PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0760 (Dowell's Draft at MP AP-1 117.07)

Photograph 2 (IMG_0625.jpg)	
Date: 06-April-2016	
Direction: Upstream	
Description: View of stream bed comprising laminar angular to subangular gravel and cobble-sized particles. Note valley wall in background.	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0760 (Dowell's Draft at MP AP-1 117.07)

Photograph 3 (072.jpg)	
Date: 06-April-2016	
Direction: Downstream	
Description: Terraces on right bank.	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0760 (Dowell's Draft at MP AP-1 117.07)

Photograph 4
(081.jpg)

Date: 06-April-2016

Direction: Upstream

Description: Rock outcrop located approximately 250-ft downstream of pipeline crossing. Also noticeable is a knick point on the stream.

TID	Unique ID	ACP Branch	Mile Post	State	County
SC_1052	saua418	AP-1	117.18	Virginia	Augusta

Attribute	Value
Stream Name	UNT to East Branch Dowells Draft
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	0.183
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	8.5
Slope At Crossing Over 200ft Long Reach (%)[4]	0.237
Proposed Construction Method[5]	1) Dam and Pump 2) Flume

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:24,000

0 500 1,000 2,000 Feet

0 0.5 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_1052

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

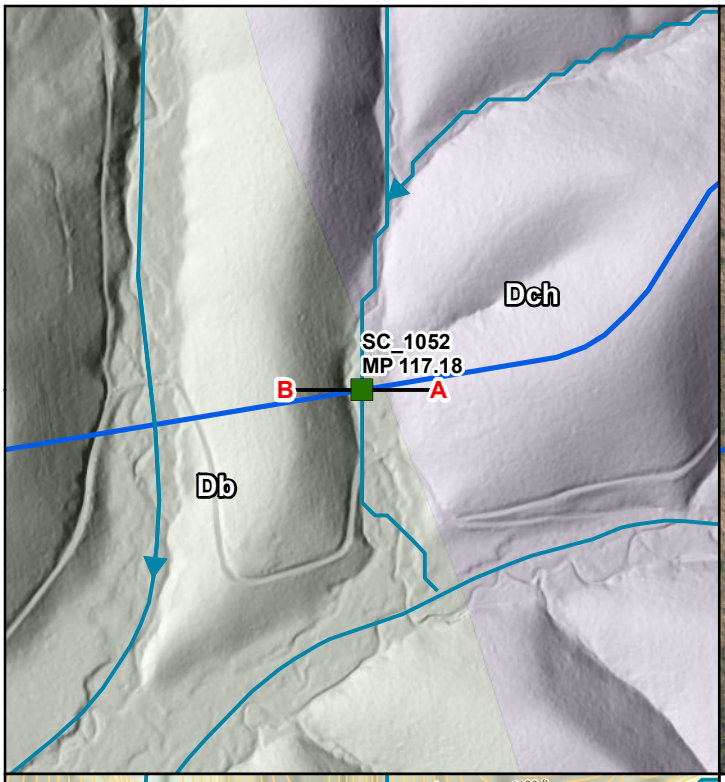
Notes:

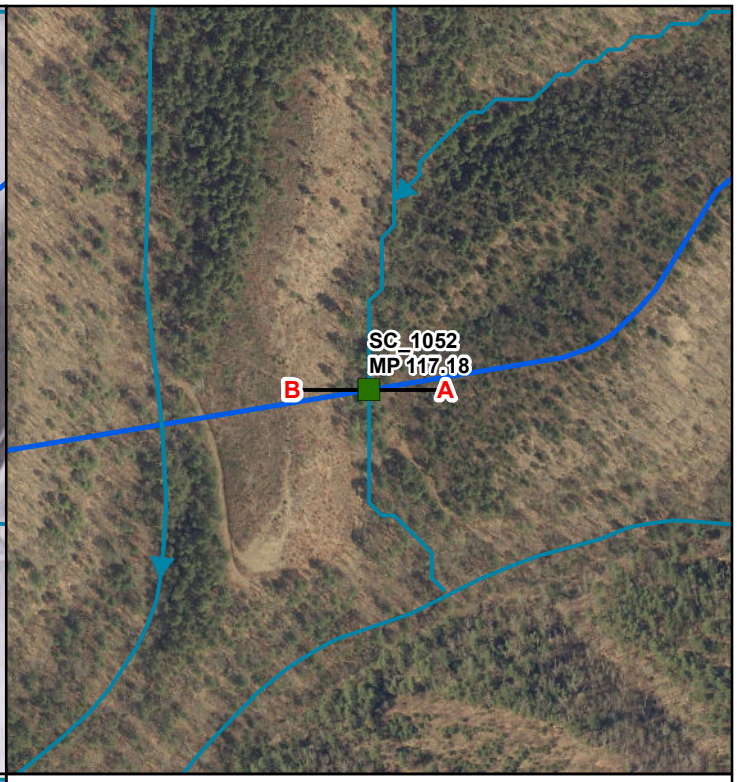
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

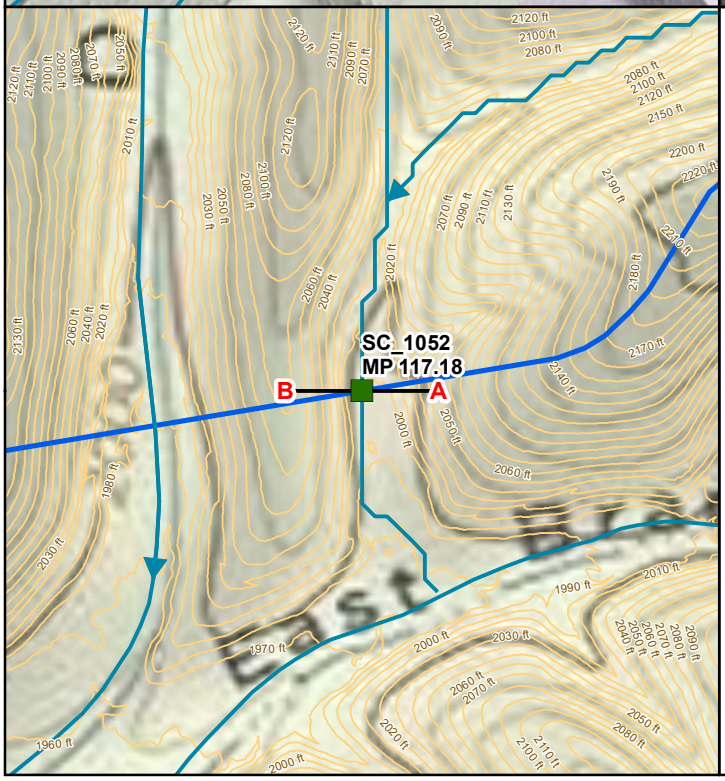
Dominion

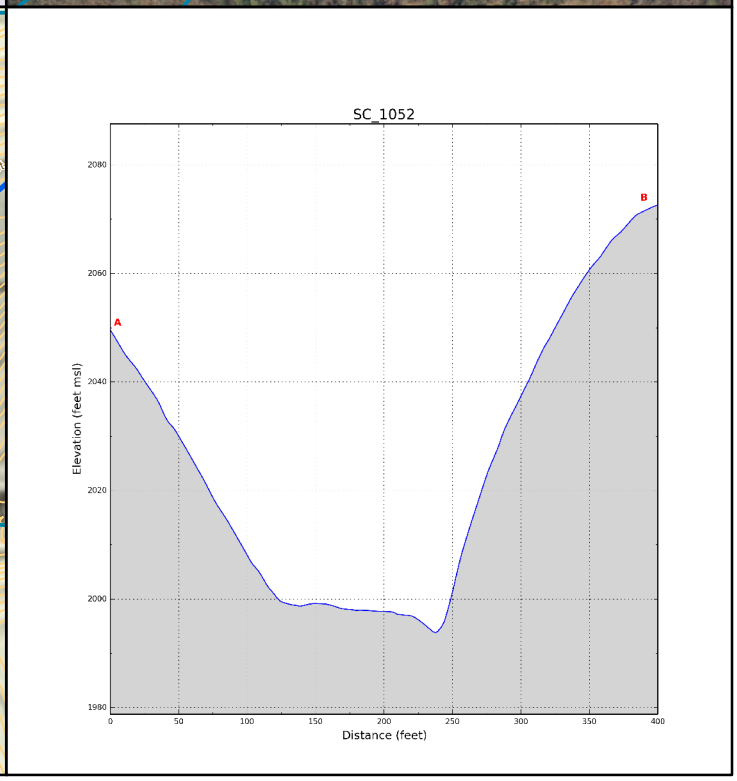
Geosyntec consultants

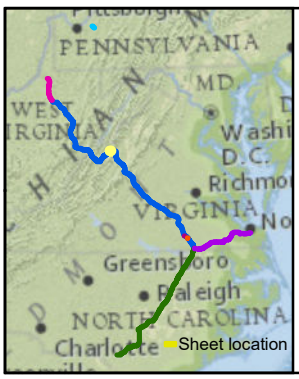
TESSELLATIONS











Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: saua418

TID_SC: SC_1052

Stream Name: UNT to East Branch Dowells Draft

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_1052

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELLATIONS

TID	SC_1052	**ACP Segment**	AP-1
Stream Name	UNT to East Branch Dowell's Draft	**MP**	117.18
Survey Date	06-April-2016	**Start Time**	1430 hrs

- Bankfull channel width is 8.5 feet and bankfull depth is 1.16 feet.
- Stream is confined on the right bank by steep slope with rock outcrop with strike and dip of N25°W 22°.
- Stream is laterally stable. No significant indicators of lateral mobility towards the left bank where the floodplain is comprised of several alluvial terraces.
- Pipeline crossing located upstream of a forest road culvert crossing.
- Stream located in a mixed deciduous and coniferous forest.
- Narrow valley with active floodplain approximately 54 feet wide.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Given debris flow hazard, it is recommended to bury pipeline into bedrock with at least 1.5-foot of cover above the crown from valley wall to valley wall.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	16-Apr-16	Stream Name:	UNT to East Branch Dowells Draft
Crossing ID:	SC_1052		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Cattle grazing

Part 2: River Valley Conditions

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Crops
- [ ] Shrubs
- [X] Deciduous Forest/trees
- [X] Coniferous Forest/trees

Valley Side Features

- [ ] None
- [ ] Occasional
- [X] Frequent

Failure Locations

- [X] None
- [ ] Away from river
- [ ] Along river

Part 3: Floodplain

Floodplain Width

- [ ] None
- [ ] 1 < river widths
- [ ] 1-5 river widths
- [X] 5-10 river widths
- [ ] > 10 river widths

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Mining
- [ ] Cattle grazing

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Orchards
- [ ] Crops
- [ ] Shrubs
- [X] Deciduous Forest/trees
- [X] Coniferous Forest/trees

Riparian Buffer Strip

- [ ] None
- [ ] < 1 river width
- [ ] 1-5 river widths
- [X] > 5 river widths

Part 4: Vertical Confinement

Terraces

- [ ] None
- [X] Left bank
- [X] Right bank

Levees

- [X] None
- [ ] Natural
- [ ] Constructed

Levee Location

- [ ] Along channel bank
- [ ] Set back < 1 river width
- [ ] Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

- [ ] Straight
- [X] Meandering
- [ ] Braided
- [ ] Anastomosed
- [ ] Engineered

Meander Characteristics

- [ ] Mild bends
- [ ] Moderate bends
- [X] Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

- [ ] None
- [ ] Occasional
- [X] Frequent
- [ ] Confined

Control Types

- [ ] None
- [X] Bedrock
- [ ] Boulders

Width Controls

- [ ] None
- [ ] Occasional
- [ ] Frequent
- [X] Confined

Control Types

- [ ] None
- [X] Bedrock
- [ ] Boulders

Other

- [ ] Debris
- [ ] Mining
- [ ] Reservoir
- [ ] Knickpoint

Flow Habit

- [X] Perennial
- [ ] Flashy perennial
- [ ] Intermittent
- [ ] Ephemeral

Channel Width: 8.5'

M-B Classification

- [ ] Cascade or step-pool
- [X] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material

- [ ] Clay
- [ ] Silt
- [ ] Sand
- [ ] Gravel
- [X] Cobbles
- [ ] Boulders
- [X] Bedrock

Bar Types

- [ ] None
- [ ] Alternate bars
- [X] Point bars
- [ ] Mid-channel bars
- [ ] Diagonal bars
- [ ] Irregular/combination
- [ ] Braided

Bar Material

- [ ] Silt
- [ ] Sand
- [X] Gravel
- [X] Cobbles

Bar Vegetation

- [X] None
- [ ] Grasses
- [ ] Reeds/shrubs
- [ ] Trees

Bar Width

- [ ] None
- [ ] Narrow
- [ ] Moderate
- [X] Wide

Percent sand in bed = <10 %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	*Left Bank*	*Right Bank*
Bank Material	[ ] Clay [ ] Silt [ ] Gravel [X] Cobbles [ ] Boulders [ ] Bedrock	[ ] Clay [ ] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [X] Bedrock
Layer Material	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	----	----
Bank Slope	[ ] Steep [ ] Moderate [X] Shallow	[X] Steep [ ] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [X] young [X] mature [X] old tree diversity [ ] Y [ ] N	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [X] young [X] mature [X] old tree diversity [ ] Y [ ] N
Bank Erosion and Failure Location	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_1052, UNT to East Branch Dowell's Draft at MP 117.18 (AP-1)

Photograph 1 (ING_0626.jpg)	
Date: 06-April-2016	
Direction: Downstream	
Description: View of steep slope providing confinement on right bank with rock outcropping at toe (red arrow)	

TID	Unique ID	ACP Branch	Mile Post	State	County
SC_1053	saua419	AP-1	117.7	Virginia	Augusta

Attribute	Value
Stream Name	UNT to East Branch Dowells Draft
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	0.064
Flow Regime	Intermittent
Measured Bank Full Width (ft)[3]	4
Slope At Crossing Over 200ft Long Reach (%)[4]	13.643
Proposed Construction Method[5]	1) Dam and Pump 2) Flume

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:24,000

0 500 1,000 2,000 Feet

0 0.5 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_1053

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

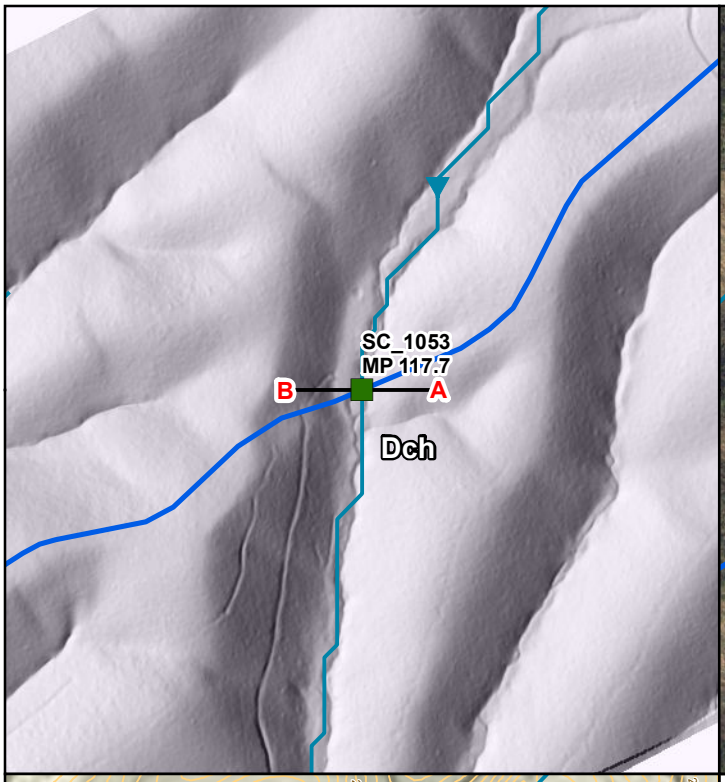
Notes:

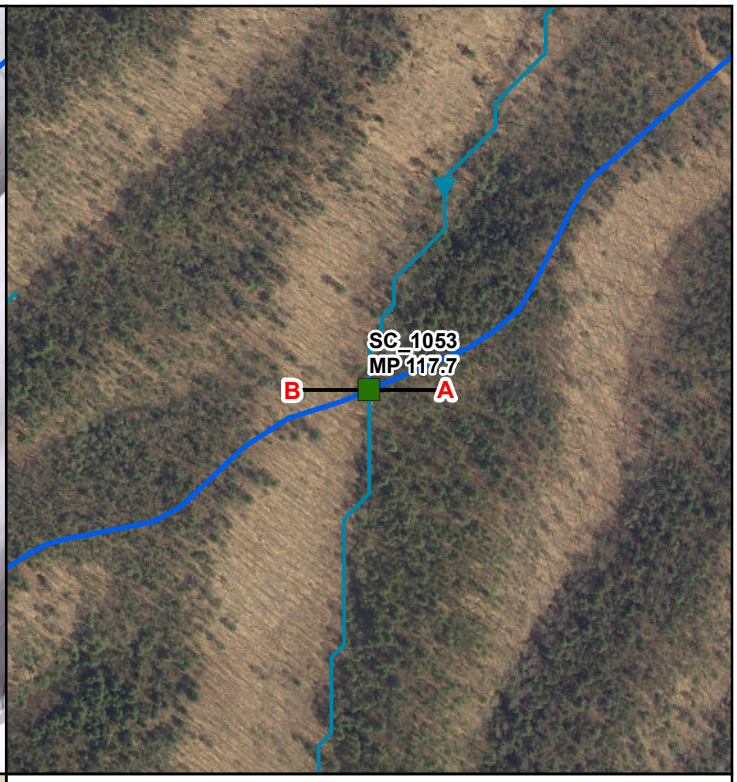
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

