Dominion Transmission, Inc.
701 East Cary Street, Richmond, VA 23219

July 27, 2015

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

Re: Atlantic Coast Pipeline, LLC & Dominion Transmission, Inc.
Atlantic Coast Pipeline & Supply Header Projects
Docket Nos. PF15-6-000 & PF15-5-000
Supplemental Information in Response to Commission Staff Comment on Draft Resource Reports

Dear Secretary Bose:

On November 13, 2014, the Federal Energy Regulatory Commission (Commission) approved Atlantic Coast Pipeline, LLC and Dominion Transmission, Inc. (DTI)'s request to utilize the pre-filing process for the Atlantic Coast Pipeline and Supply Header Projects (Projects).

On July 14, 2015, Commission staff issued comments on Draft Resource Reports 1 through 10 (Accession Number 20150714-3034). In response to Commission staff comment #1, DTI, on behalf of Atlantic Coast Pipeline, LLC and itself, hereby submits draft versions of the Karst Monitoring and Mitigation Plan; Spill Prevention, Control, and Countermeasure Plan; Winter Construction Plan; Invasive Plant Species Management Plan; and Blasting Plan for the Projects.

If you have any questions, please contact me at 866-319-3382.

Respectfully submitted,

Angela M. Woolard

Angela M. Woolard
Regulatory and Certificates Analyst III

cc: Mr. Kevin Bowman, FERC

encl(s)/

ATLANTIC COAST PIPELINE, LLC
ATLANTIC COAST PIPELINE
Docket No. PF15-6-000

and

DOMINION TRANSMISSION, INC
SUPPLY HEADER PROJECT
Docket No. PF15-5-000

Blasting Plan

Draft

Prepared by

NATURAL RESOURCE GROUP

an ERM Group company

July 2015

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LIST OF ACRONYMS AND ABBREVIATIONS

ACP	Atlantic Coast Pipeline
Atlantic	Atlantic Coast Pipeline, LLC
DTI	Dominion Transmission, Inc.
GPS	global positioning system
PPV	peak particle velocity
Project	Atlantic Coast Pipeline
SHP	Supply Header Project

1.0 INTRODUCTION

Atlantic Coast Pipeline, LLC (Atlantic) – a company formed by four major energy companies - Dominion Resources, Inc.; Duke Energy Corporation; Piedmont Natural Gas Co., Inc.; and AGL Resources, Inc. – proposes to construct and operate approximately 556.0 miles of natural gas transmission pipelines and associated aboveground facilities in West Virginia, Virginia, and North Carolina. This Project, referred to as the Atlantic Coast Pipeline (ACP), will deliver up to 1.5 billion cubic feet per day of natural gas from supply areas in the Appalachian region to demand areas in Virginia and North Carolina. Atlantic has contracted with Dominion Transmission, Inc. (DTI), a subsidiary of Dominion Resources, Inc., to construct and operate the ACP on behalf of Atlantic.

In conjunction with the ACP, DTI proposes to construct and operate approximately 36.7 miles of pipeline loop and modify existing compression facilities in Pennsylvania and West Virginia. This Project, referred to as the Supply Header Project (SHP), will enable DTI to provide firm transportation service to various customers, including Atlantic.

2.0 PURPOSE

Based on an analysis of the Natural Resource Conservation Service's Soil Survey Geographic Database, approximately 26 percent (155.8 miles) of the proposed ACP and SHP pipeline routes will cross areas with bedrock at depths of less than 60 inches. More than half (90.1 miles) of this bedrock are considered paralithic (soft) and may not require blasting during construction. The remaining areas will cross soils with a lithic contact (hard bedrock) within 60 inches of the surface that may require blasting or other special construction techniques during installation of the proposed pipelines.

This *Blasting Plan* outlines the procedures and safety measures that Atlantic's and DTI's construction contractors (referred to as the Contractor below) will adhere to while conducting blasting activities required for the construction of the ACP and SHP. Before blasting, a site-specific Blasting Specification Plan, which is consistent with the provisions in this *Blasting Plan*, will be submitted by the Contractor to Atlantic or DTI for approval. Approval of a site-specific Blasting Specification Plan does not relieve the Contractor from responsibility or liability.

3.0 GENERAL REQUIREMENTS

Blasting for grade or trench excavation will be used where deemed necessary by the Contractor, and approved by an Atlantic or DTI representative, after examination of the site. Blasting operations will be conducted by or under the direct and constant supervision of personnel legally licensed and certified to perform such activity in the jurisdiction where blasting occurs. Prior to any blasting activities, the Contractor will provide Atlantic or DTI with appropriate information documenting the experience, licenses, and permits associated with blasting personnel.

Blasting-related operations will comply with applicable Federal, State/Commonwealth, and local regulations, permit conditions, and the construction contract. These operations include:

obtaining, transporting, storing, handling, loading, detonating, and disposing of blasting material; drilling; and ground-motion monitoring.

4.0 PRE-BLASTING REQUIREMENTS

Prior to the initiation of blasting operations, the Contractor will comply with the following:

- The Contractor will obtain all required Federal, State/Commonwealth, and local permits relating to the transportation, storage, handling, loading, and detonation of explosives.
- The Contractor will be responsible for the protection of existing underground facilities.
- Before performing any work on, or accessing the construction right-of-way, the Contractor will verify with an Atlantic or DTI representative that all property owners have been notified of the upcoming construction activities. The Contractor will notify all such parties at least 48 hours prior to blasting.
- The Contractor will submit to Atlantic or DTI its site-specific Blasting Specification Plan for approval prior to the execution of blasting activity.

5.0 SITE-SPECIFIC BLASTING PLANS

For each area determined to require blasting, a site-specific Blasting Specification Plan will be prepared by the Contractor. This plan will include, at a minimum, the following information:

- blaster's name, company, copy of license, and statement of qualifications;
- seismograph company, names, equipment and sensor location;
- site location (milepost and stationing), applicable alignment sheet numbers, and associated rock type and geological structure (solid, layered, or fractured);
- copies of all required Federal, State/Commonwealth, and local permits;
- methods and materials, including explosive type, product name and size, weight per unit, and density; stemming material; tamping method; blasting sequence; use of non-electrical initiation systems for all blasting operations; and magazine type and locations for storage of explosives and detonating caps;
- site dimensions, including explosive depth, distribution, and maximum charge and weight per delay; and hole depth, diameter, pattern, and number of holes per delay;
- Global positioning system (GPS) coordinates of blasting location(s), distance and orientation to nearest aboveground and underground structures, and dates and hours blasting will be conducted;

- blasting procedures for:
  - storing, handling, transporting, loading, and firing explosives;
  - prevention of misfires, fly-rock, fire prevention, noise, and stray current accidental-detonation;
  - signs, flagmen, and warning signals prior to each blast;
  - locations where the pipeline route:
    - parallels or crosses an electrical transmission corridor, cable, or pipeline;
    - parallels or crosses a highway or road;
    - approaches within 500 feet of a water well or within 150 feet of an oil and gas well; or
    - approaches within 1,000 feet of any residence, building, or occupied structure;
  - local notification;
  - inspections after each blast; and
  - disposal of waste blasting material.

6.0 MONITORING

During blasting operations, the Contractor will be required to monitor operations in the following manner:

- The Contractor will provide seismographic equipment to measure the peak particle velocity (PPV) of all blasts in the vertical, horizontal, and longitudinal directions.
- The Contractor will measure the PPV at any existing pipelines, domestic structures, water supply wells, oil and gas wells, electrical transmission tower footings, and other utilities within 150 feet of the blasting. If none of these structures/facilities are present, the Contractor will measure the PPV at the edge of the construction right-of-way.
- The Contractor will complete a Blasting Log Record immediately after each blast and submit a copy to an Atlantic or DTI representative upon completion of blasting activities at each blasting site.

7.0 SAFETY

7.1 Protection of Aboveground and Underground Structures

Where blasting is determined to be required, Atlantic and DTI will identify any municipal water mains proposed for crossing, and will consult the local water authority. Reports of

identified crossings will include location by milepost, owner, and status and results of contacts with the water authority.

The Contractor will exercise control to prevent damage to aboveground and underground structures including pipelines, domestic structures, water supply wells, oil and gas wells, electrical transmission tower footings, and other utilities. The Contractor will implement the following procedures:

- If blasting occurs within 500 feet of an identified water well, water flow performance and water quality testing will be conducted before blasting. If the water well is damaged, the well will be repaired or otherwise restored or the well owner will be compensated for confirmed damages. Atlantic and DTI will provide an alternative potable water supply to the landowner until repairs occur.
- If blasting occurs within 150 feet of any aboveground structures, the Contractor and an Atlantic or DTI representative will inspect and photograph the structures before blasting. In the event that blasting damage to the aboveground structure is confirmed, the owner will be compensated.
- The Contractor will be responsible for the ultimate resolution of all damage claims resulting from blasting. Such liability is not restricted by the 150-foot inspection requirement cited above.
- Blasting will not be allowed within 15 feet of an existing pipeline, unless specifically authorized by an Atlantic or DTI representative.
- Holes that have contained explosive material will not be re-drilled. Holes will not be drilled where danger exists of intersecting another hole containing explosive material.
- Blasting mats or padding will be used on all shots where necessary to prevent scattering of loose rock onto adjacent property and to prevent damage to nearby structures and overhead utilities.
- Blasting will not begin until occupants of nearby buildings, stores, residences, places of business, places of public gathering, and farmers have been notified by the Contractor in advance to protect personnel, property, and livestock. The Contractor will notify all such parties at least 48 hours prior to blasting.
- Blasting in or near environmentally sensitive areas, such as streams and wildlife areas, may include additional restrictions.
- All blasting will be subject to the following limitations:
    - Maximum PPV of 12.0 inches per second, or the maximum PPV in accordance with State/Commonwealth or local regulations, in any of three mutually perpendicular axes measured at the lesser distance of the nearest facility or the edge of the permanent easement.
    - Maximum drill size will be 2.5 inches unless otherwise approved by an Atlantic or DTI representative.

- Maximum quantity of explosive per delay will be governed by the recorded measurements as influenced by the test blast program or a scaled distance formula.
- Explosive agents and ignition methods will be approved by an Atlantic or DTI representative. Ammonium nitrate/fuel oil and other free flowing explosives and blasting agents are not acceptable and will not be used.
- Drill holes will not be left loaded overnight.
- Approved stemming material will be used in all holes.

- The drilling pattern will be set in a manner to achieve smaller rock fragmentation (maximum 1 foot in diameter) to use as much as possible of the blasted rock as backfill material after the pipe has been padded in accordance with the specifications. The Contractor will submit the proposed drilling pattern to an Atlantic or DTI representative for approval.
- Under pipeline crossings and all other areas where drilling and blasting is required within 15 feet of existing facilities:
  - Drill holes will be reduced to a maximum of 2 inches or less in diameter.
  - The number of holes shot at one time will be limited to three unless otherwise approved by an Atlantic or DTI representative.
  - Appropriate delay between charges will be used to attain desired fragmentation.

7.2 Protection of Personnel

The Contractor will include in its procedures all Federal, State/Commonwealth, and local safety requirements for blasting. The Contractor's procedures will address, at a minimum, the following requirements:

- Blasting will be performed during daylight hours only.
- Only authorized, qualified, and experienced personnel will handle explosives.
- No explosive materials will be located where they may be exposed to flame, excessive heat, sparks, or impact. Smoking, firearms, matches, open flames, and heat- and spark-producing devices will be prohibited in or near explosive magazines or while explosives are being handled, transported, or used.
- A code of blasting signals will be established, posted in conspicuous places, and utilized during blasting operations. Employee training will be conducted on the use and implementation of the code.
- The Contractor will use every reasonable precaution including, but not limited to, visual and audible warning signals, warning signs, flag persons, and barricades to ensure personnel safety.

- Warning signs, with lettering a minimum of 4 inches in height on a contrasting background, will be erected and maintained at all approaches to the blast area.
- Flaggers will be stationed on all roadways passing within 1,000 feet of the blast area to stop all traffic during blasting operations.
- Both workers involved in the detonation and personnel not involved in the detonation will stand back at a distances determined by the person in charge from the time the blast signal is given until the "ALL CLEAR" is sounded.
- No loaded holes will be left unattended or unprotected. No explosives or blasting agent will be abandoned.
- In the case of a misfire, the blaster will provide proper safeguards for personnel until the misfire has been re-blasted or safely removed.
- The exposed areas of the blast will be matted wherever practicable. In cases where such a procedure is not deemed to be feasible, the Contractor will submit an alternative procedure for review by an Atlantic or DTI representative and the site in question will be visited and examined by the consultant before any approval is granted.
- Atlantic and DTI may employ two-way radios for communication between vehicles and office facilities. The Contractor will advise Atlantic or DTI and other pipeline contractors of any need to cease use of such equipment during blasting activities.
- All loading and blasting activity will cease and personnel in and around the blast area will retreat to a position of safety during the approach and progress of an electrical storm irrespective of the type of explosives or initiation system used. This is a major safety precaution and will always be observed. All explosive materials, all electrical initiation systems, and all non-electric initiation systems are susceptible to premature initiation by lightning.
- Previous blast areas must be inspected to verify the absence of misfires. No drilling may commence until such inspection occurs. If a misfire occurs adjacent to a hole to be drilled, the misfire will be cleared by the blaster using reasonable techniques required for the situation prior to commencement of drilling. If a misfire occurs at some distance from the drilling area, drilling may be stopped while clearing preparations are underway. When the misfire is to be cleared by re-shooting, drilling will be shut down and personnel evacuated to a place of safety prior to detonation.
- All transportation of explosives will be in accordance with applicable Federal, State/Commonwealth, and local laws and regulations. Vehicles used to transport explosives will be in good working condition and equipped with tight wooden or non-sparking metal floor and sides. If explosives are carried in an open-bodied truck, they will be covered with a waterproof and flame-resistant tarp. Wiring will be fully insulated to prevent short-circuiting and at least two fire extinguishers will be carried. The vehicle will be plainly marked to identify its

cargo so that the public may be adequately warned. Metal, flammable, or corrosive substances will not be transported in the same vehicle with explosives. There will be no smoking, and unauthorized or unnecessary personnel will not be allowed in the vehicle. Competent, qualified personnel will load and unload explosives into or from the vehicle.

- No sparking metal tools will be used to open kegs or wooden cases of explosives. Metallic slitters will be used to open fiberboard cases, provided the metallic slitter does not come in contact with the metallic fasteners of the case. There will be no smoking, no matches, no open lights, or other fire or flame nearby while handling or using explosives. Explosives will not be placed where they are subject to flame, excessive heat, sparks, or impact. Partial cases or packages of explosives will be re-closed after use. No explosives will be carried in the pockets or clothing of personnel. The wires of an electric blasting cap will not be tampered with in any way. Wires will not be uncoiled. The use of electric blasting caps will not be permitted during dust storms or near any other source of large charges of static electricity. Uncoiling of the wires or use of electric caps will not be permitted near radio-frequency transmitters. The firing circuit will be completely insulated from the ground or other conductors.
- No blast will be fired without a positive signal from the person in charge. This person will have made certain that all surplus explosives are in a safe place; all persons, vehicles, and/or boats are at a safe distance; and adequate warning has been given. Adequate warning of a blast will consist of, but not be limited to, the following:
    - notifying nearby homeowners and local agencies, if necessary;
    - stopping vehicular and/or pedestrian traffic near the blast site; and
    - signaling with an air horn, whistle, or similar device using standard warning signals.
- Only authorized and necessary personnel will be present where explosives are being handled or used.
- The condition of the hole will be checked with a wooden tamping pole prior to loading. Surplus explosives will not be stacked near working areas during loading. Detonating fans will be cut from spool before loading the balance of charge into the hole. No explosives will be forced into a bore hole past an obstruction. Loading will be done by a blaster holding a valid license or by personnel under his direct supervision.
- Fly-rock leaving the right-of-way will be collected immediately and disposed of at disposal sites approved by Atlantic or DTI. This work will not be left to the cleanup crew.

7.3 Lightning Hazard

A risk of accidental detonation caused by lightning strikes exists at any time the workplace is experiencing an electrical storm and there are loaded holes on site. If this hazard is

judged to exist by an Atlantic or DTI representative, work will discontinue at all operations and workers will be moved to secure positions away from the loaded holes. Furthermore, workers will not return to the work site until the storm has passed and an Atlantic or DTI representative has indicated it is clear to return.

The Contractor will have on site an approved lightning instrument capable of measuring the degree of electrical activity as a storm approaches, and the distance to the storm front from the instrument on the right-of-way.

8.0 KARST

In accordance with Atlantic's and DTI's *Karst Monitoring and Mitigation Plan*, and in addition to the measures described above, the following procedures will be implemented in areas of karst terrain:

- Blasting will be conducted in a manner that will not compromise the structural integrity or alter the karst hydrology of known or presumed habitat for federally listed threatened and endangered species in the subterranean karst environment (e.g. Madison cave isopod).
- Excavations will be inspected for voids, openings or other tell-tale signs of solution (karst) activity.
- If rock removal intercepts an open void, channel, or cave, construction activities will cease in the vicinity of the void, channel, or cave until a remedial assessment is performed by a qualified geologist or engineer with experience in karst terrain.
- Use of explosives will be limited to low-force charges designed to transfer the explosive force only to the rock which is designated for removal (e.g., maximum charge of 2 inches per second ground acceleration).
- If the track drill used to prepare drill holes for explosive charges encounters a subsurface void larger than 6 inches within the first 10 feet of bedrock, or a group of voids totaling more than 6 inches within the first 10 feet of bedrock, then explosives will not be used until a subsurface exploration is conducted to determine if the voids have connectivity to a deeper karst structure. The subsurface exploration will be carried out with track drill probes, coring drill, electrical resistivity, or other techniques capable of resolving open voids in the underlying bedrock. If a track drill or coring rig is used, then all open holes will be grouted shut after the completion of the investigation.

9.0 STORAGE REQUIREMENTS

All explosives, blasting agents, and initiation devices will be stored in locked magazines that have been located, constructed, approved, and licensed in accordance with Federal, State/Commonwealth, and local regulations. Magazines will be dry, well ventilated, reasonably cool (painting of the exterior with a reflective color), bullet and fire resistant, and kept clean and in good condition.

Initiation devices will not be stored in the same box, container, or magazine with other explosives. Explosives, blasting agents, or initiation devices will not be stored in wet or damp areas; near oil, gasoline, or cleaning solvents; or near sources of heat radiators, steam pipes, stoves, etc. No metal or metal tools will be stored in the magazine. There will be no smoking, matches, open lights, or other fire or flame inside or within 50 feet of storage magazines or explosive materials.

Magazines will be constructed and located in accordance with Federal, State/ Commonwealth, and local regulations. Magazines will be marked in minimum 3-inch-high letters with the words "DANGER – EXPLOSIVES" prominently displayed on all sides and roof, and be kept locked at all times unless explosives are being delivered or removed by authorized personnel. Admittance will be restricted to the magazine keeper, blasting supervisor, or licensed blaster.

Accurate and current records will be kept of the explosive material inventory to ensure that oldest stocks are utilized first, satisfy regulatory requirements, and for immediate notification of any loss or theft. Magazine records will reflect the quantity of explosions removed, the amount returned, and the net quantity used at the blasting site.

When explosive materials are taken from the storage magazine, they will be kept in the original containers until used. Small quantities of explosive materials may be placed in day boxes, powder chests, or detonator boxes. Any explosive material not used at the blast site will be returned to the storage magazine and replaced in the original container as soon as possible.

