ATTACHMENT 8

ATLANTIC COAST PIPELINE, LLC
ATLANTIC COAST PIPELINE
Docket Nos. CP15-554-000
CP15-554-001

Response to USFS Request for Information for Construction and Operations on Steep Slopes

Monongahela National Forest

and

George Washington National Forest

March 2017

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Executive Summary

This document responds to the USFS comments and requests for information resulting from the 21-November-2016, 8-December-2017 and 17-February-2017 coordination meetings held to present Atlantic Coast Pipeline, LLC.'s (Atlantic) Best-in-Class (BIC) and steep slope design process.

Atlantic's BIC methodology was presented to the USFS during the November 21st meeting and discussed in subsequent meetings. Atlantic is committed to the BIC program and firmly believes the implementation of these incremental measures along with the proven experience of the team will minimize the risk of slope failure along the right of way.

These requests included a demonstration of past experience constructing pipelines in similar terrain by Dominion Transmission Inc. (DTI). Similarly, examples of industry standard practices and successes were also requested. In addition to the example project and industry practices, the USFS requested a narrative detailing the process by which steep slopes are identified for the BIC program.

Atlantic submits documentation of DTI's experience constructing pipelines by providing details of representative projects completed. Demonstration of the BIC program development is provided in the INGAA Foundation Report, Mitigation of Land Movement in Steep and Rugged Terrain for Pipeline Projects: Lesson Learned from Construction Pipelines in West Virginia, April 2016.

The DTI example projects provided total approximately 278 miles of pipeline constructed in steep, Appalachian terrain. Of the eleven projects provided, 13 percent (37 miles) of the construction occurred on slopes greater than 35%. DTI has experienced very few slope stability issues related to these representative projects. One project, G 150 accounts for over 90% of the steep slope issues that occurred. A Case Study of one project, TL 590, is provided to demonstrate where slope stability issues were encountered and DTI's response and restoration measures.

In addition, the explanation of processes and methods used to select the steep slope locations for site specific design and a discussion of BIC implementation is also provided.

The information provided in this document demonstrates Atlantic's successful construction and operation of natural gas pipelines in similar terrain as that found along the proposed ACP pipeline corridor.

1 Introduction

This document responds to the USFS comments and requests for information resulting from the 21-November-2016, 8-December-2017, and 17-February-2017 coordination meetings held to present Atlantic Coast Pipeline, LLC.'s (Atlantic) Best-in-Class and steep slope design process.

Atlantic Coast Pipeline Project anticipates the need for an amendment to the Land and Resource Management Plan (LRMP) for the Monongahela National Forest (MNF) in order to construct and operate on steep slopes (40-50%) or very steep slopes (more than 50%).

In the November 21st and December 8th meetings the USFS requested that Atlantic provide '…documentation of effectiveness…' which demonstrates success in construction and restoration on slopes greater than 30%. Atlantic has not received formal comments from the December 8th meeting but has attempted to provide the information requested.

The Best-in-Class (BIC) methodology was introduced and presented to the USFS during the November 21st meeting and discussed in subsequent meetings. Atlantic is committed to the BIC program and firmly believes the implementation of these incremental measures along with the proven experience of the team will minimize the risk of slope failure along the right of way.

This document provides the information verbally requested by the USFS in the November 21st and December 8th meetings. The request included a demonstration of past experience constructing pipelines in similar terrain by Dominion Transmission Inc. (DTI). Similarly, examples of industry standard practices and successes were also requested. In addition to the example projects and industry practices the USFS requested a narrative detailing the process by which steep slopes are identified for the BIC program.

Atlantic submits documentation of DTI's experience constructing pipelines by providing details of representative projects completed.   In support of industry experience the INGAA Foundation Report, Mitigation of Land Movement in Steep and Rugged Terrain for Pipeline Projects: Lesson Learned from Construction Pipelines in West Virginia, April 2016 is provided.

The explanation of processes and methods used to select the steep slope locations for site specific design and discussion of BIC implementation is also provided.

2 Past Performance and Experience

Atlantic has prepared the following eleven case studies completed in the last ten years to demonstrate (DTI's) experience and successful past performance constructing pipelines on steep slopes. The eleven projects are:

- TL 453 Ext 1 — 12 miles of new 24-in pipeline
- PL 1 Ext 2 — 83 miles of new 24-in pipeline
- TL 492 Ext 3 — 12 miles of new 24-in pipeline
- TL 585 — 28 miles of new 20-in pipeline
- TL 492 Ext 4 — 10 miles of new 24-in pipeline
- TL 492 Ext 5 — 6 miles of new 24-in pipeline
- TL 590 — 43 miles of 30-in pipeline
- TL 570 Ext 1 — 5 miles of 20-in pipeline
- G 150 — 60 miles of 8-in pipeline
- TL 610 — 15 miles of 24-in pipeline
- TL 610 Ext 1 — 3.5 miles of 24-in pipeline

These example projects illustrate DTI's experience and effectiveness of the methods used in controlling soil movement, preventing slips, and achieving final restoration on slopes 30 percent or greater. These projects were selected due to their locations within the Appalachian region with similar slopes geology that may be encountered along the Atlantic Coast Pipeline (ACP) project within the Monongahela National Forest and George Washington National Forest.

A summary of the project characteristics is provided in Table 2.1 - 1

2.1 Dominion Transmission Inc.

2.1.1 Project 1: TL 453 Ext 1

Location: Potter County, PA

- 12 miles of new 24-inch diameter gas transmission line
- FERC Jurisdictional Project
- Construction took place in 2008
- Nominal construction right-of-way width was 75-ft
- Restoration work included standard silt fence, water bars, trench breakers, erosion control fabric, coir logs, tracked slopes, approved seed and mulch per agency recommendations
- Additional restoration work included tighter spacing of water breakers and trench plugs in select areas
- Full time environmental inspectors were onsite throughout construction
- Post construction monitoring continued for approximately 6months
- FERC inspections occurred periodically
- No instances of non-compliance or problem areas were noted during FERC Inspections
- At a minimum slope breakers and trench breakers were constructed at the FERC required spacing
- No bleeder drains were used
- Full restoration was accomplished

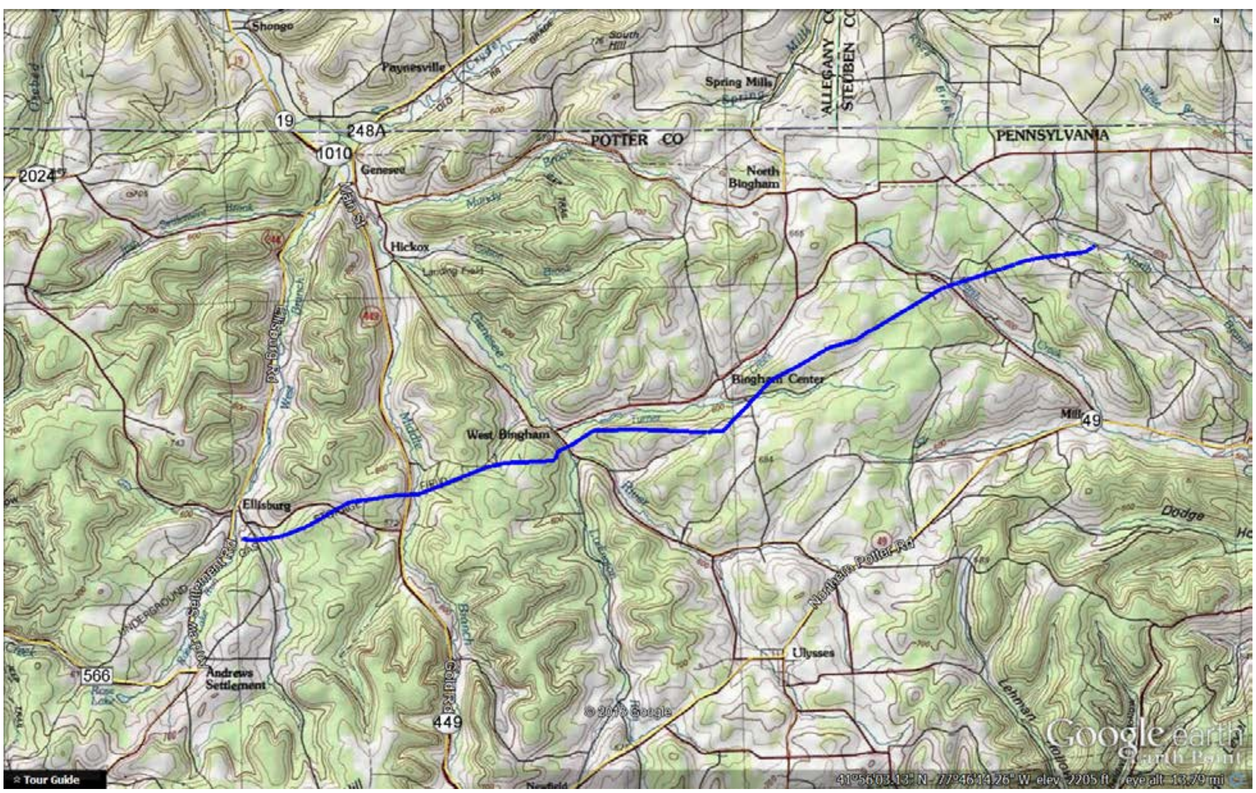

Figure 1 – TL 453 Ext 1, Vicinity Map

2.1.2 Project 2: PL 1 Ext 2

Location: Juniata, Miflin, Huntingdon, Centre and Clinton Counties, PA

- 83 miles of new 24-inch diameter gas transmission line
- FERC Jurisdictional Project
- Construction took place in 2007 / 2008
- Nominal construction right-of-way width was 75-ft
- Restoration work included standard silt fence, water bars, trench breakers, erosion control fabric, coir logs, tracked slopes, approved seed and mulch per agency recommendations
- Additional restoration work included tighter spacing of water breakers and trench plugs in select areas
- 5 full time environmental inspectors onsite throughout construction.
- Post construction monitoring continued for approximately 14 months
- Onsite FERC monitor
- No instances of non-compliance or problem areas were noted during FERC Inspections
- At a minimum slope breakers and trench breakers were constructed at the FERC required spacing
- No bleeder drains were used
- Full restoration was accomplished
- DTI awarded the Clean Stream Award for Excellence in Soil Erosion