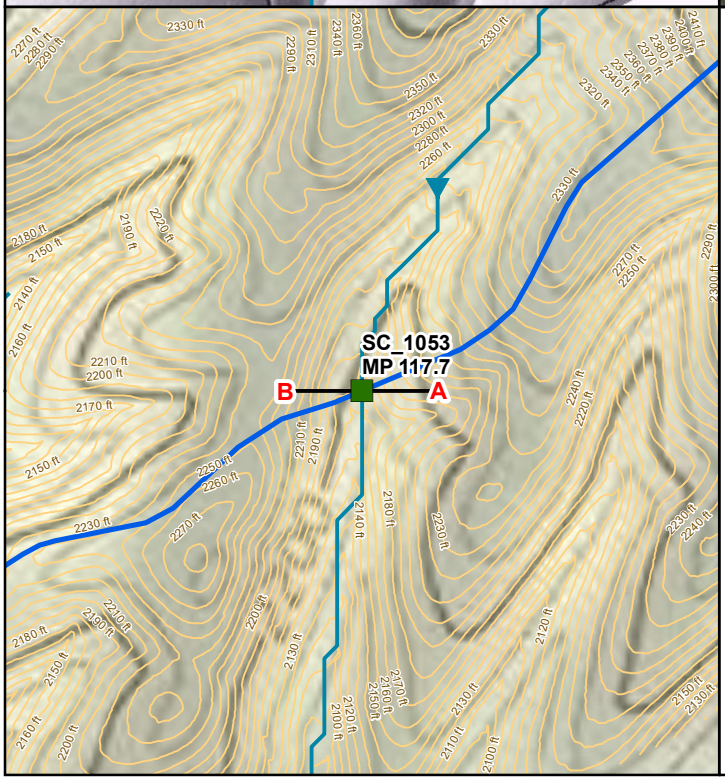
Dominion

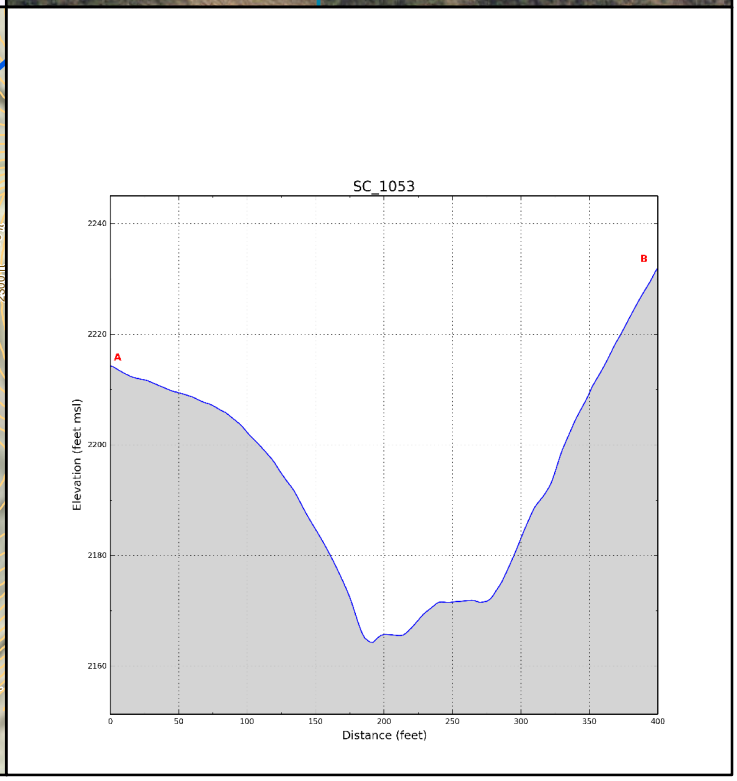
Geosyntec consultants

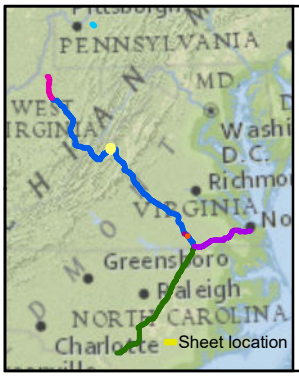
TESSELLATIONS











Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: saua419

TID_SC: SC_1053

Stream Name: UNT to East Branch Dowells Draft

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_1053

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELLATIONS

Geosyntec consultants

TID	SC_1053	**ACP Segment**	AP-1
Stream Name	UNT to East Branch Dowell's Draft	**MP**	117.70
Survey Date	06-April-2016	**Start Time**	1530 hrs

- Stream is located within a narrow, colluvial valley (51-feet wide) that is densely forested.
- Bankfull channel width is 4 feet and bankfull channel depth is 0.65 feet.
- Stream is confined on the left bank by a steep slope with the floodplain beyond the right bank with evidence of past mass sediment movements.
- Sections of stream flow go sub-surface downstream of the crossing.
- Belt width of channel is approximately 40 feet.
- Relatively steep longitudinal channel slope estimated in the field at 2.78%.
- Rock outcrop identified approximately 50 feet upstream of pipeline crossing where the stream is a cascading over the bedrock(see photo log).
- Stream bed comprised of angular to sub-angular cobble and gravel-sized particles where bedrock is not outcropping.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Given debris flow hazard, it is recommended to bury pipeline into bedrock with at least 1.5-foot of cover above the crown from valley wall to valley wall.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	6-Apr-16	Stream Name:	UNT to East Branch Dowells Draft
Crossing ID:	SC_1053		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Cattle grazing

Part 2: River Valley Conditions

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Crops
- [X] Shrubs
- [X] Deciduous Forest/trees
- [X] Coniferous Forest/trees

Valley Side Features

- [ ] None
- [ ] Occasional
- [X] Frequent

Failure Locations

- [X] None
- [ ] Away from river
- [ ] Along river

Part 3: Floodplain

Floodplain Width

- [ ] None
- [ ] 1 < river widths
- [ ] 1-5 river widths
- [ ] 5-10 river widths
- [X] > 10 river widths

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Mining
- [ ] Cattle grazing

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Orchards
- [ ] Crops
- [X] Shrubs
- [X] Deciduous Forest/trees
- [X] Coniferous Forest/trees

Riparian Buffer Strip

- [ ] None
- [ ] < 1 river width
- [ ] 1-5 river widths
- [X] > 5 river widths

Part 4: Vertical Confinement

Terraces

- [ ] None
- [ ] Left bank
- [X] Right bank

Levees

- [X] None
- [ ] Natural
- [ ] Constructed

Levee Location

- [ ] Along channel bank
- [ ] Set back < 1 river width
- [ ] Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

- [X] Straight
- [ ] Meandering
- [ ] Braided
- [ ] Anastomosed
- [ ] Engineered

Meander Characteristics

- [X] Mild bends
- [ ] Moderate bends
- [ ] Tight bends

Some Meanders
40' belt width

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

- [ ] None
- [ ] Occasional
- [ ] Frequent
- [X] Confined

Control Types

- [ ] None
- [X] Bedrock
- [ ] Boulders

Width Controls

- [ ] None
- [ ] Occasional
- [ ] Frequent
- [X] Confined

Control Types

- [ ] None
- [X] Bedrock
- [ ] Boulders

LB

Other

- [ ] Debris
- [ ] Mining
- [ ] Reservoir
- [ ] Knickpoint

Flow Habit

- [X] Perennial
- [ ] Flashy perennial
- [ ] Intermittent
- [ ] Ephemeral

Channel Width: 4.0'

M-B Classification

- [X] Cascade or step-pool
- [ ] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material	*Bar Types*	*Bar Material*	*Bar Vegetation*	*Bar Width*
[ ] Clay	[X] None	[ ] Silt	[ ] None	[ ] None
[ ] Silt	[ ] Alternate bars	[ ] Sand	[ ] Grasses	[ ] Narrow
[ ] Sand	[ ] Point bars	[ ] Gravel	[ ] Reeds/shrubs	[ ] Moderate
[ ] Gravel	[ ] Mid-channel bars	[ ] Cobbles	[ ] Trees	[ ] Wide
[X] Cobbles	[ ] Diagonal bars			
[ ] Boulders	[ ] Irregular/combination			
[X] Bedrock	[ ] Braided			

Percent sand in bed = _____ %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	*Left Bank*	*Right Bank*
Bank Material	[ ] Clay [ ] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [X] Bedrock	[ ] Clay [ ] Silt [X] Gravel [X] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	0.65'	0.65'
Bank Slope	[X] Steep [ ] Moderate [ ] Shallow	[ ] Steep [ ] Moderate [X] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [ ] Y [X] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [ ] young [X] mature [ ] old tree diversity [X] Y [ ] N	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [ ] Y [X] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [ ] young [X] mature [ ] old tree diversity [X] Y [ ] N
Bank Erosion and Failure Location	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_1053, UNT to East Branch Dowell's Draft at MP 117.70 (AP-1)

Photograph 1 (IMG_0628.jpg)	
Date: 06-April-2016	
Direction: Upstream	
Description: Stream step-pool in bedrock approximately 50 feet upstream of crossing. Stream bed comprises angular to subangular cobble and gravel-sized particles when bedrock is not evident.	

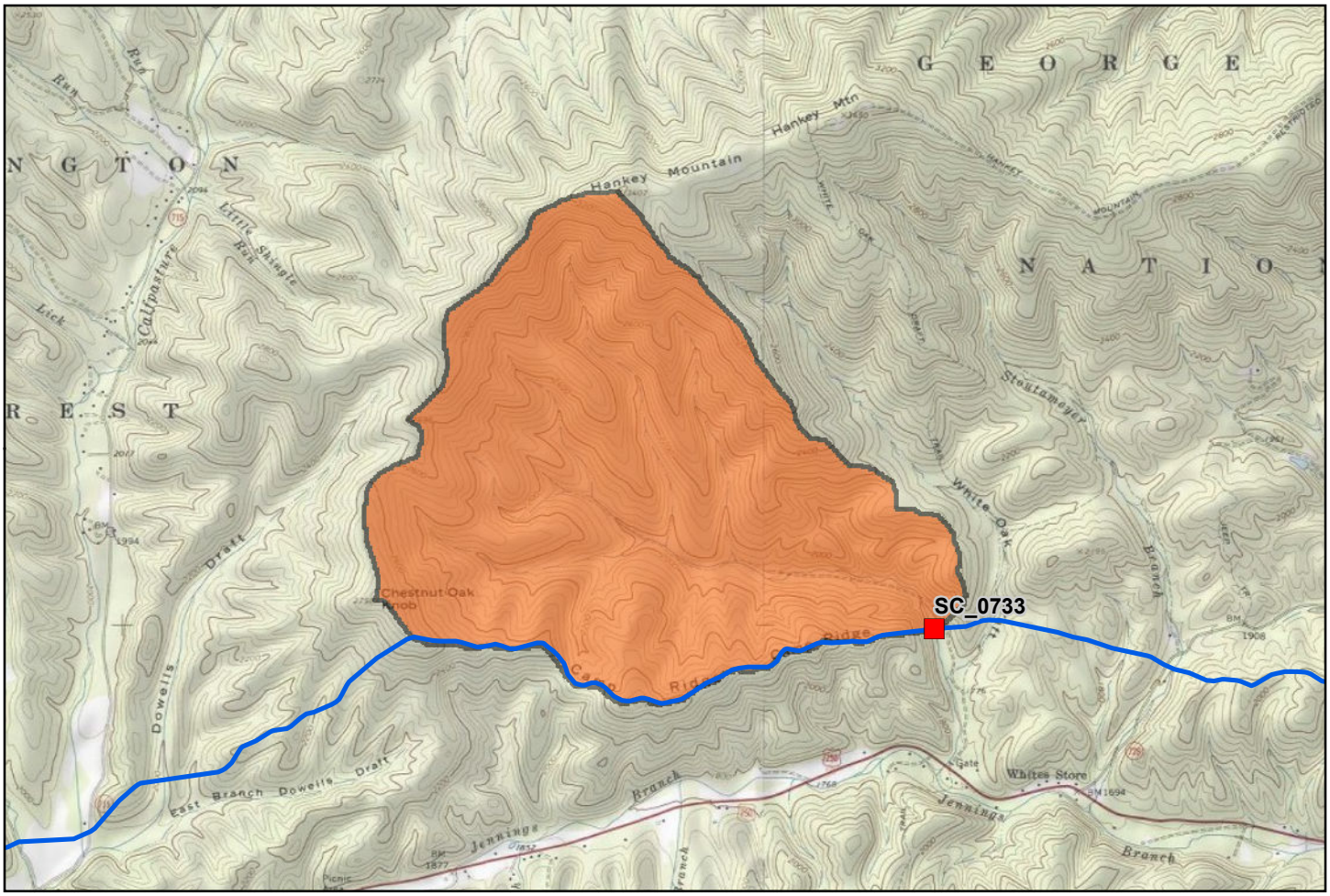
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_1053, UNT to East Branch Dowell's Draft at MP 117.70 (AP-1)

Photograph 2 (IMG_0629.jpg)	
Date: 06-April-2016	
Direction: Downstream	
Description: View of crossing location (orange survey tape) within noticeable dense deciduous forest and lateral confinement at the left bank.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0733	sauc006	AP-1	120.18	Virginia	Augusta

Attribute	Value
Stream Name	UNT to White Oak Draft
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	2.246
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	20.1
Slope At Crossing Over 200ft Long Reach (%)[4]	1.993
Proposed Construction Method[5]	Dam and Pump

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:50,000

0 1,125 2,250 4,500 Feet

0 1 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0733

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

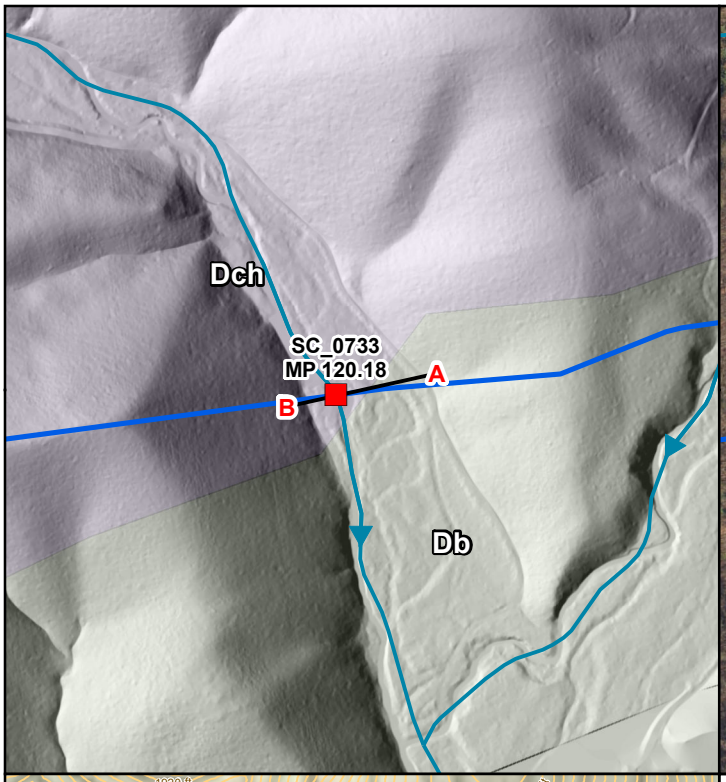
Notes:

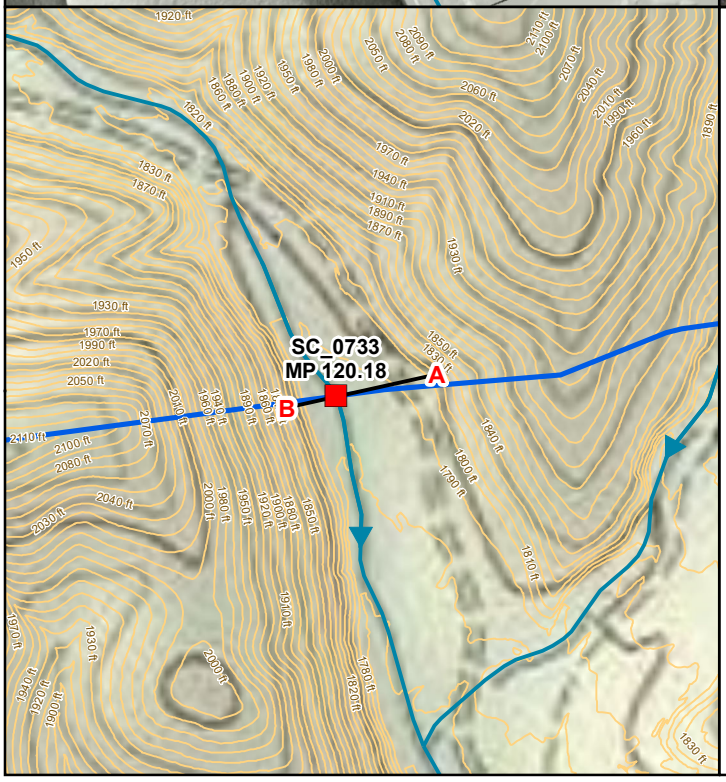
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

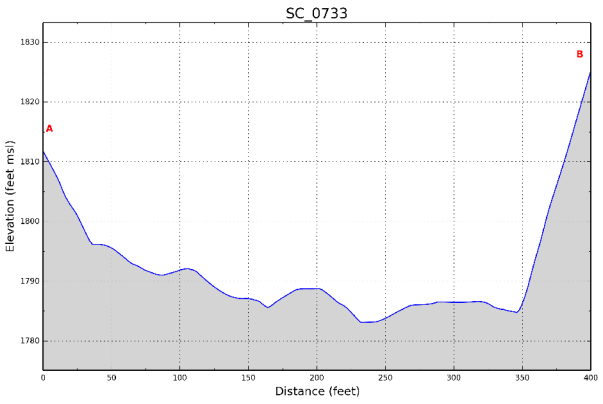
Dominion

Geosyntec consultants

TESSELATIONS







Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: sauc006

TID_SC: SC_0733

Stream Name: UNT to White Oak Draft

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0733

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELATIONS

TID	SC_0733	**ACP Segment**	AP-1
Stream Name	UNT to White Oak Draft	**MP**	120.18
Survey Date	06-April-2016	**Start Time**	1730 hrs

- Stream is located within a densely forested valley subject to debris flow with evidence of lateral migration.
- Stream is partially confined on the right bank by valley wall.
- Stream bed comprises sub-angular to sub-rounded boulder and cobble-sized particles.
- Rock outcrop identified approximately 100 feet upstream of pipeline crossing (N90°W 67°).
- Banks comprised of cobbles and boulders.
- Stream similar to SC_0701.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Given debris flow hazard, it is recommended to bury pipeline into bedrock with at least 1.5-foot of cover above the crown from valley wall beyond right bank to valley wall beyond left bank.

Geotechnical investigation to determine depth to bedrock at stream crossing is required (or crossing can be moved 100 ft upstream).