ATLANTIC COAST PIPELINE, LLC
ATLANTIC COAST PIPELINE
Docket No. PF15-6-000

and

DOMINION TRANSMISSION, INC
SUPPLY HEADER PROJECT
Docket No. PF15-5-000

Invasive Plant Species Management Plan

Draft

Prepared by

NATURAL RESOURCE GROUP

an ERM Group company

July 2015

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LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

ACP	Atlantic Coast Pipeline
Atlantic	Atlantic Coast Pipeline, LLC
DTI	Dominion Transmission, Inc.
EI	Environmental Inspector
HDD	horizontal directional drill
NCDACS	North Carolina Department of Agriculture and Consumer Services
OHV	off-highway vehicle
PDA	Pennsylvania Department of Agriculture
Projects	Atlantic Coastline Pipeline and Supply Header Project
SHP	Supply Header Project
SPCC Plan	Spill Prevention, Control, and Countermeasures Plan
VDACS	Virginia Department of Agriculture and Consumer Services

1.0 INTRODUCTION

Atlantic Coast Pipeline, LLC (Atlantic) – a company formed by four major energy companies - Dominion Resources, Inc.; Duke Energy Corporation; Piedmont Natural Gas Co., Inc.; and AGL Resources, Inc. – proposes to construct and operate approximately 556.0 miles of natural gas transmission pipelines and associated aboveground facilities in West Virginia, Virginia, and North Carolina. This Project, referred to as the Atlantic Coast Pipeline (ACP), will deliver up to 1.5 billion cubic feet per day of natural gas from supply areas in the Appalachian region to demand areas in Virginia and North Carolina. Atlantic has contracted with Dominion Transmission, Inc. (DTI), a subsidiary of Dominion Resources, Inc., to construct and operate the ACP on behalf of Atlantic.

In conjunction with the ACP, DTI proposes to construct and operate approximately 36.7 miles of pipeline loop and modify existing compression facilities in Pennsylvania and West Virginia. This Project, referred to as the Supply Header Project (SHP), will enable DTI to provide firm transportation service to various customers, including Atlantic.

2.0 PURPOSE

Noxious weeds are plant species designated by Federal, State/Commonwealth, or County/City governments as injurious to public health, agriculture, recreation, wildlife, or property (Sheley, et al., 1999). The more general term "invasive species" is used for species that are non-native to an ecosystem and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112). Invasive plants include not only noxious weeds but other plants that are not native to an area. Both noxious weeds and non-native invasive plants are considered opportunistic species that flourish in disturbed areas and prevent native plants from establishing successive communities.

The areas crossed by the ACP and SHP (collectively, the Projects) contain widespread populations of many noxious weeds and other invasive plant species. The purpose of this *Invasive Plant Species Management Plan* is to describe methods to prevent and control the introduction or spread of invasive plant species during and following construction of the Projects. Atlantic and DTI and their contractors will be responsible for implementing the procedures described in this plan.

3.0 JURISDICTION

Under Executive Order 13112, a Federal agency shall not authorize, fund, or carry out actions likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless it has been determined that the benefits of such actions outweigh the potential harm caused by invasive species, and that all feasible and prudent measures to minimize the risk of harm will be implemented.

3.1 WEST VIRGINIA

The West Virginia Noxious Weed Act (Chapter 19, Section 12D of the Code of West Virginia), which is administered by the West Virginia Department of Agriculture, prohibits

persons, including corporations, from moving, transporting, delivering, shipping, or offering for shipment noxious weeds into or within the State without a permit from the State Secretary of Agriculture. West Virginia adopts the Federal Noxious Weed List in addition to its own State noxious weed list; and both lists are regulated by the West Virginia Noxious Weed Act. The invasive plant species identified in West Virginia are listed in Table 1.

3.2 VIRGINIA

Virginia's Noxious Weed Law is administered by the Virginia Department of Agriculture and Consumer Services (VDACS). The Noxious Weed Law allows the VDACS to list weeds to be regulated; enforce quarantines to regulate the movement of listed weeds; eradicate and/or suppress weed populations to prevent dissemination. The law defines a 'noxious' weed as any plant not widely disseminated that is determined to be detrimental to crops, surface waters, or other desirable plant, livestock, land, or other property, or to be injurious to the public health or the economy (Code of Virginia § 3.2-800 thru 809).

The Regulations for the Enforcement of the Noxious Weed Law (Virginia Administrative Code 2VAC5-317-20), which became effective January 2015, lists eight noxious weeds. European wand loosestrife was previously listed under the Noxious Weed Law and therefore included in the survey list for Virginia. These nine species are consistent with those identified during correspondence with the program manager for the VDACS Plant Industry Services (VDACS, 2014). The invasive plant species identified in Virginia are listed in Table 1.

3.3 NORTH CAROLINA

North Carolina noxious weed laws are regulated by the North Carolina Department of Agriculture and Consumer Services (NCDACS). The State Noxious Weed Regulations (North Carolina Administrative Code 48 §1700), adopted under the authority of the North Carolina Plant Pest Law, were enacted to prevent the widespread establishment of harmful non-native plants that are placed on a Noxious Weed List. Any plant on the Noxious Weed List is prohibited entry into the State without a permit. Noxious weeds already present in the State are contained by prohibiting movement of the plant outside of regulated areas. In addition to the plant itself, articles that could contain noxious weed propagules, such as soil or hay, are also regulated. Regulated areas are usually defined by County boundaries and must be described by no more than 20 counties.

Although North Carolina has outlined 19 noxious weeds on the Noxious Weed List, Atlantic contacted the State Plant Pest Administrator with the NCDACS Plant Industry Division to discuss this list and to confirm what species should be documented during survey efforts (NCDACS, 2014). During this consultation, Atlantic was provided a list of 15 noxious weed species of concern as well as all species of the genus *Striga*. The invasive plant species identified by the NCDACS are listed in Table 1.

TABLE 1

Invasive Plant Species Identified along the Atlantic Coast Pipeline and Supply Header Project

Common Name	Latin Name	Atlantic Coast Pipeline	Supply Header Project
West Virginia [a]			
Tree of heaven	*Ailanthus altissima*		
Marijuana	*Cannibis sativa*		
Nodding plumeless thistle	*Carduus acanthoides*		
Curled thistle	*Carduus crispus*		
Musk thistle	*Carduus nutans*		
Poison hemlock	*Conium maculatum*		
Autumn olive	*Elaeagnus umbellate*		
Morrow's honeysuckle	*Lonicera morrowii*		
Tatarian honeysuckle	*Lonicera tatarica*		
Purple loosestrife	*Lythrum salicaria*		
Japanese stiltgrass	*Microstegium vimineum*		
Opium poppy	*Papaver somniferum*		
Japanese knotweed	*Polygonum cuspidatum*		
Mile-a-minute vine	*Polygonum perfoliatum*		
Kudzu	*Pueraria montana*		
Multiflora rose	*Rosa multiflora*		
Johnsongrass	*Sorghum halepense*		
Virginia [b]			
Giant hogweed	*Heracleum mantegazzianum*		
Cogongrass	*Imperta cylindrical*		
Water spinach	*Ipomoea aquatic*		
Purple loosestrife	*Lythrum salicaria*		
Wand loostrife	*Lythrum virgatum*		
Wavyleaf basketgrass	*Oplismenus hirtellus*		
Giant salvinia	*Salvinia molesta*		
Tropical soda apple	*Solanum viarum*		
Beach vitex	*Vitex rotundifolia*		
North Carolina [c]			
Curled thistle	*Carduus crispus*		
Musk thistle	*Carduus nutans*		
Giant hogweed	*Heracleum mantegazzianum*		
Cogongrass/Japanese blood grass	*Imperta cylindrical*		
Water spinach	*Ipomoea aquatic*		
Purple loosestrife	*Lythrum salicaria*		
Wand loosestrife	*Lythrum virgatum*		
Japanese stilt grass	*Microstegium vimineum*		
Wavyleaf basketgrass	*Oplismenus hirtellus*		
Common reed	*Phragmites australis*		
Mile-a-minute vine	*Polygonum perfoliatum*		
Giant salvinia	*Salvinia molesta*		
Tropical soda apple	*Solanum viarum*		
Witchweed	*Striga* (all species)		
Puncturevine	*Tribulus terrestris*		
Beach vitex	*Vitex rotundifolia*		
Pennsylvania [d]			
Marijuana	*Cannabis sativa*		
Musk thistle/ Nodding thistle	*Carduus nutans*		

TABLE 1 (cont'd)

Invasive Plant Species Identified along the Atlantic Coast Pipeline and Supply Header Project

Canadian thistle	*Cirsium arvense*
Bull thistle/ Spear thistle	*Cirsium vulgare*
Jimsonweed	*Datura stramonium*
Goatsrue	*Galega officinalis*
Giant hogweed	*Heracleum mantegazzianum*
Purple Loosestrife	*Lythrum salicaria*
Mile-a-minute	*Polygonum perfoliatum*
Kudzu-vine	*Pueraria lobate*
Multiflora rose	*Rosa multiflora*
Shattercane	*Sorghum bicolor*
Johnsongrass	*Sorghum halepense*

[a] Obtained from Article 12D of the West Virginia Noxious Weed Act of 1976, Title 61 Legislative Rules West Virginia Department of Agriculture, Series 14A Rules and additional U.S. Department of Agriculture listed species occurring in the State (U.S. Department of Agriculture, 2014).

[b] Obtained from the Regulations for the Enforcement of the Noxious Weed Law (Virginia Administrative Code 2VAC5-317-20) and correspondence with the Plant Industries Services Program Manager with the Virginia Department of Agriculture and Consumer Services (VDACS, 2014).

[c] Provided by the Plant Pest Administrator with the North Carolina Department of Agriculture and Consumer Services – Plant Industry Division (NCDACS, 2014).

[d] Obtained from the Pennsylvania Noxious Weed Control List (PDA, 2015).

3.4 PENNSYLVANIA

In Pennsylvania, the Noxious Weed Control Law and Noxious Weed Control List are administered by the Pennsylvania Department of Agriculture (PDA). The PDA is responsible for implementing Federal and Commonwealth eradication and control programs for suppression, control, or eradication of noxious weeds. Under the Noxious Weed Control Law, it is a violation to "sell, transport, plant, or otherwise propagate that weed within the Commonwealth" (PDA, 1997). The Secretary of Agriculture retains the right to designate weed control areas when necessary and to require affected landowners to comply with the control measures required within 30 days of the designation. The invasive plant species identified by the PDA are listed in Table 1.

4.0 INVASIVE PLANT SPECIES SURVEYS

Atlantic and DTI are conducting a field survey for State/Commonwealth listed invasive plant species within a 300-foot-wide corridor along the proposed ACP and SHP pipeline routes. A summary of the invasive plant species identified in the ACP and SHP survey corridors will be provided in Table 1 of the next version of this plan; locations by milepost will be provided as Attachment A.

5.0 INVASIVE PLANT SPECIES MANAGEMENT

The invasive plant species management program for the ACP and SHP is designed to:

- identify areas supporting invasive plants prior to construction;
- prevent the introduction and spread of invasive plants from construction equipment moving along the right-of-way;

- contain invasive plant propagules by preventing segregated topsoil from being spread to adjacent areas along the construction right-of-way; and
- address invasive plant infestations that develop during restoration and operation of the Projects.

5.1 IDENTIFICATION OF PROBLEM AREAS

As noted above, Atlantic and DTI are conducting surveys for invasive plant species within the ACP Project area and SHP Project area. Additional areas supporting invasive plant species may be identified during preconstruction inspections by Atlantic and DTI's Environmental Inspectors (EI). Prior to construction, the EIs will mark areas of invasive plant infestations by using color-coded flagging, staking, and/or signs on the construction rights-of-way. Identification of existing invasive plant locations will alert EIs and construction personnel to implement control measures during construction.

5.2 TREATMENT MEASURES

5.2.1 Pre-Treatment

Prior to clearing and grading operations, pre-treatment of invasive plant infestations may be conducted if it will aid in controlling the spread of invasive plant species during construction. The control measures to be implemented may include the application of herbicide or mechanical measures, such as mowing. The control measure chosen will be the best method available for the time, place, and species, as determined through consultation with the appropriate State/Commonwealth or Federal agency.

Herbicide application is an effective means of reducing the size of invasive plant species populations. Herbicide treatment methods will be based on species-specific and area-specific conditions (e.g., annual vs. perennial species; proximity to wetlands, open water, riparian areas, or agricultural areas; and time of year) and will be coordinated, as necessary, with State/Commonwealth and/or Federal agencies. Spot herbicide applications will be the preferred option. In areas of dense infestation, a broader application may be used. Preconstruction treatment of infestation areas will be controlled, as described in Section 7.0, to minimize impacts on surrounding vegetation.

Application of herbicides will be completed in accordance with applicable chemical contact times (as specified by the manufacturer) in advance of clearing and grading within the construction right-of-way. Treatment may be restricted in areas that are not readily accessible (e.g., difficult topography, saturated/inundated soils) or where there are documented occurrences of protected species that could be adversely impacted by herbicide applications. Atlantic and DTI will continue to work with applicable State/Commonwealth and Federal agencies to address invasive plant species control options where protected species and their habitats occur along the ACP and SHP.

Mechanical control (e.g., mowing or disking) can also be an effective control measure for annual species. The efficacy of mechanical control measures are dependent upon proper timing to cut the vegetation prior to the maturation of seed and may require multiple treatments during the growing season.

5.2.2 Preventive Measures during Construction

The following measures will be implemented to prevent the spread of invasive plant species during construction activities.

- All equipment (including timber mats) will be cleaned prior to arriving on the construction site. The equipment will be inspected by the Contractor and EI to verify that it is clean of soil and debris, which are capable of transporting invasive plant propagules, prior to working on the Projects.
- Atlantic/DTI will install intermediate cleaning stations at additional locations based on invasive plant species survey results and other mitigating factors (such as accessibility). In selecting locations for cleaning stations, Atlantic/DTI and its contractors will consider prevalence of invasive plants, the locations of sensitive resources (e.g., wetlands), landowner requirements, and/or recommendations from State/Commonwealth and/or Federal agencies. The locations of the wash stations will be provided to the FERC prior to construction.
- Cleaning will be conducted using high pressure washing equipment, compressed air, and/or manually to remove excess soil and debris from the tracks, tires, and blades of equipment.
- The Contractor and EI will maintain logs documenting the cleaning history of each piece of equipment. The EI will use stickers or other visual marking to identify that equipment has been cleaned and an inspection has been completed.
- Cleared vegetation and segregated topsoil from areas of invasive plant infestations will be maintained adjacent to the areas from which they were removed to eliminate the transport of soil-borne propagules to other areas along the right-of-way. The stockpiles will be identified as invasive plant species stockpiles with signs. The Contractor will install sediment barriers (e.g., silt fence) around the stockpiles to ensure the material is not transported to adjacent areas. During reclamation, the materials will be returned to the areas from which they were obtained.
- Equipment required for initial vegetation clearing and/or topsoil segregation in areas of invasive plant infestation will be cleaned prior to leaving the area. Once the topsoil has been segregated, subsequent equipment will not require cleaning as it will not come into contact with invasive plant species or the topsoil potential containing propagules. Equipment required for topsoil replacement during restoration activities will also be cleaned prior to moving out of an area of infestation.
- Materials used for erosion control (e.g., hay bales or straw mulch) will be certified as weed free.

5.2.3 Post-Construction Treatment Methods

Atlantic and DTI's objective is to comply with regulatory and Project-specific requirements to prevent the spread of invasive plant species and treat areas of the rights-of-way

where invasive plant species form a significant portion of the vegetation community in comparison to adjacent areas. Atlantic and DTI will utilize established restoration procedures to prevent the establishment of invasive plant species in areas disturbed by construction.

In non-frozen soil conditions, the construction Contractor will implement restoration procedures on disturbed lands immediately following construction. In frozen soil conditions, restoration activities will be delayed until the spring or summer following construction. In either case, ongoing revegetation and monitoring efforts will ensure adequate vegetative cover to discourage the establishment of invasive plant species.

Following construction, the ACP Project area and SHP Project area will be monitored in accordance with the Federal Energy Regulatory Commission's *Upland Erosion Control, Revegetation, and Maintenance Plan* and *Wetland and Waterbody Construction and Mitigation Procedures* as well as the Project-specific *Restoration and Rehabilitation Plan*. In the event that invasive plant species become established in the right-of-way, Atlantic and DTI will take all reasonably achievable efforts to control the invasive plants within the right-of-way and to work with adjacent landowners to prevent the spread of the invasive plants to adjacent lands. In addition, Atlantic and DTI will implement control measures at the aboveground facility sites to prevent the spread of invasive plant species onto adjacent properties. Weed infestations that develop as a result of construction will be treated using approved herbicides, mechanical methods (e.g., mowing), and/or alternative methods, as appropriate for the species and in accordance with applicable laws and regulations. The method selected will be the best available for the time, place, and species as determined through consultation with the appropriate State/Commonwealth or Federal agency.

Post-construction herbicide applications will be conducted prior to seed maturation where possible and where necessary. Applications will be controlled, as described in Section 7.0, to minimize impacts on surrounding vegetation. Herbicide treatment methods will be based on species-specific and area-specific conditions as described above and will be coordinated with State/Commonwealth agencies as applicable. Spot herbicide applications will be the preferred option. In areas of dense infestation, a broader application will be used and a follow-up seeding program implemented in accordance with the *Restoration and Rehabilitation Plan*. The timing of subsequent revegetation efforts will be based on the persistence of the herbicide.

Mechanical methods entail the use of equipment to mow or disk invasive plant species populations. Mechanical treatments will be conducted prior to seed maturation where required. If such a method is used, subsequent seeding will be conducted, if necessary, to re-establish a desirable vegetative cover that will stabilize the soils and slow the potential re-invasion of invasive plant species.

Where appropriate, Atlantic and DTI will consult with the appropriate State/Commonwealth or Federal agency regarding the use of biological and alternate invasive plant control methods. The implementation of these measures will require approval from the landowner or land managing agency.

Increased accessibility of lands along the proposed pipeline rights-of-way, particularly during operations, could lead to unauthorized off-highway vehicle (OHV) use into previously restricted or inaccessible areas. Atlantic and DTI prefer to limit OHV use on the proposed

pipeline rights-of-way to avoid issues with revegetation efforts or erosion problems and to address landowner concerns or preferences. In addition to these operational issues, unauthorized OHV use along the pipeline rights-of-way could allow unintended access to sensitive wildlife habitats, species, or culturally sensitive areas and lead to adverse impacts on these resources.

To minimize unauthorized OHV access along the pipeline rights-of-way and additional roads opened up for construction equipment and vehicles, Atlantic and DTI will implement measures, as appropriate, to discourage OHV access along the right-of-way. This could include installation of OHV barriers at appropriate locations along the rights-of-way. Barriers may consist of signs, fences, vegetation, or boulders. Atlantic and DTI will coordinate with the appropriate land managing agencies to identify locations where unauthorized OHV access to Federal and State/Commonwealth lands via the pipeline right-of-way is most likely. At these key crossing locations, site-specific OHV blocking measures will be developed in consultation with the land managing agencies.

6.0 MONITORING

Following construction, invasive plant infestations will be monitored as part of Atlantic's and DTI's restoration monitoring activities as described in the *Restoration and Rehabilitation Plan*. Atlantic/DTI will inspect disturbed areas after the first and second growing seasons, at a minimum, to determine the success of revegetation. Revegetation shall be considered successful if upon visual survey the density and cover of non-nuisance vegetation are similar to adjacent undisturbed lands. Atlantic and DTI will continue revegetation efforts and monitoring until successful revegetation is achieved. Following successful revegetation, Atlantic and DTI's operations staff will monitor and treat invasive plant species as part of its normal operations and maintenance activities in accordance with applicable State/Commonwealth or Federal regulations.

7.0 HERBICIDES

7.1 HERBICIDE APPLICATION AND HANDLING

Herbicide application will be based on information gathered from field surveys and consultations with applicable State/Commonwealth or Federal agencies. Before application, Atlantic or DTI or its Contractors will obtain any required State/Commonwealth or local permits and landowner approval. Herbicide application will be conducted in accordance with applicable laws and regulations by a licensed contractor.

Vehicle-mounted sprayers (e.g., handgun, boom, or injector) may be used in open areas readily accessible by vehicle. Hand application methods (e.g., backpack spraying) that target individual plants may be used to treat small or scattered invasive plant species populations in rough terrain. Calibration checks of equipment will be conducted at the beginning of spraying and periodically to ensure proper application rates.