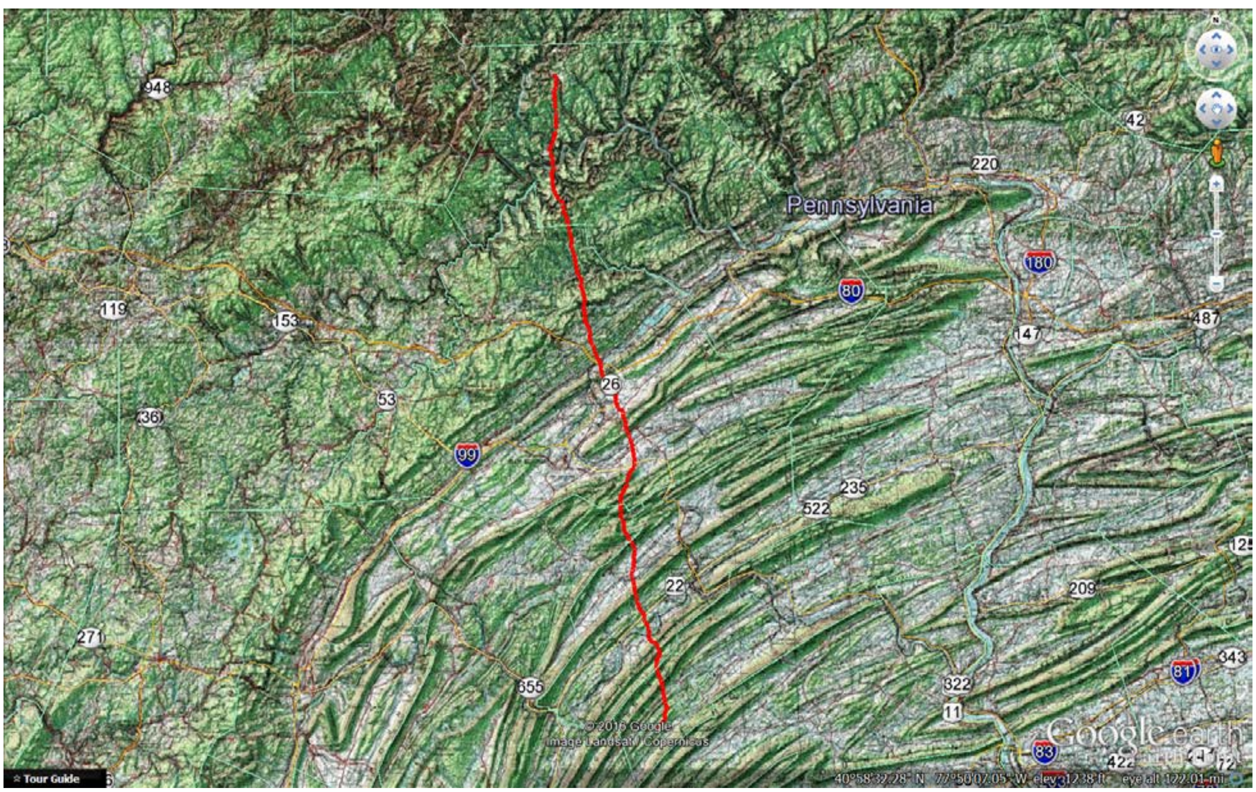

Figure 2 - PL 1 ext 2, Vicinity Map

2.1.3 Project 3: TL 492 Ext 3

Location: Wetzel County, WV and Greene County, PA

- 12 miles of new 24-inch diameter gas transmission line
- FERC Jurisdictional Project
- Construction took place in 2008
- Nominal construction right-of-way width was 75-ft
- Restoration work included standard silt fence, water bars, trench breakers, erosion control fabric, coir logs, tracked slopes, approved seed and mulch per agency recommendations
- Additional restoration work included tighter spacing of water breakers and trench plugs in select areas
- Full time environmental inspectors were onsite throughout construction
- Post construction monitoring continued for approximately 6-8 months
- FERC inspections occurred periodically
- No instances of non-compliance or problem areas were noted during FERC Inspections
- At a minimum slope breakers and trench breakers were constructed at the FERC required spacing
- No bleeder drains were used
- Full restoration was accomplished

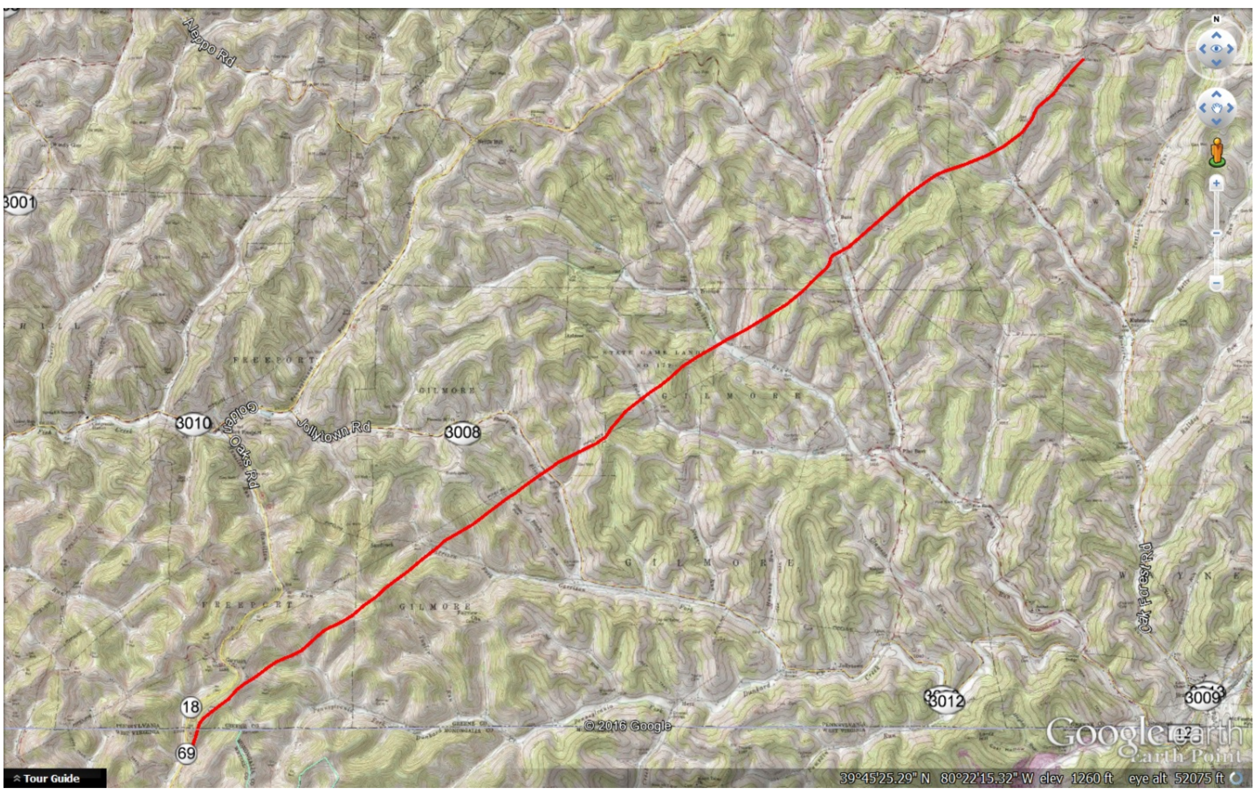

Figure 3 - TL 492 Ext 3, Vicinity Map

Figure 4 - TL 492 Ext 3, Three Years after Completion

2.1.4 Project 4: TL 585

Location: Kanawha and Clay Counties, WV

- 28 miles of 20-inch diameter take up and relay gas transmission line
- FERC Jurisdictional Project
- Construction took place in 2010
- Nominal construction right-of-way width was 75-ft
- Restoration work included Belted Silt Retention Fence, water bars, trench breakers, erosion control fabric, coir logs, tracked slopes, approved seed and mulch per agency recommendations, compost filter socks
- Additional restoration work included tighter spacing of water breakers and trench plugs in select areas
- 4full time environmental inspectors onsite throughout construction
- Post construction monitoring continued for approximately 9-10 months
- FERC inspections occurred monthly
- No instances of non-compliance or problem areas were noted during FERC Inspections
- At a minimum slope breakers and trench breakers were constructed at the FERC required spacing
- No bleeder drains were used
- Full restoration was accomplished

Figure 5 - TL 585, Vicinity Map

Figure 6 - TL 585, Final Grade Established

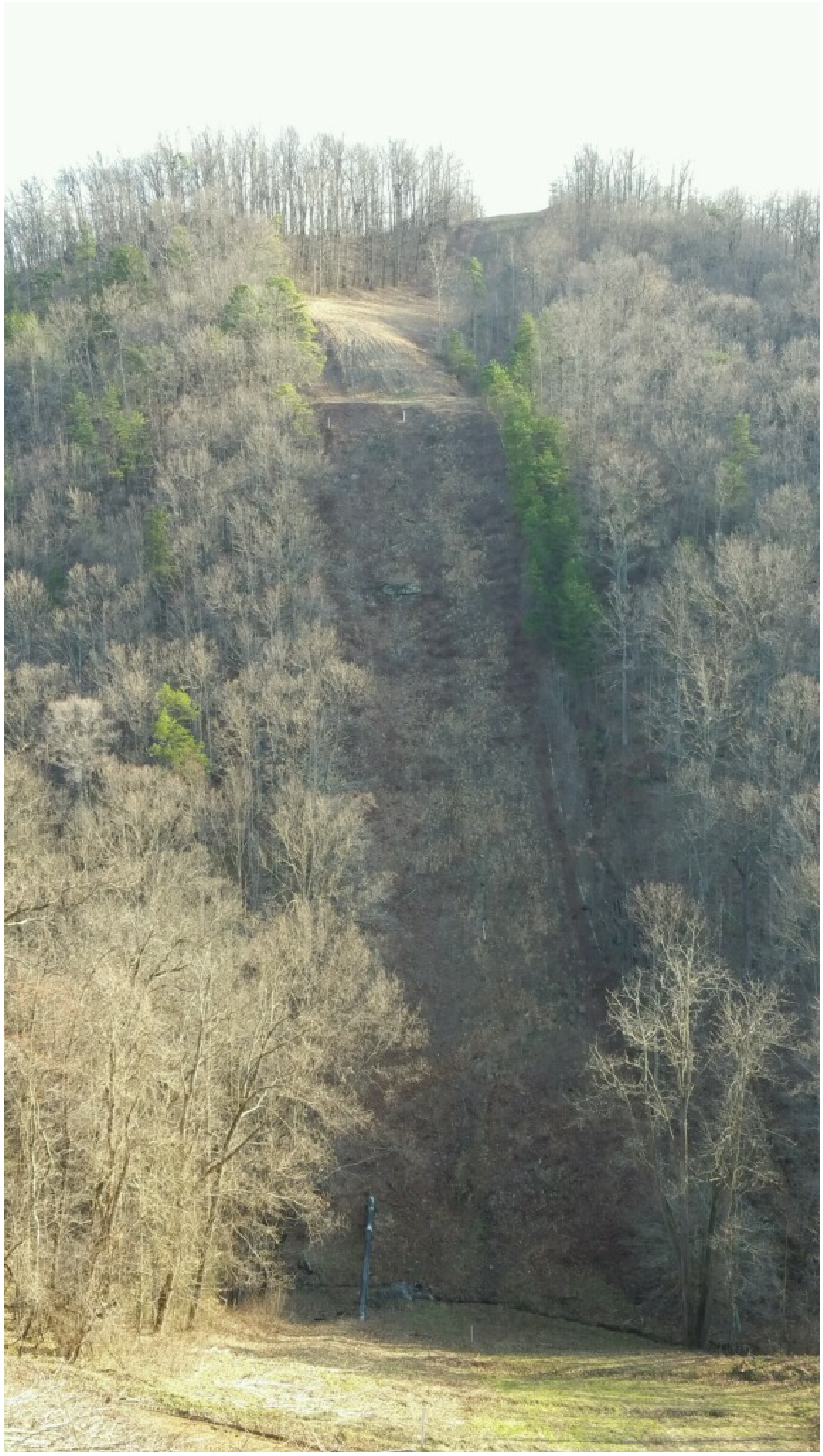

Figure 7 - TL 585, Six Years after Completion

2.1.5 Project 5: TL 492 Ext 4

Location: Greene County, PA

- 10 miles of new 24-inch diameter gas transmission line
- FERC Jurisdictional Project
- Construction took place in 2010
- Nominal construction right-of-way width was 75-ft
- Restoration work included Belted Silt Retention Fence, water bars, trench breakers, erosion control fabric, coir logs, tracked slopes, approved seed and mulch per agency recommendations, compost filter socks
- Additional restoration work included tighter spacing of water breakers and trench plugs in select areas
- 2 full time environmental inspectors onsite throughout construction
- Post construction monitoring continued for approximately 6-8 months
- FERC inspections occurred periodically
- At a minimum slope breakers and trench breakers were constructed at the FERC required spacing
- There were a couple noted slope stability issues as a result of buried layers of chips and water runoff control. Incremental measures to remediate included excavation, tracked back in, seeding, mulch and installation of a french drain system (measures included in the BIC program)
- Full restoration was accomplished