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	6-Apr-16	Stream Name:	UNT To White Oak Draft
Crossing ID:	SC_0733		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Cattle grazing

Part 2: River Valley Conditions

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Crops
- [X] Shrubs
- [X] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Valley Side Features

- [ ] None
- [ ] Occasional
- [X] Frequent

Failure Locations

- [ ] None
- [ ] Away from river
- [ ] Along river

Part 3: Floodplain

Floodplain Width

- [ ] None
- [ ] 1 < river widths
- [X] 1-5 river widths
- [ ] 5-10 river widths
- [ ] > 10 river widths

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Mining
- [ ] Cattle grazing

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Orchards
- [ ] Crops
- [X] Shrubs
- [X] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Riparian Buffer Strip

- [ ] None
- [ ] < 1 river width
- [ ] 1-5 river widths
- [X] > 5 river widths

Part 4: Vertical Confinement

Terraces

- [X] None
- [ ] Left bank
- [ ] Right bank

Levees

- [X] None
- [ ] Natural
- [ ] Constructed

Levee Location

- [ ] Along channel bank
- [ ] Set back < 1 river width
- [ ] Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

- [ ] Straight
- [X] Meandering
- [ ] Braided
- [ ] Anastomosed
- [ ] Engineered

Meander Characteristics

- [ ] Mild bends
- [X] Moderate bends
- [ ] Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

- [ ] None
- [X] Occasional
- [ ] Frequent
- [ ] Confined

Control Types

- [ ] None
- [X] Bedrock
- [X] Boulders

Width Controls

- [X] None
- [ ] Occasional
- [ ] Frequent
- [ ] Confined

Control Types

- [X] None
- [ ] Bedrock
- [ ] Boulders

Other

- [ ] Debris
- [ ] Mining
- [ ] Reservoir
- [ ] Knickpoint

Flow Habit

- [X] Perennial
- [ ] Flashy perennial
- [ ] Intermittent
- [ ] Ephemeral

Channel Width: 20.1

M-B Classification

- [ ] Cascade or step-pool
- [X] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material	*Bar Types*	*Bar Material*	*Bar Vegetation*	*Bar Width*
[ ] Clay	[ ] None	[ ] Silt	[ ] None	[ ] None
[ ] Silt	[ ] Alternate bars	[ ] Sand	[ ] Grasses	[ ] Narrow
[ ] Sand	[X] Point bars	[X] Gravel	[X] Reeds/shrubs	[ ] Moderate
[X] Gravel	[ ] Mid-channel bars	[X] Cobbles	[ ] Trees	[ ] Wide
[X] Cobbles	[ ] Diagonal bars			
[X] Boulders	[ ] Irregular/combination			
[ ] Bedrock	[ ] Braided			

Percent sand in bed = > 10 %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	*Left Bank*	*Right Bank*
Bank Material	[ ] Clay [ ] Silt [X] Gravel [X] Cobbles [X] Boulders [ ] Bedrock	[ ] Clay [ ] Silt [X] Gravel [X] Cobbles [X] Boulders [ ] Bedrock
Layer Material	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	2-3'	2-3'
Bank Slope	[ ] Steep [X] Moderate [ ] Shallow	[ ] Steep [X] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [X] young [X] mature [ ] old tree diversity [ ] Y [X] N	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [X] young [X] mature [ ] old tree diversity [ ] Y [X] N
Bank Erosion and Failure Location	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0733, UNT to White Oak Draft at MP 120.18 (AP-1)

Photograph 1 (IMG_631.jpg)	
Date: 06-April-2016	
Direction: Upstream	
Description: Stream is located in dense deciduous forest. Bed comprises subangular and subrounded boulders and cobbles. Pipeline crossing is located at orange tape (red arrow).	

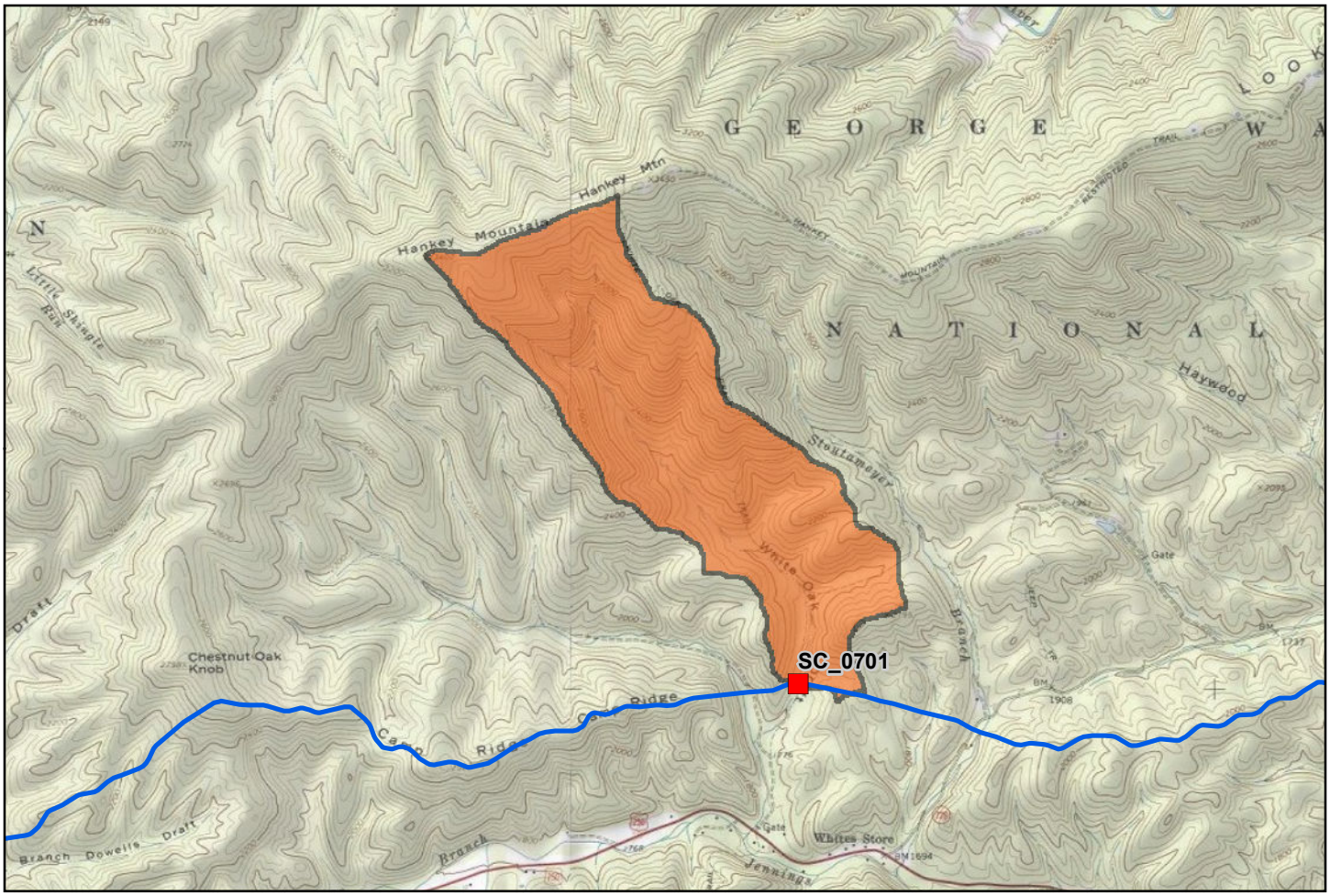
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0733, UNT to White Oak Draft at MP 120.18 (AP-1)

Photograph 2 (016.jpg)	
Date: 06-November-2015	
Direction: Upstream	
Description: View of steep slope on right bank of stream.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0701	sauc008	AP-1	120.38	Virginia	Augusta

Attribute	Value
Stream Name	White Oak Draft
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	1.020
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	12.6
Slope At Crossing Over 200ft Long Reach (%)[4]	3.826
Proposed Construction Method[5]	1) Flume 2) Dam and Pump

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:50,000

0 1,125 2,250 4,500 Feet

0 1 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0701

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

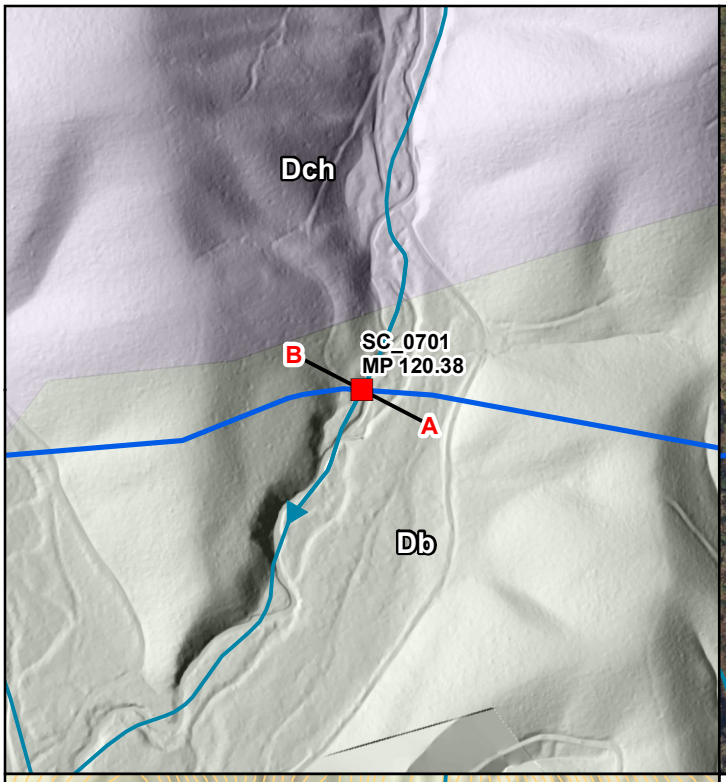
Notes:

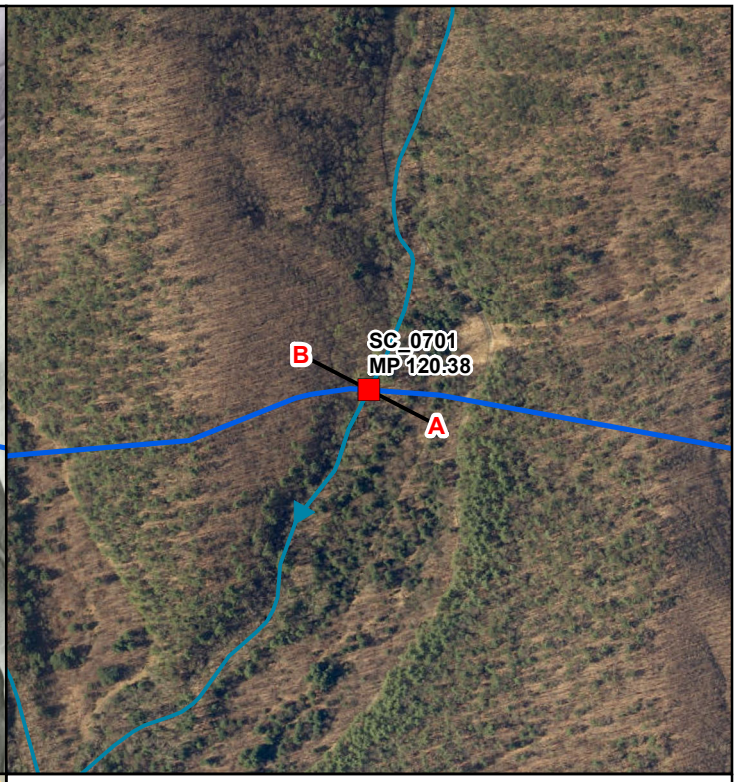
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

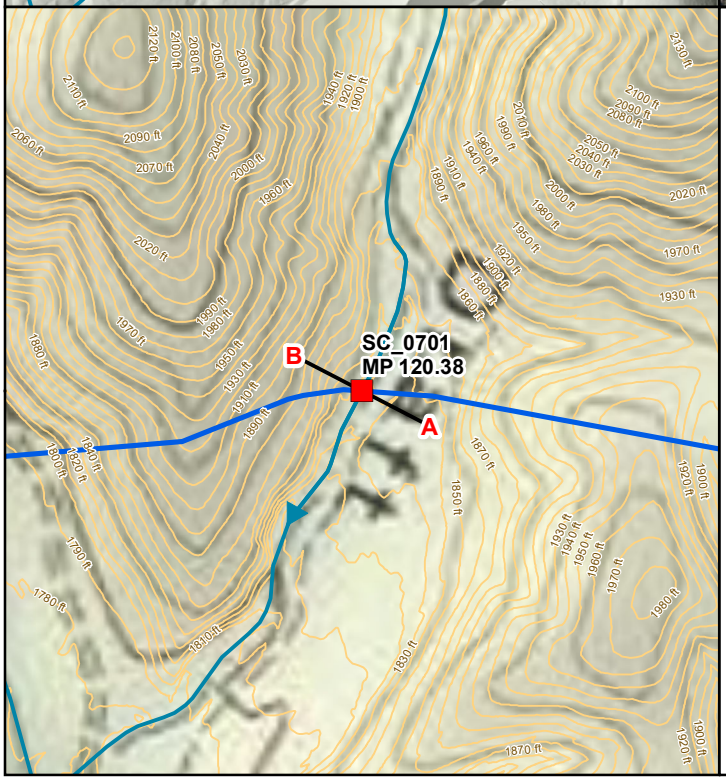
Dominion

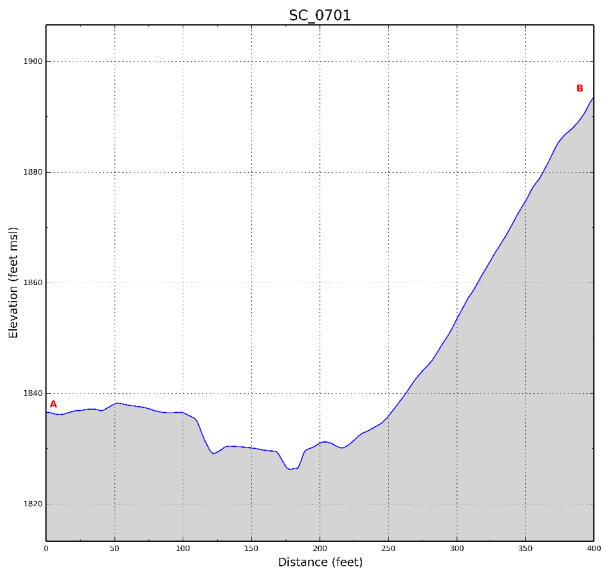
Geosyntec consultants

TESSELLATIONS









Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: sauc008

TID_SC: SC_0701

Stream Name: White Oak

Draft

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0701

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELATIONS

Geosyntec consultants

TID	SC_0701	**ACP Segment**	AP-1
Stream Name	White Oak Draft	**MP**	120.38
Survey Date	06-April-2016	**Start Time**	1645 hrs

- Stream is located within a densely forested valley.
- Step-pool stream morphology that is showing signs of geomorphic lateral and vertical instability.
- Bankfull channel width is 12.6 feet and bankfull channel depth is 0.86 feet.
- Stream bed comprised of sub-angular to sub-rounded boulder and cobble-sized particles.
- Signs of debris flow including large downed trees, upstream braiding.
- Bedrock outcrop identified approximately 170 feet downstream of pipeline crossing (S80°W 51°).
- Pebble count not conducted due to high hazard and recommendation for bedrock burial.
- The left bank has been extensively eroded about 30 yards downstream with steep, near vertical, banks between 10 and 15 feet high.
    - Top of bank height is approximately 2.5 feet in vicinity of crossing.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Given debris flow hazard, it is recommended to bury pipeline into bedrock with at least 1.5-foot of cover above the crown from valley wall beyond right bank to valley wall beyond left bank.

Geotechnical investigation to determine depth to bedrock at stream crossing is required (or crossing can be moved 170 ft downstream where bedrock was observed).

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	6-Apr-16	Stream Name:	White Oak Draft
Crossing ID:	SC_0701		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

X	Natural
	Agricultural
	Urban
	Suburban
	Rural
	Industrial
	Cattle grazing

Part 2: River Valley Conditions

Vegetation

	None
	Grass
	Pasture
	Crops
X	Shrubs
X	Deciduous Forest/trees
	Coniferous Forest/trees

Valley Side Features

	None
	Occasional
X	Frequent

Failure Locations

X	None
	Away from river
	Along river

Part 3: Floodplain

Floodplain Width

	None
	1 < river widths
X	1-5 river widths
	5-10 river widths
	> 10 river widths

Land Use

X	Natural
	Agricultural
	Urban
	Suburban
	Rural
	Industrial
	Mining
	Cattle grazing

Vegetation

	None
	Grass
	Pasture
	Orchards
	Crops
X	Shrubs
X	Deciduous Forest/trees
	Coniferous Forest/trees

Riparian Buffer Strip

	None
	< 1 river width
	1-5 river widths
X	> 5 river widths

Part 4: Vertical Confinement

Terraces

X	None
	Left bank
	Right bank

Levees

X	None
	Natural
	Constructed

Levee Location

	Along channel bank
	Set back < 1 river width
	Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

	Straight
X	Meandering
	Braided
	Anastomosed
	Engineered

Meander Characteristics

X	Mild bends
	Moderate bends
	Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

	None
	Occasional
X	Frequent
	Confined

Control Types

	None
X	Bedrock
X	Boulders

Width Controls

X	None
	Occasional
	Frequent
	Confined

Control Types

X	None
	Bedrock
	Boulders

Other

	Debris
	Mining
	Reservoir
	Knickpoint

Flow Habit

- [X] Perennial
- [ ] Flashy perennial
- [ ] Intermittent
- [ ] Ephemeral

Channel Width: 12.6

M-B Classification

- [X] Cascade or **step-pool**
- [ ] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material	*Bar Types*	*Bar Material*	*Bar Vegetation*	*Bar Width*
[ ] Clay	[ ] None	[ ] Silt	[X] None	[ ] None
[ ] Silt	[ ] Alternate bars	[ ] Sand	[ ] Grasses	[ ] Narrow
[ ] Sand	[X] Point bars	[X] Gravel	[ ] Reeds/shrubs	[ ] Moderate
[X] Gravel	[ ] Mid-channel bars	[X] Cobbles	[ ] Trees	[ ] Wide
[X] Cobbles	[ ] Diagonal bars			
[X] Boulders	[ ] Irregular/combination			
[ ] Bedrock	[ ] Braided			

Percent sand in bed = < 10 %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	*Left Bank*	*Right Bank*
Bank Material	[ ] Clay [X] Silt [X] Gravel [X] Cobbles [ ] Boulders [ ] Bedrock	[ ] Clay [X] Silt [X] Gravel [X] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	2.5'	2.5'
Bank Slope	[ ] Steep [X] Moderate [ ] Shallow	[ ] Steep [X] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [X] young [ ] mature [ ] old tree diversity [X] Y [ ] N	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [X] young [ ] mature [ ] old tree diversity [X] Y [ ] N
Bank Erosion and Failure Location	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical

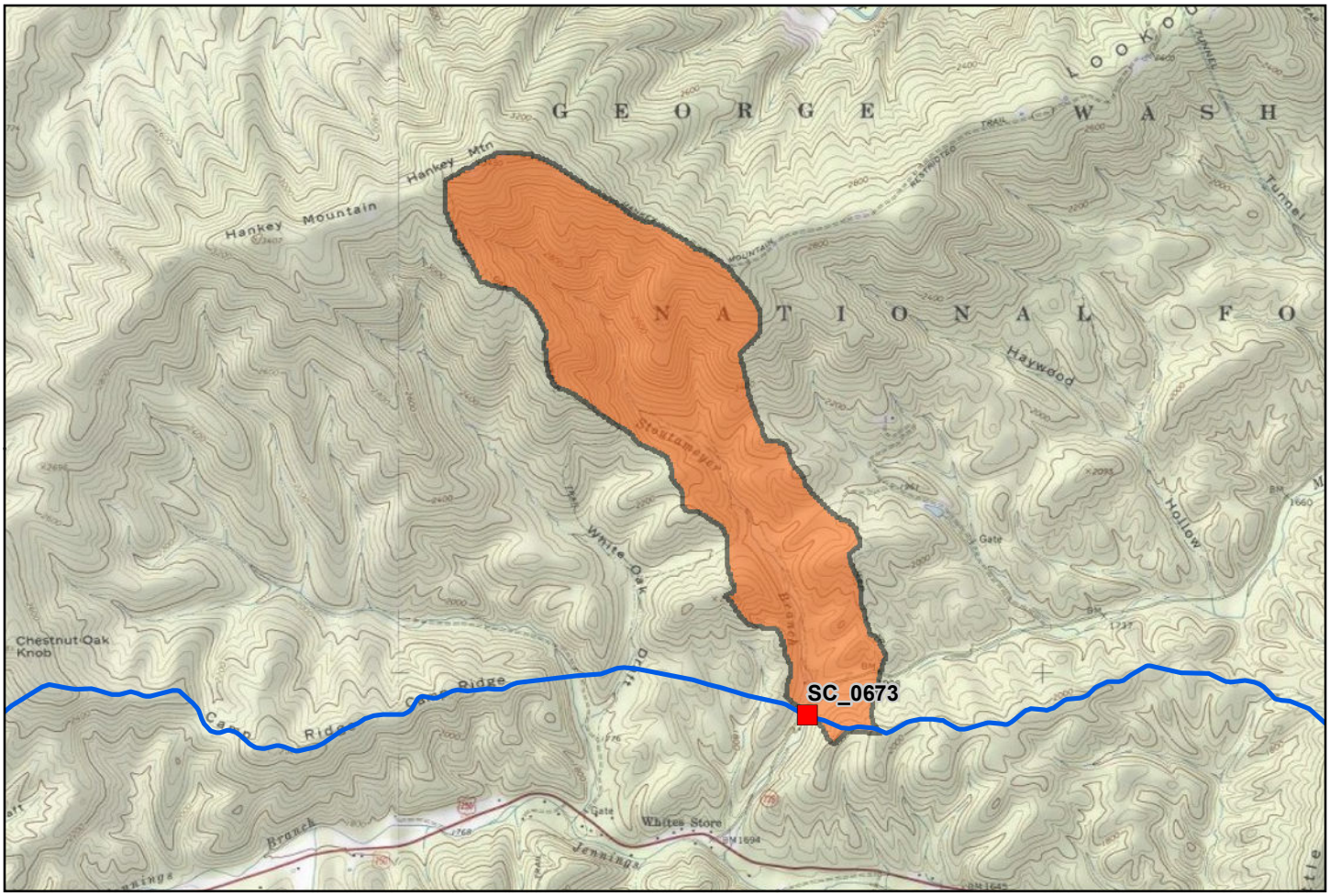
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0701, White Oak Draft at MP 120.38 (AP-1)

Photograph 1 (IMG_630.jpg)	
Date: 06-April-2016	
Direction: Upstream	
Description: Stream is located in dense deciduous forest. Bed comprises subangular and subrounded boulders and cobbles. Head cut in photo at location of crossing.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0673	nhd_va_030	AP-1	121.06	Virginia	Augusta

Attribute	Value
Stream Name	Stoutameyer Branch
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	1.074
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	13.3
Slope At Crossing Over 200ft Long Reach (%)[4]	2.900
Proposed Construction Method[5]	1) Dam and Pump 2) Flume

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:50,000

0 1,125 2,250 4,500 Feet

0 1 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0673

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

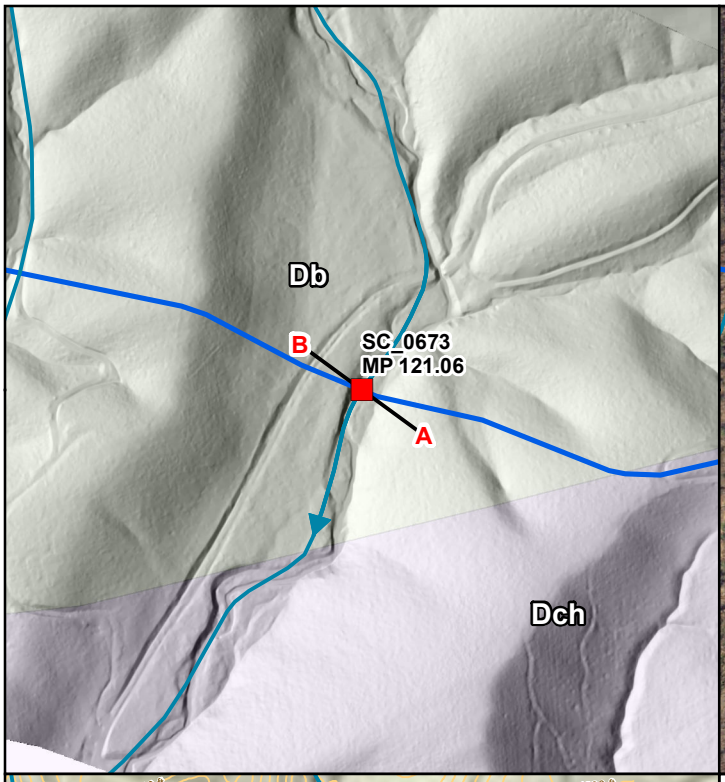
Notes:

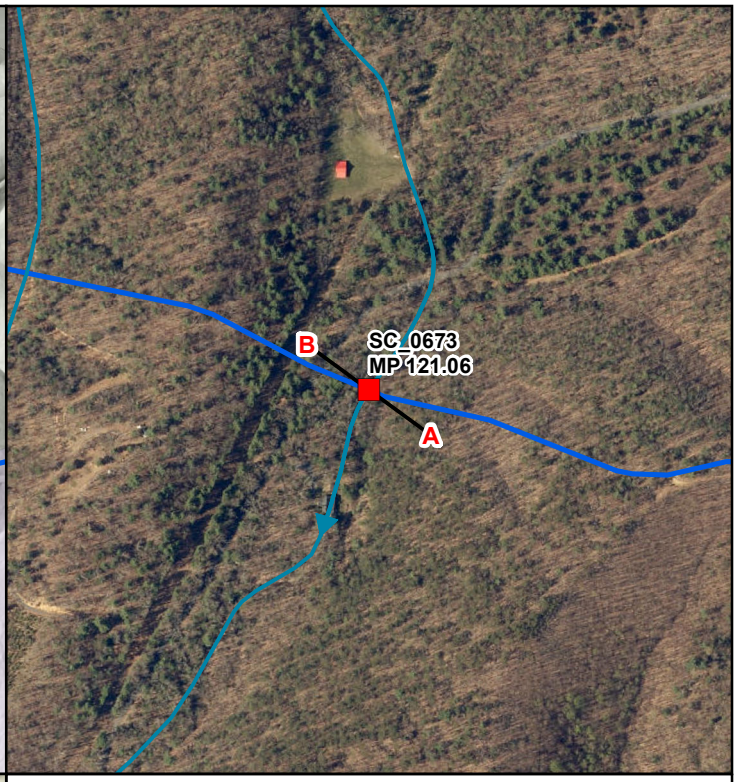
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

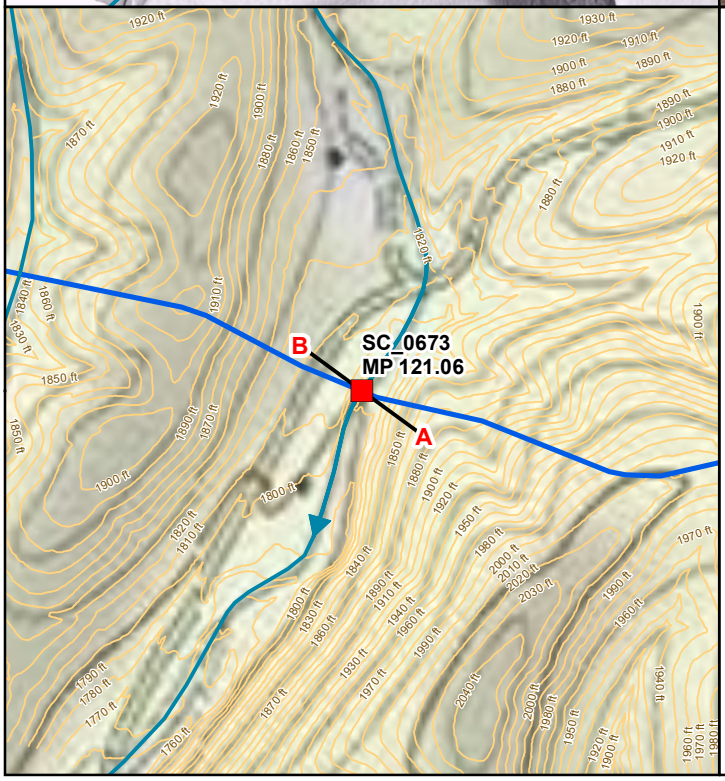
Dominion

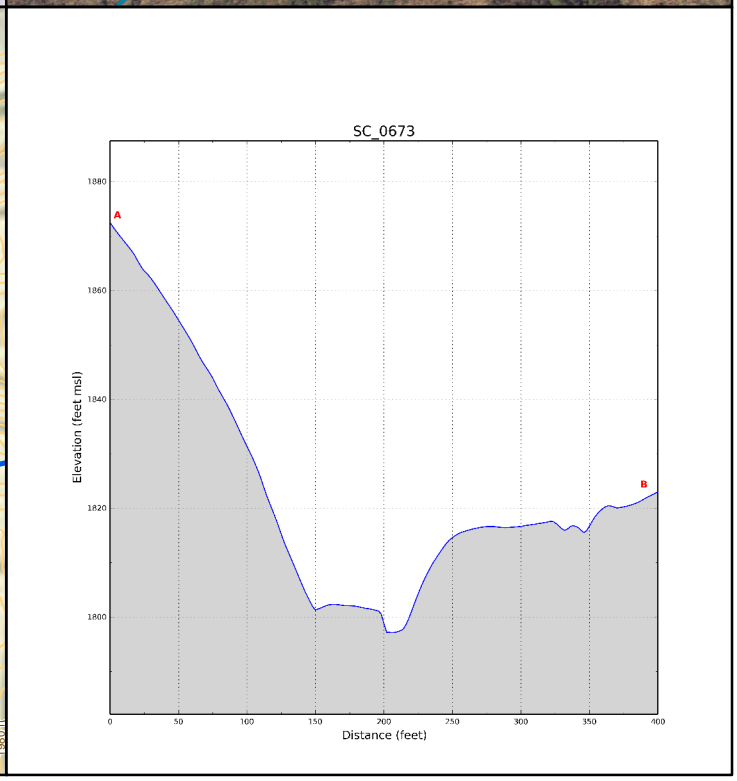
Geosyntec consultants

TESSELLATIONS









Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: nhd_va_030

TID_SC: SC_0673

Stream Name: Stoutameyer Branch

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0673

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELLATIONS

Geosyntec consultants

TID	SC_0673	**ACP Segment**	AP-1
Stream Name	Stoutameyer Branch	**MP**	121.06
Survey Date	29-September-2016	**Start Time**	0840 hrs

- Crossing along a riffle in straighter section of the stream.
- Terraced on left bank with valley confinement.
- Steep slope leading to road and topographic confinement on right bank.
- BFW = 13.3 ft and BFD is approximately 1 ft.
- Maximum eroded right bank height downstream of crossing approximately 10-12-ft
- Left bank height of 3.2-ft
- Bed comprises sub-angular to rounded cobbles with gravels and few boulders up to about 2-ft diameter. Although wide range of grain size present, bed appears well armored.
- Established riparian buffer up to road on right bank and up to valley wall along left bank.
- Hummocky terrain on left floodplain within riparian buffer with minor terracing, signs of historic channels and debris materials.
- Relatively steep reach. Measured 2.9% slope using autolevel.
- Stream appears to be fairly confined and meandering within armored channel with some erosion at meanders, particularly on right bank downstream of crossing.

Recommendation:

Evaluate scour depth for pipeline burial depth. Bury pipeline from valley wall to valley wall.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	4-May-16	Stream Name:	Stoutameyer Branch
Crossing ID:	SC_0673		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Cattle grazing

Part 2: River Valley Conditions

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Crops
- [ ] Shrubs
- [X] Deciduous Forest/trees
- [X] Coniferous Forest/trees

Valley Side Features

- [ ] None
- [ ] Occasional
- [X] Frequent

Failure Locations

- [X] None
- [ ] Away from river
- [ ] Along river

Part 3: Floodplain

Floodplain Width

- [ ] None
- [X] 1 < river widths
- [ ] 1-5 river widths
- [ ] 5-10 river widths
- [ ] > 10 river widths

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Mining
- [ ] Cattle grazing

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Orchards
- [ ] Crops
- [ ] Shrubs
- [X] Deciduous Forest/trees
- [X] Coniferous Forest/trees

Riparian Buffer Strip

- [ ] None
- [ ] < 1 river width
- [ ] 1-5 river widths
- [X] > 5 river widths

Part 4: Vertical Confinement

Terraces

- [ ] None
- [X] Left bank
- [X] Right bank

Levees

- [X] None
- [ ] Natural
- [ ] Constructed

Levee Location

- [ ] Along channel bank
- [ ] Set back < 1 river width
- [ ] Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

- [ ] Straight
- [X] Meandering
- [ ] Braided
- [ ] Anastomosed
- [ ] Engineered

Meander Characteristics

- [X] Mild bends
- [ ] Moderate bends
- [ ] Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

- [ ] None
- [ ] Occasional
- [ ] Frequent
- [X] Confined

Control Types

- [ ] None
- [X] Bedrock
- [X] Boulders

Width Controls

- [ ] None
- [ ] Occasional
- [X] Frequent
- [ ] Confined

Control Types

- [ ] None
- [X] Bedrock
- [X] Boulders

Other

- [ ] Debris
- [ ] Mining
- [ ] Reservoir
- [ ] Knickpoint

Flow Habit

- [X] Perennial
- [ ] Flashy perennial
- [ ] Intermittent
- [ ] Ephemeral

Channel Width: 13.3

M-B Classification

- [X] Cascade or step-pool
- [ ] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material	*Bar Types*	*Bar Material*	*Bar Vegetation*	*Bar Width*
[ ] Clay	[ ] None	[ ] Silt	[X] None	[ ] None
[ ] Silt	[X] Alternate bars	[ ] Sand	[ ] Grasses	[X] Narrow
[ ] Sand	[ ] Point bars	[ ] Gravel	[ ] Reeds/shrubs	[ ] Moderate
[ ] Gravel	[ ] Mid-channel bars	[X] Cobbles	[ ] Trees	[ ] Wide
[X] Cobbles	[ ] Diagonal bars			
[X] Boulders	[ ] Irregular/combination			
[ ] Bedrock	[ ] Braided			

Percent sand in bed = _____ %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	*Left Bank*	*Right Bank*
Bank Material	[ ] Clay [ ] Silt [X] Gravel [X] Cobbles [X] Boulders [ ] Bedrock	[ ] Clay [ ] Silt [X] Gravel [X] Cobbles [X] Boulders [ ] Bedrock
Layer Material	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	1.2'	1.2'
Bank Slope	[ ] Steep [X] Moderate [ ] Shallow	[ ] Steep [ ] Moderate [X] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [ ] Y [X] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [ ] young [X] mature [ ] old tree diversity [X] Y [ ] N	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [ ] Y [X] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [ ] young [X] mature [ ] old tree diversity [X] Y [ ] N
Bank Erosion and Failure Location	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [ ] fluvial [ ] geotechnical

GEOSYNTEC CONSULTANTS

Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0673, Stoutameyer Branch at MP 121.06 (AP-1)

Photograph 1
(IMG_4247)

Date: 29 September 2016

Direction: looking upstream

Description: Well defined channel with cobble bed. View from just downstream of crossing illustrating stable low banks.

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0673, Stoutameyer Branch at MP 121.06 (AP-1)

Photograph 2 (IMG_4248.JPG)	
Date: 29 September 2016	
Direction: looking downstream	
Description: Steep eroded right bank on outside bend, downstream of crossing. Minor terraced floodplain off left bank.	

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0673, Stoutameyer Branch at MP 121.06 (AP-1)

Photograph 3 (IMG_4250.JPG)	
Date: 29 September 2016	
Direction: looking downstream	
Description: Steep eroded right bank on outside bend downstream of crossing. Channel bed well armored.	

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0673, Stoutameyer Branch at MP 121.06 (AP-1)

Photograph 4 (IMG_4251)	
Date: 29 September 2016	
Direction: looking downstream	
Description: Well armored meander bend downstream of crossing. Floodplain off right bank relatively accessible, structures present. Left bank of channel is confined by valley wall.	

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0673, Stoutameyer Branch at MP 121.06 (AP-1)

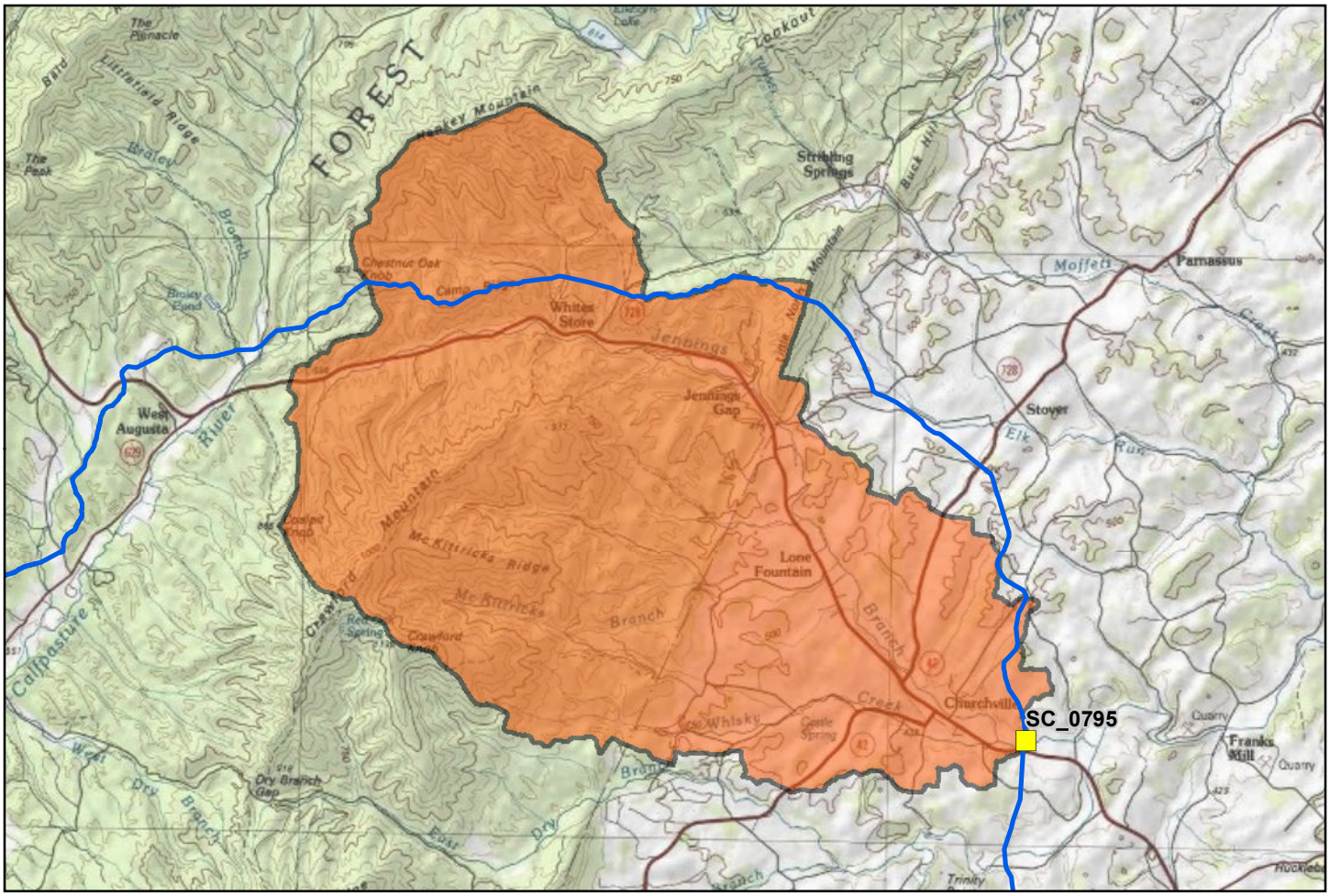
Photograph 5 (IMG_4255.JPG)	
Date: 29 September 2016	
Direction: looking downstream at right bank.	
Description: Eroded bank showing signs of stratification. Potential historic debris flow or channel deposits.	