Herbicides will be transported to the site with the following provisions:

- on-site herbicide quantities will be limited where practical;

- concentrate will be transported in approved containers only, in a manner that will prevent tipping or spilling, and in a compartment that is isolated from food, clothing, and safety equipment;
- mixing will be conducted in an upland area and at a distance greater than 100 feet from waterbodies or wetlands; greater than 200 feet from private wells; greater than 300 feet from karst features; and greater than 400 feet from public wells. The property owner will be consulted about the presence and location of wells prior to herbicide application;
- storage and handling of all herbicides and equipment will be in accordance with all applicable regulations; and
- all herbicide equipment and containers will be maintained as needed and inspected for leaks on a daily basis.

7.2 HERBICIDE SPILLS

Atlantic and DTI have prepared and will implement a *Spill Prevention, Control, and Countermeasures Plan* (SPCC Plan) to avoid or minimize the potential impact of hazardous material spills during construction and operation of the Projects. In accordance with this plan, herbicide contractors will be responsible for keeping spill kits in their vehicles and in herbicide storage areas to allow for quick and effective response to spills. Response to an herbicide spill will vary depending on the material spilled, and the size and location of the spill. The order of priorities after discovering a spill are to protect the safety of personnel and the public, minimize damage to the environment, and conduct cleanup and remediation activities.

All herbicide contractors will obtain and have readily available copies of the appropriate Safety Data Sheets (formally known as Material Safety Data Sheets) and labels for the herbicides used. All herbicide spills will be reported in accordance with applicable laws and requirements. Further information regarding spill response and reporting is provided in the SPCC Plan.

8.0 FEDERALLY MANAGED LANDS

The ACP crosses approximately 29.7 miles of U.S. Forest Service lands in the Monongahela and George Washington National Forests and approximately 1.5 miles of U.S. Fish and Wildlife Service land in the Great Dismal Swamp National Wildlife Refuge. For these crossings, Atlantic will prepare a *Plan of Development* or *Construction, Operations, and Maintenance Plan*, which will identify construction procedures and mitigation measures to be implemented on federally managed lands. The results of the invasive plant species surveys and proposed control measures in on Federal lands will be included in these plans.

The ACP also crosses approximately 0.1 mile of National Park Service land along the Blue Ridge Parkway. Atlantic is evaluating the use of the horizontal directional drill construction method to install the proposed pipeline under Blue Ridge Parkway. The horizontal directional drill (HDD) method would avoid direct impacts on the parkway, including impacts on vegetation immediately adjacent to the parkway. This will limit the potential for the spread of invasive species or propagules along the parkway.

Atlantic will coordinate the development of the above-referenced plan in federally managed lands in consultation with appropriate representatives from the affected units.

9.0 REFERENCES

North Carolina Department of Agriculture and Consumer Services. 2014. Call dated June 2, from G. Blosser (Natural Resource Group, LLC) to P. Wilson.

Pennsylvania Department of Agriculture. 1997. Legal Reference: Noxious Weed Law Summary. Available online at: http://www.agriculture.state.pa.us/portal/server.pt/gateway/PTARGS_0_2_75292_10297_0_43/AgWebsite/Files/Publications/NoxiousWeedLawSummary.pdf. Accessed April 2015.

Pennsylvania Department of Agriculture. 2015. Noxious, Invasive and Poisonous Plant Program. Available online at: http://www.agriculture.state.pa.us/portal/server.pt/gateway/PTARGS_6_2_24476_10297_0_43/AgWebsite/ProgramDetail.aspx?name=Noxious-Invasive-and-Poisonous-Plant-Program&navid=12&parentnavid=0&palid=116&. Accessed April 2015.

Sheley, R., J. Petroff, M. Borman. 1999. Introduction to Biology and Management of Noxious Rangeland Weeds, Corvallis, OR.

U.S. Department of Agriculture. 2014. Introduced, Invasive, and Noxious Plants. Available at: http://plants.usda.gov/java/noxiousDriver. Accessed December 2014.

Virginia Department of Agriculture and Consumer Services. 2014. Call dated June 2, from G. Blosser (Natural Resource Group, LLC) to L. Nichols.

ATLANTIC COAST PIPELINE AND SUPPLY HEADER PROJECT
INVASIVE PLANT SPECIES MANAGEMENT PLAN

Attachment A
Invasive Plant Species Identified along the Atlantic Coast Pipeline and Supply Header Project

[To be provided with the next version]

ATTACHMENT A

Invasive Plant Species Identified along the Atlantic Coast Pipeline and Supply Header Project

Facility, State/ Commonwealth	County/City	Begin Milepost	End Milepost	Invasive Plant Species	Prevalence
ATLANTIC COAST PIPELINE					
West Virginia					
Virginia					
North Carolina					
SUPPLY HEADER PROJECT					
Pennsylvania					
West Virginia					

ATLANTIC COAST PIPELINE, LLC
ATLANTIC COAST PIPELINE
Docket No. PF15-6-000

and

DOMINION TRANSMISSION, INC
SUPPLY HEADER PROJECT
Docket No. PF15-5-000

Karst Terrain Assessment, Construction, Monitoring, and Mitigation Plan

Draft

Prepared by
GeoConcepts Engineering, Inc.

July 2015

Table of Contents

Plan Outline

At the request of Atlantic Coast Pipeline, LLC, (Atlantic), and Dominion Transmission, Inc. (DTI), GeoConcepts has developed a plan describing the assessment, monitoring, and mitigation activities for the proposed Atlantic Coast Pipeline (ACP) and the Dominion Supply Header Project (SHP) routes through areas of karst terrain. The requested plan is outlined as follows:

Definitions

This section provides a summary of karst-specific terms used in the plan.

Geological Overview

This section provides a brief discussion of karst terrain and features and the overall regional karst geology of the proposed pipeline alignment.

Pre-Construction Assessment and Field Survey

This section describes in detail the pre-construction database and remote sensing review, as well as field survey methods and procedures which are currently being completed.

Construction Monitoring Protocols

This section describes the methods and procedures to be utilized during the construction phase of the ACP/SHP. It includes:

- a description of the pre-excavation electrical resistivity investigation (ERI) methods and procedures, and the manner in which the ERI data will be analyzed, summarized, and presented;
- a description of the activities to be conducted by the field geologist during excavation and trenching activities, including how the observations will be made and the reporting format and frequency.

Karst Mitigation and Conservation Procedures

This section discusses the best management practices (BMPs) to be utilized for mitigating, remediating, and minimizing impacts to karst features that may be encountered during construction activities. This includes features that either are within or receive drainage from the pipeline right-of-way, or that are intercepted during the excavation and trenching process. The format and manner in which the mitigation and remedial activities will be undertaken and reported are addressed in this section of the plan. The intent is to provide agreed upon solutions to the karst features that may be encountered prior to the start of construction so that those features can be protected. However, in some cases, the actual remedial measure employed may be customized to the specific karst features identified.

Definitions

Karst Specialist – A Licensed Professional Geologist engaged in the practice of engineering geology (or) a Virginia Registered Professional Engineer engaged in the practice of Geotechnical Engineering, with a minimum of 10 years of experience in karst geology characterization and remediation. Practice experience shall be demonstrated by a statement of qualifications (e.g., resume, Curriculum Vitae, project experience).

Cave – A natural hole in the ground, large enough for human entry. This covers the enormous variety of caves that do occur, but eliminates the many artificial tunnels and galleries incorrectly named caves. The size criterion is arbitrary and subjective, but practical, as it eliminates narrow openings irrelevant to explorers but very significant hydrologically, that may be better referred to as *proto-caves*, *sub-conduits*, or *fissures*. A cave may be a single, short length of accessible passage, or an extensive and complex network of tunnels as long as hundreds of kilometers.

Cavern – A cave which is large enough to allow the passage of a human being, but which does not have an existing opening (entrance) to the surface.

Doline; Sinkhole – A basin- or funnel-shaped hollow or depression in limestone, ranging in diameter from a few meters up to a kilometer and in depth from a few to several hundred meters. Some dolines are gentle grassy hollows or depressions; others are rocky cliff-bounded basins. A distinction may be made by direct solution of the limestone surface zone (solution dolines), and those formed by collapse over a cave (collapse dolines), but it is generally not possible to establish the origin of individual examples. Generally referred to as a "sinkhole" in the United States, the term doline is more widely accepted by the international geology community.

Throat – An opening within a sinkhole leading into the subsurface, too small to qualify as a cave and often called a *proto-cave*, *sub-conduit*, or *fissure*. Throats may be "open" (i.e. air-filled or water-filled), or "closed/clogged" (filled with debris including but not limited to: loose-soil; gravel; rock; dead-fall wood or brush; or trash).

Parapet – The outer edge or perimeter of a doline (sinkhole).

Ponor – a) Hole or opening in the bottom or side of a depression where a surface stream or lake flows either partially or completely underground into the karst groundwater system. b) Hole in the bottom or side of a doline through which water passes to or from an underground channel. Also known as a swallow hole.

Solution Cavity – A natural cavity or depression formed by the dissolution of soluble bedrock, typically not large enough to allow the entry of a human being and, therefore, not classified as a cave.

Breccia – Angular fragments of rock commonly, but not inevitably, cemented by finer-grained materials including silica, iron minerals, and calcite to form a new rock. Many fault planes are marked by zones of broken rock, either loose or re-cemented, forming a fault breccia.

Non-Karst Closed Depression – A natural or non-natural topographic depression that is not formed by karst processes and is not floored by bedrock. Examples include (but are not limited to) construction-related soil subsidence, silage pits, farm ponds, scour pools, animal wallows, large animal burrows, and pits created by removal of tree stumps.

Sinking Stream – A perennial or intermittent stream whose bed and bank disappear entirely underground, usually through an open throat sinkhole or cave entrance.

Losing Stream – A perennial or intermittent stream which loses flow volume into its bed due to the presence of sub-channel (hyporheic) solution cavities or conduits.

Geological Overview of the Karst Terrain Sections of the Proposed ACP/SHP

Overview of Karst Terrain along the project alignment

The term "karst" refers to a type of landform or terrain, just like "desert", "marsh", "tundra", "steppe" or "montane". It was named for a province in Slovenia where it was first described in the late 17th and early 18th century by geologists of the former Austro-Hungarian Empire. Simply stated, karst terrain is characterized or diagnosed by the presence of sinkholes, caverns, an irregular "pinnacled" bedrock surface, and many large springs; however, the development of karst terrain is a result of the presence of soluble bedrock such as limestone, dolomite, marble or gypsum. Any landscape that is underlain by soluble bedrock has the potential to develop a karst terrain landform.

As in any region where soluble bedrock is present, a karst landform regime has developed in three known regions of the proposed ACP/SHP. Folding and faulting of the local carbonate rocks has opened up numerous fractures both parallel with the axis of the geologic structures, as well as perpendicular to them. Surface fractures and joints weather differentially, producing a pinnacled or "saw-tooth" profile at the bedrock/soil interface (referred to as the "epikarst" zone). In contrast, rock-enclosed fractures can be secondarily enlarged by the action of carbon dioxide charged groundwater, in some cases forming water-filled or air-filled conduits. As the regional terrain is "mature" karst, nearly all the fractures have undergone successive cycles of sediment filling and flushing. In areas such as the ACP Project area, where there is little topographic relief and a relatively minimal groundwater gradient, the great majority of solution fissures are sediment-filled.

The most prevalent type of karst features in the project area are dolines or "sinkholes", and these features comprise the greatest potential geohazard risk to any type of construction in karst terrain. Sinkholes fall into two broad categories, "vault-collapse" sinkholes, and "cover-collapse" sinkholes. Vault-collapse type sinkholes (i.e., where a cavern "vault" or roof has failed catastrophically) are rare in the ACP/SHP Project area. Cover-collapse sinkholes, which are common in the ACP Project area, develop by the raveling of fines from the soil overburden into solution channels within the bedrock mass, in which water is the transport medium for the movement of the soil fines. The natural raveling process is generally a very slow one, such that sinkhole development generally occurs over a very long time span. However, various changes at a site can sometimes lead to the very sudden development of sinkholes. The most common changes that will exacerbate sinkhole development are:

1. Increase or redirection of overland or subsurface water flow paths, which accelerates the raveling of soil fines;
2. Removal of vegetation cover and topsoil (i.e., stripping and grubbing), which can reduce the cohesive strength of the soils overlying a conduit; and
3. Sudden changes in the elevation of the water table (such as drought, over-pumping of wells, or quarry dewatering), which removes the neutral buoyancy of the water supporting a conduit's soil plug, and can often result in rapid and catastrophic soil collapse.

Geological Setting

The proposed ACP/SHP will cross three distinct provinces of karst geology, from east to west:

1. The **Great Valley subsection of the Valley and Ridge physiographic province**, encompassing all of Augusta County, Virginia from the Blue Ridge on the east to Little North Mountain on the west.
2. The **Folded Appalachian subsection of the Ridge and Valley province**, encompassing all of Highland County, Virginia and extending from the North Mountain area on the east to the Allegheny Mountain on the west; and

3. The **Allegheny Front and Appalachian Plateau** provinces of West Virginia, encompassing Pocahontas and Randolph Counties, West Virginia.

The Great Valley (Augusta County, VA)

The Great Valley section is a generally downwarped trough (synclinorium) of Paleozoic limestones, shales, and sandstones that lie between the Blue Ridge Massif on the east and the Allegheny Mountains to the west. The Valley extends between the two mountain uplands from northeast to southwest, parallel with the average strike of the bedrock.

The karst terrain of the Great Valley section of the ACP Project Area is characterized by numerous circular to oval-shaped sinkholes, ranging in size from a few feet to several hundred feet in diameter, the majority of which are completely vegetated and lack any opening to the subsurface ("throat") at their base. Sinkhole depths can vary, but are usually controlled by the angle of repose of the sediments lining their walls. Steep, rock-walled sinkholes are rare in this section, but generally occur in the small hills and uplands that are erosional remnants of the prior valley floor.

The Great Valley section contains the largest karst springs in the region. It is also characterized by sinkholes called "estavelles", which are insurgences for water during dry periods, and flood or act as springs (resurgences) during wet seasons. There are also numerous caves (i.e., air-filled voids large enough to permit the entry of a human being and that have an entrance to the surface) and subsurface caverns (air-filled voids large enough for human entry with no connection to the surface) in the region. Most of the caves and caverns range in length from a few feet to several miles; however, the average length is less than a 2,500 feet. This is in contrast to the Folded Appalachian and Appalachian Plateau provinces to the west, where some of the longest caves in the region have been surveyed, many of which are more than 10 miles in length. Nevertheless, though not of great length, some of the most voluminous caves in the region occur in the Great Valley section.

A unique type of karst terrain has developed in the eastern portion of Augusta County along the base of the Blue Ridge Mountains. Here, the characteristic karst terrain has been buried beneath a mantle of alluvial material which was shed off the mountains to the east. This alluvium ranges in age from less than 1 million years (Quaternary Period) to over 50 million years (Paleogene Period). The alluvium thins towards the west, and disappears completely west of Waynesboro, Virginia. Although the primary karst terrain is mantled by the alluvium, numerous shallow broad sinkholes are present and indicate the presence of large karst features in the underlying bedrock.

Bedrock Geology

Specifically, the proposed ACP Project area in the Great Valley section has been extensively studied and mapped as being underlain by a series of karst-forming carbonate and calcareous clastic rocks ranging in age from the Lower Cambrian to Middle Ordovician geological periods as follows:

Ordovician Period

Martinsburg Formation (Om)

The upper 100 to 200 feet of this formation is a brown, medium-to coarse-grained, fossiliferous sandstone. An olive-green silty shale and dark-gray siltstone comprises the middle portion of this formation, along with a medium-to coarse-grained, locally pebbly sandstone. The Stickley Run Member exists as the lower 400 to 900 feet of the formation. This is a medium-gray to grayish-black, very-fine-grained (aphanitic), very-thin- to thin-bedded, argillaceous limestone with interbedded medium- to dark-gray, calcareous shale.

Edinburg Formation (Oeln)

A black, fine-grained to aphanitic limestone with layered black shale that commonly contains pyrite, and medium- to light-gray, fine- to coarse-grained, nodular limestone with thin partings of black shale. This formation lies in thicknesses ranging from 450 to 1,000 feet throughout the three subject areas.

Lincolnshire Limestone (Oeln)

Gradational contact with the overlying Edinburg. A light- to very-dark-gray, fine- to coarse-grained, medium to very-thick-bedded limestone with black chert nodules. The Murat Limestone Member, generally found at the top of the formation, is a light colored, coarse-grained limestone composed of fossil fragments. Thicknesses throughout the subject areas range from 50 to 250 feet.

New Market Limestone (Oeln)

Unconformable upper contact with the Lincolnshire. The upper unit of this formation is a medium-gray, aphanitic, thick-bedded, limestone with scattered calcite crystals. The lower unit is a medium- to dark-gray, fine-grained, thin-bedded, argillaceous, bioturbated limestone that is dolomitic in parts, with its base being a carbonate pebble conglomerate. Formation thicknesses throughout the subject areas range from 100 to 250 feet.

Pinesburg Station Dolomite* (Ob)

This formation is a medium-to light gray, fine-grained, medium- to thick-bedded dolostone, with sparse fossils. When weathered, this dolomite is very-light-gray, and exhibits a "butcher-block" structure. A medium-gray, fine-grained limestone exists as the base of this unit. The formation's average thickness is 400 feet.

Rockdale Run Formation* (Ob)

The upper contact with the overlying Pinesburg Station is unconformable. This formation is comprised of a medium-gray, fine-grained, fossiliferous limestone and a light- to medium-gray, fine-grained, laminated dolomitic limestone and dolostone with mottled beds. Thin lenses of gray chert are common near the base of the formation. Formation thickness ranges from 1,500 to 2,400 feet.

Stonehenge Limestone* (Ob)

Upper contact with the Rockdale Run Formation is gradational. The upper 400 to 500 feet is comprised of a medium- to dark-gray and black, fine- to medium-grained limestone, with thin beds of macerated fossil debris. The lower 50 to 150 feet (Stoufferstown Member) is a dark-gray to black, fine-grained limestone with thin sheet-like, crinkly partings due to cleavage, and thin beds of coarse-grained, bioclastic limestone.

***Beekmantown Group (Note – This unit consists of the Pinesburg Station Dolomite, Rockdale Run Formation, and the Stonehenge Limestone)**

Cambrian Period

Conococheague Formation (OCco)

The upper contact with the Stonehenge Limestone of the Beekmantown Group is unconformable. The upper 2,000 feet of this formation is a light- to dark-gray, fine-grained, laminated limestone, dolomitic limestone, and dolostone with flat-pebble conglomerate beds. Some cross laminated sandstone beds occur in the uppermost part of this unit. The Lower 200 to 500 feet (Big Spring Station Member) consists of a light-gray, fine-grained dolostone, medium- to dark-gray, fine-grained laminated limestone and dolomitic limestone, and gray, coarse-grained sandstone and dolomitic sandstone. Beds of flat-pebble conglomerate occur in the dolomite.

Elbrook Formation (Ce)

This unit's thickness ranges from 2,000 to 2,500 feet. The formation is a dark- to medium-gray, fine- to medium-grained limestone, dolomitic limestone, dolostone, and dolomitic shale. These lithologies commonly occur as erosion-surface-bounded sequences of algal limestone overlain by laminated dolomite. Decalcified, ocherous shale-like chips on the ground surface characterize this unit. The lower 300 to 400 feet is green to greenish-gray, fine-grained dolostone, dolomitic limestone, and shale.

Waynesboro Formation (Cw)

The upper contact with the Elbrook Formation is gradational. A dusky-red to olive-gray, fine- to medium-grained sandstone and dusky-red to gray shale exists as the upper 300 feet. The middle 400 feet is a medium- to dark-gray, saccharoidal dolomite and fine-grained limestone. The lower 500 feet is dusky-red, olive-gray, and dark-gray shale and dusky-red to brownish-gray, fine- to medium-grained sandstone. Overall thickness is approximately 1,200 feet.