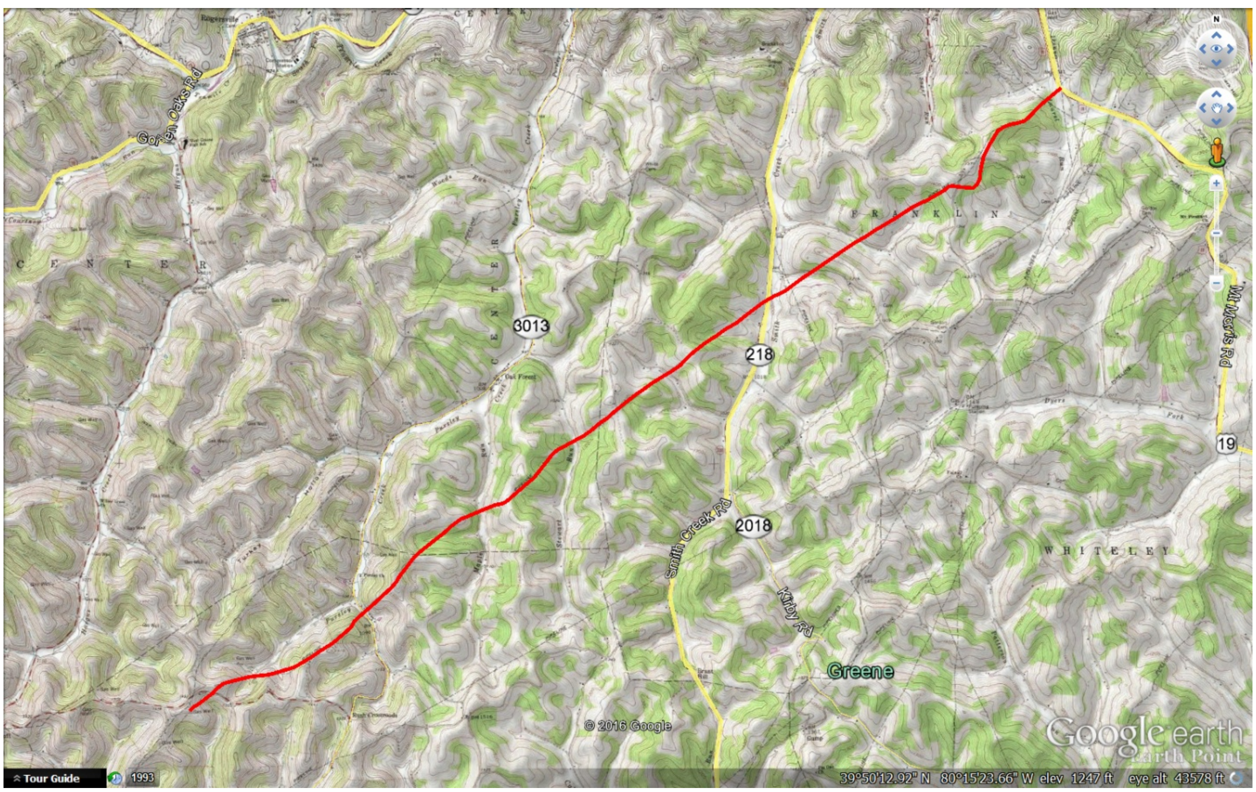

Figure 8 - TL 492 Ext 4, Vicinity Map

Figure 9 - TL 492 Ext 4, Restored Right of Way

2.1.6 Project 6: TL 492 Ext 5

Location: Greene County, PA

- 6 miles of new 24-inch diameter gas transmission line
- FERC Jurisdictional Project
- Construction took place in 2011 / 2012
- Nominal construction right-of-way width was 75-ft
- Restoration work included Belted Silt Retention Fence, water bars, trench breakers, erosion control fabric, coir logs, tracked slopes, approved seed and mulch per agency recommendations, compost filter socks
- Additional restoration work included tighter spacing of water breakers and trench plugs, sakrete trench breakers, and bleeder drains utilized in select areas
- 1-2 full time environmental inspectors onsite throughout construction
- Post construction monitoring continued for 18 months
- Onsite FERC monitor
- At a minimum, slope breakers and trench breakers were constructed at the FERC required spacing
- Several slope stability issues were noted as a result of buried layers of chips, water runoff control, and very steep slope with a road above. Incremental measures (i.e. BIC) included excavation, controlling water runoff with a french drain system, seeding, mulching, and installation of a retaining wall
- Full restoration was accomplished

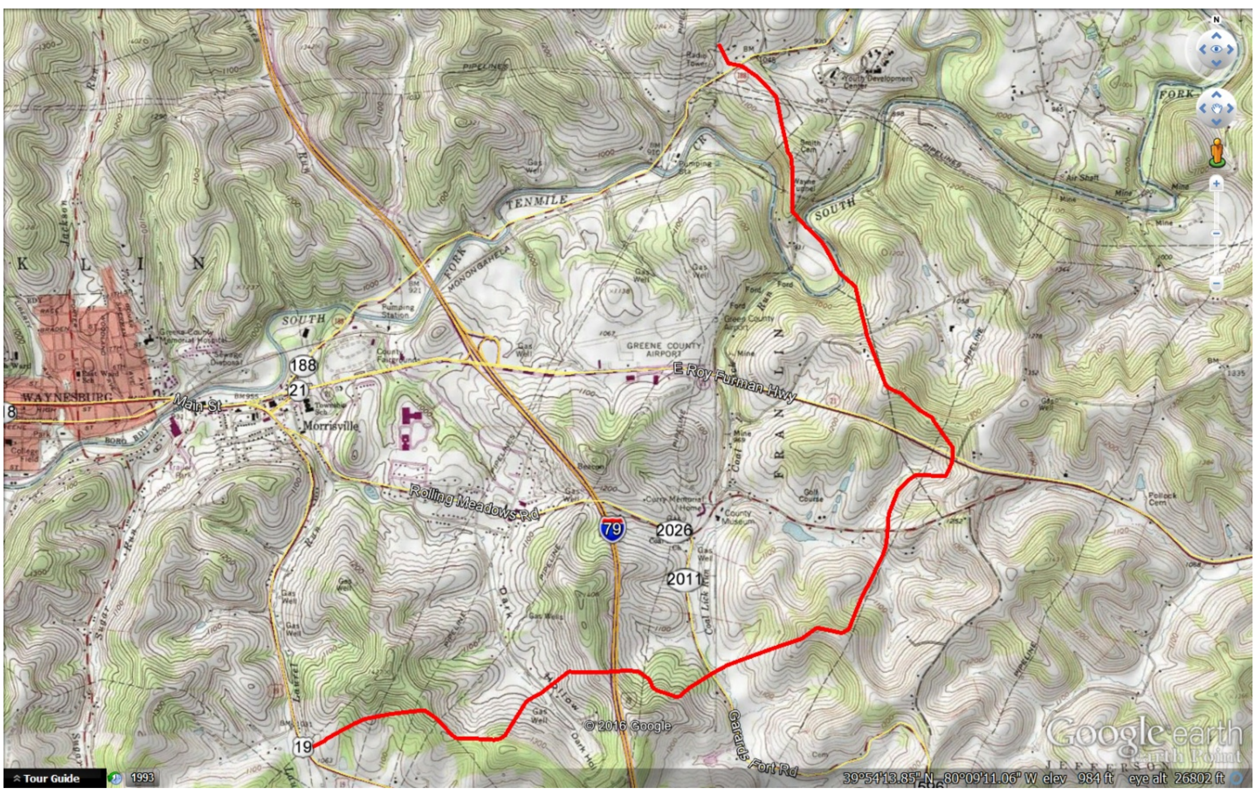

Figure 10 –TL 492 Ext 5, Vicinity Map

Figure 11 - TL 492 Ext 5, Restored Right of Way

2.1.7 Project 7: TL 590

Location: Greene County, PA and Marshall County, WV

- 43 miles of new 30-inch diameter gas transmission line
- FERC Jurisdictional Project
- Construction took place in 2011 / 2012
- Nominal construction right-of-way width was 90-ft
- Restoration work included Belted Silt Retention Fence, water bars, trench breakers, erosion control fabric, coir logs, tracked slopes, approved seed and mulch per agency recommendations, compost filter socks
- Additional restoration work included tighter spacing of water breakers and trench plugs, sakrete trench breakers, and bleeder drains utilized in select areas
- 10 full time environmental inspectors onsite throughout construction
- Onsite FERC monitor
- No instances of non-compliance or problem areas were noted during FERC Inspections
- At a minimum slope breakers and trench breakers were constructed at the FERC required spacing
- Project has seen several slope stability issues but the most significant of these occurred in the Marshall County, WV. Reasons for the slope stability issues varied but included buried layers of chips and water control. Multiple new methods were implemented to stabilize the slopes including soil nails, retaining walls, peanut pipe, under drains, calcinate soil enhancers.
- Right of way restored. Continual monitoring of the right of way is ongoing to monitor for slope stability issues.

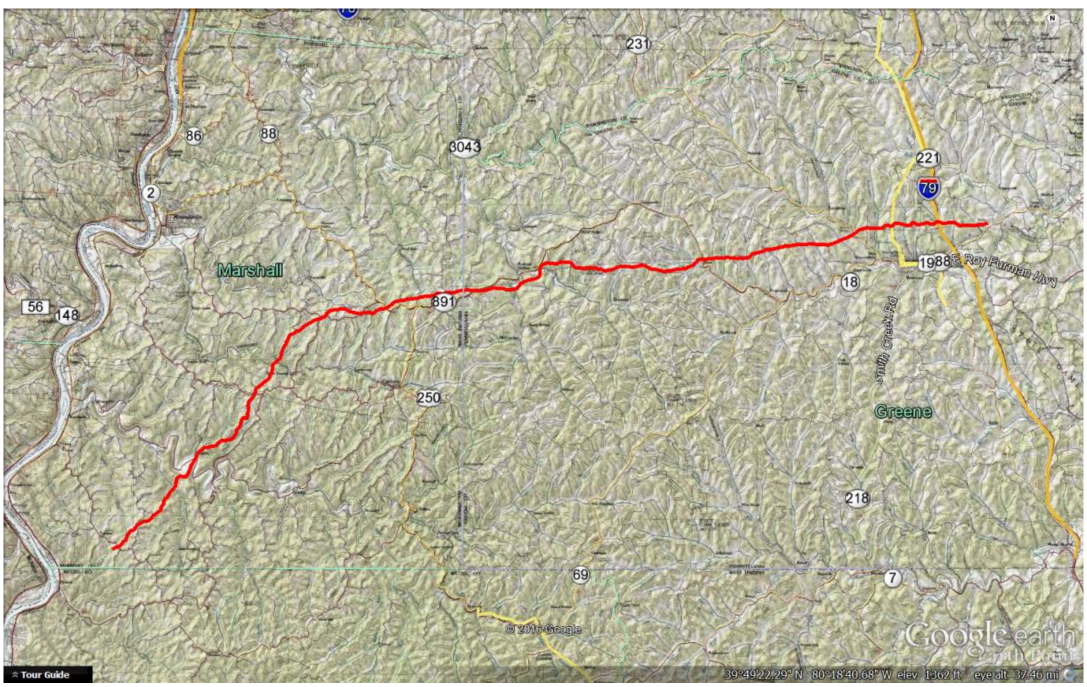

Figure 12 - TL 590, Vicinity Map

Figure 13 - TL 590, Restored Right of Way

2.1.8 Project 8: TL 570 Ext 1

Location: Kanawha County, WV

- 5 miles of new 20-inch diameter gas transmission line
- FERC Jurisdictional Project
- Construction took place in 2011 / 2012
- Nominal construction right-of-way width was 75-ft
- Restoration work included Belted Silt Retention Fence, water bars, trench breakers, erosion control fabric, coir logs, tracked slopes, approved seed and mulch per agency recommendations, compost filter socks
- Additional restoration work included tighter spacing of water breakers and trench plugs, sakrete trench breakers
- 3-4 full time environmental inspectors onsite throughout construction
- Post construction monitoring continued for approximately 18 months
- Onsite FERC monitor
- At a minimum slope breakers and trench breakers were constructed at the FERC required spacing
- Slope stability issues were observed due to improper installation of waterbars. Waterbars were reworked, seeded and mulched
- Full restoration was accomplished