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0673 (Stoutameyer Branch at MP AP-1 121.06)

Photograph 6 (IMG_4253.JPG)	
Date: 29 September 2016	
Direction: looking down on channel bed.	
Description: Cobble bed with some gravels.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0795	saua413	AP-1	129.18	Virginia	Augusta

Attribute	Value
Stream Name	Jennings Branch
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	34.463
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	65
Slope At Crossing Over 200ft Long Reach (%)[4]	0.183
Proposed Construction Method[5]	1) Cofferdam 2) Dam and Pump

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:150,000

0 3,350 6,700 13,400 Feet

0 3.5 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0795

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

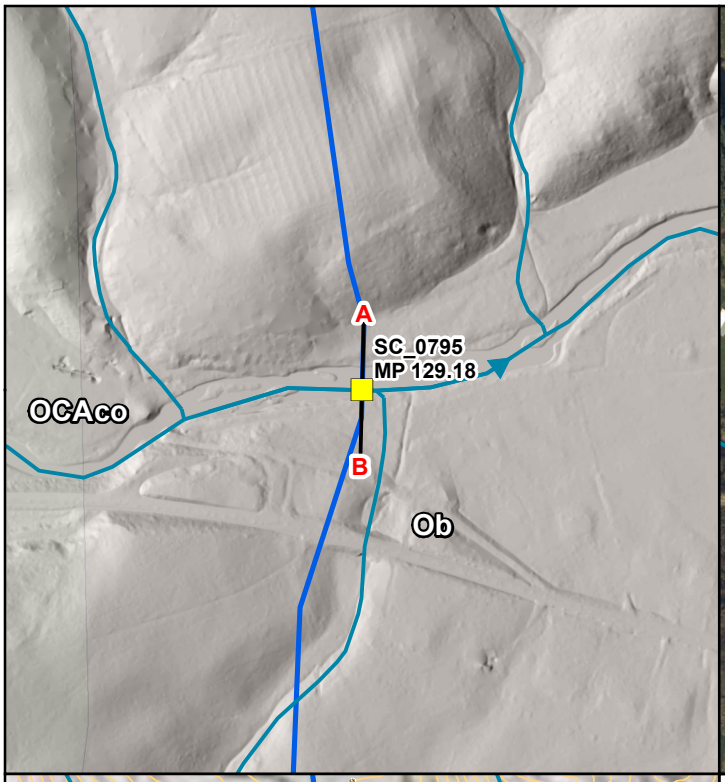
Notes:

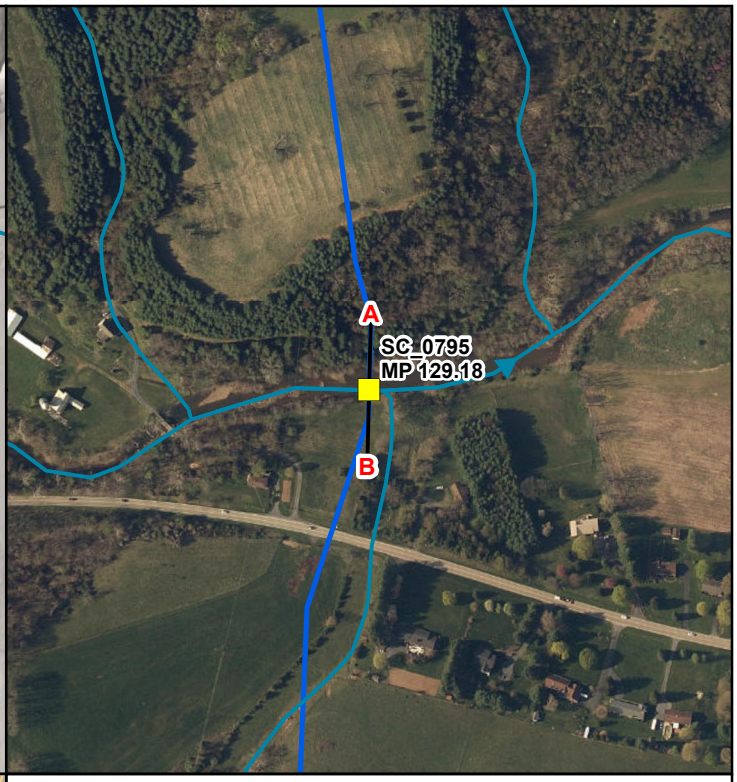
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

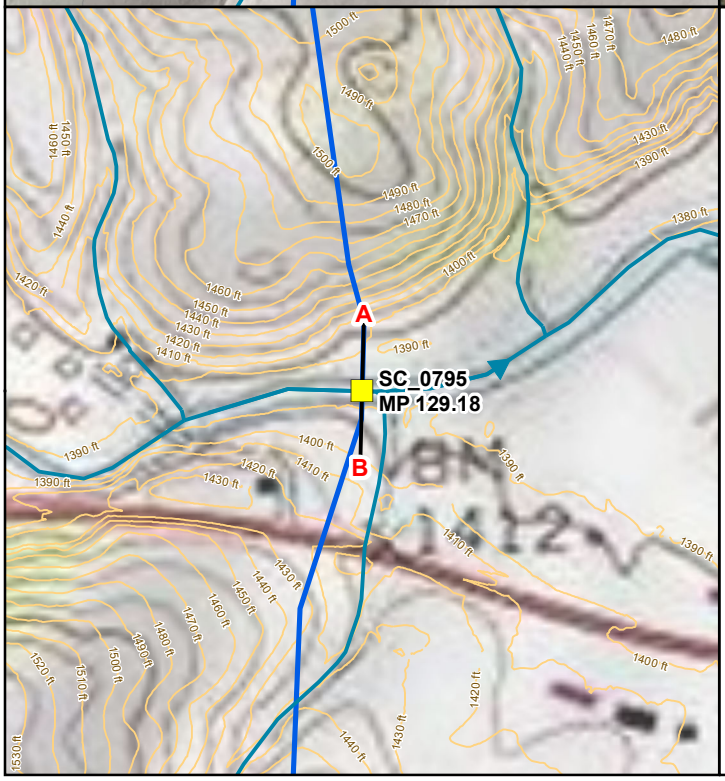
Dominion

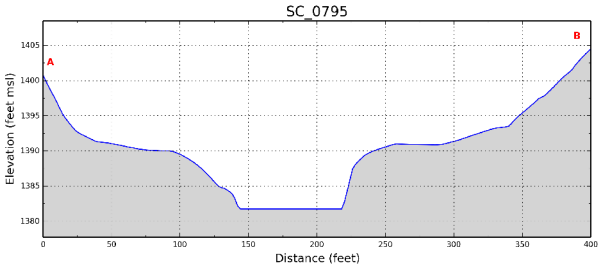
Geosyntec consultants

TESSELLATIONS









Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: saua413

TID_SC: SC_0795

Stream Name: Jennings Branch

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0795

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELATIONS

Geosyntec consultants

TID	SC_0795	**ACP Segment**	AP-1
Stream Name	Jennings Branch	**MP**	129.18
Survey Date	05-April-2016	**Start Time**	1550 hrs

- Pipeline is crossing through red tract. Therefore survey had to be conducted at bridge crossing located on Hangers Mill Rd.
- Evaluation of USGS topographical map indicates that stream is laterally confined at crossing with low likelihood for lateral migration.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Evaluate scour depth for pipeline burial depth. Use typical procedures for locating sag bends.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	5-Apr-16	Stream Name:	Jennings Branch
Crossing ID:	SC_0795		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

- [ ] Natural
- [X] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [X] Cattle grazing

Part 2: River Valley Conditions

Vegetation

- [ ] None
- [X] Grass
- [X] Pasture
- [ ] Crops
- [ ] Shrubs
- [X] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Valley Side Features

- [ ] None
- [ ] Occasional
- [ ] Frequent

Failure Locations

- [X] None
- [ ] Away from river
- [ ] Along river

Part 3: Floodplain

Floodplain Width

- [ ] None
- [ ] 1 < river widths
- [ ] 1-5 river widths
- [ ] 5-10 river widths
- [X] > 10 river widths

Land Use

- [ ] Natural
- [X] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Mining
- [X] Cattle grazing

Vegetation

- [ ] None
- [X] Grass
- [X] Pasture
- [ ] Orchards
- [ ] Crops
- [ ] Shrubs
- [X] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Riparian Buffer Strip

- [ ] None
- [X] < 1 river width
- [ ] 1-5 river widths
- [ ] > 5 river widths

Part 4: Vertical Confinement

Terraces

- [X] None
- [ ] Left bank
- [ ] Right bank

Levees

- [X] None
- [ ] Natural
- [ ] Constructed

Levee Location

- [ ] Along channel bank
- [ ] Set back < 1 river width
- [ ] Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

- [ ] Straight
- [X] Meandering
- [ ] Braided
- [ ] Anastomosed
- [ ] Engineered

Meander Characteristics

- [X] Mild bends
- [ ] Moderate bends
- [ ] Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

- [X] None
- [ ] Occasional
- [ ] Frequent
- [ ] Confined

Control Types

- [X] None
- [ ] Bedrock
- [ ] Boulders

Width Controls

- [X] None
- [ ] Occasional
- [ ] Frequent
- [ ] Confined

Control Types

- [X] None
- [ ] Bedrock
- [ ] Boulders

Other

- [ ] Debris
- [ ] Mining
- [ ] Reservoir
- [ ] Knickpoint

Flow Habit

- [X] Perennial
- [ ] Flashy perennial
- [ ] Intermittent
- [ ] Ephemeral

Channel Width: 65'

M-B Classification

- [ ] Cascade or step-pool
- [X] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material

- [ ] Clay
- [X] Silt
- [ ] Sand
- [X] Gravel
- [X] Cobbles
- [ ] Boulders
- [ ] Bedrock

Bar Types

- [ ] None
- [ ] Alternate bars
- [X] Point bars
- [ ] Mid-channel bars
- [ ] Diagonal bars
- [ ] Irregular/combination
- [ ] Braided

Bar Material

- [X] Silt
- [X] Sand
- [X] Gravel
- [X] Cobbles

Bar Vegetation

- [ ] None
- [X] Grasses
- [X] Reeds/shrubs
- [ ] Trees

Bar Width

- [ ] None
- [X] Narrow
- [ ] Moderate
- [ ] Wide

Percent sand in bed = _____ %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	*Left Bank*	*Right Bank*
Bank Material	[X] Clay [X] Silt [X] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [X] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	3.5' *from bed*	1.8' *from water*
Bank Slope	[ ] Steep [X] Moderate [ ] Shallow	[ ] Steep [X] Moderate [ ] Shallow
Bank Vegetation	[ ] None [X] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [ ] Y [X] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [ ] young [X] mature [ ] old tree diversity [X] Y [ ] N	[ ] None [X] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [ ] Y [X] N Tree density [X] sparse [ ] dense Tree health [X] good [ ] poor tree ages [ ] young [X] mature [ ] old tree diversity [X] Y [ ] N
Bank Erosion and Failure Location	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0795, Jennings Branch at MP 129.18 (AP-1)

Photograph 1 (IMG_0015)	
Date: 05-April-2016	
Direction: Upstream	
Description: View of thin riparian buffer near downstream bridge crossing over Hangers Mill Rd. located 0.5 miles downstream of pipeline crossing (located on red tract).	

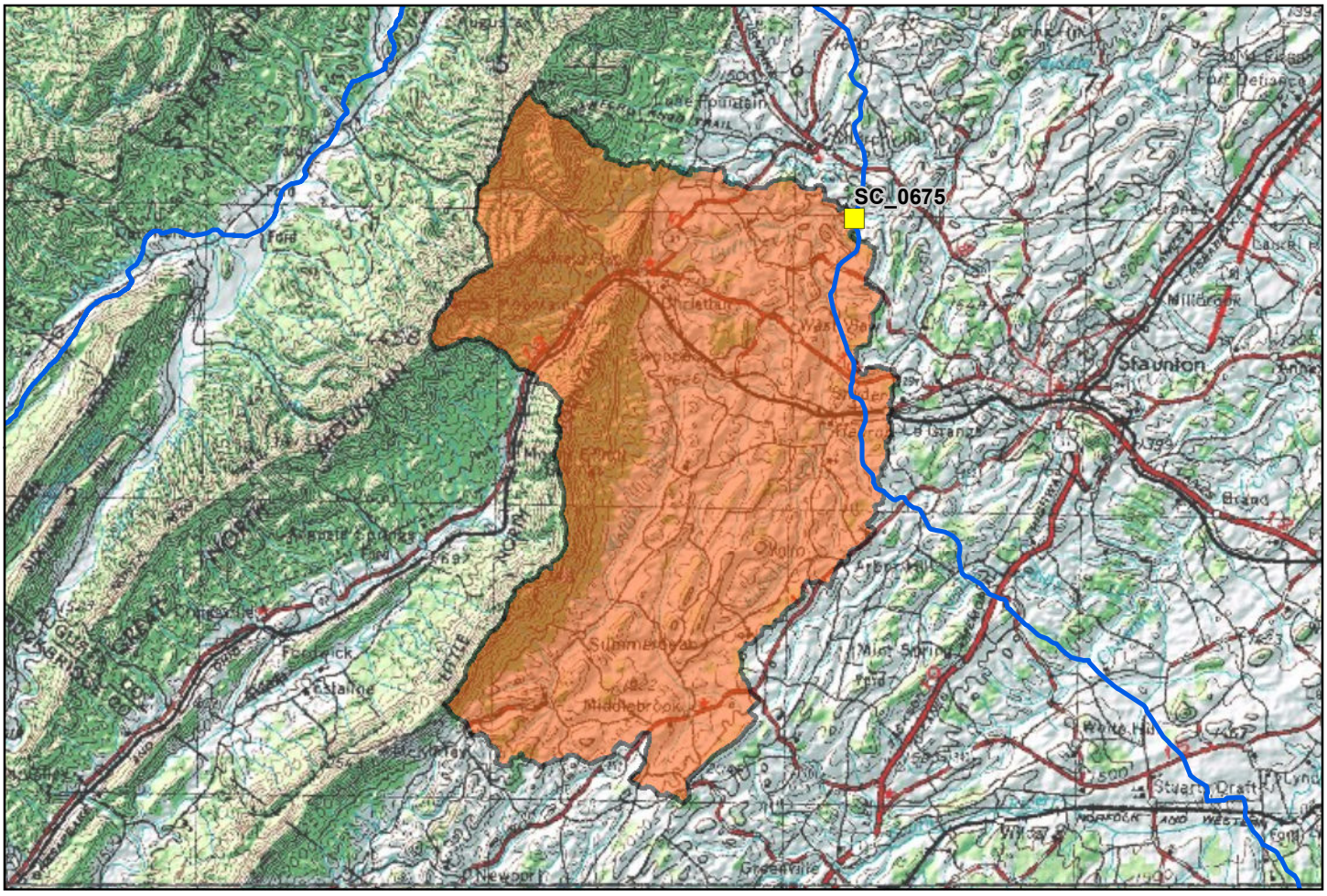
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0795, Jennings Branch at MP 129.18 (AP-1)

Photograph 2 (IMG_0016)	
Date: 05-April-2016	
Direction: Downstream	
Description: View of unconfined stream	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0675	saua070	AP-1	130.38	Virginia	Augusta

Attribute	Value
Stream Name	Middle River
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	89.662
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	84
Slope At Crossing Over 200ft Long Reach (%)[4]	0.418
Proposed Construction Method[5]	1) Cofferdam 2) Dam and Pump

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:300,000

0 6,500 13,000 26,000 Feet

0 7 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0675

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

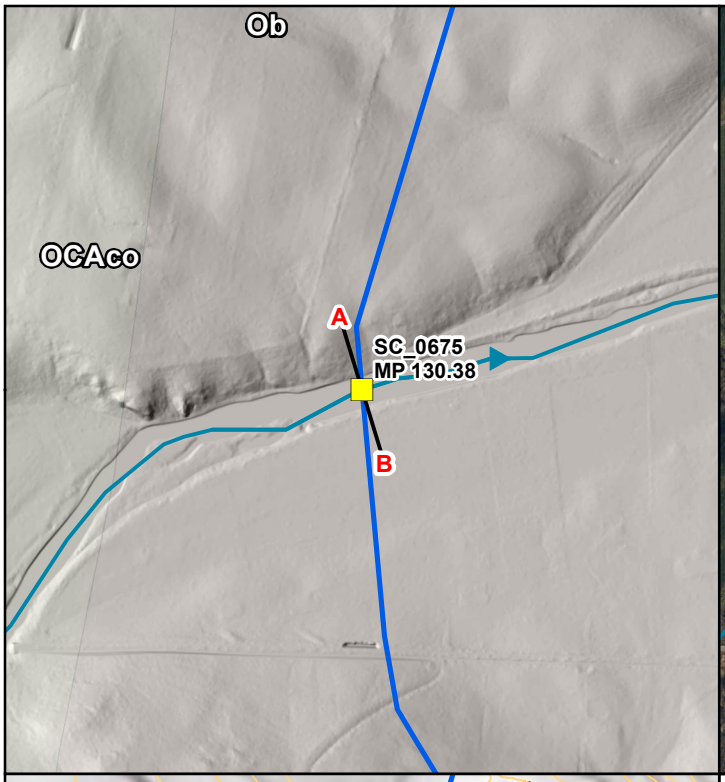
Notes:

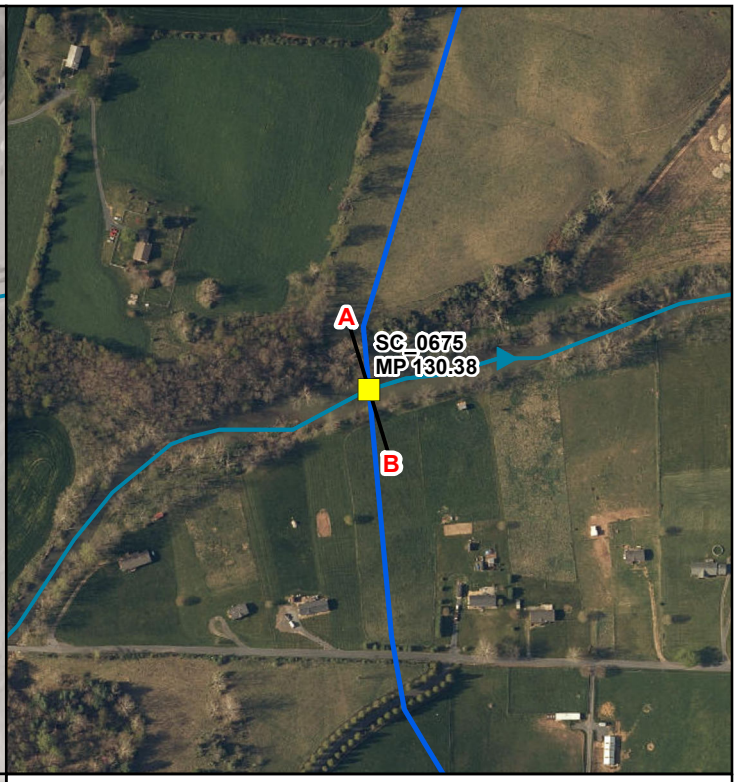
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