Tomstown Dolomite/Shady Dolomite (Ct/Cs)

The upper 600 feet is light- to dark-gray, fine- to coarse-grained, medium- to thick-bedded, locally laminated dolostone with white chert rosettes and nodules in the upper 50 feet. The middle unit (about 210 feet) is very-light- to medium-gray, medium-grained, very-thick-bedded dolostone and high-magnesium dolostone. The lower unit (about 325 feet) is dark-gray to black, very-fine-grained, thin- to very-thin-bedded limestone and dolomitic limestone with argillaceous laminations. The overall unit thickness ranges from 1,100 to 1,200 feet. The Shady Dolomite is the homologous unit in the southeastern Great Valley at the base of the western edge of the Blue Ridge Mountains.

The Folded Appalachians (Highland County, VA)

The western edge of the Great Valley is demarcated by the North Mountain Fault, and the ridges of Little North and Great North Mountain. Further to the west, Highland County is divided from Augusta County by a series of high mountain ridges and deep intervening valleys, collectively referred to as "Shenandoah Mountain". The rocks underlying this section are younger than those of the Great Valley, dating primarily from the Late Ordovician through the Middle Silurian periods in age, and are all clastic rocks (e.g., sandstone, siltstone, shale, etc.) and not prone to the development of karst terrain.

The first significant karst section going west along the proposed pipeline alignment is Bullpasture Mountain, a large upward fold (anticline) in the eastern part of Highland County. Several large cave systems occur on Bullpasture Mountain and its northern extension in West Virginia, where it is referred to as Simmon's Hill. Numerous sinkholes occur on the summit of the mountain, and also along its western flank. The karst forming units here date from the Upper Silurian through Lower Devonian Periods.

Further west, the next significant karst areas are the deep hollows of the Jack Mountain anticlinorium. Here, the Upper Silurian and Devonian carbonates are exposed at the base of a series of hollows that lie between Little Doe Hill, Doe Hill, and Jack Mountain. On the western slope of Jack Mountain these same units are extensively exposed as well.

The current proposed pipeline route ascends Monterey Mountain to the west of Monterey, Virginia and then crosses the Hightown Valley and Lantz Mountain. Monterey Mountain and Lantz Mountain form the eastern and western limbs of an enormous "breached" anticline, an upward fold whose axial portion has been eroded away, revealing much older carbonate rocks than are present through most of this section, which are more typical of the Great Valley subprovince. The Hightown Valley (and Bluegrass Valley to the north) have extensive karst terrain development, with shallow pinnacled bedrock, frequent rock outcrops, numerous caves and sinkholes, and large perennial springs. The most extensive caves in the area are located within this valley. Soil cover collapse sinkholes are extremely common in the Hightown Valley, especially in pastured fields along the flanks of the ridges where they form drains for water running off the impervious clastic rocks on the slopes above.

Carbonate rocks of Late Silurian and Devonian age are again exposed along the flanks of Lantz Mountain to the west of the Hightown Valley. There are no large caves mapped near the proposed pipeline alignment; however, several large caves are known along the western slope of Lantz Mountain to the north.

Bedrock Geology

The proposed ACP pipeline route in the Folded Appalachians section has been mapped as being underlain by a series of karst-forming carbonate rocks ranging in age from the Lower Ordovician to Lower Devonian geological periods as follows:

Devonian Period

Helderberg Group (Dh)

This group consists of thick (3 to 9 feet) to massively bedded, dark gray/black micritic limestone with reef structures. The limestone shows some degree of recrystallization. The uppermost Helderberg is typically silicified near its contact with the overlying Oriskany sandstone. In many areas the Helderberg gives off a distinct petroliferous odor when freshly broken. The contact with the overlying Oriskany Sandstone is poorly exposed regionally, but the contact with the underlying Tonoloway Formation is distinct where the massive bedding of the Helderberg gives way to the thin-bedding of the Tonoloway Formation. Thickness in the survey area is approximately 400 feet. The group is a major cave forming unit is present in the area.

Silurian Period

Tonoloway Limestone (Sto)

This formation consists of extremely thin bedded (0.5 inches or less) dark gray micritic limestone interbedded with fissile, calcareous shale. The formation gives off a distinct petroliferous odor when freshly broken. The contact with the overlying Helderberg group is distinct; however, it grades into the underlying Wills Creek Limestone. The thickness is approximately 300 feet.

Wills Creek Limestone (Swc)

This formation consists of thin bedded (less than 5 inches) dark gray calcareous shale and fossiliferous micrite, which is poorly exposed in the ACP Project area. The thickness is approximately 200 feet.

Ordovician Period

Middle Ordovician Limestones, Undivided (Olm)

These limestones consist of the Edinburg Formation, the Lincolnshire Formation, and the New Market Limestone. The Edinburg is a black, fine-grained to aphanitic limestone with layered black shale that commonly contains pyrite, and medium- to light-gray, fine- to coarse-grained, nodular limestone with thin partings of black shale. Thickness is 400 feet to 500 feet. The Edinburg grades downward into the Lincolnshire Formation, a light- to very-dark-gray, fine- to coarse-grained, medium to very-thick-bedded limestone with black chert nodules. Thicknesses throughout the ACP Project area range from 25 to 250 feet. This unit is underlain by the New Market Limestone. The upper contact with the Lincolnshire is generally unconformable. The upper unit of this formation is a medium-gray, aphanitic, thick-bedded, limestone with scattered calcite crystals. The lower unit is a medium- to dark-gray, fine-grained, thin-bedded, argillaceous, bioturbated limestone that is dolomitic in parts, with its base being a carbonate pebble conglomerate. Formation thicknesses throughout the ACP Project area range from 0 to 150 feet.

Beekmantown Formation (Ob)

This formation is a medium-to light gray, fine-grained, medium- to thick-bedded dolostone, with sparse fossils. When weathered, this dolomite is very-light-gray, and exhibits a "butcher-block" structure. A medium-gray, fine-grained limestone exists as the base of this unit. This formation is comprised of a medium-gray, fine-grained, fossiliferous limestone and a light- to medium-gray, fine-grained, laminated dolomitic limestone and dolostone with mottled beds. Thin lenses of gray chert are common near the base of the formation. Formation thickness ranges from 1,500 to 2,400 feet. The Beekmantown Formation typically consists of three members, which although distinct in the Great Valley region are hard to distinguish in the Folded Appalachian province.

The Allegheny Front & Appalachian Plateau (Pocahontas, Randolph Counties, WV)

The proposed pipeline route ascends the steep slopes of Allegheny Mountain after leaving Highland County, Virginia and crosses primarily clastic rocks not prone to the development of karst terrain. On the west side of Allegheny Mountain, the pipeline route descends into the valley of the Greenbrier River. Near Durbin, West Virginia, and on either flank of Cheat Mountain to the west, Mississippian Age carbonates of the Greenbrier Group are exposed in thin bands not more than 0.25 to 0.4 mile in diameter.

In general, the Greenbrier Group carbonates exhibit a high density of karst features relative to the other two karst sections along the pipeline route. There are several factors that contribute to this, the main one being that the Greenbrier carbonates act as a drain system for groundwater infiltrating downward through the fractures in the clastic rocks above them. Where they are exposed along the mountain flanks, the steep groundwater gradients have enhanced this cavern development. In many places, surface water plunges directly into the carbonates via steep-walled, open throat sinkholes (swallets). Most of the caves are linear networks, and exhibit conduit flow, capturing surface streams up-gradient which then emerge as springs at the down-gradient end.

Bedrock Geology

The proposed ACP Project area in the Appalachian Plateau section is mapped as being underlain exclusively by the karst-forming carbonate rocks of the Greenbrier Group described as follows:

Mississippian Period

Greenbrier Group (Mg)

In the Project area, the Greenbrier Group (or "Big Lime" as it is known locally) is up to 400 feet in thickness. It is primarily a gray to dark gray, massively bedded marine limestone, with interbeds of red and green marine and nonmarine shale and thin discontinuous beds of sandstone. The Group is divided into six stratigraphic units. From oldest to youngest these are: the Denmar Limestone, Taggard Shale, Pickaway Limestone, Union Limestone, Greenville Shale, and Alderson Limestone. The principle cave forming units are the Pickaway and Union limestones.

Pre-Construction Assessment and Field Survey

The proposed ACP/SHP involves the installation of a gas pipeline extending through West Virginia, Virginia, and into southern North Carolina. The currently proposed pipeline construction alignment information shows that the primary route being considered for the pipeline passes across approximately 32.5 miles of karst terrain located in Randolph and Pocahontas Counties in West Virginia, and Highland and Augusta Counties in Virginia, based on regional geological mapping. Two alternate routes were also being investigated: the MNF-5 Route, encompassing 11.2 miles of karst terrain in Randolph and Pocahontas Counties West Virginia, and Highland County, Virginia; and the AT South Crossing, encompassing 4.6 miles of karst terrain in Augusta County, Virginia, except where access was prohibited by the landowner.

The "Area of Interest" (hereinafter referred to as the "AOI") assessed by data desktop review generally extended 0.25 mile from either side of the centerline of the proposed pipeline and alternate routes, and 150 feet from the centerline for field review. However, if observed or mapped karst features received drainage from the proposed pipeline work area then these features were delineated to the extent possible, and included in the assessment, even if they were outside of these perimeters.

Thus, the pre-construction assessment and field survey scope can be summarized as follows:

- Located and delineated surface karst features (e.g., sinkholes and karst related subsidence, cave entrances, closed depressions, and sinking and losing streams) within the AOI, with particular emphasis on features that had a direct connection with the phreatic zone such as "open-throat" sinkholes, karst windows, cave entrances, abandoned wells, sinking streams, and areas that

could affect the integrity of the pipeline, such as actively forming cover-collapse sinks, areas of soil subsidence, or caves which have passages that extend below the proposed right-of-way at elevations less than 15 feet below the surface. Direct field observations were made by conducting a site reconnaissance over the entire AOI.

- Delineated zones of karst terrain, subsidence, and drainages based on the surface karst features assessment.
- Prepare a report summarizing the methods and findings of the assessment.

Methods and Procedures

The above scope of services was accomplished by the following means:

Existing Data Review and Analysis

Potential karst features were identified remotely and/or by database review, and then their presence was confirmed in the field. This process helped to focus the actual field location and survey tasks. The following sources were reviewed:

1. The (proprietary) Cave Databases of the Virginia Speleological Survey (VSS) and the West Virginia Speleological Survey (WVSS);
2. Caves of Virginia (Douglas, 1961);
3. Description of Virginia Caves (Holsinger, 1975);
4. Caverns of West Virginia (Davies, 1965);
5. Maps of selected karst features (sinkholes, caves, springs) available from the Virginia Division of Mines and Mineral Resources and the United State Geological Survey (USGS);
6. 2-foot and 4-foot contour interval maps for the AOI (to determine the presence of surface karst features not included in the above listed databases based on the presence of closed, descending contours or other suspect karst "fingerprint" features);
7. LIDAR data (where available);
8. Aerial photographs (both recent and historical);
9. USGS Topographic 7.5-minute topographic quadrangles;
10. Sinkhole and depression locations available from the U.S. Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) soil studies for the Counties through which the ACP will pass.
11. Weary, D.J. and D.H. Doctor. 2014. Karst in the United States: A digital map compilation and database, USGS open-file report 2014-1156, 23p

In addition, the survey team reviewed the readily available geological literature for bedrock and structural characteristics, relying upon the closest resolution mapping that existed for the particular AOI being examined.

Field Reconnaissance

Upon completion of the existing data review activities for a specific area, GeoConcepts will undertake field reconnaissance and survey activities. Specifically, the field reconnaissance will entail:

1. Location and verification of surface karst features identified in the database review;
2. Location of uncatalogued or previously unidentified surface karst features, specifically sinkholes, cave entrances, dry runs and sinking streams.

The field reconnaissance will place particular emphasis on locations where pathways existed to phreatic groundwater such as open-throat sinkholes, cave entrances, karst "windows", and sinking streams.

Potential reroutes will be identified based on the field observation of sensitive karst features, such as significant caves, sinking streams, or open throat sinkholes.

The AOI will be delineated and the path of the AOI was examined for karst features (both catalogued and previously unidentified) by field survey. This will entail conducting a site reconnaissance over the AOI (i.e., the proposed pipeline route) in a systematic manner, to observe any existing surface karst features that fit the criteria. The locations and outlines of all relevant features were recorded using a sub-meter accurate Global Positioning System (GPS) device. For the purpose of this study, the outline (parapet) of sinkholes were defined by the last closed descending contour at mapping interval available for the area under study. Cave entrances were identified as single points, unless the entrance was located within a larger sinkhole structure, in which case the cave entrance was indicated as a point within the sinkhole's parapet. Sinking streams were located as points of entry into the subsurface; however, losing streams were identified as linear features.

All digital data will be transmitted in the Universal Transverse Mercator (UTM) Coordinate system. The horizontal datum of reference is NAD83.

Summary Report

The results of the data review and field survey will be summarized in a final report. The report will detail the methods and findings, and will contain an inventory, and delineation of karst features and terrain. The frequency and density of karst features will be correlated with the encompassing geological unit at the formational level (e.g., Elbrook Formation, etc.). The report will be accompanied by a data set containing the attributed digital points and polygon data as shapefiles with metadata (maps and/or tables). The report shall include a description of how the project was designed to avoid known karst features.

Construction Monitoring

The purpose of this section of the plan is to establish a standard set of monitoring protocols for karst features encompassed by the proposed ACP pipeline right-of-way and adjacent areas. The intent of these protocols is to minimize impact to the subterranean environment, ensure water quality, and protect the integrity of the pipeline.

I. Geophysical Survey

To obtain more information about the subsurface conditions, and possible karst development along the proposed ACP pipeline alignment, an electrical resistivity investigation (ERI) will be conducted in the areas that are mapped with limestone bedrock. The ERI will be performed along the entire length of the pipeline centerline following vegetation clearing but prior to any earth-disturbance and/or excavation activity.

Instrumentation

The geophysical survey instrument which will be used during this survey is an electrical resistivity meter that maps the resistivity changes in the earth. Resistivity refers to the electrical resistance of a material. The ERI survey will be conducted by introducing a measured current into the earth through two electrodes and measuring the resultant voltage (i.e., potential) across two different electrodes. At the low currents used, voltage is proportional to the current. The meter measures the voltage/current ratio or resistance in Ohms.

The ERI survey will be conducted using an earth resistivity meter which measures the apparent conductivity of the subsurface employing an artificial source that is introduced through point electrodes. The automatic electrode system is designed to optimize survey efficiency by gathering maximum information with a minimum of electrodes. The instrument also uses redundancies in the data set to

reduce the effects of lateral heterogeneities in the earth and to calculate uncertainties in the data. The survey will be conducted automatically using a dipole-dipole array system.

Interpretation Method

The ERI data will be converted into a resistivity depth model using a Rapid 2D resistivity inversion model and the least-squares method (RES2DINV). Soundings from each line will be modeled to produce the measured apparent resistivity pseudo-sections. The model will calculate the apparent resistivity pseudo-sections using finite-difference forward modeling. The least-squares optimization technique will be used for the inversion routine that calculates the modeled resistivity section. The generated profiles will include cross-sections that consist of the inverse model resistivity cross-section. The horizontal and vertical scales will be in meters.

The cross-section is the inverse model resistivity pseudo-section. The ER data will be converted into a resistivity depth model (RES2DINV) using a resistivity inversion model by the least-squares method, which will be topographically corrected. RES2DINV will confirm the model reliability by calculating the modeled data into empirical data or the calculated resistivity pseudo-section. The difference between the measured and calculated data is the percent error. The modeled calculated error will be calculated within the five percent range, which is considered very accurate.

Low resistive materials can be caused by certain conductive soils, such as clay, wet silts, and sands, or ionized water. High resistive materials are caused generally by porous soils (i.e., poorly consolidated gravels), laminated bedrock with interstitial clay-filled voids, wood, or large, air-filled cavities. Lower ER anomalies are generally associated with soil-filled voids, saturated sinkhole soils, and water-bearing fractures. High ER anomalies are frequently associated with caverns, buried air filled structures, or weathered, laminated bedrock with air filled cavities.

Resistivity values can vary widely as the geology, mineralogy, and stratigraphy changes from site to site. Therefore, it is important to correlate resistivity results with boring logs for equivalent sections at a specific locality. Typical values are:

Subsurface Material	Resistivity Range (Ωm)
Topsoil	1 – 10
Clays	10 – 100
Sands and Gravels (unconsolidated)	600 – 10,000
Fresh Water	3 – 100
Limestone	100 – 10,000
Sandstone	100 – 1,000
Igneous and Metamorphic Rocks	100 – 1,000,000
Open Voids (i.e. caverns, solution conduits)	>10,000

Although the above values are characteristic of various subsurface materials, the absolute resistivity ranges will vary considerably depending on the local geology. Therefore, it is required that the ERI survey is calibrated using soil test borings. In addition, if high ER anomalies are detected, their locations will need to be documented and further investigated. The specific type of investigation will be dictated by the characteristics of each anomaly identified.

II. Inspection Protocols

Pre-Construction Inspection

Prior to the commencement of any earth disturbance activity, the area of the pipeline that will be affected by the planned activities will be inspected by the karst specialist (KS) as follows:

a. The KS will inspect the entire section of the pipeline right-of-way in the designated work area, and note any suspect karst features including sinkholes, caves, areas of soil subsidence, or closed depressions.

b. The locations of observed features will be noted on site drawings and flagged for surveying and/or recorded using sub-meter accuracy GPS instrumentation.

c. The KS will issue a report summarizing the findings of the inspection. Findings will supplement the summary report and shall include an inventory of feature type(s), drainages, and potential impact to the feature by the planned activities, and recommendations to limit impacts if they are expected.

d. Features that are considered to have potential impact are: caves, sinkholes with throats, ponors, open solution cavities, abandoned wells, and sinking streams. (Note – If a sinkhole throat is filled, the type of fill, i.e. rock, soil, flood debris, etc., will be described in detail).

e. Features that are not considered to have a potential impact are: soil-bottomed (stable) sinkholes (i.e., no evidence of recent soil raveling or tension cracks along the parapet), karst springs, or non-karst closed depressions.

f. The pre-construction inspection will have a "shelf-life" of 1 year from the day of the inspection. If work does not commence within 1 year, a new inspection will need to be completed prior to any earth disturbing activities.

g. The pre-construction inspection report shall be delivered to Atlantic/DTI no later than 1-month after the completion of the field survey.

Monitoring of Pre-Identified Features during Construction

Features identified during the pre-construction inspection will be monitored as follows:

a. If an identified feature with potential impact to the subterranean environment falls within the area designated for earth disturbing activities, the feature will be documented by field location and with photographs, and then assessed for pre-construction remediation by Atlantic/DTI staff with input and guidance to be provided by the KS. Remediation will be in compliance with the USDA-NRCS's Conservation Practice Standard Code 527 "Karst Sinkhole Treatment" (2010) and the West Virginia Department of Environmental Protection Division of Water and Waste Management Ground Water Protection Program Sinkhole Mitigation Guidance, August 8, 2005. (see Appendix A)

b. If a feature that has potential impact falls within the right-of-way but is not intercepted by the excavation, that feature will be monitored during the work by Atlantic/DTI staff for changes such as:

    1. soil subsidence;
    2. rock collapse;
    3. sedimentation;
    4. increased surface water infiltration;
    5. flooding;
    6. clogging; and/or other changes in morphology or function that might indicate potential impact to the epikarst stratum caused by the work.

c. All features, whether remediated or left in an undisturbed natural state, will be monitored by Atlantic/DTI staff, or their designee, for any changes in appearance, drainage, siltation, etc., at 1 year, 2 year, and 5 year intervals after the completion of the earth disturbing activities. If changes in the features are observed, Atlantic/DTI staff will report the condition to the KS who will provide consultation on potential impacts to the karst environment and possible remedial actions.