Figure 14 - TL 570 Ext 1, Vicinity Map

Figure 15 - TL 570 Ext 1, Restored Right of Way, Ridge

Figure 16 - TL 570 Ext 1, Restored Right of Way, Steep Slope

2.1.9 Project 9: G 150

Location: Marshall, Ohio and Brooke Counties, WV

- 60 miles of new 8-inch diameter gas transmission line
- Construction took place in 2012
- Nominal construction right-of-way width was 100-ft
- Restoration work included Belted Silt Retention Fence, water bars, trench breakers, erosion control fabric, coir logs, tracked slopes, approved seed and mulch per agency recommendations, compost filter socks
- Full time environmental inspectors were onsite throughout construction.
- At a minimum slope breakers and trench breakers were constructed at the WVDEP required spacing
- Project has experienced slope stability issues throughout the alignment. Reasons for slope stability issues have been attributed to water control and non-optimal location of pipeline due to non-jurisdictional status. Many incremental controls were installed to stabilize slopes including soil nails, retaining walls, peanut pipe, under drains and calcinate soil enhancers.
- Right of way restored; continual monitoring of the right of way for slope stability issues continues

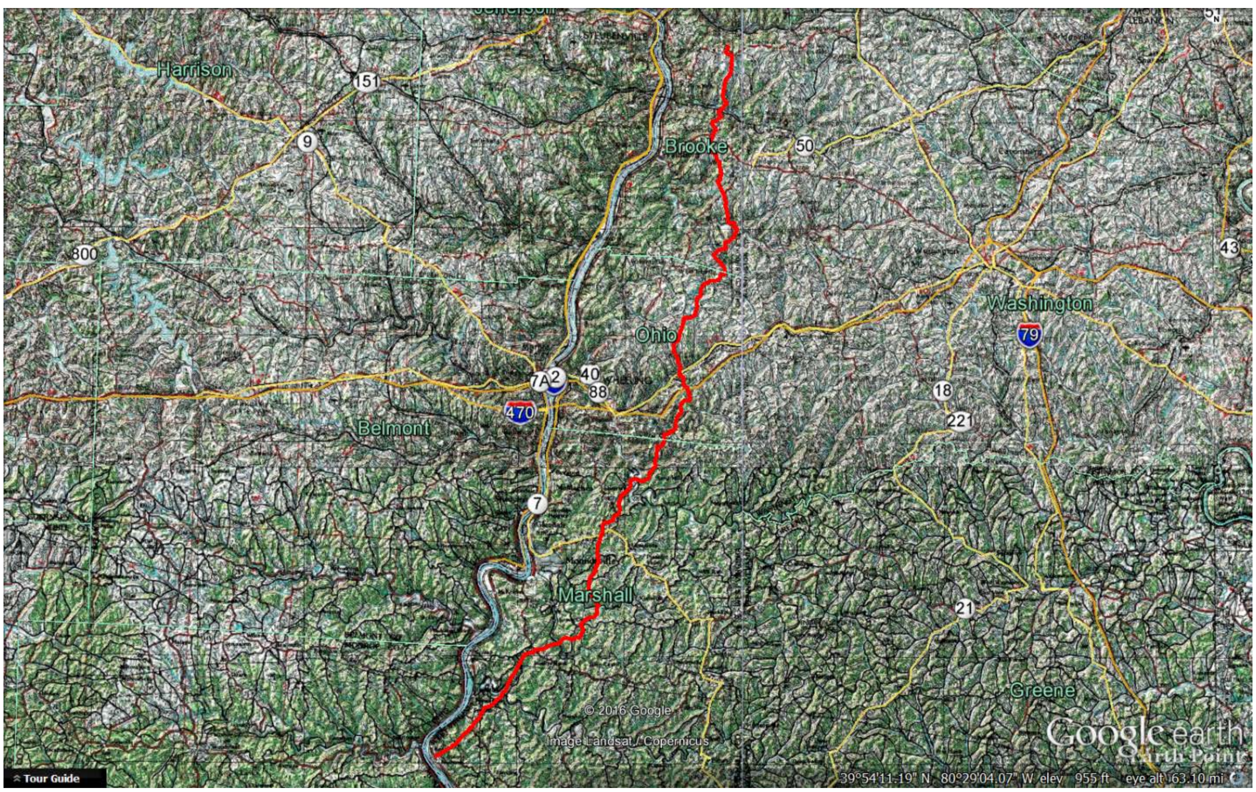

Figure 17 - G 150, Vicinity Map

Figure 18 - G 150, Restored Right of Way

Figure 19 - G 150, Restored Right of Way, Steep Slope

2.1.10 Project 10: TL 610 Ext 1

Location: Tioga County, PA

- 15 miles of new 24-inch diameter gas transmission line
- FERC Jurisdictional Project
- Construction took place in 2013
- Nominal construction right-of-way width was 75-ft
- Restoration work included Belted Silt Retention Fence, water bars, trench breakers, erosion control fabric, coir logs, tracked slopes, approved seed and mulch per agency recommendations, compost filter socks
- Additional restoration work included tighter spacing of water breakers and trench plugs and bleeder drains utilized in select areas
- 3 full time environmental inspectors onsite throughout construction.
- Post construction monitoring continued for approximately 12 months
- FERC inspections occurred monthly
- No instances of non-compliance. One problem area for missing orange safety fence was noted during FERC Inspections.
- At a minimum slope breakers and trench breakers were constructed at the FERC required spacing
- Full restoration was accomplished

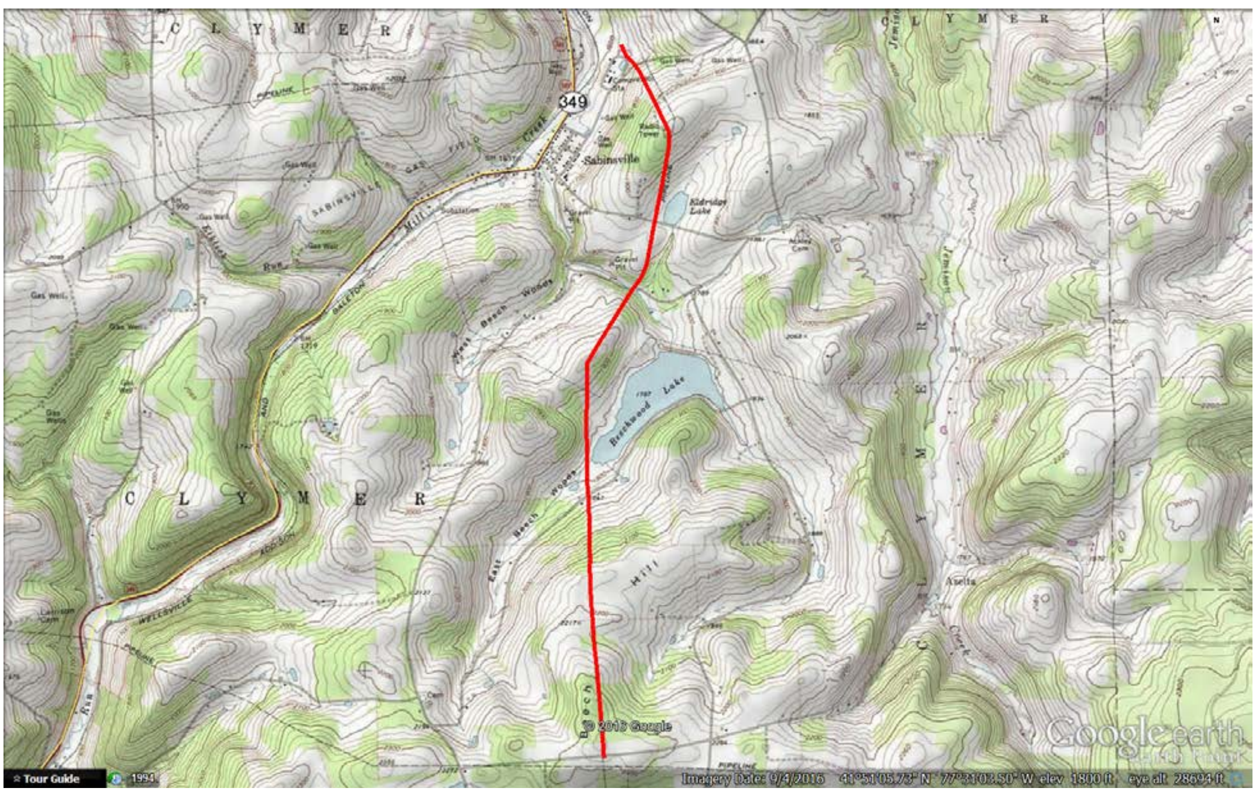

Figure 20 - TL 610 Ext 1, Vicinity Map

Figure 21 - TL 610 Ext 1, Restored Right of Way

2.1.11 Project 11: TL 610

Location: Tioga County, PA

- 3.5 miles of new 24-inch diameter gas transmission line
- FERC Jurisdictional Project
- Construction took place in 2013
- Nominal construction right-of-way width was 75-ft
- Restoration work included Belted Silt Retention Fence, water bars, trench breakers, erosion control fabric, coir logs, tracked slopes, approved seed and mulch per agency recommendations, compost filter socks
- Additional restoration work included tighter spacing of water breakers and trench plugs
- 3 full time environmental inspectors onsite throughout construction
- Post construction monitoring continued for approximately 12 months
- FERC inspections occurred monthly
- No instances of non-compliance or problem areas were noted during FERC Inspections
- At a minimum slope breakers and trench breakers were constructed at the FERC required spacing
- No bleeder drains were used
- Full restoration was accomplished

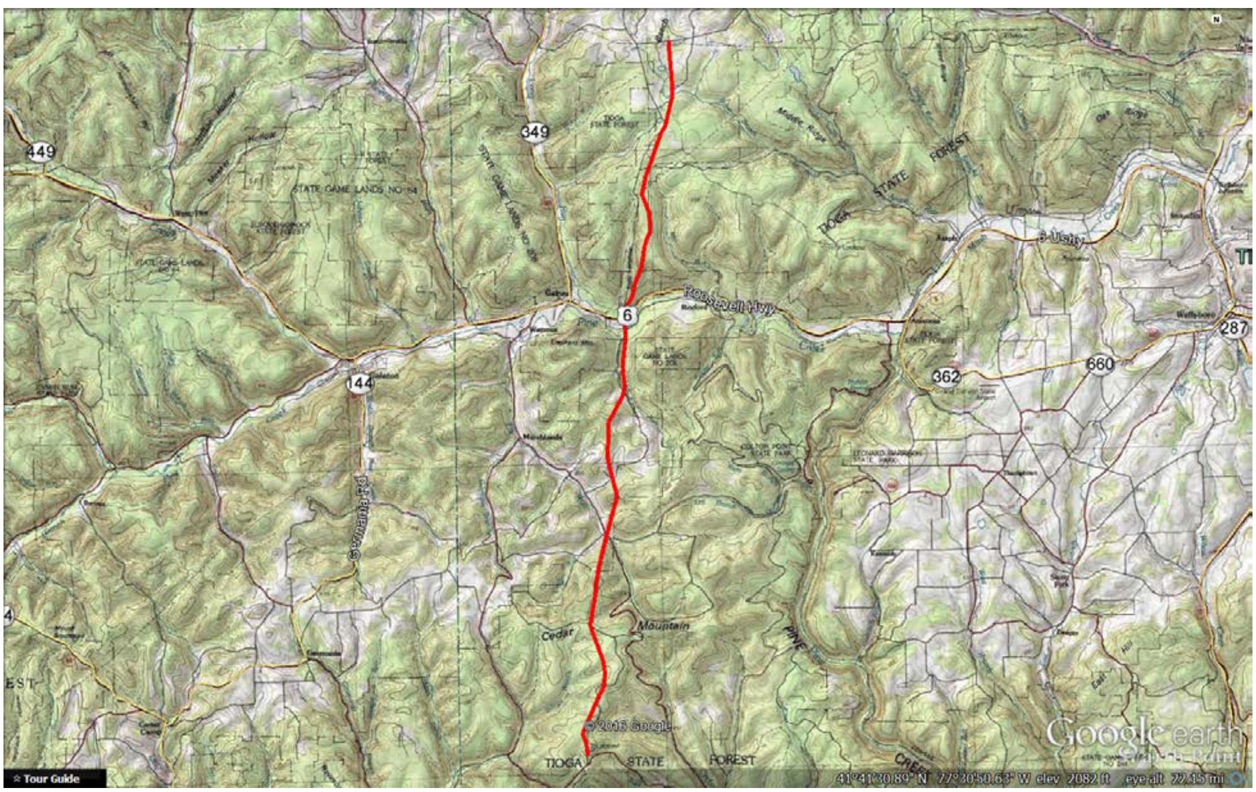

Figure 22 - TL 610, Vicinity Map

Figure 23 - TL 610, Restored Right of Way

2.1.12 Case Study: TL 590

PIPELINE CONSTRUCTION AND HISTORY

DTI's TL 590, 30-inch, approximately 43-mile long natural gas transmission pipeline was installed in 2011-2012 in Greene County, PA and Marshall County, WV. Construction began around August 2011 and the pipeline was placed in service in September 2012.