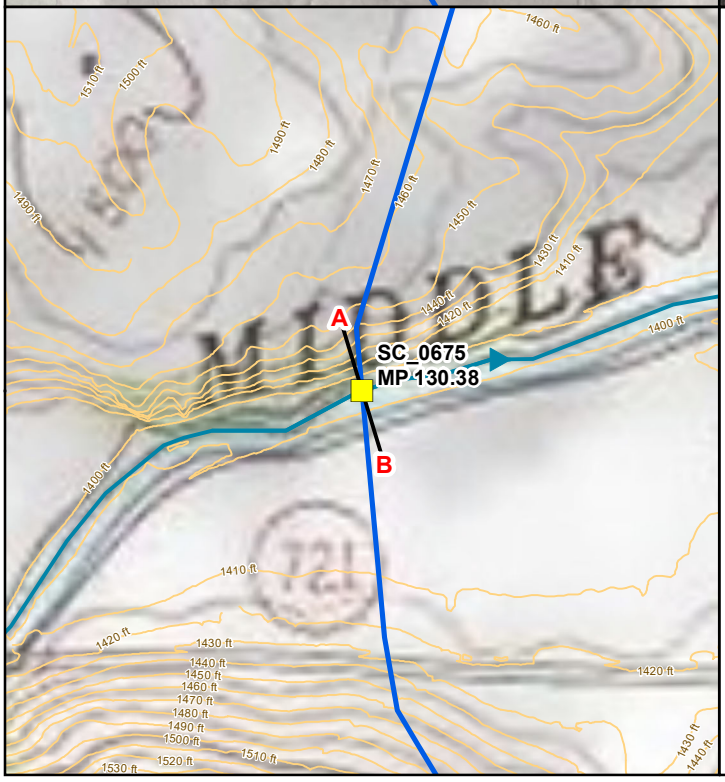
Dominion

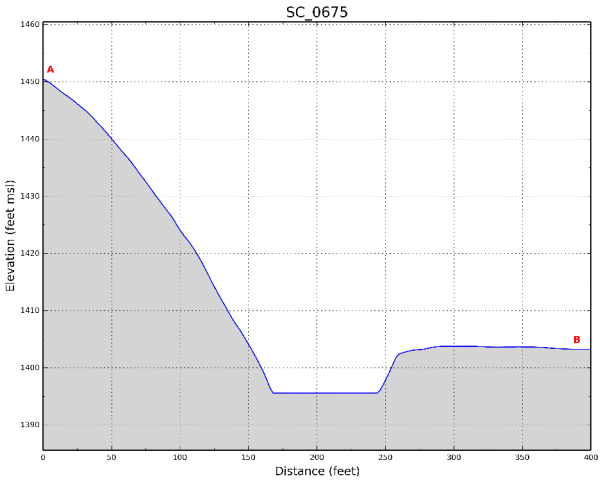
Geosyntec consultants

TESSELLATIONS









Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: saua070

TID_SC: SC_0675

Stream Name: Middle River

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0675

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELLATIONS

Geosyntec consultants

TID	SC_0675	**ACP Segment**	AP-1
Stream Name	Middle River	**MP**	130.38
Survey Date	05-April-2016	**Start Time**	1500 hrs

- Bankfull channel width is 84 feet.
- Stream crossing is at a pool with maximum water depth of approximately 3.8 feet (below water surface). Bankfull height is approximately 3.5 feet above water surface
- Top of banks heights varied with the left bank being confined by a steep maturely forested hill slope with multiple rock outcrops. The right top of bank height is approximately 7.5 feet above water surface and is not laterally confined and riparian buffer is thin (less than one river width).
- Wide floodplain beyond the right top of bank. The bankfull floodplain is only a few feet wide on both banks.
- Stream bed comprised of cobbles and sand (about 50-50 coverage) with scattered boulders.
- Right bank materials comprise fine-grained soils.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Evaluate scour depth for pipeline burial depth. Sag bend on right bank should be located approximately one river width from top of right bank.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	5-Apr-16	Stream Name:	Middle River
Crossing ID:	SC_0675		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

	Natural
X	Agricultural
	Urban
	Suburban
	Rural
	Industrial
X	Cattle grazing

Part 2: River Valley Conditions

Vegetation

	None
X	Grass
X	Pasture
	Crops
	Shrubs
	Deciduous Forest/trees
X	Coniferous Forest/trees

Valley Side Features

	None
	Occasional
X	Frequent

Failure Locations

	None
	Away from river
	Along river

Part 3: Floodplain

Floodplain Width

	None
	1 < river widths
	1-5 river widths
X	5-10 river widths
	> 10 river widths

Land Use

	Natural
X	Agricultural
	Urban
	Suburban
	Rural
	Industrial
	Mining
X	Cattle grazing

Vegetation

	None
X	Grass
X	Pasture
	Orchards
X	Crops
	Shrubs
	Deciduous Forest/trees
	Coniferous Forest/trees

Riparian Buffer Strip

	None
X	< 1 river width *on right bank*
	1-5 river widths
	> 5 river widths

Part 4: Vertical Confinement

Terraces

	None
	Left bank
X	Right bank

Levees

X	None
	Natural
	Constructed

Levee Location

	Along channel bank
	Set back < 1 river width
	Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

X	Straight
	Meandering
	Braided
	Anastomosed
	Engineered

Meander Characteristics

X	Mild bends
	Moderate bends
	Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

X	None
	Occasional
	Frequent
	Confined

Control Types

X	None
	Bedrock
	Boulders

Width Controls

	None
	Occasional
	Frequent
X	Confined

Control Types

	None
	Bedrock
	Boulders

Other

	Debris
	Mining
	Reservoir
	Knickpoint

Left Bank Bluff
Right Bank Terrace

Flow Habit

- [X] Perennial
- [ ] Flashy perennial
- [ ] Intermittent
- [ ] Ephemeral

Channel Width: 84' at Full Bank

M-B Classification

- [ ] Cascade or step-pool
- [X] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material

- [X] Clay
- [X] Silt
- [X] Sand
- [ ] Gravel
- [X] Cobbles
- [ ] Boulders
- [ ] Bedrock

Bar Types

- [ ] None
- [ ] Alternate bars
- [ ] Point bars
- [ ] Mid-channel bars
- [ ] Diagonal bars
- [ ] Irregular/combination
- [ ] Braided
- X *Lateral*

Bar Material

- [X] Silt
- [X] Sand
- [X] Gravel
- [X] Cobbles

Bar Vegetation

- [ ] None
- [X] Grasses
- [ ] Reeds/shrubs
- [ ] Trees

Bar Width

- [ ] None
- [X] Narrow ~20'
- [ ] Moderate
- [ ] Wide

Percent sand in bed = 50 %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	*Left Bank*	*Right Bank*
Bank Material	[X] Clay [ ] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [X] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height		7.6' *To terrace above from water* *2.5' above surface water to bank full*
Bank Slope	[X] Steep [X] Moderate [ ] Shallow	[X] Steep [ ] Moderate [ ] Shallow
Bank Vegetation	[ ] None [X] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [X] sparse [ ] dense Tree health [X] good [ ] poor tree ages [ ] young [X] mature [ ] old tree diversity [ ] Y [X] N	[ ] None [X] Grasses/annuals [ ] Reeds/shrubs [ ] Trees: Falling trees? [X] Y [ ] N Tree density [X] sparse [ ] dense Tree health [X] good [ ] poor tree ages [ ] young [X] mature [ ] old tree diversity [ ] Y [X] N
Bank Erosion and Failure Location	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general *Normal Approach Protocol* type of erosion [X] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical

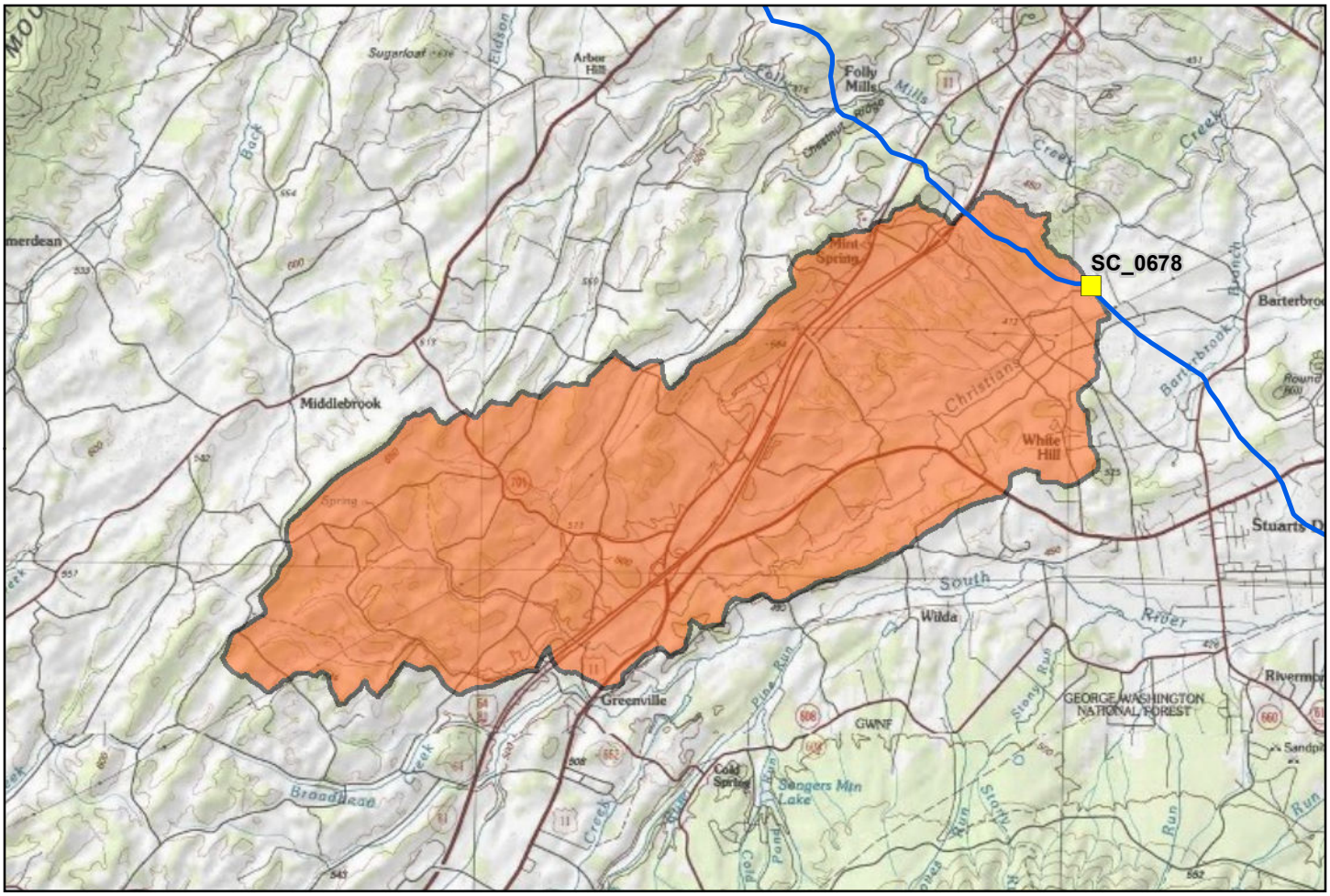
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0675, Middle River at MP 130.38 (AP-1)

Photograph 1 (IMG_0014)	
Date: 05-April-2016	
Direction: Downstream	
Description: Notice sloping left bank where rock outcrops were noticeable (not shown on photo). Right bank exhibits a gentle slope.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0678	saub007	AP-1	142.51	Virginia	Augusta

Attribute	Value
Stream Name	Christians Creek
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	25.610
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	29
Slope At Crossing Over 200ft Long Reach (%)[4]	0.350
Proposed Construction Method[5]	1) Dam and Pump 2) Flume

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:150,000

0 3,350 6,700 13,400 Feet

0 3.5 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0678

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

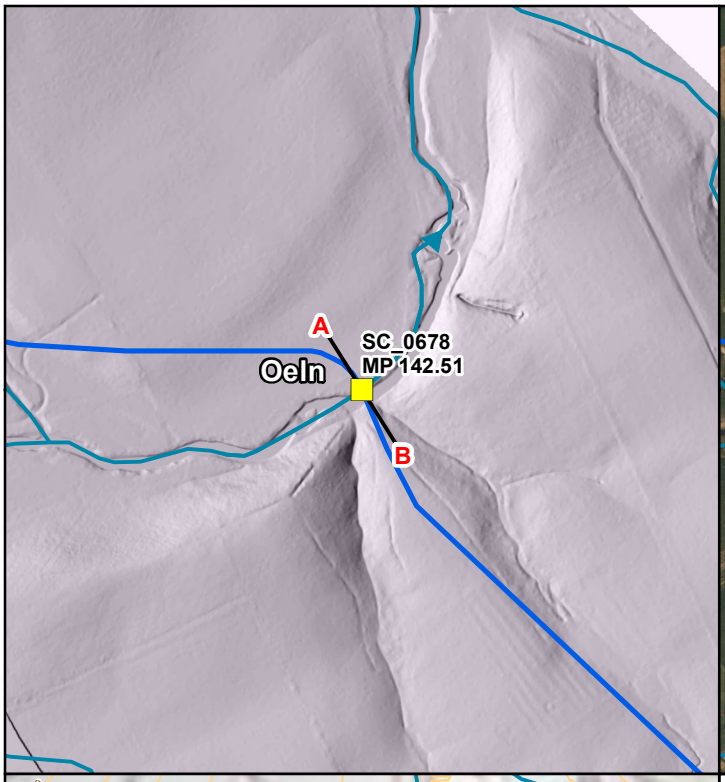
Notes:

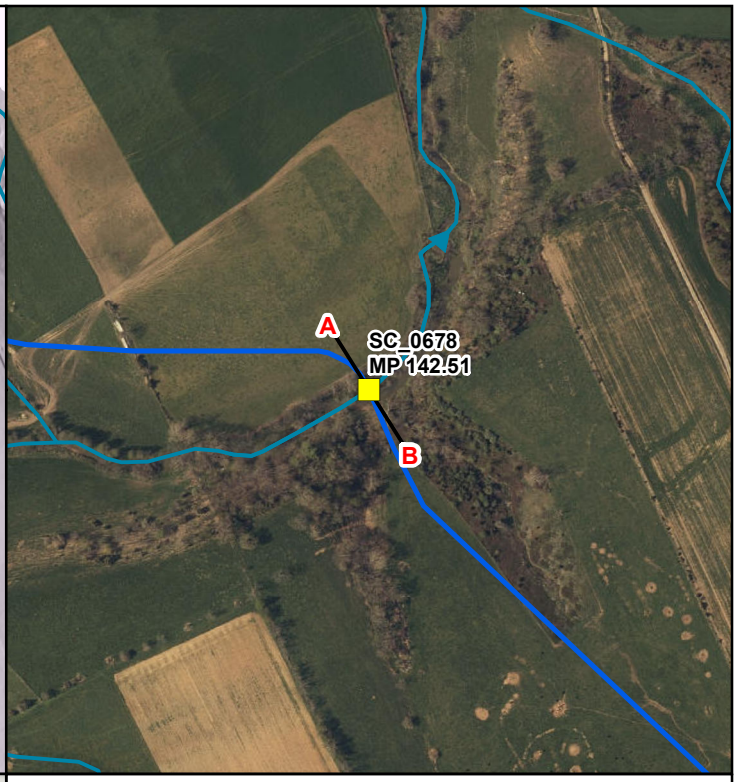
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