Monitoring of Features that are intercepted during Construction

Features that are intercepted during construction shall be monitored as follows:

Level 1 Inspection of Features intercepted during construction

If any feature is intercepted during work activities including drilling, blasting, and excavation or trenching, the onsite geologist will conduct an initial assessment of the feature to determine if further inspection (Level 2) by the KS will be required. Suspect features shall include:

1. Bedrock enclosed conduits or voids;
2. Solution pockets that extend beyond visual examination range (and therefore may be open);
3. Areas of soft soils;
4. Soil voids;
5. Highly fractured bedrock;
6. Areas of breccia enclosed within the surrounding bedrock.

Level 2 Inspection of Features intercepted during Construction

If any of the aforementioned features are observed during the Level 1 inspection, work will stop within a 100-foot radius of the feature, and then the KS will conduct a Level 2 inspection as follows:

a. The KS will examine the feature and determine if it has potential impact to the subterranean environment based on potential connectivity with the phreatic aquifer via the epikarst stratum. The choice of characterization methods will be determined by the KS, and will include any combination of (but not be limited to):

    1. visual assessment;
    2 geophysical survey;
    3 track drill probes;
    4. infiltration or dye trace testing; or
    5. other techniques utilized to facilitate subsurface characterization of karst features.

b. If the feature is determined to have potential impact to the subterranean environment, the KS will advise Atlantic/DTI staff regarding appropriate remedial actions.

c. If the feature is determined to not have potential impact to the subterranean environment, work will resume as planned.

d. All features that are intercepted during construction and subsequently remediated will be located by Atlantic/DTI staff surveyors exclusively, and monitored by Atlantic/DTI staff, or their designee, for any changes in appearance, drainage, siltation, etc., at 1 year, 2 year, and 5 year intervals after the completion of the earth disturbing activities. If any changes are observed, the KS will provide consultation on potential impact and recommend remedial actions, if necessary.

e. All Level 2 inspections, findings, and remedial activity will be summarized in a report by the KS, to be delivered to Atlantic/DTI after the completion of the field work.

Monitoring of Features that Form During Construction

Features that form during construction will be monitored as follows:

Level 1 Inspection of Features that form during construction

If any feature forms during work activities including hydrostatic testing, drilling, blasting, and excavation or trenching, Atlantic/DTI staff will conduct an initial assessment of the feature to determine if further inspection (Level 2) by the KS will be required. Suspect features will include:

a. Sinkholes;
b. Soil subsidence areas; and/or
c. Rock collapses.

This will apply to any of the above features that may form either within the work area, whether located along the proposed disturbance section or anywhere within the covered lands within a 100-yard radius the work area.

Level 2 Inspection of Features that form during Construction

If any of the aforementioned features are observed during the Level 1 inspection, work will stop in the area of the feature based on the observed site conditions, and then the KS will conduct a Level 2 Inspection as follows:

a. The KS will examine the feature and determine if it has potential impact to the subterranean environment based on potential hydraulic connectivity with the phreatic aquifer via the epikarst stratum.

b. The choice of characterization methods will be determined by the KS, and will include any combination of (but not be limited to) the following:

    a. visual assessment;
    b. electrical resistivity survey;
    c. track drill probes;
    d. infiltration testing; and/or
    e. other techniques utilized to perform subsurface characterization of karst features.

c. If the feature is determined to have potential impact to the subterranean environment, the KS will consult with Atlantic/ DTI staff regarding appropriate remedial actions.

d. If the feature is determined to not have potential impact to the subterranean environment, work will commence as planned.

e. All features that form during construction, whether remediated or left in an undisturbed natural state, will be located on the site plans by the Atlantic/DTI staff surveyors, and will be monitored for any changes in appearance, drainage, siltation, etc. at 1 year, 2 year, and 5 year intervals after the completion of the earth disturbing activities. If any changes are observed, the KS will provide consultation on potential impact to the karst environment and remedial actions, if necessary. This monitoring will be carried out on all features that form during work activities, regardless of whether they have a potential impact to the karst environment or not.

Karst Mitigation and Conservation Procedures

The following procedures will be used for the mitigation of karst features that may have potential impact on the structural integrity of the pipeline, impact groundwater quality and quantity, or present a risk to human and/or environmental receptors. Please note that other resource protection measures that may be implemented for the ACP may provide redundancy with regard to the karst mitigation and conservation procedures detailed herein Additionally, there may be opportunities to utilize silt fencing or other measures identified for ESC and slope stabilization.

Measures to Avoid Impact to the Karst Aquifer and Environment

These measures shall apply to any karst feature which allows the unfiltered and unimpeded flow of surface drainage into the subsurface environment, including (but not limited to): open throat sinkholes, caves which receive surface drainage, sinking streams, and losing stream segments.

1. Protect known and/or future mapped recharge areas of cave streams and other karst features by following relevant conservation standards, specifically those pertaining to stream and wetland crossings and spill prevention, containment, and control.

2. Buffers of 300 feet around karst features[1] in all work areas (within and off the right-of-way, including discharge areas) must be clearly marked in the field with signs and/or highly visible flagging until construction related ground disturbing activities are completed.

3. Earth disturbing activities will be conducted in a manner that minimizes alteration of existing grade and hydrology of existing surficial karst features. Land disturbances including permanent filling, excavating, or otherwise altering existing karst features, or any of these activities within 300 feet of a feature, will be avoided, if possible, or minimized. In addition to the aforementioned requirements, the following will be implemented in these areas:

    a. If new open throated sinkholes form within the right-of-way or construction work area, work in that area will stop and the sinkhole will be isolated from the rest of the work area with sandbags or other suitable materials. The sinkhole will be inspected and appropriate action taken (e.g., pipeline relocated, sinkhole remediated, etc.) to ensure pipeline integrity and protection of the aquatic resource and subterranean habitat. If the sinkhole must be filled, an inverted filter to bridge the karst feature above the water table rather than filling it below will generally be used (see Appendix A).

    b. If a subsurface void should open or be intersected or a new sinkhole forms within the right-of-way or construction work area, work in that area will stop and the void will be isolated from the rest of the work area with sandbags or other suitable materials. The void will be inspected by the KS and appropriate action taken including filter fabric secured over the void and other such measures as necessary (e.g. pipeline relocated, sinkhole remediated, etc.) to ensure pipeline integrity and protection of the aquatic resource and subterranean habitat (standard operating procedures for sinkhole remediation can be found in Appendix A).

    c. In linear excavations adjacent to karst features, spoils will be placed on the upgradient side of the excavation so that if any erosion takes place the stockpiled soil will flow back into the excavation and not down-gradient towards the karst feature.

    d. Surface water control measures, including, but not limited to: diversion (direct water flow into trench or off right-of-way areas past the area of concern), detention or collection and transportation, will be utilized to prevent construction-influenced surface water from free flowing into open throated surface karst features, and eventually into the subsurface.

    e. Open throated surface karst features will not be utilized for the disposal of water.

4. Blasting will be conducted in a manner that will not compromise the structural integrity or alter the karst hydrology of known or inferred subsurface karst structures. If rock is required to be hammered or blasted out of the way of a new pipeline installation, then the following parameters will be adhered to:

    a. The excavation will be carefully inspected for any voids, openings or other tell-tale signs of solution activity.

    b. If the rock removal intercepts an open void, channel, or cave, the work in that area will be stopped until a remedial assessment can be carried out by a qualified geologist or engineer with experience in karst terrain.

    c. All use of explosives will be limited to low-force charges that are designed to transfer the explosive force only to the rock which is designated for removal (e.g., maximum charge of 2 inches per second ground acceleration).

    d. If the track drill used to prepare the hole(s) for the explosive charge(s) encounters a subsurface void larger than 6 inches within the first 10 feet of bedrock, or a group of voids totaling more than 6 inches within the first 10 feet of bedrock, then explosives should not be used (or) a subsurface exploration should be conducted to determine if the voids have

[1]specific Specific geologic structures that characterize the karst landscape including sinkholes, caves, sinking or losing streams, ponors, pinnacled bedrock, and large springs.

connectivity with a deeper structure. The subsurface exploration can be carried out with track drill probes, coring drill, electrical resistivity, or other techniques capable of resolving open voids in the underlying bedrock. If a track drill or coring rig is used, then all open holes will be grouted shut after the completion of the investigation.

5. Horizontal Directional Drilling (HDD) will not be used in karst terrain.
6. If authorized by the landowner, block (e.g. gate) all access roads and rights-of-way leading to cave entrances or open throat sinkhole structures to prevent unauthorized access.
7. Comply with requirements of project SPCC plan.
8. A Spill Prevention, Control, and Countermeasures Plan (SPCC) has been developed for the proposed ACP/SHP which will further avoid and minimize potential impact of spills by implementing the following measures:
    a. equipment refueling will not be performed within flagged or marked buffer areas of streambeds, sinkholes, fissures, or areas draining into these or other karst features, except by hand-carried cans (5 gallon maximum capacity) when necessary;
    b. equipment servicing and maintenance areas will be sited outside of flagged or marked buffer areas of streambeds, sinkholes, fissures, or areas draining into these or other karst features;
    c. prevent runoff resulting from construction equipment washing operations to directly enter any karst feature by locating these operations outside of the buffer area;
    d. construction equipment vehicles, materials, hazardous materials, chemicals, fuels, lubricating oils, and petroleum products will not be parked, stored, or serviced within 300 feet of any karst feature;
    e. all equipment will be checked by a construction inspector daily for leaks prior to beginning work in karst areas; damaged or defective equipment will be removed or repaired; and
    f. if a reportable spill has impacted a karst feature:
        i. follow the SPCC Plan and
        ii. call the National Response Center (800-424-8802) and the Virginia Department of Environmental Quality (800-469-8892) or the West Virginia Department of Environmental Protection (304-558-5938), as appropriate.
9. Hydrostatic test water will not be obtained from karst features (only free-flowing streams). Water from these sources will be withdrawn at a rate that does not reduce downstream flows by more than 25 percent.
10. Do not discharge hydrostatic testing water from new pipe directly into flagged or marked buffer areas of sinkholes, fissures, or other karst features or channels or surface features that flow towards those features. Discharge hydrostatic testing water in the following manner (in order of priority and preference):
    a. Discharge hydrostatic test water down-gradient of flagged or marked buffer areas of sinkholes, fissures, or other karst features unless on-the-ground circumstances (e.g., man-made structures, terrain, other sensitive resources) prevent such discharge.
    b. If those circumstances occur, discharge water into uplands greater than 300 feet from flagged or marked buffer areas of sinkholes, fissures, or other karst features unless on-the-ground circumstances (e.g. man-made structures, terrain, other sensitive resources) prevent such discharge.
    c. If not practicable, discharge water as far from flagged or marked sinkholes, fissures, or other karst features as practical and utilize additional sediment and water flow control devices to minimize effects.

References

Campbell, E. V., Williams, S. T., Duncan, I. J., Hibbits, H. A., Floyd, J. M., Reis, J. S. and G. P. Wilkes, 2006, Interstate 81 Corridor Digital Geologic Compilation: Virginia Department Mines, Minerals, and Energy - Division Mineral Resources, Open File Report 06-01.

Davies, W. E., 1958, Caverns of West Virginia, State of West Virginia Geologic and Economic Survey. Volume XIX A., reprinted with supplement, 1965.

Denton, R. K. Jr., 2013, Towards a Karst Assessment Standard Practice, Proceedings of the 13th Conference on Engineering and the Environment in Karst, National Cave and Karst Research Institute, Carlsbad, NM.

Douglas, Henry H., 1964, Caves of Virginia: Virginia Cave Survey, Falls Church, VA, 761 p.

Field, Malcolm, 2002, A Lexicon of Cave and Karst Terminology with Special Reference to Environmental Karst Hydrology: United States Environmental Protection Agency, EPA/600/R-02/003.

Ford, D. C., and P. W. Williams, 1989, Karst Geomorphology and Hydrology, University Press, Cambridge, Great Britain.

Hubbard, Jr. David, 1988, Selected Karst Features of the Central Valley and Ridge Province, Virginia: Virginia Division Mineral Resources, publication 83.

Hubbard, D. A., Jr., 2003, Use of regional sinkhole mapping for sinkhole susceptibility maps. *In* Beck, B. F., ed., ASCE Geotechnical Special Publication No. 122, p. 61-71.

Medville, D. M., and H. E. Medville, 1995, Caves and Karst of Randolph County, West Virginia Speleological Survey, Bulletin 13.

Moore, Clyde H. and William J. Wade, 2013, Carbonate Reservoirs: Porosity and Diagenesis in a Sequence Stratigraphic Framework, 2nd Edition, Elsevier.

NiSource Multi-Species Habitat Conservation Plan, Appendix L-9 – L-13, Sinkhole Mitigation Procedures, USFWS June 2013.

Rader, Eugene K., and Thomas M. Gathright, 2001, Geologic Map of the Augusta, Page, and Rockingham Counties Portion of the Charlottesville 30 x 60 Minute Quadrangle: Publication 159, Virginia Department Mines, Minerals, and Energy - Division Mineral Resources.

Rader, Eugene K. and G. P. Wilkes, 2001, Geologic Map of the Virginia Portion of the Staunton 30 x 60 Minute Quadrangle, VDMME-DMR, Charlottesville, VA, Pub. 163.

Southworth, S., Aleinikoff, J., N., Bailey, C. M., Burton, W. C., Crider, E. A., Hackley, P. C., Moot, J. P., and R. P. Tollo, 2009, Geologic Map of the Shenandoah National Park Region, Virginia: U. S. Geological Survey Open File Report 2009-1153.

Virginia Division of Mineral Resources, 1993, Geologic map of Virginia: scale 1:500,000.

West Virginia DEP, 2005, Sinkhole Mitigation Guidance Document, August 8, 2005, WVDEP Division of Water and Waste Management, Groundwater Protection Program.

Appendix A – Sinkhole Mitigation Guidance Documents

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

KARST SINKHOLE TREATMENT

(No.)

CODE 527

DEFINITION

The treatment of sinkholes in karst areas to reduce contamination of groundwater resources, and/or to improve farm safety.

PURPOSE

This practice may be applied as part of a conservation management system in karst topography, which is an area underlain by solutioned carbonate bedrock with sinkholes and caverns. The practice supports one or more of the following purposes:

- Improve water quality
- Improve farm safety

CONDITIONS WHERE PRACTICE APPLIES

On any land surface or in conjunction with any existing practice where the soils and geologic conditions are characterized by sinkholes or karst topography.

This practice does not apply to erosional or collapse features caused by failure or leakage of underground pipes or constructed surface drainage features (e.g., canals), or due to piping of unstable soil materials, or due to poorly compacted or poorly constructed features.

This practice does not apply to sinkholes that may appear in or beneath structures or in flowing streams. Treatment of sinkholes in these areas will be determined through engineering investigations and structural design solutions.

CRITERIA

General Criteria Applicable to all Purposes

The installation and operation of karst sinkhole treatment(s) will comply with all Federal, State, and local laws, rules, and regulations.

A geologic investigation of the potential impact of the treatment on groundwater, surface water run-in, and the karst features will be conducted by a qualified geologist.

Trash and other material will be removed from the sinkhole and disposed of in an environmentally sound manner.

Excess surface water caused by construction activities will be diverted from the sinkhole area.

Nutrient and pest management plans will be developed for the drainage area of the sinkhole controlled by the landowner.

Vegetative Treatment. All sinkholes treated will have a vegetated buffer established and/or maintained. The buffer will be a minimum of 25-feet wide measured from the rim of the sinkhole. The buffer area may be extended to prevent concentrated flow channels from occurring and entering the sinkhole. The width of the vegetated buffer will be established and maintained in accordance with the type of buffer chosen. The sinkhole and surrounding buffer area will be fenced.

Livestock will be excluded from the vegetative buffer except when grazing would be beneficial to maintenance of the buffer.

Nutrients, herbicides, pesticides, and animal waste will not be applied within an established buffer area. Only mechanical treatments shall be used for weed control.

Appropriate erosion and sediment control measures will be used to reduce the amount of sediment entering sinkhole openings during the establishment of the vegetative buffer.

Surface Water Control. Changes to the volume of surface water that enters a sinkhole may disturb the underground hydrology. To the extent possible, the surface water flow should be maintained at historic (or predevelopment) volumes.

Pre-existing concentrated flow channels will be stabilized but should not otherwise be altered. If a plug or inverted filter is used, the area to be protected will be characterized by a qualified Geologist to enable a suitable design. Concentrated flow caused by construction activities will be dispersed with a suitable spreading or diversion technique.

Sinkhole Treatment/Closing. Adequate protection of most sinkhole and sinkhole areas can be achieved by the use of vegetative buffers and livestock exclusion. However, if an open sinkhole is a safety hazard, it may be treated with a rock filter, gabions, or other methods approved by the State Conservation Engineer or delegated authority.

Sinkholes to be treated or closed via a reverse filter or plug shall be excavated to stable, unweathered bedrock, if possible, prior to construction.

Sinkholes that open into caves shall not be filled under any circumstances. Gated openings may be used for safety reasons.

CONSIDERATIONS

Current and planned land use should be considered. In particular, structures, septic drain fields, wells, feedlots, ponds, and animal waste storage systems should not be located over a sinkhole site or within the impact area.

Sinkholes may be natural conveyances of organic material and nutrients important to cave fauna.

For a sinkhole receiving contaminated overland flow, every effort should be made to first treat the source of the contamination. Although it is important to maintain the hydrology of the karst system, it may be more beneficial to the groundwater quality to divert the contaminated water away from the sinkhole. In some cases, it may be necessary to completely plug a sinkhole with sealing materials rather than treat it with an inverted filter. Acceptable sealing materials are provided in ASTM D 5299, part 6.4. An example of this would be a sinkhole in a feedlot or a site that is difficult to protect by any other method.

The sinkhole treatment should not result in excessive surface water ponding or high soil moisture conditions over an extended period of time.

When filling a sinkhole, mounding of the fill material may be needed to offset future settlement due to consolidation and migration of the fill material into subsurface voids. Additional fill may be required as treatment ages.

Treatment of one sinkhole may have an effect on other sinkholes or solution features in the vicinity.

The use of a conservation easement for the buffer and sinkhole should be considered.

PLANS AND SPECIFICATIONS

Plans and specifications for Sinkhole and Sinkhole Area Treatment will be in keeping with this standard and will describe the requirements for applying the practice to achieve its intended purpose.

Plans and specifications shall include the following:

- Plan view showing sinkhole and sinkhole area Include topographic information and photographs
- The geologic investigation will include a study of potential impacts on the karst resource
- Depth to stable, unweathered bedrock
- Description of planned treatment measures
- The drainage area of sinkhole delineated on a topographic map
- Availability of safe outlet for surface water, if applicable
- Operation and Maintenance requirements
- Special safety requirements

OPERATION AND MAINTENANCE

An operation and maintenance (O&M) plan will provide specific instructions for maintaining the sinkhole and sinkhole area treatment, including reference to periodic inspections and the prompt repair and/or replacement of damaged components.

West Virginia Department of Environmental Protection
Division of Water and Waste Management
Groundwater Protection Program

Sinkhole Mitigation Guidance

August 8, 2005

Purpose:

These sinkhole mitigation designs serve to allow the filling of sinkholes while maintaining recharge to the aquifer, reducing potential contamination threats to groundwater, and eliminating safety hazards at sinkhole entries.

General:

Consideration should be given to the method used for removing contaminated materials from sinkholes and reducing or eliminating direct inflow of surface water into sinkholes. Land treatment methods that improve the filtration and infiltration of surface water before it enters the sinkhole should be used along with the mitigation of the sinkhole.

Before selecting a treatment option the following should be considered:

- Land use
- Existing and planned land treatment
- Sinkhole drainage area
- Dimensions of the sinkhole opening
- Safe outlet for diverted surface water
- Environmentally safe disposal of sinkhole “clean out” material
- Availability and quality of filter material
- Safety of equipment and operators and laborers during installation

Treatment selection should be based on the dimensions of the sinkhole drainage area and include direct sinkhole treatment with surface water control measures and filter strips. Whichever treatment option is chosen, it should avoid surface water ponding or the creation of high soil moisture conditions in excess of 72 hours.