LANDSLIDE CHARACTERIZATION

Soils in the area of this case study are mapped as Culleoka-Dormont-Peabody complex, 35 to 65 percent slopes, very stony.

Mass soil movements occurred on the slope shown below. Retaining walls installed in a terraced fashion were utilized to hold soils in place to become successfully vegetated and stable. The walls failed after a large snow melt/rain event in March. The soil movement was approximately 95 ft wide by 160 ft long.

FIELD EXPLORATION AND FINDINGS

The pipeline was continuously being monitored post-construction by environmental inspectors. This mass movement was identified very early and temporary measures were installed as precautionary measures to protect sensitive resources nearby. Based on knowledge gained from construction and post construction restoration, it was noted that rock outcrops were present and the soil was not bonding to the shale and siltstone layer below. It was evident that the slope failures occurred due to very steep slopes (80-90%), construction activities and weather conditions, and surface and subsurface water.

SLOPE STABILIZATION MEASURES

A plan for necessary repairs was developed and implementation began when the weather permitted around August. The plan consisted of stabilizing and bonding the soils utilizing subsurface drains, coconut erosion control blanket and a series of soil nails. One key factor identified necessary to ensure successful implementation of the repairs was completing the work during favorable weather conditions.

The soils were pulled back up onto the steep slope with an excavator and tracked in for adequate compaction. The area was then reseeded and mulched. Threaded rods were drilled and anchored into the bedrock. The area was then covered with coconut erosion control blanket and steel mesh. A steel washer (plate) and nut were placed on the threaded rods to tighten the mesh to the ground and secure the soil system.

AREAS OF IMPROVEMENT

When working on these types of slopes, it is critical to control surface and subsurface water, monitor the conditions of the soil when replacing it, and take note of the stratum below to ensure the soil has a layer to bond and will remain in place.

Soil movement following event – Aerial view

Soil movement following event – looking upslope

Restoration operations – final grading

Restoration operations – Installation of soil nails

Restoration operations – Installation of soil nails with TECO mesh

Restored ROW

Table 2.1 – 1 Summary of Example Projects

Pipeline	FERC	County	State	Year Constr.	Dia (in)	Length (Mi)	Constr. ROW (ft)	Erosion Control Devices Implemented	Stabilization Issues	% of Mileage with Issues	Total Mileage Impacted	Remediation (if any)	Comments
TL-453 Ext 1	Yes	Potter	PA	2008	24	12	75	Standard silt fence, water bars, trench breakers, erosion control fabric, approved seed and mulch per agency recommendations	None	0%	0.00	N/A	N/A
PL-1 Ext 2	Yes	Juniata, Miflin, Huntingdon, Centre, Clinton	PA	2007 / 2008	24	83	75	Standard silt fence, water bars, trench breakers, erosion control fabric, approved seed and mulch per agency recommendations	None	0%	0.00	N/A	N/A
TL-492 Ext 3	Yes	Wetzel, Greene	WV/PA	2008	24	12	75	Standard silt fence, water bars, trench breakers, erosion control fabric, approved seed and mulch per agency recommendations	None	0%	0.00	N/A	N/A
TL-585	Yes	Kanawha	WV	2010	20	28	75	Belted Silt Retention Fence, water bars, trench breakers, erosion control fabric, approved seed and mulch per agency recommendations, compost filter socks	None	0%	0.00	N/A	N/A
TL-492 Ext 4	Yes	Greene	PA	2010	24	10	75	Belted Silt Retention Fence, water bars, trench breakers, erosion control fabric, approved seed and mulch per agency recommendations, compost filter socks	There were a couple noted slope stability issues as a result of buried layers of chips and water runoff control.	0%	0.01	Incremental measures included excavation, tracked back in, seeding, mulching and installation a french drain system	No further issues Dominion no longer allows burial of chips on the ROW
TL-492 Ext 5	Yes	Greene	PA	2011 / 2012	24	6	75	Belted Silt Retention Fence, water bars, trench breakers, erosion control fabric, approved seed and mulch per agency recommendations, compost filter socks	There were a couple noted slope stability issues as a result of buried layers of chips, water runoff control, and very steep slope with a road above.	0.6%	0.04	Applied incremental controls (i.e. BIC) such as excavation, controlling runoff with a french drain system, seeding, mulching, and installation a retaining wall.	No further issues
TL-590	Yes	Greene / Marshall	PA/WV	2011 / 2012	30	43	90	Belted Silt Retention Fence, water bars, trench breakers, erosion control fabric, approved seed and mulch per agency recommendations, compost filter socks, and retaining walls along roads.	Have had several slope stability issues throughout but mostly in the Marshall county, WV portion. There are numerous reasons for the slope stability issues including buried layers of chips, soils, and water control.	2%	0.86	Applied incremental measures (similar to BIC) to stabilize have been utilized including soil nails, retaining walls, peanut pipe, under drains, etc	Continually monitoring
TL-570 Ext 1	Yes	Kanawha	WV	2011 / 2012	20	5	75	Belted Silt Retention Fence, water bars, trench breakers, erosion control fabric, approved seed and mulch per agency recommendations, compost filter socks	Had some slope stability issues due to improper slope on waterbars.	1%	0.05	Waterbars were reworked, seeded and mulched	No further issues

Pipeline	FERC	County	State	Year Constr.	Dia (in)	Length (Mi)	Constr. ROW (ft)	Erosion Control Devices Implemented	Stabilization Issues	% of Mileage with Issues	Total Mileage Impacted	Remediation (if any)	Comments
G-150	No	Marshall, Ohio, Brooke	WV	2012	8	60	100	Belted Silt Retention Fence, water bars, trench breakers, erosion control fabric, approved seed and mulch per agency recommendations, compost filter socks	Have had several slope stability issues throughout. There are numerous reasons for these including soils, water control, poor placement of pipe due to non-jurisdictional status, etc.	17%	10.20	Incremental measures to stabilize have been utilized including soil nails, retaining walls, peanut pipe, under drains, etc	Continually monitoring
TL-610	Yes	Tioga	PA	2013	24	15	75	Belted Silt Retention Fence, water bars, trench breakers, erosion control fabric, approved seed and mulch per agency recommendations, compost filter socks	None	0%	0.00	N/A	N/A
TL-610 Ext 1	Yes	Tioga	PA	2013	24	3.5	75	Belted Silt Retention Fence, water bars, trench breakers, erosion control fabric, approved seed and mulch per agency recommendations, compost filter socks	None	0%	0.00	N/A	N/A
					TOTALS	**277.5**				**4.02%**	**11.16**		

2.1.13 Slopes

Table 2.2.1-1 below illustrates the miles of steep slope of each project. Slope percentages in the table are determined using available digital elevation data. This table illustrates DTI's experience on steep slopes similar to those anticipated on the ACP project.

TABLE 2.2.1-1

Slope Classes Crossed by Existing Dominion Projects [a]

	Project Name	Length (miles)	Slope Class Crossing Length (miles)					
			0–8 %	8–20 %	20–35 %	35–60 %	60–100 %	>100 %
1	TL-453 Ext 1	11.6	5.1	5.5	1.0	<0.1	<0.1	0.0
2	PL-1 Ext 2	80.3	34.0	27.9	11.2	6.7	0.5	0.0
3	TL-492 Ext 3	10.3	0.6	1.5	5.3	2.9	<0.1	0.0
4	TL-585	26.4	3.1	8.1	9.1	5.6	0.5	0.0
5	TL-492 Ext 4	8.2	0.5	1.8	4.5	1.4	0.0	0.0
6	TL-492Ext 5	6.0	0.9	2.5	2.3	0.3	<0.1	0.0
7	TL-590	42.3	3.1	11.3	21.8	5.9	0.2	0.0
8	TL-570 Ext 1	5.0	0.8	1.0	0.8	1.5	0.9	0.0
9	G-150	57.8	5.5	16.9	25.6	9.0	0.8	0.0
10	TL-610 Ext 1	3.5	1.2	1.7	0.5	0.1	0.0	0.0
11	TL-610	14.9	5.8	5.1	3.1	0.9	0.0	0.0

[a] Slope percentages were determined using available digital elevation model raster data and running the slope analysis tool in the GIS program ArcMap.

Table 2.2.1-2 lists the length of slope and slope classification proposed to crossed in the MNF and GWNF by ACP. This is presented for comparison to projects referenced in the above table.

TABLE 2.2.1-2

Slope Classes Crossed by ACP Route [a]

Forest Name	Total Crossing Length (miles)	Slope Class Crossing Length (miles)					
		0–8 %	8–20 %	20–35 %	35–60 %	60–100 %	>100 %
George Washington National Forest	15.9	2.0	4.4	5.6	3.5	0.4	<0.1
Monongahela National Forest	5.2	0.7	1.8	2.0	0.7	0.0	0.0

[a] Slope percentages were determined using available digital elevation model raster data and running the slope analysis tool in the GIS program ArcMap.

2.1.14 Bedrock Type and Depth

Table 2.2.2-1 list the type of bedrock encountered by each project along with the representative depth of the bedrock. Generally, this illustrates the conditions expected on the ACP project are similar to those DTI has encountered on other projects.

TABLE 2.2.2-1

Potential Areas of Shallow Bedrock Crossed by Existing Dominion Project Routes [a]

	Project Name	Total Crossing Length (miles)	Bedrock Type [b]	
			Lithic (miles)	Paralithic (miles)
1	TL-453 Ext 1	11.6	1.0	0.0
2	PL-1 Ext 2	80.3	67.4	0.0
3	TL-492 Ext 3	10.3	4.6	0.2
4	TL-585	26.4	21.0	1.9
5	TL-492 Ext 4	8.2	3.2	0.0
6	TL-492Ext 5	6.0	2.4	0.0
7	TL-590	42.3	24.0	1.3
8	TL-570 Ext 1	5.0	3.2	0.0
9	G-150	57.8	43.7	4.8
10	TL-610 Ext 1	3.5	1.5	0.1
11	TL-610	14.9	10.7	0.0

[a] Based on analysis of the SSURGO database (Soil Survey Staff, 2016).

[b] Paralithic refers to "soft" bedrock that will not likely require blasting during construction. Lithic refers to "hard" bedrock that could require blasting or other special construction techniques during installation of the proposed pipeline.

Areas of shallow bedrock are shown below in Table 2.2.2-1. The depth of bedrock along with type is very similar to the conditions anticipated on the ACP project.

TABLE 2.2.2-2

Potential Areas of Shallow Bedrock Crossed by Existing Dominion Project Routes [a]

			Bedrock Type [b]									
			Lithic (miles)					Paralithic (miles)				
				Depth Class (inches)					Depth Class (inches)			
	Project Name	Total Crossing Length (miles)	Total	0-20	20-40	40-60	>60	Total	10-20	20-40	40-60	>60
1	TL-453 Ext 1	11.6	1.0	--	1.0	--	--	0.0	--	--	--	--
2	PL-1 Ext 2	80.3	67.4	4.1	10.2	34.1	19.0	0.0	--	--	--	--
3	TL-492 Ext 3	10.3	4.6	0.2	4.2	0.2	--	0.2	--	0.2	--	--
4	TL-585	26.4	21.0	2.3	14.1	4.6	--	1.9	--	--	1.9	--
5	TL-492 Ext 4	8.2	3.2	0.2	2.9	0.1	--	0.0	--	--	--	--
6	TL-492Ext 5	6.0	2.4	0.2	2.1	0.1	--	0.0	--	--	--	--
7	TL-590	42.3	24.0	0.8	17.3	0.2	5.7	1.3	--	1.3	--	--
8	TL-570 Ext 1	5.0	3.2	--	1.8	1.4	--	0.0	--	--	--	--
9	G-150	57.8	43.7	--	13.1	22.2	8.4	4.8	--	3.2	1.6	
10	TL-610 Ext 1	3.5	1.5	0.3	1.1	0.1	0.0	0.1	--	--	0.1	--
11	TL-610	14.9	10.7	0.1	10.1	0.3	0.2	0.0	--	--	--	--

[a] Based on analysis of the SSURGO database (Soil Survey Staff, 2016).