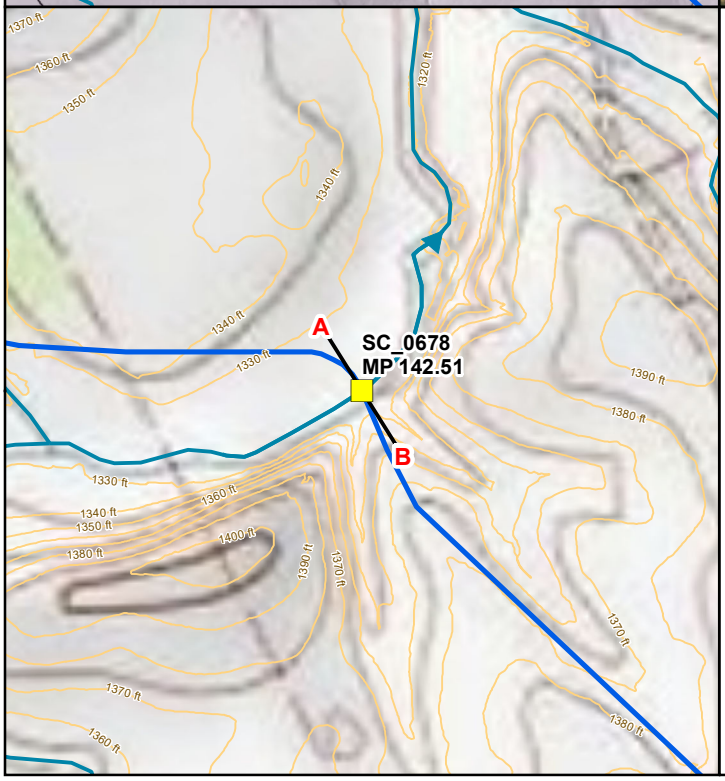
Dominion

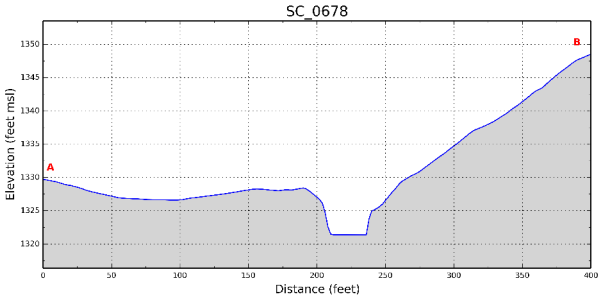
Geosyntec consultants

TESSELATIONS









Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: saub007

TID_SC: SC_0678

Stream Name: Christians Creek

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0678

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELATIONS

Geosyntec consultants

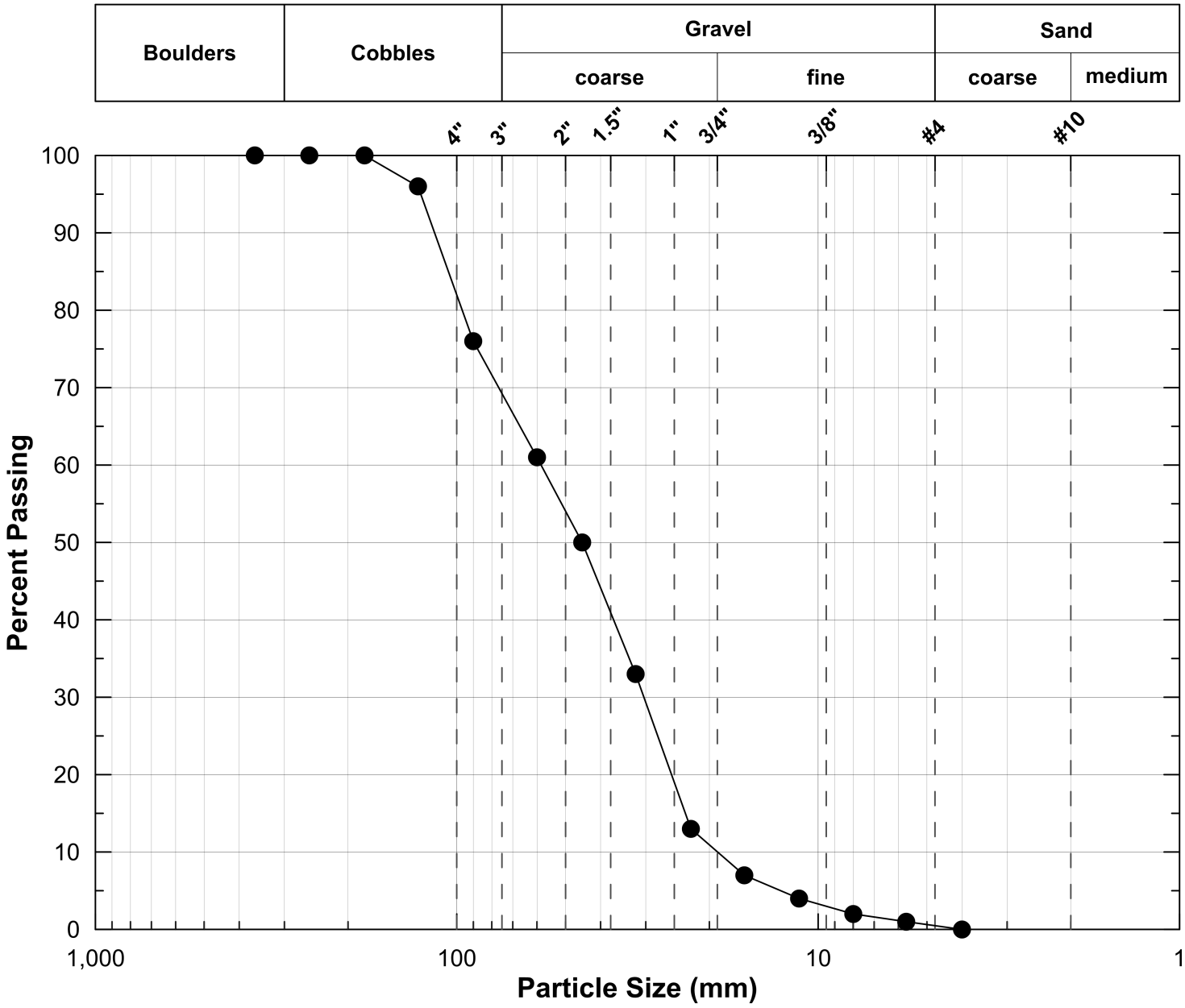
TID	SC_0678	**ACP Segment**	AP-1
Stream Name	Christians Creek	**MP**	142.51
Survey Date	05-April-2016	**Start Time**	1230 hrs

- Bankfull channel width is 29 feet.
- Top of bank heights varied due to the incised nature of the channel. The left bank is 4.5-ft and the right bank is 3.4-ft high. The bankfull height is 1.5-ft (measured on the right bank near the crossing) which corresponds to a bank height ratio (BHR) of 2.3 to 3.0 which is an indicator of channel instability.
- Stream bed comprised of cobble, gravel, and silt/clay.
- Riparian buffer on both banks is largely young, deciduous trees and is approximately two river widths on left bank and four widths on the right bank.
- Conducted Wolman pebble count on the cobble/gravel riffle upstream of crossing. The D_{50} is 45 mm (coarse gravel).
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Evaluate scour depth for pipeline burial depth. Lateral migration towards the left bank should be evaluated by a fluvial geomorphologist to define best location for sag bend.

Wolman Pebble Count at SC_0678



Geosyntec consultants

engineers | scientists | innovators

Wolman Pebble Count

Phase 2 Hydrotechnical Characterization Program
Virginia and West Virginia
Atlantic Coast Pipeline
February 2017 Dominion Transmission Inc.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	5-Apr-16	Stream Name:	Christians Creek
Crossing ID:	SC_0678		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

	Natural
X	Agricultural
	Urban
	Suburban
	Rural
	Industrial
X	Cattle grazing

Part 2: River Valley Conditions

Vegetation

	None
X	Grass
X	Pasture
X	Crops
	Shrubs
	Deciduous Forest/trees
	Coniferous Forest/trees

Valley Side Features

	None
	Occasional
X	Frequent

Failure Locations

	None
	Away from river
X	Along river

Part 3: Floodplain

Floodplain Width

	None
	1 < river widths
	1-5 river widths
X	5-10 river widths
	> 10 river widths

Land Use

	Natural
X	Agricultural
	Urban
	Suburban
	Rural
	Industrial
	Mining
X	Cattle grazing

Vegetation

	None
X	Grass
	Pasture
	Orchards
	Crops
X	Shrubs
X	Deciduous Forest/trees
	Coniferous Forest/trees

Riparian Buffer Strip

	None
	< 1 river width
X	1-5 river widths
	> 5 river widths

Part 4: Vertical Confinement

Terraces

X	None
	Left bank
	Right bank

Levees

X	None
	Natural
	Constructed

Levee Location

	Along channel bank
	Set back < 1 river width
	Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

X	Straight
	Meandering
	Braided
	Anastomosed
	Engineered

Meander Characteristics

X	Mild bends
	Moderate bends
	Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

X	None
	Occasional
	Frequent
	Confined

Cobbles

Control Types

X	None
	Bedrock
	Boulders

Width Controls

	None
	Occasional
	Frequent
X	Confined

Right Bank 3wf

Control Types

	None
	Bedrock
	Boulders

Other

	Debris
	Mining
	Reservoir
	Knickpoint

Flow Habit

- [X] Perennial
- [ ] Flashy perennial
- [ ] Intermittent
- [ ] Ephemeral

Channel Width: 29'

M-B Classification

- [ ] Cascade or step-pool
- [X] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material

- [X] Clay
- [X] Silt
- [ ] Sand
- [ ] Gravel
- [X] Cobbles
- [ ] Boulders
- [ ] Bedrock

Bar Types

- [ ] None
- [ ] Alternate bars
- [X] Point bars
- [ ] Mid-channel bars
- [ ] Diagonal bars
- [ ] Irregular/combination
- [ ] Braided

Bar Material

- [X] Silt
- [ ] Sand
- [X] Gravel
- [X] Cobbles

Bar Vegetation

- [ ] None
- [X] Grasses
- [ ] Reeds/shrubs
- [ ] Trees

Bar Width

- [ ] None
- [ ] Narrow
- [ ] Moderate
- [ ] Wide

~0.5 to1 width

Percent sand in bed = _____ %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	*Left Bank*	*Right Bank*
Bank Material	[X] Clay [X] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [X] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	4.5'	3.4'
Bank Slope	[X] Steep [X] Moderate [ ] Shallow	[X] Steep [X] Moderate [ ] Shallow
Bank Vegetation	[ ] None [X] Grasses/annuals [X] Reeds/shrubs [ ] Trees: Falling trees? [X] Y [ ] N Tree density [X] sparse [ ] dense Tree health [X] good [ ] poor tree ages [X] young [ ] mature [ ] old tree diversity [ ] Y [X] N	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [ ] Trees: Falling trees? [X] Y [ ] N Tree density [X] sparse [ ] dense Tree health [X] good [ ] poor tree ages [X] young [ ] mature [ ] old tree diversity [ ] Y [X] N
Bank Erosion and Failure Location	location of erosion [X] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [X] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [X] fluvial [ ] geotechnical

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0678, Christians Creek at MP 142.51 (AP-1)

Photograph 1 (IMG_0012)	
Date: 05-April-2016	
Direction: Downstream	
Description: View looking downstream at stream crossing location.	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0678, Christians Creek at MP 142.51 (AP-1)

Photograph 2 (IMG_0009)	
Date: 05-April-2016	
Direction: Downstream	
Description: View downstream from upstream cobble/gravel riffle at sharp meander bend where Wolman Pebble Count was conducted.	

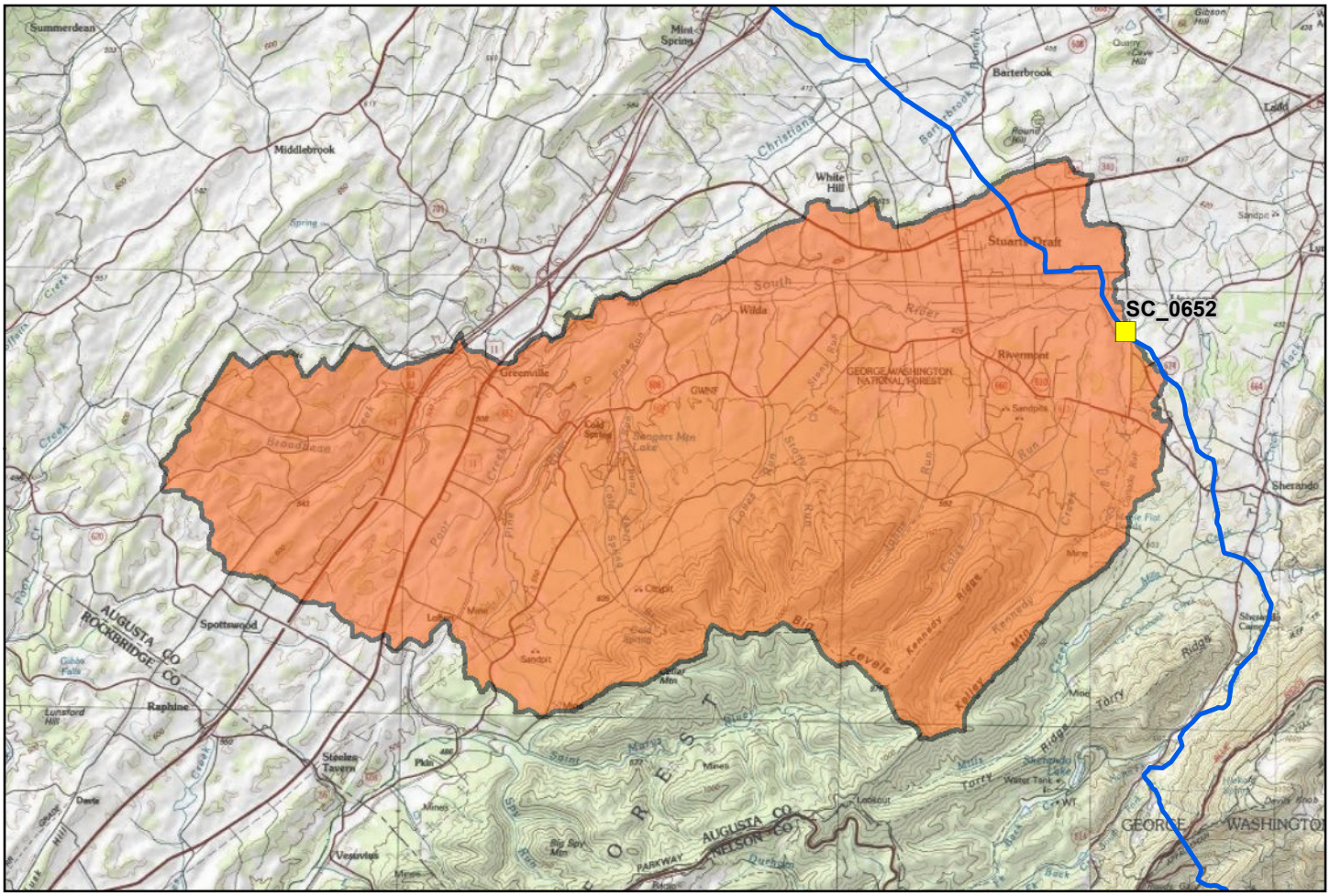
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0678, Christians Creek at MP 142.51 (AP-1)

Photograph 3 (IMG_0007)	
Date: 05-April-2016	
Direction: Right bank	
Description: View of meander upstream of cobble/gravel riffle in Photo where pool depth (below water) is 3.5 feet. Also noticeable in the photo is the terrace on the right bank.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0652	sauc113	AP-1	148.57	Virginia	Augusta

Attribute	Value
Stream Name	South River
Physiographic Province[1]	Blue Ridge
Drainage Area (square miles)[2]	69.407
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	47.5
Slope At Crossing Over 200ft Long Reach (%)[4]	0.086
Proposed Construction Method[5]	1) Flume 2) Dam and Pump

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:200,000

0 4,500 9,000 18,000 Feet

0 4.5 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0652

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

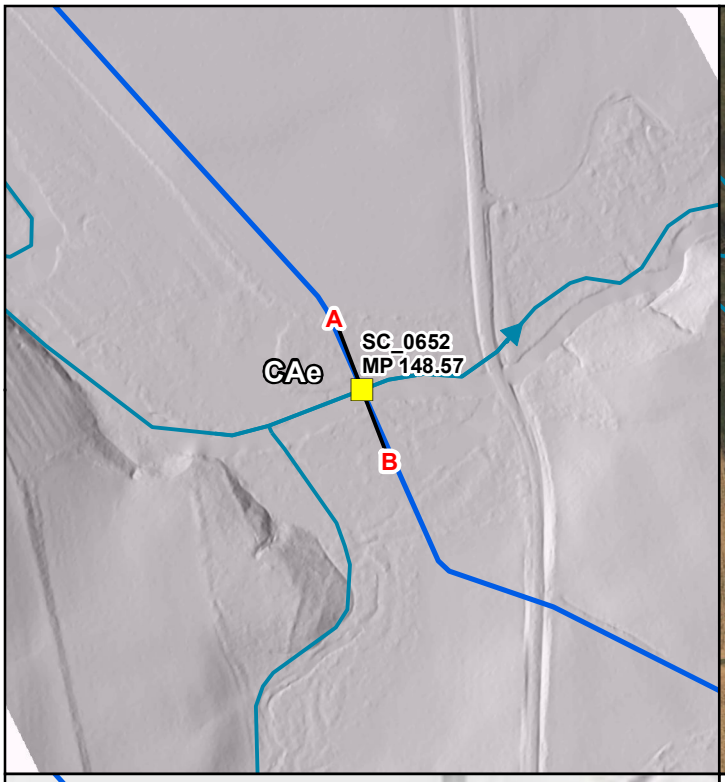
Notes:

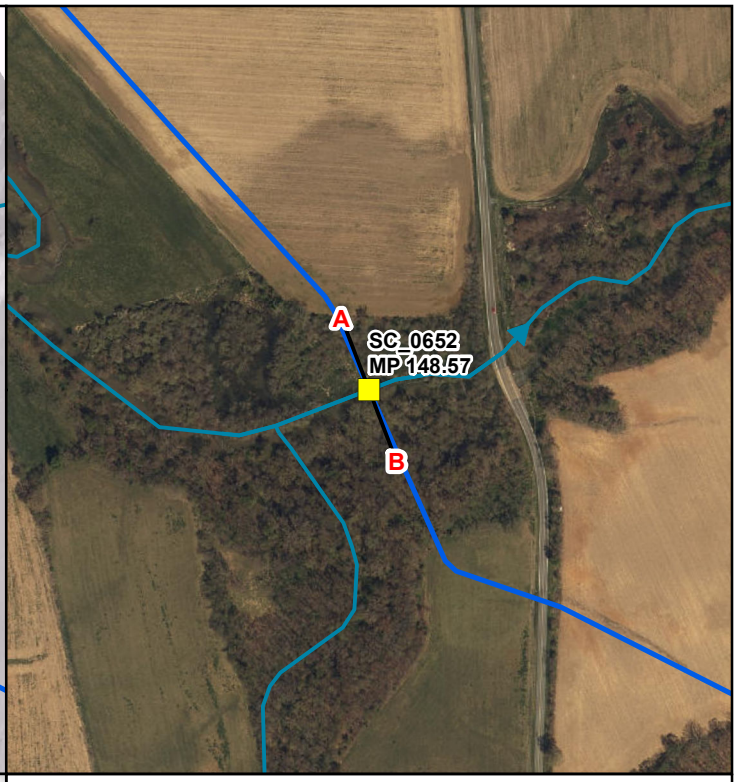
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

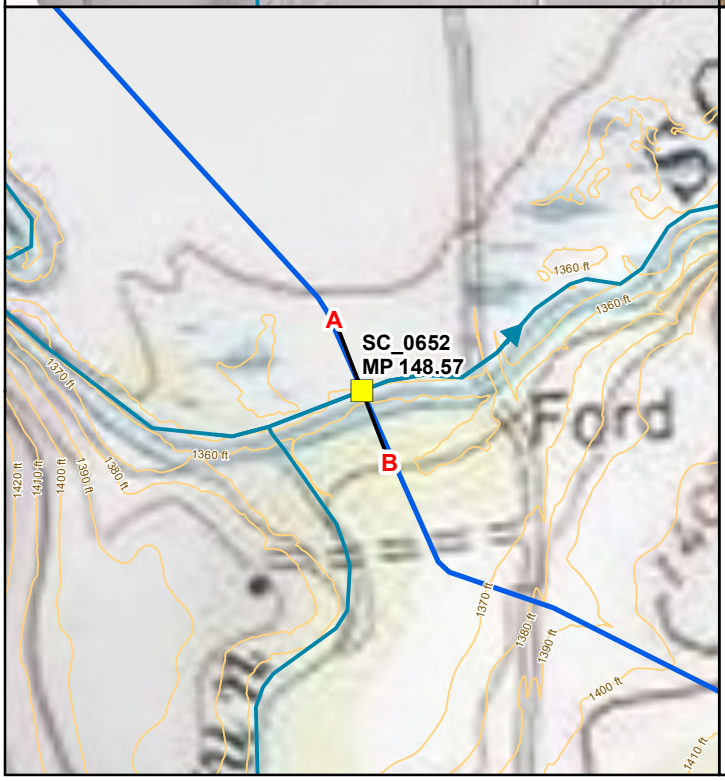
Dominion

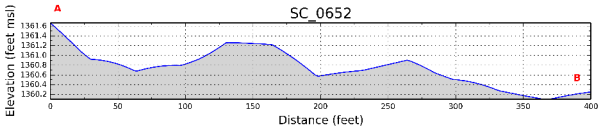
Geosyntec consultants

TESSELATIONS









Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: sauc113

TID_SC: SC_0652

Stream Name: South River

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0652

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELLATIONS

Geosyntec consultants

TID	SC_0652	**ACP Segment**	AP-1
Stream Name	South River	**MP**	148.57
Survey Date	05-April-2016	**Start Time**	1115 hrs