Treatment designs apply to sinkholes with excavated depths of 5 to 25 feet and with drainage areas up to 15 acres. Excavations up to 5 feet are sufficient for most sinkholes. Sinkholes with excavation depths of greater than 25 feet or with uncontrolled drainage areas greater than 15 acres may require adjustments to the treatment measure(s) and/or surface water control measure(s). In these cases, geologic and engineering assistance must be obtained and a site-specific treatment design prepared.

Treatment for Sinkholes with Drainage Areas Less than 5 Acres

Treat the sinkhole using the mitigation design in Figure 1 of this guidance document. The treatment site should be inspected after periods of heavy precipitation because some material may run into adjacent sinkhole voids causing a surface depression. In this case, maintenance will include adding soil material at the surface. The existing land use or practice may continue over the treated sinkhole as long as the treatment is maintained.

Treatment for Sinkholes with Drainage Areas of 5 Acres or More and Having a Safe Outlet

The following additional treatment criteria are applicable to sinkholes with drainage areas of 5 acres or more where a safe outlet can be provided to divert surface water away from the sinkhole. A safe outlet is one that does not erode, divert surface water to another sinkhole or injection well, or cause flood damage to crops, property, buildings, or highways/roads.

Surface water control measures should be situated to reduce the internal drainage area around the sinkhole to less than 5 acres. The choice of surface water control measures is generally based on site-specific conditions.

Treatment for Sinkholes with Drainage Areas of 5 to 15 acres and Having No Safe Outlet

Treat the sinkhole using the mitigation design in Figure 2 of this guidance document. The site should be inspected after periods of heavy precipitation because some material may run into adjacent sinkhole voids causing a surface depression. In this case, maintenance will include adding soil material at the surface. The sinkhole should remain as unused land.

Vegetated Buffer Area

A vegetated buffer area should be installed around the sinkhole to improve runoff water quality by filtration and adsorption of contaminants. The vegetated buffer area should be installed within the sinkhole drainage area and should begin at the treated sinkhole.

The minimum width (in feet) of the vegetated buffer area is determined by multiplying the sinkhole drainage area (in acres) by seven. This width should provide beneficial filtering for some distance outside the sinkhole because surface water runoff may be temporarily held before reaching the treated sinkhole.

Appropriate vegetation should be used for the buffer area. Use native vegetation as much as possible. **DO NOT** use noxious plants or weeds. It is recommended that a plant nursery be consulted for the appropriate vegetation.

Acceptable Materials

Engineering fabric - must meet the applicable requirements of AASHTO M-288.

Aggregates – fine aggregates, gravel, or rock rip rap that conforms to the West Virginia Department of Highways, Standard Specifications for Roads and Bridges, Sections 702, 703, and 704.

Specifications

Use the following guidance for installing a mitigation design for sinkholes and sinkhole areas with drainage areas of less than 5 acres:

1. Remove and properly dispose of materials dumped in and around the sinkhole in accordance with applicable federal, state, and local laws.

2. Excavate loose material from the sinkhole and try to expose the solution void(s) in the bottom. Enlarge the sinkhole, as necessary, to allow for installation of the filter material.

3. Select stone that is approximately 1.5 times larger than the solution void(s). Place the stone into the void(s) forming a competent bridge. Stone used for the bridge should have rock strength equal to, at least, moderately hard (*e.g.*, resistant to abrasion or cutting by a knife blade but can be easily dented or broken by light blows with a hammer). Shale or similar soft and non-durable rock is not acceptable.

4. Place a layer of filter material over the bridge to a minimum thickness of 24 inches. Approximately 35 percent of the material should be larger than the opening between the bridge and the void(s). There should be no discernable large openings around the bridge. The material should be either gabion stone, stone for rip rap, or stone for special rock fill that conforms to West Virginia Department of Highways, *Standard Specification Roads and Bridges*, Section 704.

5. Place a layer of smaller size filter material over the previous layer to a minimum thickness of 10 inches. The size of the material should be ¼ to ½ the size of that used in the previous layer. The material should be No. 57 aggregate, which conforms to West Virginia Department of Highways, *Standard Specifications Roads and Bridges*, Sections 703.1.1, 703.1.2, 703.1.3, 704.1.4, and 703.2.1. Unacceptable filter material consists of pea gravel or slags (steel, electromagnetic, or power plant).

6. Place a layer of sand-sized filter material over the previous layer ~~at~~ to a minimum thickness of 10 inches. The sand must be compatible in size with the previous layer to prevent piping. The material should be fine aggregate that conforms to West Virginia Department of Highways, *Standard Specification Roads and Bridges*, Sections 702.1.1, 702.1.2, and 702.1.3.

7. Engineering fabric conforming to AASHTO M 288 may be substituted for the stone and sand filter materials discussed in 5 and 6.

8. Backfill over the top filter layer or engineering fabric with soil material to the surface. This should be mineral soil with at least 12 percent fines. Reuse soil material excavated from the sinkhole as much as possible and place any available topsoil over the backfill. Overfill by about 5 percent to allow for settling.

9. Establish vegetation on the mitigated sinkhole and other disturbed areas of the site.

Use the following guidance for installing a mitigation design for sinkholes and sinkhole areas with drainage areas of 5 to 15 acres:

1. Remove and properly dispose of materials dumped in and around the sinkhole.

2. Excavate loose material from the sinkhole.

3. Place a layer of filter material into the sinkhole, allowing the stone to fill the void(s) below the bottom of excavated sinkhole. The size should be ¼ to ½ the size of the void(s). This material can be WVDOH gabion stone, rip rap stone, or special rock fill stone.

4. Place a layer of the same size filter material to a thickness of about ¾ TD (TD = total depth) above the sinkhole bottom.

5. Place a layer of smaller size filter material over the previous layer to a thickness of about ¼ D. Bring this layer to surface level. The size should be ¼ to ½ the size of the previous layer. The material should be No. 57 aggregate, which conforms to West Virginia Department of Highways, *Standard Specification Roads and Bridges*, Sections 703.1.1, 703.1.2, 703.1.3, 703.2.1, and 704.1.4. Unacceptable stone consists of pea gravel or slags (steel, electrometallurgical, or power plant).

6. Shale or similar soft and non-durable rock is not acceptable.

7. Establish vegetation on the mitigated sinkhole and disturbed areas of the site.

Engineering Fabric Requirements for Subsurface Drainage

Engineering fabric used in the mitigation of sinkholes should meet the applicable requirements of AASTHO M 288, Section 7.2

Engineering Fabric Installation

Proper construction and installation techniques are essential to ensure that the intended function of the engineering fabric is fulfilled.

When sewn seams are necessary, the seam strength must be equal to or greater than 90 percent of the specified grab strength, as measured in accordance with ASTM D 4632.

When sewn seams are used for the seaming of the engineering fabric, the thread must be high strength polypropylene, or polyester. Nylon thread is unacceptable.

For Sinkhole Mitigation Design A, place the engineering fabric loosely, with no wrinkles or folds, and with no void spaces between the fabric and the bridge. Overlap successive sheets of engineering fabric a minimum of 12 inches, with the upstream sheet overlapping the downstream sheet.

Prior to covering, the engineering fabric should be inspected to ensure that it has not been damaged (*e.g.* holes, tears, rips) during installation. An engineer or the engineer's designated representative should conduct the inspection. The designated representative should be a certified field inspector.

Damaged fabric must be repaired immediately. Cover the damaged area with an engineered fabric patch that overlaps to 12 inches beyond the damaged area.

Any damaged engineering fabric that cannot be repaired shall be replaced as directed by the engineer.

Place material over the engineering fabric in such a manner as to avoid stretching and subsequently tearing the fabric. Do not drop stone and soil placement from a height greater then one meter. Do not allow stone with a mass of more than 100 kg to roll down the slope of the sinkhole.

Grading the sinkhole slope is not permitted if the grading will result in the movement of the stone directly above the engineering fabric.

Operation and Maintenance

The owner/operator is responsible for maintaining the mitigated sinkhole and sinkhole area. At a minimum, the following maintenance practices should be performed:

1. Mow grass and plantings as necessary to promote vigorous growth.

2. Inspect mitigation measures at least twice a year and after all major rain events. Repairs to the sinkhole mitigation measures should be made promptly were warranted.

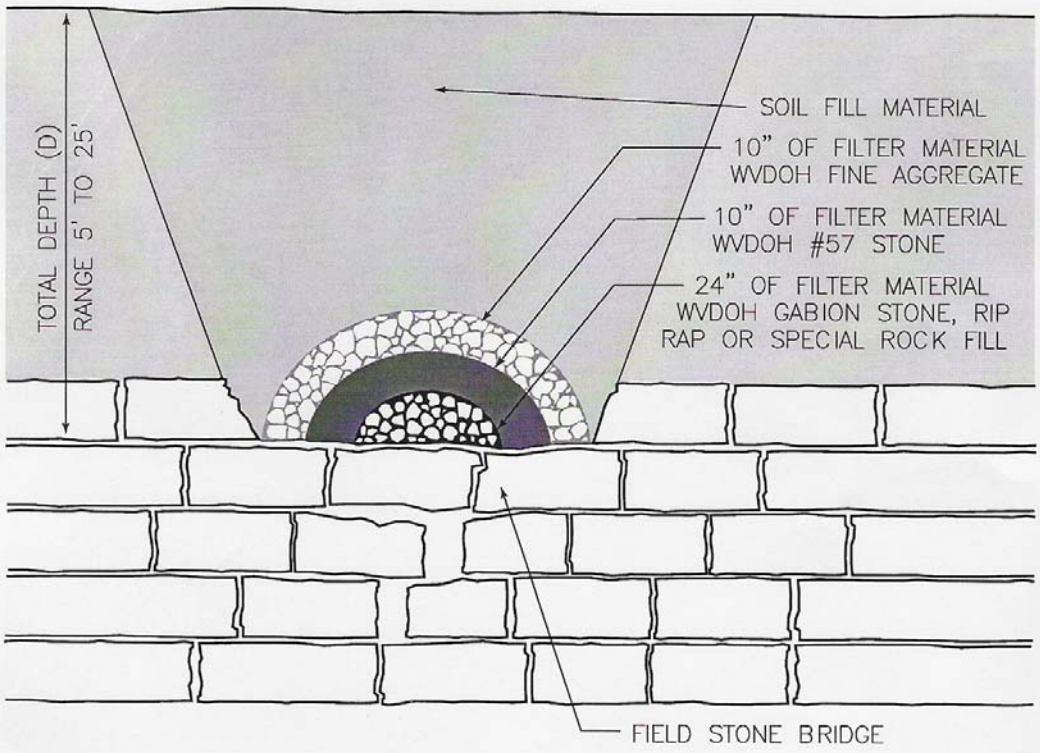
References:

USDA Natural Resources Conservation Center, January 2004. *Maryland Conservation Practice Standard, Sinkhole and Sinkhole Area Treatment, Code 725*.

West Virginia Department of *Highways, Standard Specifications Roads and Bridges*, 2000, Section 702, “Fine Aggregates”, Section 703, “Coarse Aggregates”, Section 704, “Stone and Crushed Aggregate”, Section 715, “Miscellaneous Materials”.

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION
SINKHOLE MITIGATION GUIDANCE

FIGURE 1



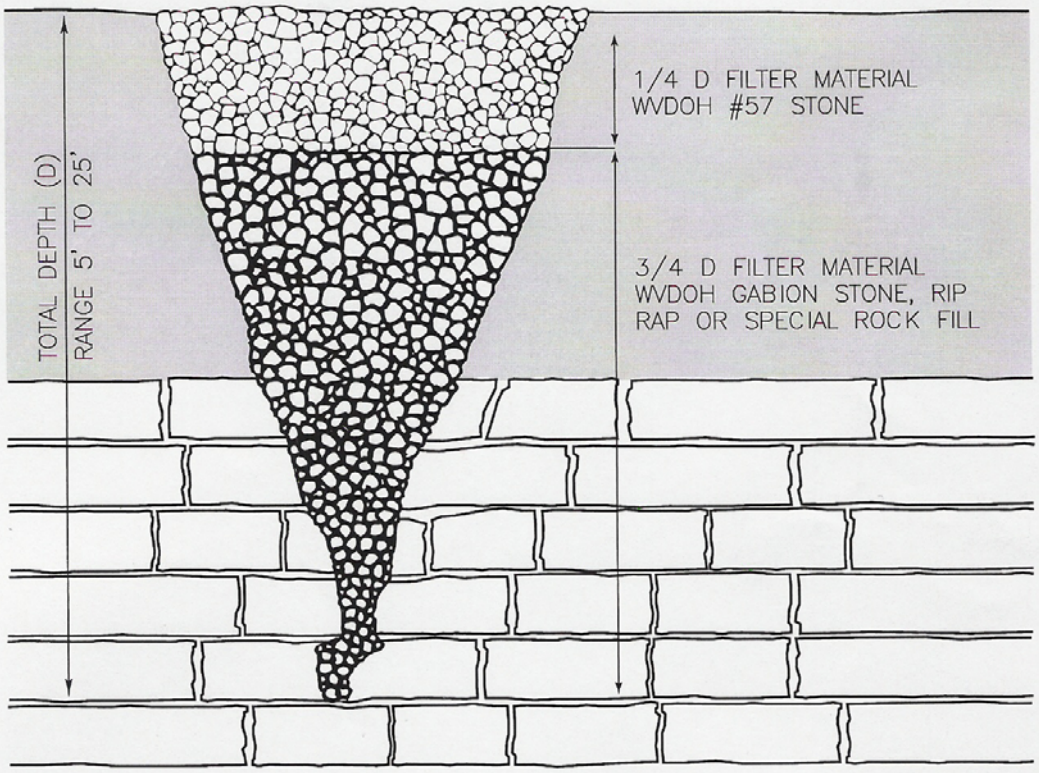
NOTE:
A NONWOVEN GEOTEXTILE MEETING AASHTO M288, SECTIONS 7.1+7.2 MAY BE SUBSTITUTED FOR THE WVDOH #57 STONE AND WVDOH FINE AGGREGATE

SINKHOLE MITIGATION

(DRAINAGE AREA LESS THAN 5 ACRES)

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION
SINKHOLE MITIGATION GUIDANCE

FIGURE 2



SINKHOLE MITIGATION

(DRAINAGE AREA 5 TO 15 ACRES)

ATLANTIC COAST PIPELINE, LLC
ATLANTIC COAST PIPELINE
Docket No. PF15-6-000

and

DOMINION TRANSMISSION, INC
SUPPLY HEADER PROJECT
Docket No. PF15-5-000

Spill Prevention, Control, and Countermeasure Plan

Draft

Prepared by

NATURAL RESOURCE GROUP

an ERM Group company

July 2015

TABLE OF CONTENTS

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LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

ACP	Atlantic Coast Pipeline
Atlantic	Atlantic Coast Pipeline, LLC
DTI	Dominion Transmission, Inc.
EI	Environmental Inspector
Projects	Atlantic Coast Pipeline and Supply Header Projects
SHP	Supply Header Projects
SPCC Plan	Spill Prevention, Control, and Countermeasure Plan

1.0 INTRODUCTION

Atlantic Coast Pipeline, LLC (Atlantic) – a company formed by four major energy companies - Dominion Resources, Inc.; Duke Energy Corporation; Piedmont Natural Gas Co., Inc.; and AGL Resources, Inc. – proposes to construct and operate approximately 556.0 miles of natural gas transmission pipelines and associated aboveground facilities in West Virginia, Virginia, and North Carolina. This Project, referred to as the Atlantic Coast Pipeline (ACP), will deliver up to 1.5 billion cubic feet per day of natural gas from supply areas in the Appalachian region to demand areas in Virginia and North Carolina. Atlantic has contracted with Dominion Transmission, Inc. (DTI), a subsidiary of Dominion Resources, Inc., to construct and operate the ACP on behalf of Atlantic.

In conjunction with the ACP, DTI proposes to construct and operate approximately 36.7 miles of pipeline loop and modify existing compression facilities in Pennsylvania and West Virginia. This Project, referred to as the Supply Header Project (SHP), will enable DTI to provide firm transportation service to various customers, including Atlantic.

2.0 PURPOSE

The purpose of this *Spill Prevention, Control, and Countermeasure Plan* (SPCC Plan) is to identify preventive measures, such as training, equipment inspection, and refueling procedures, to reduce the likelihood of spills; and mitigation measures, such as containment and cleanup, to minimize potential impacts should a spill occur. Atlantic's and DTI's construction contractors (referred to as the Contractors below), whose activities could result in a spill of fuel or other hazardous materials, will be required to adopt the following protocols for spill prevention, cleanup, and reporting during construction of the ACP and SHP.

3.0 TRAINING

Experienced, well-trained personnel are essential for the successful implementation of the SPCC Plan. Contractors will provide spill prevention and response training as well as safety training to their work crews. The training program will be designed to improve awareness of safety requirements, pollution control laws, and proper operation and maintenance of equipment. Contractors will train all employees who handle fuels and other regulated substances to prevent spills and to quickly and effectively contain and cleanup spills that may occur in accordance with applicable regulations and the provisions of this plan.

4.0 ROLES AND RESPONSIBILITIES

A. **Spill Coordinator** - Each Contractor will appoint a Spill Coordinator who will be responsible for coordinating Contractor Work Crews for spill cleanup, conducting site investigations, and completing spill reports. The Spill Coordinator will report spills to an Environmental Inspector (EI), who will initiate the spill reporting process (see Section 7.0). The Spill Coordinator will be responsible for completing a Spill Report Form (Attachment A) within 24 hours of the occurrence of a spill, regardless of the size of the spill.

B. Contractor Work Crews - Contractor Work Crews will comply with this SPCC Plan and will notify the crew foreman or Spill Coordinator immediately of any spill of fuel or other hazardous material, regardless of the volume of the spill.

C. Environmental Inspectors – The EIs will monitor the Contractors' compliance with the provisions of the SPCC Plan to ensure that spill resources are allocated and cleanup is accomplished in accordance with this plan and any applicable regulatory requirements. The EIs will work in conjunction with Atlantic's and DTI's environmental team to promptly report spills to appropriate Federal, State/Commonwealth, and local agencies, as required, and to coordinate with these agencies regarding contacting additional parties or agencies as may be required.

5.0 PREVENTIVE MEASURES

Contractors will minimize the potential for a spill during construction activities by implementing appropriate measures to prevent and contain spills. Equipment and materials will be located onsite to meet the provisions of this plan. The Contractors will comply with applicable environmental and safety laws and regulations and will ensure that a copy of this plan is available onsite to all Construction Work Crew members. All cleanup and other construction-related spill activities will be completed by the appropriate Contractors.

Spill prevention measures are described below.