[b] Paralithic refers to “soft” bedrock that will not likely require blasting during construction. Lithic refers to “hard” bedrock that could require blasting or other special construction techniques during installation of the proposed pipeline.

2.1.15 Soil Unit Characteristics

Selected physical and interpretive characteristics of the Soil Map Units eleven representative projects are included in Appendix A. Also included in Appendix A are tables for the soil unit characteristics for the portion of the MNF and GWNF crossed by the ACP project.

2.2 Best-in-Class Implementation on Similar Projects

The approach and measures for mitigation of steep slope and erosion related hazards as proposed in the BIC program have been used in northwestern West Virginia, in particular in Marshall and Wetzel Counties, which have similar geology, hydrology, and terrain (i.e. rugged, steep, and frequently wet and sensitive to disturbance) to the conditions observed at identified BIC slopes along the ACP project alignment. The specific project names and locations and number of sites where this work has been implemented are not included herein, in order to maintain confidentiality requirements. But, as a general description, the work was constructed in the 2013-2015 timeframe and included new natural gas pipeline projects up to approximately 24-inches in diameter with varying overall project lengths of less than approximately 25 miles; and also included mitigation of numerous targeted steep and unstable slope and erosion related sites throughout an existing pipeline system.

The approach, methods, and nature of the mitigation work that is proposed in the BIC program is generally based on the standard plans and procedures developed by the FERC for pipeline right-of-way construction, restoration, and mitigation as described in the documents titled: "Wetland and Waterbody Construction and Mitigation Procedures" and "Upland Erosion Control, Revegetation, and Maintenance Plan". These plans and procedures were initially developed in 1996, and have been used for planning, permitting, design, and construction on many, if not the majority, of FERC pipeline projects constructed in the United States since that time. The plans and procedures have periodically been updated, thereby incorporating input and feedback from industry, designers, contractors, and regulatory agencies; the most recent update was completed in May of 2013. The core components of the FERC plan and procedures address fundamental erosion related issues such as, but not limited to: definition of construction work areas, existing drainage, spoils management, temporary right-of-way slope erosion control, permanent right-of-way slope erosion control, revegetation, monitoring and maintenance. The plan and procedures documents are uniquely designed to support pipeline projects, recognizing the specialized nature of planning, permitting, designing, and constructing linear right-of-way alignments.

The BIC program builds on the core components of the FERC plan and procedures, in order to be consistent with industry standards and permitting requirements for erosion and sediment control, and then goes beyond those standards by providing a framework for integrating mitigation efforts with the project specific geologic hazards planning efforts that identify applicable steep slope and erosion related processes at any given location. The general approach for the BIC program incorporates applicable approaches, methods, experience and expertise described in the INGAA Foundation, Inc. technical document titled "Mitigation of Land Movement in Steep and Rugged Terrain for Pipeline Projects: Lessons Learned from Constructing Pipelines in West Virginia", dated April 2016. The BIC program was further developed to be specific to the project needs and requirements of the ACP project.

The BIC program identifies the governing steep slope and erosion processes at any given site through the definition of typical site scenarios, and then outlines targeted incremental mitigation control measures for each of the defined scenarios. The typical scenarios are defined as the following: planar and side slopes without evidence of previous movement, planar and side slopes with evidence of previous movement, planar and side slope with increased potential for instability when disturbed, steep slopes near narrow ridge tops, steep slopes with sensitive resources at the toe of the slope (i.e. a stream, wetland or road), and steep slopes previously modified by cutting and filling. Each of these scenarios includes defined supporting incremental mitigation controls that are applicable and provide mitigation of the defined hazards.

Incremental mitigation controls are selected for each defined scenario that best fit the site conditions if warranted. The final specification of mitigation measures includes review of the applicable and available geohazards technical report(s) and soils information for a given site, and then focuses on addressing targeted groupings of right-of-way related steep slope and erosion related processes, including the following:

a) Identify and mitigate for potential sub-surface/surface drainage issues (Group 1);
b) Identify and mitigate for temporary ROW surface or subsurface drainage (Groups 1 and 2);
c) Identify and mitigate for disturbed ROW backfill resulting from construction, including short- and long-term mitigation/stabilization measures (Group 2);
d) Identify and mitigate for potential erosion of surface soils (Group 3);
e) Identify and mitigate for stabilization of trench and ROW backfill (Group 4);
f) Identify and mitigate for potential for surface run-off on and within the ROW (Group 5);
g) Identify and mitigate for potential surface run-off coming onto (from outside sources), across, along, and adjacent the ROW (Group 6);
h) Identify and mitigate for temporary erosion and sediment control issues, primarily using Silt Fence (addressed under ES&C Plan) (Group 7);
i) Identify and mitigate for oversized backfill, bedrock trench, etc; and shallow groundwater and buoyancy issues (Groups 8 and 9);
j) Identify and mitigate for special considerations for construction through benched topography (Group 10);
k) Identify and mitigate for monitoring for active/future movement during construction or long-term Operation (Group 11);
l) Identify and mitigate for active movement through stress relief excavations (during construction short-term), over the long-term (Operations), or isolate ROW in active land movement areas (shear trench) (Group 12);
m) Identify and mitigate for ROW layout and configuration (Group 13), use these typical layouts and geometries to plan and coordinate construction and engineering mitigation measures;
n) Identify and mitigate for special engineering conditions through development of studies, investigations, special contractors or other specialized detailed engineering, as needed (Group 14);
o) Identify and mitigate through avoidance by excavation, HDD, deeper trench, micro-re-route, larger re-route, etc.), or develop special access (i.e. when access is limited to the temporary constructed ROW, and other permanent access needs to be developed to provide long-term access for maintenance and operation), (Group 15);
p) Identify and mitigate for karst hazards using special engineering studies and measures (Group 16);

Refer to the BIC program documents for detailed summaries and sheets summarizing the defined typical scenarios, and listing the supporting incremental mitigation control measures (i.e. incremental controls) applicable to each scenario.

3 Geohazard Mitigation and Site Specific Design

Atlantic's consultant Geosyntec Consultants, Inc. (Geosyntec) conducted Phase 1 and Phase 2 geohazard analyses of potential steep slope instability along the alignment of the proposed ACP Project [Geosyntec, 2016_a][1]. The results of these analyses, and consideration of other factors, indicate that at 15 locations [Geosyntec, 2016_b][2], additional study is required to quantify the hazard through site-specific geotechnical assessment and analysis. To meet Dominion's commitment to implementing a BIC slope instability mitigation program [ACP, 2016][3], site-specific design hazard mitigation measures are anticipated at 15 locations on the ACP AP-1 Segment. Design of hazard mitigation measures is considered part of Phase 3 of the ACP geohazard analysis program.

The Phase 1 geohazard analysis of potential slope instability is based on an initial desktop review of available topographic, geologic and soil mapping, and aerial photograph and LiDAR imagery, in which geomorphic characteristics of the terrain along the alignment suggesting potential slope instability (hummocky terrain, surface expression of sliding surfaces, talus slopes, etc…) were identified. This was followed by Phase 2 geohazard analysis, which included aerial and site-specific ground reconnaissance where field observations of slope instability indicators (vegetation age and type, pistol-butt trunks, stretched roots, presence of seeps or springs, hummocky ground surfaces, tension cracks, head scarps, debris lobes, etc.) and other slope attributes, such as inclination, underlying geology and near surface soil conditions, were considered. At some locations, supplemental data was collected by intrusive geotechnical site investigation, including hand excavated test pits and geotechnical boreholes, from which selected samples of representative materials were tested in the laboratory. Additional investigations are also proposed.

A logical evaluation procedure and flow diagram was developed for the BIC implementation process (see Figures 4.1-1 and 4.1-2) which indicates that all slopes across the ACP Project, with inclinations greater than 30%, are to be classified in accordance with one of six primary typical scenarios developed for the BIC steep slope geohazard mitigation program [Golder, 2016][4] . Slopes classified as typical scenario "B" (steep slopes with evidence of active movement) or "C" (steep slopes with increased potential for instability when disturbed) are candidates for site specific design. The site-specific design procedure includes the application of a combination of BIC incremental mitigations, regrading where possible, and geo-structural measures, as appropriate.

[1] Geosyntec [2016a]. Geohazard Analysis Program Phase 2 Report, Atlantic Coast Pipeline and Supply Header Project. 1 August 2016.

[2] Geosyntec [2016b]. Technical Memorandum "List of Steep Slope Geohazard Sites Identified for Site-Specific Designs" delivered to Robert Hare (Dominion Transmission, Inc.) with copy to Andreas Kammereck (Golder Associates, Inc.) and Stephen Lindsay (ERM) dated 27 October 2016 (Revised 4 January 2017). 2 pages.

[3] ACP [2016]. Atlantic Coast Pipeline Supply Header Project, Steep Slopes Best in Class (BIC) Program, Implementation Plan Process – Undated. 18 pages.

[4] Golder [2016]. Geotechnical and Geological Engineering Support for Pipelines in Steeply Sloping Terrain, Best Management Practices and Construction Techniques for Mitigation of Steep Slop Hazards, Final Draft, March 2016. 180 pages

Permanent regrading with implementation of surface and subsurface drainage mitigation measures is a preferred approach where slope instability hazard mitigation is required, but may only be conducted in areas that are suitable for application of these techniques, and such locations would not be identified for site-specific design. It is important to note that only areas located outside the lands managed by the United States Forest Service (Forest Service) can be permanently regraded. Where physical constraints, such as existing roadways and streams, prevent regrading, other site-specific techniques must be used. Site-specific design of geo-structural controls (i.e., retaining structures, soil nails and Tecco™ mesh, etc.) will be used in combination with BIC incremental mitigation for slopes with evidence of active instability (i.e. creep, landslides, debris flows, etc.) or slopes with increased potential for instability when disturbed (i.e. slopes inclinations greater than the angle of repose of disturbed native material on slopes or in the pipe trench), where regrading cannot be implemented.

The Forest Service [Forest Service, 2016][5] issued a request that ACP present site-specific design at 4 sites in or proximal to, the Monongahela National Forest (MNF), and at 6 sites in the George Washington National Forest (GWNF).

None of the sites identified by the Forest Service in the MNF were on Geosyntec's initial list of site-specific design locations, but one site, MNF#1 (MP 73.20 to MP 73.50), identified as being of particular concern to the Forest Service, and was added. A site-specific design package was prepared for site MNF#1 and presented to the Forest Service for review and comment. Details for the design for site MNF#1 are discussed below.

Three of the GWNF sites were on Geosyntec's list of site-specific design sites (3 were not). A site-specific design package was prepared for one location which was identified as being of particular concern to the Forest Service, site GWNF#2 (MP 84.95 to MP 85.05), and was presented to the Forest Service for review and comment. Preparation of site-specific design for the other 2 site-specific design locations in the GWNF is underway. Details for the design for site GWNF#2 are presented below.

3.1 Site MNF#1 (MP 73.20 to MP 73.50)

This location was not identified for site-specific design because it was not considered to meet the criteria that would warrant a site-specific design. The steep slope here is located on a ridge that drops steeply to the east, but gently to the west and the inclination along the trench alignment is on average less than 50%. The site is considered to be reasonably well drained and the amount of grading required to develop the right-of-way working surface is expected to be modest. No instability is currently evident on the slope, along the proposed right-of-way and the inclination is such that even disturbed native material is anticipated to rest as backfill in the pipeline ditch in a stable fashion (this is a scenario "D" slope, not a scenario "B" or "C" slope). Implementation of incremental BIC mitigations will provide satisfactory long-term stability of the slope and the "site-specific" design prepared for this site illustrates implementation of selected incremental BIC mitigations, which are listed below along with the reason they would be selected.

