No			
6. FERC 3rd Party Monitor		☐ Yes ☐ No			
7. PennEast Env. Lead		☐ Yes ☐ No			
8. NJDEP		☐ Yes ☐ No			
9. PADEP Emergency Notif.		☐ Yes ☐ No			
10. PADEP Waterways Notif.		☐ Yes ☐ No			
11. USACE Regulatory Notif.		☐ Yes ☐ No			
12. USFWS Notif.		☐ Yes ☐ No			
13. Landowner(s)		☐ Yes ☐ No			

Comments / Conditions

PennEast Pipeline Project - CP15-558-000

Inadvertent Return Report Form

IR Tracking No:		Report Date:	
PADEP Permit No:		Initial/Interim/Final:	
Resources Effected:		USACE Permit No:	
Milepost/Station No.:		Location/Coordinates:	
Alignment Sheet No:		Est. Quantity Released:	
Diagram Reference:		Photo Reference:	

[description] (facing [direction])	[description] (facing [direction])
[description] (facing [direction])	[description] (facing [direction])
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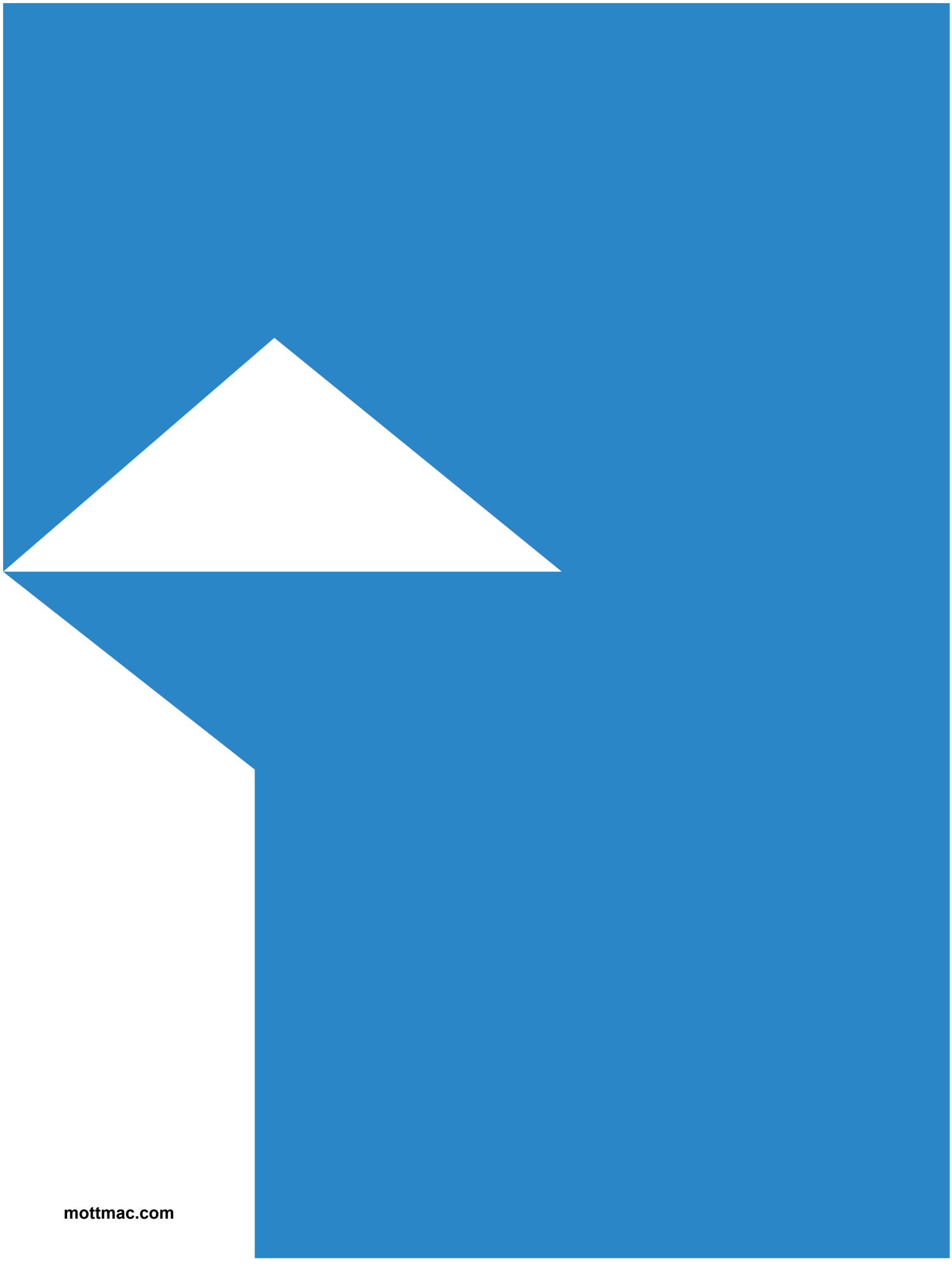

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