A. Petroleum and Hazardous Liquid Storage, Refueling, and Equipment Maintenance

1. Staging Areas and Facility Sites:

    a. Prior to construction the Contractors will provide site-specific descriptions and maps depicting locations of fixed and mobile oil containers and type of material located within containers. The site-specific descriptions and maps will identify the direction, rate of flow, and total quantity of petroleum or hazardous liquid which could be discharged from containers or from major equipment failures.

    b. Contractors will visually inspect aboveground storage containers for leaks and spills on a regular basis and whenever containers are refilled. Contractors will maintain inspection records for every container.

    c. Contractors will construct secondary containment structures (e.g., temporary liners and seamless impermeable berms) around aboveground, single wall, storage containers so that liquids will be contained and collected in specified areas isolated from waterbodies in the event of a leak or spill. Double wall containers

will not require secondary containment. Storage containers will not be placed in areas subject to periodic flooding and washout.

d. Secondary containment structures must provide a containment volume equal to a minimum of 110 percent of the maximum storage volume of the storage container for single wall containers.

e. Secondary containment structures must be constructed so that no outlet is provided and any spill will be contained within the containment structure. Accumulated rainwater may be removed if authorized by the EI. Accumulated water with a visible sheen will be collected for proper storage, transport, and disposal.

f. Contractors will remove all secondary containment structures at the conclusion of the Projects. Contractors also will be responsible for returning the storage impoundment area to its original contours and appearance upon completion of the Projects.

g. Hazardous materials, including chemicals, fuels, and lubricating oils, will be stored only at designated staging areas and in appropriate service vehicles. The storage areas will be located at least 100 feet away from wetlands, waterbodies, and springs; at least 200 feet away from private water supply wells; at least 300 feet away from karst features; and at least 400 feet away from municipal water supply wells unless a larger buffer is required by regulatory agencies.

h. Storage containers will display labels that identify the contents of the container and whether the contents are hazardous. Contractors will maintain and provide to Atlantic and DTI, when requested, copies of all Material Safety Data Sheets. All containers used for the storage of hazardous materials, including chemicals, fuels, and lubricating oils, will be of material and construction compatible with the material stored and the conditions of storage such as pressure and temperature. All containers will be in good condition.

i. Contractors will conduct routine equipment maintenance, such as oil changes, in staging areas and will dispose of waste oil in an appropriate manner (e.g., the Contractors will collect the waste oil in labeled, sealed containers and transport the waste oil to a recycling facility).

j. Contractors will correct visible leaks in storage containers as soon as possible. Leaks outside of secondary containment, regardless of volume, will be reported to the Spill Coordinator and an EI.

k. Drain valves on temporary storage containers will be locked to prevent accidental or unauthorized discharges from the containers.

l. All fuel nozzles will be equipped with functional automatic shut-off valves.

m. The drivers of tank trucks will be responsible for spill prevention and the provision of secondary containment during tank truck unloading. Procedures for loading and unloading tank trucks will meet the minimum requirements established by applicable law and associated regulations. Drivers will observe and control the fueling operations at all times to prevent overfilling. Contractors will be responsible for training drivers of tank trucks to comply with these provisions.

n. Prior to departure of any tank truck, all outlets of the vehicle will be closely examined by the driver for leakage and tightened, adjusted, or replaced, as necessary, to prevent liquid leakage while in transit. Contractors will be responsible for training drivers of tank trucks to comply with these provisions.

2. Right-of-Way:

a. All machinery will arrive on the right-of-way in a clean, washed condition, maintained free of fluid leaks.

b. Overnight parking of equipment, as well as refueling and servicing of construction equipment, will be restricted to upland areas at least 100 feet away from waterbodies, wetlands, and springs; at least 200 feet from private water-supply wells; at least 300 feet from karst features; and at least 400 feet from municipal water-supply wells. Where this is not practicable, and where the EI finds in advance no reasonable alternative, the equipment will be fueled by designated personnel with specific training in refueling, spill containment, and cleanup, under the supervision of an EI. Prior to refueling, appropriate steps will be taken (including deployment of secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill.

d. Fuel trucks transporting fuels to construction areas will only travel on approved access roads.

e. Contractors will keep a spill kit onsite and on all equipment in case of machinery leaks or spills. If a spill kit is used, it will be replaced within 24 hours.

3. Restricted Refueling Areas will be identified in the field with flagging or signs. A site-specific plan and written approval from an EI will be required to refuel in restricted areas.

a. Approval must be received from an Atlantic or DTI representative and, where necessary, appropriate regulatory permits must be obtained, prior to refueling in Restricted Refueling Areas.

b. In large wetlands where no upland site is available for refueling, auxiliary fuel tanks may be mounted to equipment to minimize the need for refueling.

c. Trained personnel must be available for refueling, and the EI must be present unless a case-specific exemption is obtained in writing from an Atlantic or DTI representative.

d. Equipment such as large, stationary pumps will be fitted with auxiliary tanks as appropriate. The auxiliary tanks will be placed within secondary containment which provides for a containment volume equal to a minimum of 110 percent of the volume of the auxiliary tanks.

e. Refueling within Restricted Refueling Areas will take place in areas designated by an EI. Fuel trucks with a capacity in excess of 300 gallons will not be allowed within a Restricted Refueling Area unless adequate secondary containment is provided.

f. Refueling of dewatering pumps, generators, and other small, portable equipment will be performed using approved containers with a maximum volume of 5 gallons.

B. Spill Response Equipment

1. Staging Areas and Facility Sites:

a. Contractors will stock a sufficient supply of sorbent and barrier materials at construction staging areas to allow the rapid containment and recovery of a spill. Sorbent and barrier materials will also be used to contain runoff from spill areas.

b. Shovels and 55 gallon drums will be kept at each individual staging area. If small quantities of soil become contaminated within the staging area, they will be collected and placed in the drums. The drums will be labelled to indicate the contents of the drum, including the spilled/recovered material.

c. Large quantities of contaminated soil will be collected using heavy equipment and will be stored in drums or other suitable containers prior to disposal. The drums will be labelled to indicate the contents of the drum, including the spilled/recovered material.

d. The Contractors will dispose of all contaminated soil in accordance with applicable State/Commonwealth and Federal regulations.

2. Right-of-Way

a. Each construction crew will have adequate absorbent materials and containment booms on hand to enable the rapid and complete

cleanup of spills, as well as sufficient tools and materials to stop leaks.

b. Contractors must maintain spill kits containing a sufficient quantity of absorbent and barrier materials to adequately contain and recover foreseeable spills. These kits may include, but are not limited to: absorbent pads, straw bales, absorbent clay, sawdust, floor drying agents, spill containment barriers, plastic sheeting, skimmer pumps, and 55 gallon drums. The equipment will be located near fuel storage areas and other locations, as necessary, to be readily available in the event of a spill.

c. All fuel equipment, and where practicable, service trucks, will carry adequate spill response materials. Spill response materials present on trucks will consist of absorbent pads, absorbent material, plastic bags, and a shovel.

d. The Spill Coordinator will inform the EIs and all Contractor personnel of the location of spill control equipment and materials, and have them readily accessible while construction activities are occurring.

e. If a spill kit is used, it will be replaced within 24 hours.

C. Concrete Coating

1. Concrete coating activities will not be performed within 100 feet of wetlands, waterbodies, or springs, or with 300 feet of karst features unless the location is an existing industrial site designated for such use.

6.0 SPILL RESPONSE

A. The first priorities after discovering a spill are to protect the safety of personnel and the public and to minimize damage to the environment. Actions to be taken immediately following a spill will include the following:

1. The safety of the situation (including the surrounding public) will be assessed.
2. Sources of ignition will be removed from the area by trained personnel **if safe to do so**.
3. The source of the spill will be shut off by trained personnel **if safe to do so**.
4. Efforts to contain the spill immediately will be initiated by trained personnel **if safe to do so**.
5. Cleanup activities will be initiated as soon as possible after the spill is contained using properly trained and protected personnel with adequate spill cleanup materials and equipment (see Section 8.0).

6. If necessary, an Emergency Response Contractor will be secured for large spills to further contain and clean up the spill.

7.0 SPILL REPORTING

A. All spills will be reported immediately to Atlantic or DTI. Reports will include the following information (found on the Spill Report Form):

1. Date, time, and location of the spill.
2. Type of material spilled.
3. Amount of material spilled.
4. Extent of spill area.
5. Whether the material has reached or has the potential to reach a wetland, waterbody, or karst feature.
6. Status of spill containment and cleanup.
7. Circumstances leading up to the spill.

B. Atlantic's and DTI's environmental team will report the spill to the applicable regulatory agencies if the spill meets or exceeds a reportable threshold. Table 1 lists the Federal and State/Commonwealth agencies that would be contacted, as appropriate.

C. Contractors are responsible for assisting Atlantic and DTI with preparing follow-up written incident reports to regulatory agencies upon request.

8.0 SPILL CONTAINMENT AND CLEANUP

A. Land Spill

1. Berms will be constructed with available equipment to physically contain the spill and sorbent materials will be applied to the spill area. Traffic on contaminated soils will be minimized.
2. Contaminated soils and vegetation will be removed and disposed of at a properly licensed waste disposal facility.
3. Waste materials from the spill will be disposed of according to applicable regulatory requirements.
4. The following information will be provided to an EI and Atlantic and DTI as available following containment and cleanup (but no later than 24 hours after transport and disposal of the contaminated waste material):
    a. The amount of the spilled material that was recovered during cleanup.
    b. Proposed reclamation of remaining contaminated areas.

TABLE 1

Agency Notification List

Agency	Program	Contact Information	Hours of Operation	Applicable Areas Served
Federal				
Environmental Protection Agency	National Response Center	800-424-8802	24-hour hotline	All Areas
Pennsylvania				
Department of Environmental Protection	Southwest Regional Office	412-442-4000	24-hour hotline	Greene and Westmoreland Counties
Commonwealth of Pennsylvania	Pennsylvania Emergency Response Management	717-651-2001	24-hour hotline	Entire Commonwealth
West Virginia				
Department of Environmental Protection (WVDEP)	Emergency 24-hour Hotline for Hazardous Waste Release	800-642-3074	24-hour hotline	Entire State
WVDEP	Elkview Emergency Response Unit	304-558-5938	Monday – Friday 8:00 am – 4:00 pm	Entire State
Virginia				
Department of Environmental Quality (VDEQ)	Pollution Response Program-Valley Regional Office	540-574-7800	Monday – Friday 8:30 am – 4:30 pm	Augusta, Highland, and Nelson Counties
VDEQ	Pollution Response Program-Blue Ridge Regional Office	540-562-6700	Monday – Friday 8:30 am – 4:30 pm	Buckingham, Cumberland, Prince Edward, and Nottoway Counties
VDEQ	Pollution Response Program-Piedmont Regional Office	804-527-5020	Monday – Friday 8:30 am – 4:30 pm	Dinwiddie, Brunswick, and Greensville Counties
VDEQ	Pollution Response Program-Tidewater Regional Office	757-518-2000	Monday – Friday 8:30 am – 4:30 pm	Southampton County and Cities of Suffolk and Chesapeake
VDEQ	Pollution Response Program – Online Reporting System	Online form at: http://www.deq.virginia.gov/Programs/PollutionResponsePreparedness/PollutionReportingForm.aspx	24-hour online reporting option	Entire Commonwealth
Department of Emergency Management	Virginia Emergency Response Team	800-468-8892 or 804-674-2400	24-hour hotline	Entire Commonwealth
North Carolina				
Department of Environment and Natural Resources	Division of Water Resources – Raleigh Regional Office Emergency Response	919-791-4200 800-858-0368	Monday – Friday 8:00 am – 5:00 pm After hours and weekends	Halifax, Johnston, Nash, Northampton, and Wilson Counties
Department of Environment and Natural Resources	Division of Water Resources – Fayetteville Regional Office Emergency Response	910-433-3300 800-858-0368	Monday – Friday 8:00 am – 5:00 pm After hours and weekends	Cumberland, Robeson, and Sampson Counties

c. Storage method for the contaminated waste material before transport and disposal.

d. Transport and disposal documentation for the contaminated waste material.

5. If necessary, an Emergency Response Contractor will be secured for large spills to further contain and clean up the spill.

B. Wetland or Waterbody Spill: Containment and cleanup measures for spills, regardless of size, that occur near or into a wetland or waterbody may require approvals or permits from regulatory agencies. Contractors must receive written permission from Atlantic or DTI before placing equipment into any wetland or waterbody for the purpose of spill cleanup. Measures to be implemented immediately to control a spill include the following:

1. For spills in standing water, floating booms, skimmer pumps, and holding tanks will be readily available and used, as appropriate, by the Contractors to recover and contain released materials on the surface of the water.

2. Berms and/or trenches will be constructed in upland areas to contain a spill before it enters a wetland or waterbody. Deployment of booms, skimmers, and sorbent materials will be utilized if the spill reaches a waterbody. The spilled product will be retrieved and the contaminated area cleaned-up in accordance with recommendations from site remediation specialists and applicable regulations and guidelines.

3. If necessary, an Emergency Response Contractor will be secured for large spills in wetlands or waterbodies to further contain and clean up the spill.

C. **Karst**: In addition to the measures described above, the following procedures will be implemented in areas of karst terrain:

1. Buffers of 300 feet around karst features (e.g., sinkholes, caves, sinking or losing streams, ponors, pinnacled bedrock, and large springs) within or adjacent to the construction right-of-way will be marked with signs and/or highly visible flagging until construction related ground disturbing activities are completed.

2. Equipment refueling will not be permitted within flagged or marked buffer areas for karst features or areas draining into karst features, except by hand-carried cans (5 gallon maximum capacity), when necessary.

3. Equipment servicing and maintenance areas will be sited outside of flagged or marked buffer areas for karst features or areas draining into karst features.

4. Erosion and sediment controls will be implemented, as appropriate, to prevent runoff resulting from construction equipment washing operations (if applicable) to directly enter a karst feature by locating these operations outside of karst buffer areas.

5. Construction equipment, vehicles, materials, hazardous materials, chemicals, fuels, lubricating oils, and petroleum products will not be parked, stored, or serviced within 300 feet of a karst feature.
6. Equipment will be checked for leaks daily by the Contractors prior to beginning work in karst areas; and damaged or defective equipment will be removed or repaired prior to use in karst areas.
7. Atlantic or DTI will notify the National Response Center and either the West Virginia Department of Environmental Protection or Virginia Department of Environmental Quality if a reportable spill impacts a karst feature (see Table 1).

9.0 CERTIFICATION BY A PROFESSIONAL ENGINEER

This SPCC Plan has been certified by a professional engineer in accordance with 40 Code of Federal Regulations 112.7 - *General Requirements for Spill Prevention, Control, and Countermeasure Plans*.

_____ _____

Professional Engineer Date

10.0 CERTIFICATION BY THE CONTRACTOR

The Contractor listed below agrees to follow the requirements of Atlantic's and DTI's *Spill Prevention, Control, and Countermeasure Plan* during all work activities conducted for Atlantic or DTI.

_____ _____

Contractor Date

_____ _____

Responsible Official (Print Name) Title

_____

Responsible Official (Signature)

ATLANTIC COAST PIPELINE, LLC
ATLANTIC COAST PIPELINE

and

DOMINION TRANSMISSION, INC.
SUPPLY HEADER PROJECT

Spill Prevention, Control, and Countermeasure Plan

ATTACHMENT A
Spill Report Form

Atlantic Coast Pipeline and Supply Header Project
Spill Report Form

Date of Spill:_____ Date of Spill Discovery:_____

Time of Spill:_____ Time of Spill Discovery:_____

Name and Title of Discoverer:_____

Type of material spilled and manufacturer's name:_____

Legal Description of spill location to the quarter section:_____

Directions from nearest community:_____

Estimated volume of spill:_____

Weather conditions:_____

Topography and surface conditions of spill site:_____

Spill medium (pavement, sandy soil, water, etc.):_____

Proximity of spill to surface waters: _____

Did the spill reach a waterbody? _____Yes _____No

If so, was a sheen present? _____Yes _____No

Describe the causes and circumstances resulting in the spill:_____

_____

_____

Describe the extent of observed contamination, both horizontal and vertical (i.e., spill-stained soil in a 5-foot radius to a depth of 1 inch): _____

_____

_____

Describe immediate spill control and/or cleanup methods used and implementation schedule: _____

_____

Current status of cleanup actions:_____

Name and Company for the following:

Construction Superintendent:_____

_____

Spill Coordinator:_____

_____

Environmental Inspector:_____

Person Who Reported the Spill:_____

_____

Environmental Inspector:_____

Form completed by:_____Date:_____

Spill Coordinator must complete this for any spill, regardless of size, and submit the form to the Environmental Inspector within 24 hours of the occurrence.

ATLANTIC COAST PIPELINE, LLC
ATLANTIC COAST PIPELINE

and

DOMINION TRANSMISSION, INC.
SUPPLY HEADER PROJECT

Spill Prevention, Control, and Countermeasure Plan

ATTACHMENT B
Site-Specific Descriptions and Maps Depicting Locations of Fixed and Mobile Oil Containers and Type of Material Located within Containers

(to be provided by the Contractors prior to construction)

ATLANTIC COAST PIPELINE, LLC
ATLANTIC COAST PIPELINE
Docket No. PF15-6-000

and

DOMINION TRANSMISSION, INC
SUPPLY HEADER PROJECT
Docket No. PF15-5-000

Winter Construction Plan

Draft

Prepared by

NATURAL RESOURCE GROUP

an ERM Group company

July 2015

TABLE OF CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

ACP	Atlantic Coast Pipeline
Atlantic	Atlantic Coast Pipeline, LLC
ATWS	additional temporary workspace
DTI	Dominion Transmission, Inc.
EI	Environmental Inspector
FERC	Federal Energy Regulatory Commission
NOAA	National Oceanic and Atmospheric Administration
Plan	Upland Erosion Control, Revegetation, and Maintenance Plan
Procedures	Wetland and Waterbody Construction and Mitigation Procedures
Projects	Atlantic Coast Pipeline and Supply Header Projects
SHP	Supply Header Project

1.0 INTRODUCTION

Atlantic Coast Pipeline, LLC (Atlantic) – a company formed by four major energy companies - Dominion Resources, Inc.; Duke Energy Corporation; Piedmont Natural Gas Co., Inc.; and AGL Resources, Inc. – proposes to construct and operate approximately 556.0 miles of natural gas transmission pipelines and associated aboveground facilities in West Virginia, Virginia, and North Carolina. This Project, referred to as the Atlantic Coast Pipeline (ACP), will deliver up to 1.5 billion cubic feet per day of natural gas from supply areas in the Appalachian region to demand areas in Virginia and North Carolina. Atlantic has contracted with Dominion Transmission, Inc. (DTI), a subsidiary of Dominion Resources, Inc., to construct and operate the ACP on behalf of Atlantic.

In conjunction with the ACP, DTI proposes to construct and operate approximately 36.7 miles of pipeline loop and modify existing compression facilities in Pennsylvania and West Virginia. This Project, referred to as the Supply Header Project (SHP), will enable DTI to provide firm transportation service to various customers, including Atlantic.

2.0 PURPOSE

Construction of the ACP and SHP (collectively, the Projects) is scheduled to begin in the Fall of 2016 subject to the receipt of necessary permits and authorizations. Atlantic and DTI anticipate that construction of the proposed pipelines and aboveground facilities will be complete by the Fall of 2018. Within the ACP Project area and SHP Project area, the timing and extent of Winter conditions, such as snowfall and frozen soils, vary a great deal. The northern portions of the Projects, including Pennsylvania and the mountainous regions of West Virginia and Virginia, can have temperatures below freezing from early October through late April, with frozen soil conditions potentially occurring within these months (National Oceanic and Atmospheric Administration [NOAA], 2012a and 2012b). Southern portions of the ACP, including the coastal areas in Virginia and North Carolina, can have temperatures below freezing between late October and early April, but sustained temperatures below freezing and frozen soil conditions are less likely than in northern or mountainous regions (NOAA, 2012c).

The purpose of this *Winter Construction Plan* is to identify best management practices for construction activities during the Winter. Under frozen soil conditions, the measures in this plan will supersede relevant or corresponding measures in the Federal Energy Regulatory Commission's (FERC) *Upland Erosion Control, Revegetation, and Maintenance Plan* (Plan) and *Wetland and Waterbody Construction and Mitigation Procedures* (Procedures) as well as Atlantic's and DTI's *Restoration and Rehabilitation Plan*. In the transitional period between non-frozen and frozen soil conditions, Atlantic and DTI will implement appropriate measures as described in the Plan, Procedures, *Restoration and Rehabilitation Plan*, or this *Winter Construction Plan* based on site-specific conditions (e.g., soil stability) as determined by Atlantic's and DTI's Environmental Inspectors (EI), activity inspectors, and construction manager.

3.0 SNOW REMOVAL

Snow will be removed from construction work areas to expose soils for grading and excavation. Snow removal will be limited to active construction areas and areas needed to maintain access to the construction rights-of-way. Snow will be bladed or pushed to the edges of the right-of-way with a motor-grader, snowplow, or bulldozer, and stockpiled within the right-of-way or in approved additional temporary workspace (ATWS) areas. Snow will not be bladed off the right-of-way. The bladed equipment on the motor-grader, snowplow, or bulldozer will be fitted with a "shoe" to minimize impacts on the underlying soil and vegetation. Alternatively, in the event of extreme snow events or significant snow drifts, snow may be blown off the right-of-way using industrial blowers mounted to construction vehicles. Snow that is blown off the construction right-of-way will be directed away from existing roads and driveways, parking areas, residences, or other landowner structures. Regardless of the method used, snow removal equipment will access the construction areas from approved access roads, and will operate from within the construction right-of-way or approved ATWS areas.