[5] Forest Service [2016]. U.S. Forest Service Request for Site-Specific Design of Stabilization Measures in Selected High-Hazard Portions of the Proposed Atlantic Coast Pipeline Route, September 27, 2016

ITEM	INCREMENTAL CONTROL	DESCRIPTION
1B	ENHANCED DRAINS (GERMAN DRAINS)	to be applied selectively where seepage is encountered in the pipe trench and needs to be removed
1C	TARGETED SEEP DRAINS, AT INTERSEPTED SEEPS	to be installed at locations where trench excavation encounters seepage
2A	GRADING TEMPORARY ROW SURFACE	sloping and texturing to mitigate erosion during both construction and post-construction
2B	GRADE TEMPORARY ROW WITH OUTBOARD WEDGE	to minimize potential for surface runoff to flow back towards the trench line from slope breakers
2D	BACKFILL USING ONLY DRY AND MOIST SOILS – DO NOT USE SATURATED SOILS AS BACKFILL	typical control statement to assure soil strength in backfill
2E	REMOVE UNSUITABLE EXISTING SOILS AS BACKFILL	typical control statement to assure soil strength in backfill
2G	GRADING TO MATCH EXISTING CONTOURS	to minimize disturbance to the slope by reducing both excavation quantities and restoration work
2J	SPOILS MANAGEMENT	generic BIC measures to assure spoils are placed in stable configuration for short- and long-term
3A	TRACK DISTURBED SLOPES	to enhance growth of post-construction vegetation by creating micro-sites and to mitigate erosion
4A	TRENCH BREAKERS (FOAM AND SANDBAGS), MODIFIED SPACING	notes need for site specific attention to actual conditions in selecting actual trench breaker locations
4F	TRENCH BREAKER WITH DRAINAGE	BIC measures to prevent water collection by conveying seepage through breakers to surface as needed
5A	SLOPE BREAKERS (TEMP AND PERMANENT), MODIFIED SPACING	notes need for site specific attention to actual conditions in selecting actual slope breaker locations
5B	SLOPE BREAKER ARMORED OUTLET	precaution to dissipate energy from discharging surface runoff to mitigate potential erosion
5D	ACCESS ROADS	BIC measures related to preventing surface water run-on

ITEM	INCREMENTAL CONTROL	DESCRIPTION
		from existing access roads
7A	BELTED REINFORCED SILT FENCE	to intercept soils in surface runoff to prevent material leaving the work area
7B	SUPER SILT FENCE	to retain soil material that may be inadvertently piled along the edge of the workspace
10A	BENCH RE-CONSTRUCTION THROUGH NATURAL STEPS	to avoid development of a trough along the trench line which is low lying and susceptible to erosion
11F	CONDUCT AS-BUILT SURVEY OF TRENCH BREAKERS	so that trench breakers and slope breakers can be co-located for improved overall function
14C	BLASTING PLAN(S)	notes possible (but unlikely) localized presence of rock that will require controlled blasting

3.2 Site GWNF#2 (MP 84.95 to MP 85.05)

This location was identified for site-specific design because it was considered to meet the criteria of a typical scenario “C” and thus would warrant a site-specific design. The steep slope here is characterized by an approximately 100-ft long segment that is inclined at 100% immediately above an ephemeral stream. The trench excavation is expected to encounter seepage but no existing instability was noted within the currently selected right-of-way footprint. However, due to permit constraints, grading to develop the right-of-way working surface flatter than the angle of repose of grading and trench excavation spoils, will not be possible.

No instability is currently evident on the slope, the inclination is such that even disturbed native material might not rest as backfill in the pipe trench in a stable fashion without mitigation measures. This is essentially a scenario C slope (C1 at the bottom and C2 towards the top). Implementation of typical BIC mitigations is required but those alone will not provide the level of satisfactory long-term stability for the slope that is required to meet BIC program objectives. The “site-specific” design prepared for this site incorporates soil nails and Tecco mesh in addition to selected BIC incremental mitigation measures, some of, which will be applied depending on actual site conditions. The possible BIC mitigation measures are listed below along with the reason they may need to be applied, and include:

ITEM	INCREMENTAL CONTROL	DESCRIPTION
1B	ENHANCED DRAINS (GERMAN DRAINS)	to be applied selectively where seepage is encountered in the pipe trench and needs to be removed
1C	TARGETED SEEP DRAINS,	to be installed at locations where trench excavation

ITEM	INCREMENTAL CONTROL	DESCRIPTION
	AT INTERSEPTED SEEPS	encounters seepage
2A	GRADING TEMPORARY ROW SURFACE	sloping and texturing to mitigate erosion during both construction and post-construction
2B	GRADE TEMPORARY ROW WITH OUTBOARD WEDGE	to minimize potential for surface runoff to flow back towards the trench line from slope breakers
2D	BACKFILL USING ONLY DRY AND MOIST SOILS – DO NOT USE SATURATED SOILS AS BACKFILL	typical control statement to assure soil strength in backfill
2E	REMOVE UNSUITABLE EXISTING SOILS AS BACKFILL	typical control statement to assure soil strength in backfill
2F	UTLIZE ROCK BACKFILL WITH DRAIN	to assure high strength backfill on extremely steep slope and prevent water pressure build-up
2G	GRADING TO MATCH EXISTING CONTOURS	to minimize disturbance to the slope by reducing both excavation quantities and restoration work
2J	SPOILS MANAGEMENT	generic BIC measures to assure spoils are placed in stable configuration for short- and long-term
2L	SOIL NAIL AND TECCO MESH	geo-structural stabilization system to assure long-term acceptable stability performance on slope
3A	TRACK DISTURBED SLOPES	to enhance growth of post-construction vegetation by creating micro-sites and to mitigate erosion
3C	INSTALL COIR CLOTH	to promote vegetation growth on steep slopes
3D	ROCK ARMORING	to stabilize to of extremely steep slope
3E	COIR LOGS ON DISTURBED SLOPES	to facilitate surface water diversion on potions of slope too steep for conventional slope breaker
4A	TRENCH BREAKERS (FOAM OR SANDBAGS), MODIFIED SPACING	notes need for site specific attention to actual conditions in selecting actual trench breaker locations
4C	SACK-CRETE BREAKERS (STRUCTURAL BREAKERS)	to provide improved stabilization of trench backfill in steeper slope inclination locations
4D	SLEEVE INTERFACE BETWEEN PIPELINE AND	to allow decoupling of movement in the trench backfill

ITEM	INCREMENTAL CONTROL	DESCRIPTION
	BREAKER	from the pipe where sack-crete breakers pick up load
4F	TRENCH BREAKER WITH DRAINAGE	BIC measures to prevent water collection by conveying seepage through breakers to surface
5A	SLOPE BREAKERS (TEMP AND PERMANENT), MODIFIED SPACING	notes need for site specific attention to actual conditions in selecting actual slope breaker locations
5B	SLOPE BREAKER ARMORED OUTLET	precaution to dissipate energy from discharging surface runoff to mitigate potential erosion
5H	SURFACE WATER DIVERSIONS	temporary measures to facilitate work at toe of slope
6E	TYPICAL BANK ARMORING	placement of rip rap revetment at toe of slope to prevent washout at trench
6F	RIPRAP GRADATIONS	associated with installation of revetment
7A	BELTED REINFORCED SILT FENCE	to intercept soils in surface runoff to prevent material leaving the work area
8A	ROCK GUARD ON PIPELINE	to protect pipe coating from damage
10A	BENCH RE-CONSTRUCTION THROUGH NATURAL STEPS	to avoid development of a trough along the trench line which is low lying and susceptible to erosion
11F	CONDUCT AS-BUILT SURVEY OF TRENCH BREAKERS	so that trench breakers and slope breakers can be co-located for improved overall function
13B	TYPICAL WATER BODY FLUME	to isolate stream flow from work area to protect water quality
14C	BLASTING PLAN(S)	notes possible (but unlikely) localized presence of rock that will require controlled blasting

4 Best-in-Class (BIC)

Atlantic recognizes the increased risk of instability associated with pipeline construction particularly while traversing steep slopes. As a baseline, Atlantic developed a program for use on projects within steep terrain. The program outlines the following engineering design methods which will apply to slip prevention and correction during construction:

- Drainage improvement that may include providing subsurface drainage at seep locations through granular fill and outlet pipes, incorporating drainage into trench breakers using granular fill, and/or intercepting groundwater seeps and diverting them from the ROW;
- Buttressing slopes with Sakrete trench breakers;
- Changing slope geometry;
- Benching and re-grading with controlled backfill;
- Using alternative backfill;
- Chemical stabilization of backfill;
- Geogrid reinforced slope that consists of benching existing slope, installing subsurface drains, and incorporating Geogrid reinforcement into compacted backfill; and/or
- Retaining structures.

Selection of the most appropriate engineered prevention measure or combination is dependent on the individual site conditions and constraints at the time of construction.

For the ACP Project, we have committed to identifying mitigation measures beyond standard practices through a BIC Program. The focus of the BIC Program is to proactively address steep slopes (defined as slopes with an inclination greater than 30 percent and greater than 100 feet in length) and landslide hazards related to pipeline construction, compressor station, and metering and regulation facilities that could potentially impact environmental resources, in particular streams, wetlands, and waterbodies. The BIC program is intended to incorporate the permit requirements from West Virginia and Virginia and then exceed these regulatory standards, in order to mitigate for potential erosion and sediment discharges related to steep slope and landslide hazards.

The ultimate goal of the BIC Program is to develop project-specific engineering mitigation recommendations and thereby support preparation of steep slope control measures and site-specific Erosion & Sediment Control (ESC) Plans for the ACP Project. The BIC Program has achieved this by assembling a team of internal Dominion stakeholders along with supporting external subject matter experts (SMEs) to develop project- specific mitigation recommendations, by using a process-based approach that includes: hazard identification and assessment (i.e. find and then understand the hazard), engineering mitigation design (i.e. targeted design measures that mitigate the hazard), monitoring (i.e. track performance to understand if additional mitigation is needed), and operational measures (i.e. monitor and maintain and operate the system, as needed).

The BIC Program Team participated in a series of design workshops to examine the identified hazards and supporting information along the pipeline alignment. The hazards were initially identified by studies such as the Geohazards Assessment or the karst study, and/or from other targeted studies such as the Order 1 soil survey. These studies identify and assess or support the review of the hazard, and provide a basis to select the most applicable and robust BIC mitigation response to minimize or eliminate the hazard, and then monitor the hazard through ongoing operations.

The conceptual work-flow process of the BIC Program is organized around four general steps, briefly described as follows:

- Hazard Identification: Geologic hazards are systematically identified during the Geohazards Analysis Program through desktop analysis and field reconnaissance as well as by supporting evaluations (e.g. karst studies and soil surveys). Refer to **Figure 4.1-1** for the conceptual work-flow process diagram describing the general approach.

- Hazard Characterization, Assessment, and Threat Classification: As part of the Geohazards Analysis Program, the nature of the geohazards and their potential impacts on the pipeline and environmental resources are assessed. A semi-quantitative ranking of hazard threat level to the proposed pipeline from various geohazards is used to identify areas for further investigation to determine where appropriate mitigation and monitoring measures may need to be designed and implemented during construction. Refer to **Figure 4.1-1** for the conceptual work-flow process diagram describing the general approach.

- Hazard Mitigation: Areas for mitigation are selected based upon potential risk to the pipeline, environment, and operation and maintenance. Overall hazard reduction techniques may include BIC construction practices and/or best management practices.

  Site and hazard specific plans were developed based on the recommendations of the Geohazards Analysis Program and mitigation techniques selected by a BIC team of experts. The site and hazard specific plans address the specific geologic hazard (e.g., slip, stream scour, ground displacement) with detailed mitigation measures, as applicable, for construction and/or operation of the Project. DTI has incorporated these mitigation ESC Plans in **Appendix C**. Refer to **Figure 4.1-2** for the conceptual work-flow process diagram.

- Hazard Monitoring: DTI will monitor mitigation techniques to assess their effectiveness and the need for further mitigation, if appropriate. Refer to **Figure 3** for a conceptual work flow process diagram.

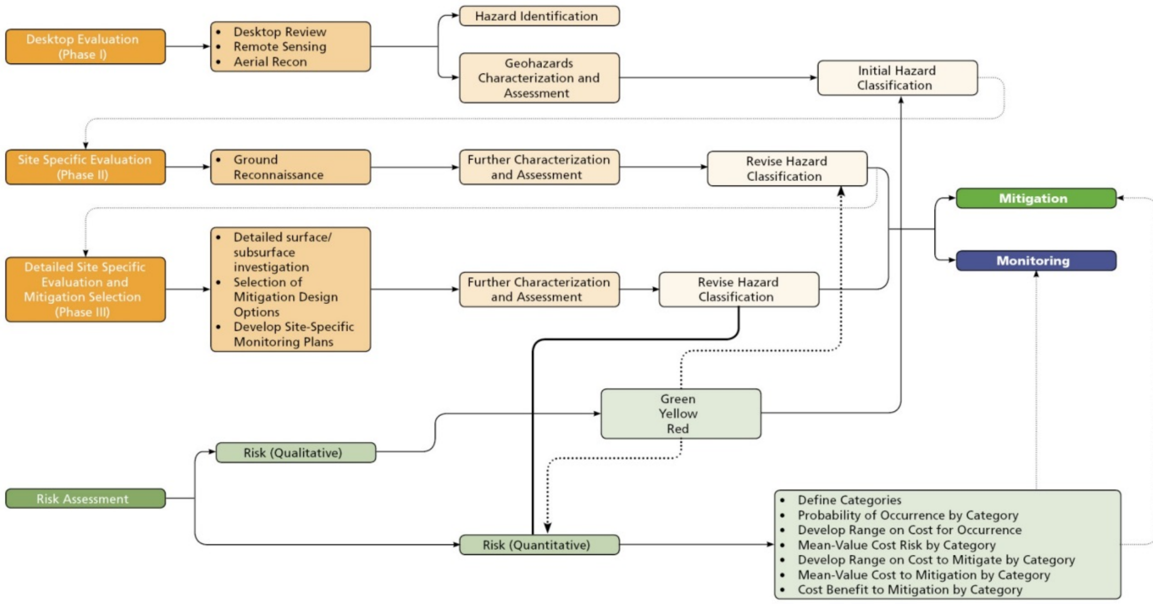

Figure 4.1-1 - Hazard Identification and Assessment

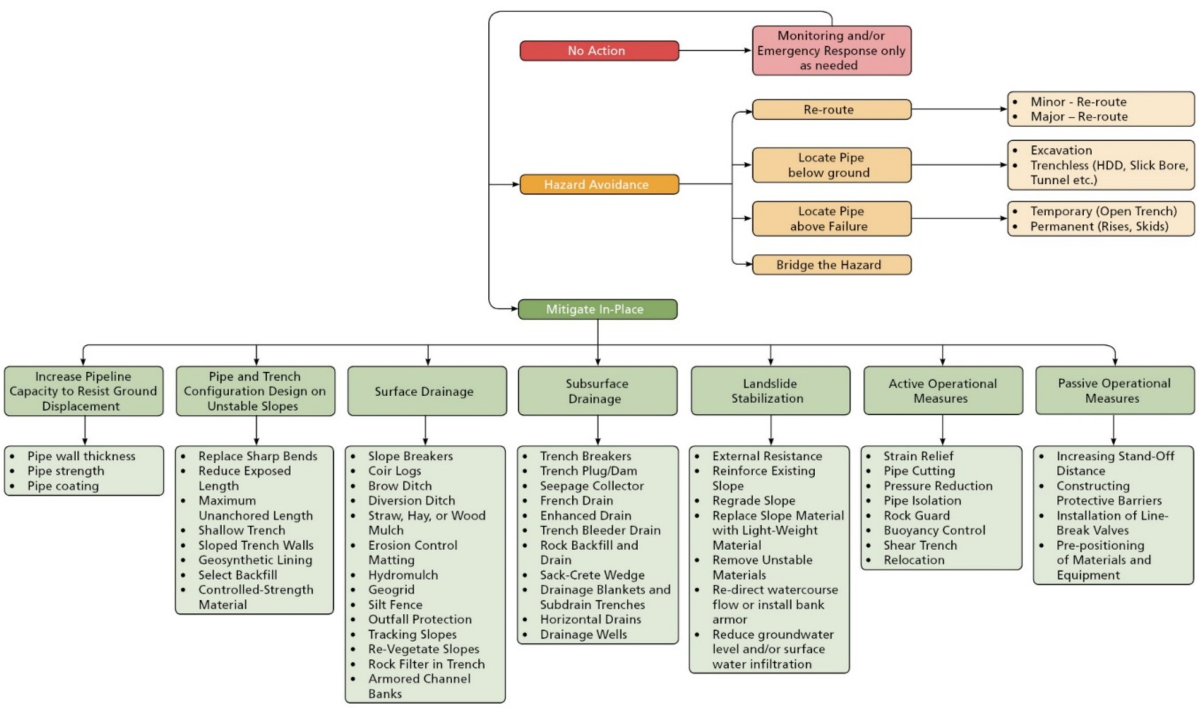

Figure 4.1-2 - Hazard Mitigation

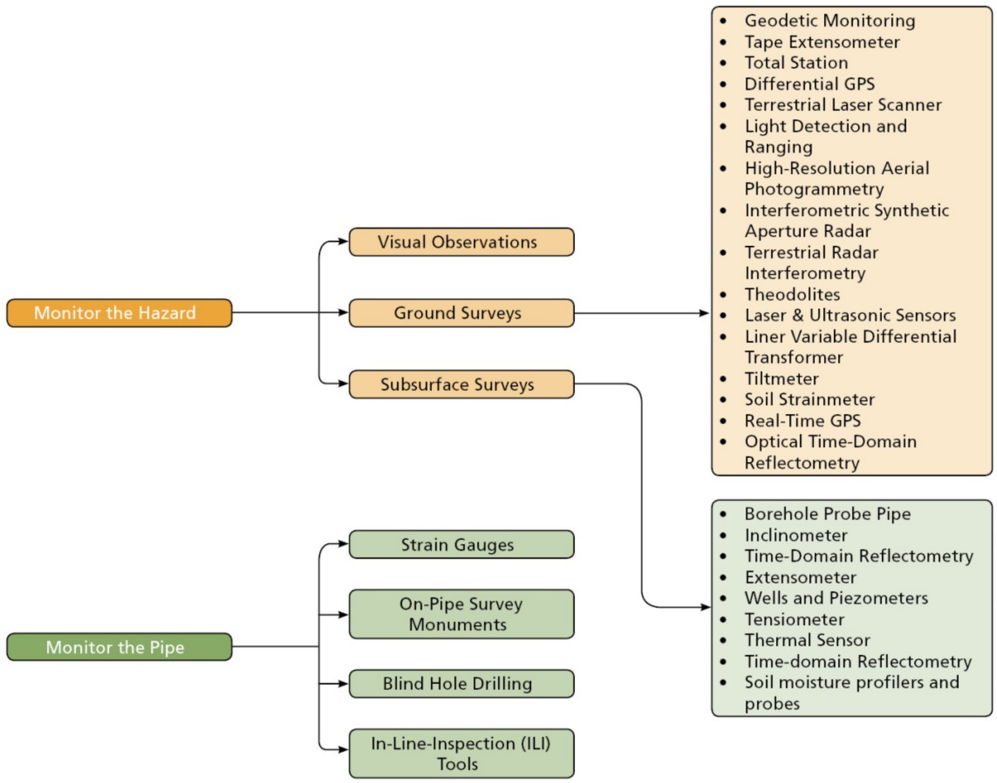

Figure 4.1-3 - Hazard Monitoring

The ultimate goal of the BIC Program was to develop project-specific engineering mitigation recommendations targeting un-authorized discharges to water bodies resulting from steep slope, landslide and erosion hazards.

As one of the initial steps in the BIC Program, ACP implemented a comprehensive Geohazards Analysis Program to assess potential geohazards, including slope failures, along the proposed pipeline route. The study for slope failures included:

- A desktop analysis to prepare an inventory of and categorize potential slope hazards along the proposed routes;
- A field program to verify the locations and limits of slope hazards along the routes;
- A risk analysis of slope hazards along the routes; and
- Recommendations for landslide and landslip mitigation, if and where warranted.

ACP has completed the desktop portion of the Geohazards Analysis Program and the field reconnaissance portion and filed a report on the results of the Program to FERC. The final report provided recommendations on geological hazards and potential risks to be mitigated during construction and operation of the proposed ACP facilities. Through desktop study and field verification, the Geohazards Analysis Program identified six recurring typical steep slope hazard scenarios which collectively encompass the majority of the steep slopes identified along the ACP alignment. Some sites may have the characteristics of more than one typical scenario type, particularly those that contain sensitive resources at the slope's toe or where previously modified by cutting and filling.

The six typical scenarios are identified by letters A through F and each are generally described as follows:

Primary Scenarios

A. Steep slopes without evidence of previous movement;

B. Steep slopes with evidence of active movement;

C. Steep slopes with increased potential to become unstable after construction disturbance;

D. Steep slopes near narrow ridge tops;

Secondary Scenarios

E. Steep slopes with a sensitive resource at toe (e.g. streams, wetlands, roads); and

F. Steep slopes previously modified by cutting and filling.

Project-specific steep slope geohazard mitigation Typical Designs (TDs) for each of the six typical scenarios were developed as part of the BIC Program. Additionally Site-Specific Designs (SSDs) were developed for those locations with unique geohazard concerns, property owner/regulatory requests, and/or a greater potential for instability.

Implementation of the BIC Steep Slope Hazard Mitigation Program in the field during construction will follow a detailed decision tree/work flow. In summary, the TD packages are intended to provide a comprehensive and programmatic approach to address the hundreds of BIC locations along the pipeline alignment. TD packages include Incremental Control (IC) measures (i.e. Typical Details) that provide targeted mitigation for steep slope related hazards that are above and beyond the standard erosion and sediment controls necessary to meet regulatory requirements. The TDs list BIC ICs that are available for use at a site. The host of ICs for each typical scenario provides options to the field team to respond to site-specific field conditions.

SSD packages are site specific steep slope mitigation plans that address specialized steep slope or related hazards and conditions at targeted sites, and require geotechnical, hydro-technical engineering, or geologic technical support to develop the design package. SSD packages typically include detailed engineering drawing sets, showing plan and profile and section views of the intended design, supported by details and specifications, and may require specialized work plans. Incremental controls proposed for SSDs are the same as used for the TDs. There are currently fifteen locations along the ACP pipeline, identified through the Geohazards Analysis Program, that were addressed with a SSD. These design plans are provided in **Appendix C**.

ACP will provide specific employee training which has been developed from the steep slope program. ACP personnel with responsibility for pipeline routing, construction, or operation must be trained in this procedure on an annual basis. The training may be completed by an online learning management system (LMS) module or may be conducted by Dominion Environmental Services personnel, or DTI Engineering Management. At a minimum, the following personnel will be trained:

- Engineering Directors and Managers;
- Design and construction engineers;
- Operations Directors, Managers and Supervisors;
- Construction supervisors; and
- Construction and operations Environmental Compliance Coordinators (ECC).

The training must include the following:

- Types and causes of slope failures;
- Routing avoidance and desktop methods;
- Field reconnaissance;
- Risk prioritization;
- Pipeline design and engineering to prevent slope failures;
- Addressing slope failures during construction;
- Addressing slope failures post construction; and
- Reporting requirements.

5 Attachments

A. SSURGO Soil Tables
B. Mitigation of Land Movement in Steep and Rugged Terrain for Pipeline Projects: Lessons Learned from Constructing Pipelines in West Virginia
C. Sample Site Specific Designs in MNF and GWNF
D. Appendix D Addition Information Requested in March 24, 2017 Meeting
    1) Rainfall Data for TL 590 Project
    2) Additional Photos, timeline for construction and weather events during the construction phase of the examples provided.
    3) Information on slope failures and instability over the past year, particularly after seasonal events such as the storms of June 2016