Snow also will be removed, as necessary, from approved access roads by plowing to the edges of the road or blowing off the road (away from driveways, parking areas, residences, or other landowner structures) to allow safe access to the construction right-of-way. Access roads will be maintained in accordance with applicable permit requirements and landowner agreements. Snow removal from private access roads will continue as necessary through the end of active construction. Atlantic and DTI will not be responsible for snow plowing or removal on publicly maintained roads.

Snow will be removed from both the working and spoil sides of the construction right-of-way prior to topsoil segregation and grading to prevent mixing of snow with excavated spoil. Snow will be removed and stockpiled along the edges of the construction right-of-way or in approved ATWS areas, or blown off the right-of-way as described above. Gaps will be left in stockpiled snow piles based on an assessment of drainage patterns to allow water to drain off of the right-of-way during the Spring thaw or other warm periods. Gaps also will be left in the stockpiled snow at drainage crossings.

If practicable, and in times of extremely cold weather, snow may be stored over the trenchline prior to trench excavation to prevent frost penetration along the trenchline. This snow will be bladed or pushed to the edge of the spoil side of the construction right-of-way immediately prior to topsoil removal and trenching activities.

Any additional snow which accumulates on the right-of-way during construction will be removed and stockpiled along the edges of the construction right-of-way or in approved ATWS areas, or blown off the right-of-way as described above. Large accumulations of snow on excavated spoil piles will be removed as practicable prior to backfilling. Snow will not be mixed with spoil during backfilling to the extent practicable.

Generally, snow will be allowed to melt in place during the Spring thaw or other warm periods. The EIs for the Projects will work with the Contractors to identify sites where large accumulations of melting snow may flow away from the right-of-way causing erosion. Erosion control devices and diversion berms will be installed as appropriate in these areas in accordance

with the Plan and Procedures or as described in Section 7.0 below. If site-specific conditions require the placement of erosion control devices or diversion berms outside the limits of the construction corridor or approved ATWS areas, Atlantic and/or DTI will request approval from the FERC and the affected landowner prior to installing these items.

4.0 GENERAL CONSTRUCTION AND RESTORATION MEASURES

In non-frozen conditions, all construction activities (topsoil removal and segregation, grading, trenching, pipe installation, backfilling, restoration, and clean-up) will be conducted in accordance with the Plan and Procedures, as appropriate. The following alternative methods will be implemented in frozen soil conditions, should these conditions be encountered during construction.

In agricultural lands, topsoil will be removed and segregated from the trenchline and the spoil side of the construction right-of-way with the exception of areas directly beneath snow stockpiles. In open uplands, including pasture and hay fields, topsoil will be removed and segregated from the trenchline only with the exception of limited areas where grading is necessary to create a level work surface within the construction right-of-way. Topsoil typically will be removed using a step blade attached to a bulldozer. Alternatively, Atlantic and DTI may remove topsoil in frozen conditions by ripping with a grader or heavy disc or by utilizing a pavement excavator to pulverize the topsoil and allow for conventional removal.

The method of topsoil removal will be determined by Atlantic's or DTI's EIs and construction manager based on site-specific conditions, including depth and extent of frost penetration into the soil. The method selected will be the best available for retaining soil and root structure within the excavated topsoil to the extent practicable given the soil conditions. Segregated topsoil will be placed on the construction right-of-way adjacent to stockpiled snow. Subsoil excavated from the trenchline will be stockpiled separately from topsoil in the area immediately adjacent to the trench.

Trenching, lowering-in, and backfilling operations will be scheduled to minimize the exposure time of excavated spoil material to freezing conditions and to reduce the potential for snow accumulation in the trench. Any appreciable accumulations of snow in the trench (generally greater than 12 inches in depth) will be removed prior to installation of the pipeline. Backfilling operations will commence as soon as practicable after the pipeline is installed in the trench.

In upland areas, the trench will be backfilled with subsoil as described below. Depending on the extent of frost penetration in topsoil piles, however, the topsoil may be stockpiled over the Winter for replacement during the following Spring when it can be worked and contoured.

Stockpiled subsoil will develop a layer of frost penetration, the thickness of which will be dependent on water content, temperature, wind, and snow cover conditions. Prior to backfilling, frozen material will be skimmed off the top of the subsoil pile to provide access to underlying, unfrozen subsoil for backfilling. The unfrozen subsoil material will be backfilled over the pipeline first, followed by the frozen subsoil material. If frozen subsoil exhibits lumps or sharp edges that could damage the coating on the pipeline, Atlantic's or DTI's construction manager

will determine appropriate backfill measures to be implemented. Such measures may include the use of mechanical shakers or grinders to break up frozen subsoils prior to backfilling, or in extreme cases, the use of sand padding around the pipe. If sand padding is used, it will be obtained from an upland commercial source and used in upland areas only.

In certain limited areas, such as graded slopes and road and railroad crossings, subsoil (in addition to topsoil) may be stockpiled over the Winter for replacement during the following Spring. In these areas, Atlantic and DTI will ensure that there are adequate gaps between the topsoil and subsoil piles to allow water to drain between the piles during the Spring thaw and to prevent mixing of the soils. Signs will be installed as necessary to differentiate between the subsoil and topsoil piles.

Where topsoil is stockpiled over Winter, Atlantic and DTI will cover the pile in mulch or implement other methods of topsoil conservation to prevent loss of topsoil during the Winter and throughout the Spring melt or other warming event. Gaps will be installed within soil piles based on an assessment of drainage patterns to allow water to drain off of the right-of-way during the Spring thaw, and berms or water bars will be installed as necessary to prevent water flow down the right-of-way.

Where final grading and restoration cannot be completed due to frozen conditions, the right-of-way will be left in a roughened condition to reduce the potential for erosion during the Spring melt. In upland areas, a slight subsoil crown may be left over the pipeline to account for settling as backfilled soils thaw. If a crown is left over the pipeline, breaks will be installed to allow water to drain across the right-of-way during the Spring melt. Atlantic and DTI will install erosion and sedimentation control devices in accordance with the Plan and Procedures or as described in Section 7.0 below, but will not reseed during frozen conditions.

In areas where topsoil replacement is delayed to the following Spring due to frozen soil conditions, or in areas where seeding is delayed due to seeding period restrictions, Atlantic and DTI will mulch disturbed areas within the right-of-way in non-cultivated uplands in accordance with the Plan.

Final cleanup activities will be performed once the ground is fully thawed in the Spring and the topsoil (and subsoil, if applicable) stockpiled over Winter has dried sufficiently to allow it to be worked without causing excessive compaction and/or rutting. The schedule for final clean-up will be determined based on ground conditions, but Atlantic and DTI anticipate that activities will resume in the Spring or as soon as extended periods above freezing occur. Final clean-up and restoration activities (including final grading, topsoil replacement, and reseeding) will be conducted in accordance with the Plan and Procedures and *Restoration and Rehabilitation Plan*.

The potential for soil compaction is minimal under frozen soil conditions; however, Atlantic and DTI will implement measures identified in the Plan and Procedures to decompact soils, where necessary, during final clean-up and restoration activities.

5.0 WETLANDS

Construction in Winter months may minimize impacts in wetlands because construction will occur outside of the wet (Spring, Summer, and Fall) seasons in areas where sustained frozen conditions occur along the pipeline routes. In Winter conditions, frozen soils may provide stability for construction equipment working on the right-of-way and help prevent sloughing of the pipe trench which could occur in the Spring, Summer, and Fall seasons due to saturated conditions.

Construction across wetlands will be conducted in accordance with the Procedures, except that snow berms (rather than silt fences) may be installed as temporary erosion control devices to prevent sediment migration off the right-of-way. Silt fence will be installed across the right-of-way on the approaches to wetlands prior to the Spring run-off or warm Winter periods.

In non-frozen soil conditions in wetlands, Atlantic and DTI will remove and segregate topsoil from the area disturbed by trenching, except in areas where standing water is present or soils are saturated. In frozen soil conditions in wetlands, Atlantic and DTI will remove and segregate topsoil from the area disturbed by trenching, but a thin layer of topsoil may be left over the trenchline during the process of removing the topsoil to prevent the introduction of subsoil into the segregated topsoil. In both non-frozen and frozen conditions, the trench in wetlands will be backfilled with subsoil as described above for uplands and the topsoil (where segregated) will be replaced at the time of construction. Atlantic and DTI will not stockpile topsoil from wetlands over the Winter for replacement the following Spring; this will minimize the need to conduct restoration activities in wetlands during the wet (Spring, Summer, and Fall) season.

Contours in wetlands will be restored as near as practicable to pre-construction condition. If necessary, Atlantic and DTI will use mechanical shakers or grinders, or other suitable methods to break up frozen topsoil prior to replacement over the trench. In frozen soil conditions, a topsoil crown will be left over the trenchline to account for settling as backfilled soils thaw. Breaks will be installed in the crown to allow water to flow across the trenchline and to prevent water from ponding on either side of the crown.

6.0 WATERBODIES

Construction in the Winter may minimize impacts on waterbodies because construction will occur outside of the wet seasons in the areas crossed. This may avoid or minimize the potential for increased turbidity within waterbodies as well as impacts on fisheries.

Construction activities will be conducted in accordance with the Procedures. Contours of the bed and banks will be restored as near as practicable to pre-construction condition. Additional measures, such as the installation of erosion control blankets, will be implemented as necessary to stabilize the bed and banks of the waterbody in advance of the return of water flow or the Spring melt.

Atlantic and DTI will use stream gauge data from the U.S. Geological Survey to determine the highest anticipated flows during the time of each waterbody crossing. The duration of in-stream construction activities (excluding blasting, if required) will be limited to

24 hours across minor waterbodies and 48 hours across intermediate waterbodies. In the absence of stream gauge data, Atlantic's and DTI's engineers and EIs will estimate the highest anticipated flows based on the width of the waterbody at the ordinary high water mark, the depth of the waterbody, existing flows at the time of the crossing, and the weather forecast at the time of the crossing. As a contingency, Atlantic and DTI will stage additional materials (e.g., flume pipes and erosion control devices) at the crossing in the event that the volume of flow increases due to a precipitation event or unexpected snow melt.

If thick ice is encountered on waterbodies at the time of construction, the ice will be removed where required for safe construction and placed outside of the waterbody on the spoil side of the right-of-way.

7.0 EROSION CONTROLS, MULCHING, AND SEEDING

Temporary and permanent erosion and sedimentation control measures will be implemented in accordance with the Plan and Procedures or as described below depending on ground conditions. The EIs for the Projects will verify that the erosion and sedimentation control measures are appropriate for the weather conditions. The following measures will be implemented in order for erosion control devices to be effective throughout the Winter and able to withstand the runoff that accompanies Spring thaw and snow melt conditions:

- Temporary erosion control devices (silt fences in non-frozen conditions or straw bales, straw logs, or snow berms in frozen conditions) will be installed where appropriate during topsoil stripping and grading activities to prevent the movement of disturbed soils off the right-of-way.
- In non-frozen conditions, temporary slope breakers consisting of mounded and compacted soil will be installed during clearing and grading activities in areas required by the Plan and Procedures. In frozen conditions, temporary slope breakers will not be installed during initial clearing and grading activities because soils will be frozen and not subject to erosion. However, temporary slope breakers will be installed prior to the Spring thaw, where required by the Plan and Procedures, as follows:
    - In cultivated lands, temporary slope breakers consisting of mounded and compacted subsoil will be placed across the right-of-way. Breaks will be installed in snow and topsoil piles where intersected by the temporary slope breakers to promote water flow off of the right-of-way during melting periods. When restoration activities resume the following Spring or Summer, the temporary slope breakers will be removed; the topsoil stockpiled over Winter will be replaced across the right-of-way; and silt fences will be installed in areas required by the Plan or Procedures.
    - In open uplands, including cleared forests, grasslands, hay fields, and pasture, temporary slope breakers consisting of mounded and compacted subsoil will be placed across the right-of-way. Breaks will be installed in snow and topsoil piles where intersected by the temporary slope breakers to promote water flow off of the right-of-way during the Spring thaw.

When restoration activities resume the following Spring, the temporary slope breakers will be left in place; the topsoil stockpiled over Winter will be replaced over the right-of-way, including over the temporary slope breakers; and silt fences will be installed in areas required by the Plan or Procedures. In this way, the temporary slope breakers will form the basis of permanent slope breakers across the right-of-way. [1]

- Erosion control devices will be inspected by the EIs and repaired as necessary to be functional for Spring runoff.
- If an erosion control device is located in an area which is not accessible due to weather conditions or saturated soils during Spring thaw, Atlantic or DTI will request a variance from the FERC.
- Mulch will be applied to topsoil stockpiled over Winter as described in Section 4.0 above.
- Mulch will be applied to disturbed areas within the construction right-of-way in non-cultivated uplands in areas where topsoil replacement is delayed to the following Spring or Summer due to frozen soil conditions or in areas where seeding is delayed due to seeding period restrictions.
- Where required on the construction right-of-way, mulch typically will be applied at a rate of 2 tons/acre. When mulching before seeding, however, mulch will be applied at a rate of 3 tons/acre on slopes within 100 feet of waterbodies and wetlands. If conditions preclude crimping, Atlantic or DTI may elect to spray water to freeze the mulch in place, or apply a biodegradable tackifier.
- Following final grading and cleanup, and in the appropriate season, Atlantic and DTI will condition the construction right-of-way for planting including the preparation of a seedbed and application and incorporation of soil amendments, as appropriate. Reseeding will be conducted in accordance with the Plan and Procedures and *Restoration and Rehabilitation Plan*, as appropriate.

8.0 TEMPORARY EQUIPMENT BRIDGES

Temporary bridges will be installed at waterbody crossings as required by the Procedures. Snow will be removed from the temporary bridges by plowing the snow off the bridge onto the right-of-way or approved ATWS. Snow will not be plowed off the bridge into the waterbody.

9.0 TRENCH DEWATERING

Trench dewatering in both non-frozen and frozen conditions will be conducted in accordance with the Plan and Procedures, as appropriate. Under frozen conditions, dewatering structures may need to be larger and located further away from the construction area to avoid trench water moving back into the construction right-of-way due to low infiltration rates.

[1] In pasture and hayfields, temporary slope breakers will be removed if requested by the landowner.

10.0 HYDROSTATIC TESTING

Hydrostatic testing is not anticipated in the Winter or in frozen conditions.

11.0 WINTER AND SPRING INSPECTIONS

Following pipeline construction activities and prior to the resumption of restoration activities the following Spring, Atlantic's and DTI's EIs will inspect the condition of erosion control devices within 48 hours of a significant rain or snow melt event, if accessible and weather permitting, to ensure that the devices remain in place and are effective in controlling snow melt and Spring runoff. The EIs will use public roads and approved access roads for access to the construction right-of-way. Particular attention will be paid to steep slopes and wetland and waterbody crossings. The EIs will determine the most effective means of correcting problems, taking into account the suitability of the right-of-way for equipment access, damage that could occur as a result of equipment crossing the right-of-way (e.g., in saturated soil conditions), and the urgency/significance of the problem.

To ensure that sufficient materials are available to repair or replace erosion control devices as necessary at the time they are inspected, Atlantic and DTI will stockpile materials within its staging areas over the Winter and Spring so they are available to the EIs and Contractor personnel. Atlantic's and DTI's EIs and the construction contractors will attempt to complete repairs at the time non-functioning or damaged erosion control devices are discovered. If repairs to erosion control devices cannot be completed within 7 days, Atlantic or DTI will seek a variance from FERC.

12.0 SPRING THAW CONDITIONS

When possible, construction during Spring thaw conditions will be avoided or minimized to reduce or avoid impacts within the construction right-of-way. However, in the event that the construction activities are required in Spring thaw conditions, the following measures will be implemented to prevent soil mixing, rutting, and compaction:

- The Contractors will work only in well drained, dry sites and/or frozen areas until conditions improve.
- The Contractors will use equipment best suited to existing ground conditions, e.g., low ground pressure equipment.
- The Contractors will install mats along the travel lane where soils are excessively wet and rutting is occurring to prevent mixing of topsoil and subsoil.
- The Contractors may use frost driving measures, such as snow packing, to increase the load bearing capacity of the ground where necessary to remove equipment off the right-of-way (but not as a condition to allow construction to continue). The frost driving measures will be implemented in the early morning or evening to take advantage of colder temperatures.

- When ground conditions are frozen, construction activities in problem areas will be postponed until evening or early morning.
- If the EI and construction manager determine that muddy conditions are severe and rutting occurs, work will be suspended until conditions improve.
- The EI will monitor, report, and initiate repairs in problem areas associated with Spring thaw.
- If the measures above do not allow for suitable soil conditions, Atlantic's or DTI's Contractors will suspend construction activities in problem areas until soil conditions are suitable.

13.0 SPRING RIGHT-OF-WAY ASSESSMENT

Atlantic and DTI will conduct pedestrian, windshield, and aerial reconnaissance surveys along the construction right-of-way in the late Winter or early Spring of 2017 and 2018 after the snow cover has disappeared and thaw is progressed. The surveys will identify erosion control structures in need of repair, areas of slope instability along the construction right-of-way, areas where settling of soils or subsidence has occurred along the trench line, and areas where erosion is occurring. Data from the surveys will be used to plan final clean-up and restoration activities in the Spring of 2017 or 2018, depending on the construction spread.

14.0 FINAL CLEAN-UP AND RESTORATION

In frozen conditions, final clean-up and restoration (including weed treatments where required, topsoil replacement, final grading, and seeding) will be deferred to the Spring of 2017 and 2018, depending on construction spread. EIs will be deployed to verify that clean-up and restoration work is conducted in compliance with the environmental requirements of the Projects.

Special measures will be implemented during final clean-up and restoration in the event that subsidence is identified along the trenchline. In areas where topsoil is stockpiled over the Winter, the right-of-way may be re-graded prior to topsoil replacement. Additional subsoil will be placed over the trenchline during grading to restore pre-construction contours to the extent practicable. If subsidence has occurred in areas where topsoil is replaced prior to the end of active construction (e.g., in wetlands or in areas where construction occurred during non-frozen conditions), the topsoil will be removed and the right-of-way re-graded as described above to restore pre-construction contours to the extent practicable. In both cases, topsoil will be replaced after re-grading is complete. If insufficient topsoil is available to restore the area to pre-construction condition, additional topsoil will be obtained from local sources to restore the area.

15.0 TRAINING

Prior to construction, Atlantic and DTI will conduct environmental training for all company and contractor personnel. The training program will focus on the Plan and Procedures, this *Winter Construction Plan*, Certificate and permit conditions, and construction, restoration, and mitigation plans. In addition, Atlantic and DTI will provide large-group training sessions

before each work crew begins construction. Periodic follow-up training for groups of newly assigned personnel will be provided as necessary by the EIs. Besides training rosters, which will be kept to verify that personnel have been trained, Atlantic and DTI will issue hardhat stickers to be placed on each worker's hardhat as field verification that the worker has completed the training.

16.0 MONITORING AND REPORTING

Atlantic and DTI will conduct monitoring and reporting in accordance with the Plan and Procedures, Certificate and permit conditions, and the *Restoration and Rehabilitation Plan*.

17.0 REFERENCES

National Oceanic and Atmospheric Administration. 2012a. Charleston, West Virginia Field Office, Spring Freeze Maps. Available online at: http://www.erh.noaa.gov/rlx/climate/springfreeze.html. Accessed June 2015.

National Oceanic and Atmospheric Administration. 2012b. Charleston, West Virginia Field Office, Fall Freeze Maps. Available online at: http://www.erh.noaa.gov/rlx/climate/fallfreeze.html. Accessed June 2015.

National Oceanic and Atmospheric Administration. 2012c. Eastern Regional Headquarters. Spring and Fall Freeze Dates and Probabilities for Southeastern North Carolina and Northeastern South Carolina. Available online at: http://www.erh.noaa.gov/ilm/climate/freeze/. Accessed June 2015.

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