- Bankfull channel width is 47.5 feet.
- Bankfull height is 1.5-feet and corresponds to the surrounding floodplain elevation.
- Stream crossing occurs at a riffle with a mid-channel bar which is focusing channel erosion along both the right and left banks.
- Stream crossing is about 350 feet upstream of Patton Farm Rd. (State Highway 634) where eight approximately 3-foot diameter culverts comprise the road crossing which acts as a grade control for the upstream segment of stream.
- Stream bed comprised predominantly of sand and silt/clay.
- Riparian buffer on right bank is a mature forested wetland over five river widths wide. The left bank riparian buffer is approximately four river widths wide and is largely an herbaceous wetland comprised of patchy and less mature trees.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Evaluate scour depth for pipeline burial depth. Lateral migration does not appear to be a significant hazard on the right bank, but does pose a moderate hazard along the left bank. Begin sag bends at edge of farmers field and riparian buffer on left bank and at least one river width from the right bank river bank.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	5-Apr-16	Stream Name:	South River
Crossing ID:	SC_0652		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

	Natural
	Agricultural
	Urban
	Suburban
	Rural
	Industrial
X	Cattle grazing

Part 2: River Valley Conditions

Vegetation

	None
	Grass
X	Pasture
	Crops
	Shrubs
	Deciduous Forest/trees
	Coniferous Forest/trees

Valley Side Features

X	None
	Occasional
	Frequent

Failure Locations

XX	None
	Away from river
	Along river

Part 3: Floodplain

Floodplain Width

	None
	1 < river widths
	1-5 river widths
	5-10 river widths
X	> 10 river widths

Land Use

	Natural
	Agricultural
	Urban
	Suburban
	Rural
	Industrial
	Mining
X	Cattle grazing

Vegetation

	None
	Grass
X	Pasture
	Orchards
	Crops
	Shrubs
X	Deciduous Forest/trees
	Coniferous Forest/trees

Riparian Buffer Strip

	None
	< 1 river width
	1-5 river widths
X	> 5 river widths

Part 4: Vertical Confinement

Terraces

X	None
	Left bank
	Right bank

Levees

X	None
	Natural
	Constructed

Levee Location

	Along channel bank
	Set back < 1 river width
	Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

	Straight
X	Meandering
	Braided
	Anastomosed
	Engineered

C6

Meander Characteristics

X	Mild bends
	Moderate bends
	Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

	None
X	Occasional
	Frequent
	Confined

Control Types

	None
	Bedrock
	Boulders

Width Controls

X	None
	Occasional
	Frequent
	Confined

Control Types

X	None
	Bedrock
	Boulders

Other

	Debris
	Mining
	Reservoir
	Knickpoint

`400' to
Road crossing
with culverts

Flow Habit

- [X] Perennial
- [ ] Flashy perennial
- [ ] Intermittent
- [ ] Ephemeral

Channel Width: 47.5'

M-B Classification

- [ ] Cascade or step-pool
- [X] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material

- [ ] Clay
- [X] Silt
- [X] Sand
- [ ] Gravel
- [ ] Cobbles
- [ ] Boulders
- [ ] Bedrock

Fine Sand

Bar Types

- [ ] None
- [ ] Alternate bars
- [ ] Point bars
- [X] Mid-channel bars
- [ ] Diagonal bars
- [ ] Irregular/combination
- [ ] Braided

Bar Material

- [X] Silt
- [X] Sand
- [ ] Gravel
- [ ] Cobbles

Bar Vegetation

- [X] None
- [ ] Grasses
- [ ] Reeds/shrubs
- [ ] Trees

Bar Width

- [ ] None
- [ ] Narrow
- [ ] Moderate *30'*
- [ ] Wide

Percent sand in bed = 90 %

Minor Aquatic Beds

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	***Left Bank***	***Right Bank***
Bank Material	[X] Clay [ ] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [ ] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[ ] No layers [X] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[ ] No layers [X] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	1.5'	1.5'
Bank Slope	[X] Steep [ ] Moderate [ ] Shallow	[X] Steep [ ] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [X] Reeds/shrubs [ ] Trees: NO Falling trees? [ ] Y [ ] N Tree density [ ] sparse [ ] dense Tree health [ ] good [ ] poor tree ages [ ] young [ ] mature [ ] old tree diversity [ ] Y [ ] N	[ ] None [ ] Grasses/annuals [X] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [ ] young [X] mature [ ] old tree diversity [ ] Y [X] N
Bank Erosion and Failure Location	location of erosion [X] outside meander bend [X] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general *around tree root system* type of erosion [X] fluvial [ ] geotechnical

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0652, South River at MP 148.57 (AP-1)

Photograph 1 (IMG_0003)	
Date: 05-April-2016	
Direction: Downstream	
Description: Low gradient stream channel and stream bed comprised of silt and sand. Mid-channel bars from high-fine sediment load in channel direct the flow along both banks contributing to erosion of the banks and falling trees on both banks. The riparian buffer on the right bank is greater than five river widths (mature forested wetland) and four river widths on left bank (herbaceous and immature forested wetland). Bank height is about 1.5 ft high and comprised of fine-grained soils.	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

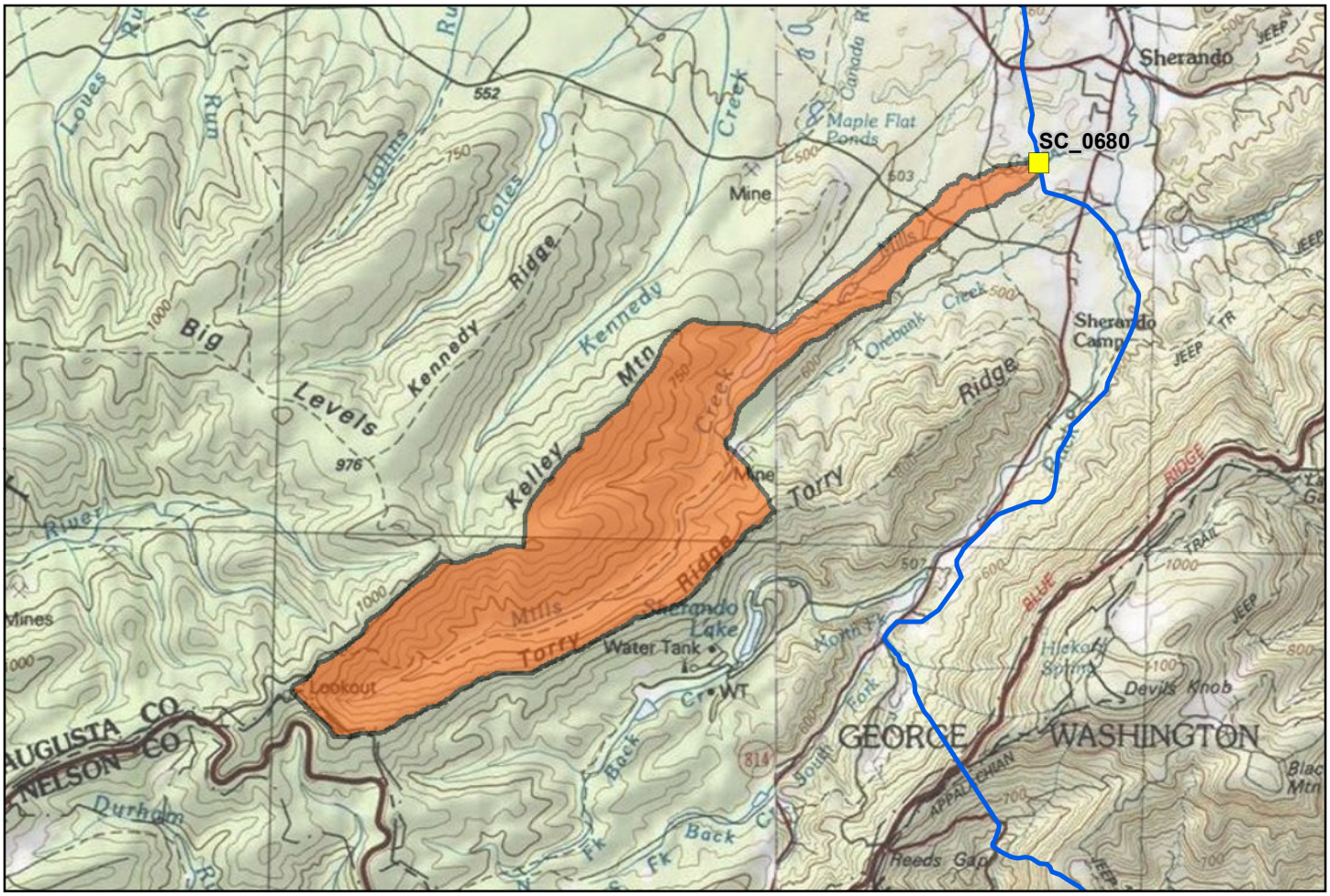
Subject Site: SC_0652, South River at MP 148.57 (AP-1)

Photograph 2
(IMG_0004)

Date: 05-April-2016

Direction: From right bank looking at left bank

Description: Upstream side of Patton Farm Rd. (State Highway 634) where eight 3-ft diameter culverts convey the South River low flow conditions. The Culvert crossing is approximately 350 feet downstream of the stream crossing provides grade control for channel upstream.



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0680	saua052	AP-1	152.87	Virginia	Augusta

Attribute	Value
Stream Name	Mills Creek
Physiographic Province[1]	Blue Ridge
Drainage Area (square miles)[2]	4.391
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	22
Slope At Crossing Over 200ft Long Reach (%)[4]	1.653
Proposed Construction Method[5]	1) Flume 2) Dam and Pump

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:100,000

0 2,250 4,500 9,000 Feet

0 2 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0680

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

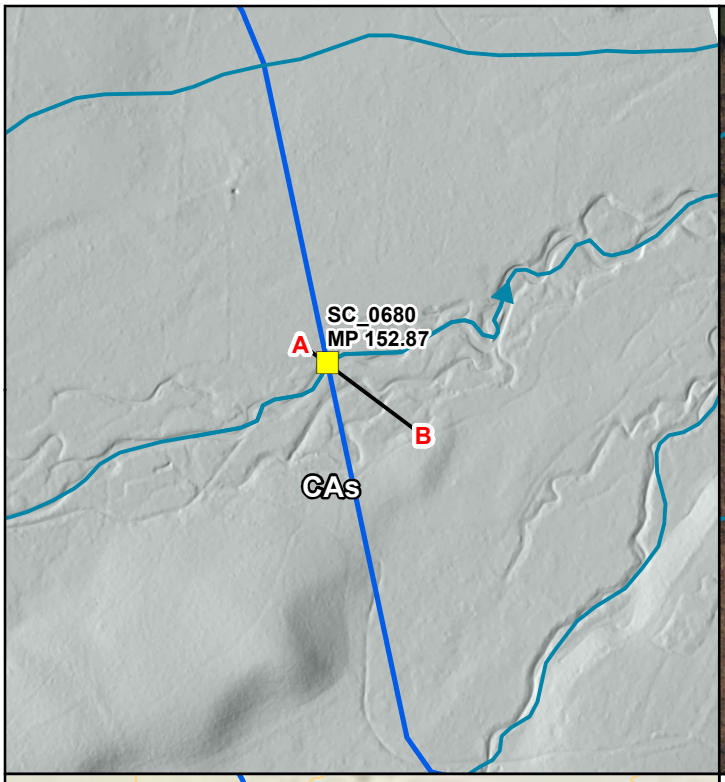
Notes:

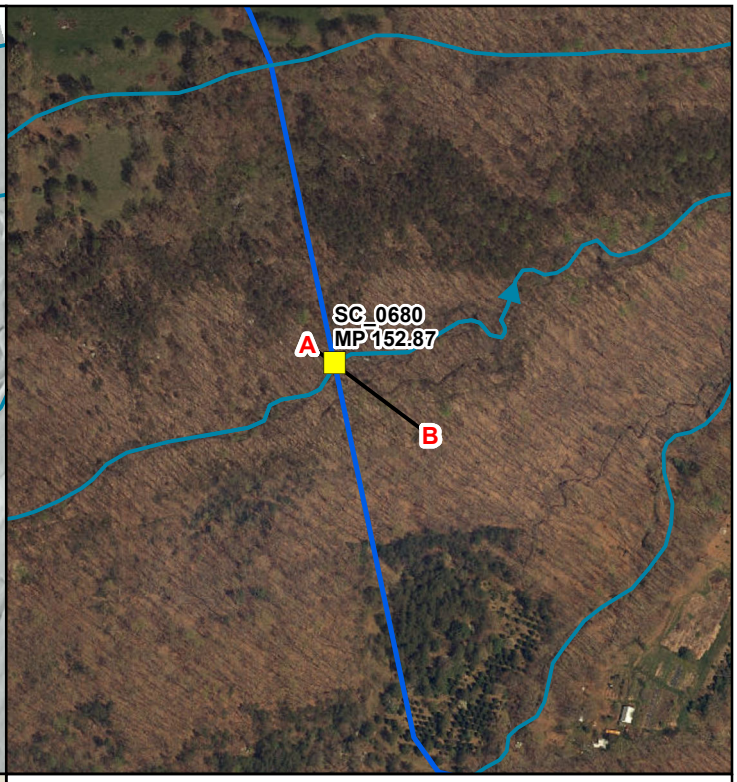
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

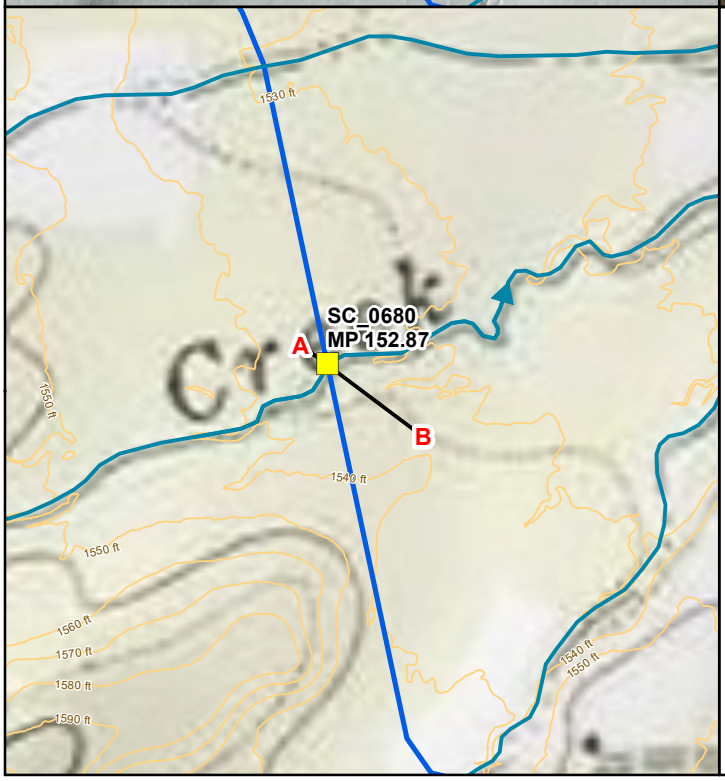
Dominion

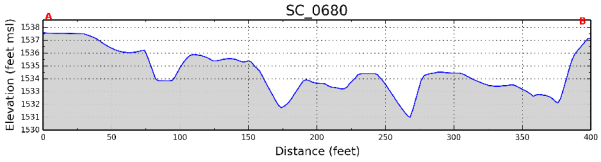
Geosyntec consultants

TESSELLATIONS









Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: saua052

TID_SC: SC_0680

Stream Name: Mills Creek

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0680

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELATIONS

TID	SC_0680	**ACP Segment**	AP-1
Stream Name	Mills Creek	**MP**	152.87
Survey Date	27-Sep-2016	**Start Time**	1420 hrs

- Stream observed approximately 0.75-miles upstream of pipeline crossing in densely forested area.
- Stream observed along a 1500-ft long stretch.
- Riffle-pool morphology.
- BFW = 22 feet, BFD (maximum) = 1.8 feet.
- Stream was dry at the time of the survey, which allowed observation and measurement of stream bed morphology.
- Stream bed comprises gravel and cobble-sized particle with most particle sizes between 60 and 90 mm.

Recommendation:

Evaluate scour depth for pipeline burial depth. Conduct lateral migration evaluation to set location of sag bends.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	27-Sep-16	Stream Name:	Mills Creek
Crossing ID:	SC_0680		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Cattle grazing

Part 2: River Valley Conditions

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Crops
- [ ] Shrubs
- [X] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Valley Side Features

- [X] None
- [ ] Occasional
- [ ] Frequent

Failure Locations

- [X] None
- [ ] Away from river
- [ ] Along river

Part 3: Floodplain

Floodplain Width

- [ ] None
- [ ] 1 < river widths
- [ ] 1-5 river widths
- [ ] 5-10 river widths
- [X] > 10 river widths

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Mining
- [ ] Cattle grazing

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Orchards
- [ ] Crops
- [ ] Shrubs
- [X] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Riparian Buffer Strip

- [ ] None
- [ ] < 1 river width
- [ ] 1-5 river widths
- [X] > 5 river widths

Part 4: Vertical Confinement

Terraces

- [X] None
- [ ] Left bank
- [ ] Right bank

Levees

- [X] None
- [ ] Natural
- [ ] Constructed

Levee Location

- [ ] Along channel bank
- [ ] Set back < 1 river width
- [ ] Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

- [ ] Straight
- [X] Meandering
- [ ] Braided
- [ ] Anastomosed
- [ ] Engineered

Meander Characteristics

- [ ] Mild bends
- [X] Moderate bends
- [ ] Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

- [X] None
- [ ] Occasional
- [ ] Frequent
- [ ] Confined

Control Types

- [X] None
- [ ] Bedrock
- [ ] Boulders

Width Controls

- [X] None
- [ ] Occasional
- [ ] Frequent
- [ ] Confined

Control Types

- [X] None
- [ ] Bedrock
- [ ] Boulders

Other

- [ ] Debris
- [ ] Mining
- [ ] Reservoir
- [ ] Knickpoint

Flow Habit

- [ ] Perennial
- [ ] Flashy perennial
- [X] Intermittent
- [ ] Ephemeral

Channel Width: 22'

M-B Classification

- [ ] Cascade or step-pool
- [X] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material

- [ ] Clay
- [ ] Silt
- [ ] Sand
- [X] Gravel
- [X] Cobbles
- [ ] Boulders
- [ ] Bedrock

Bar Types

- [X] None
- [ ] Alternate bars
- [ ] Point bars
- [ ] Mid-channel bars
- [ ] Diagonal bars
- [ ] Irregular/combination
- [ ] Braided

Bar Material

- [ ] Silt
- [ ] Sand
- [ ] Gravel
- [ ] Cobbles

Bar Vegetation

- [ ] None
- [ ] Grasses
- [ ] Reeds/shrubs
- [ ] Trees

Bar Width

- [ ] None
- [ ] Narrow
- [ ] Moderate
- [ ] Wide

Percent sand in bed = <5 %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	***Left Bank***	***Right Bank***
Bank Material	[X] Clay [X] Silt [X] Sand [X] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [X] Silt [X] Sand [X] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	3'	3'
Bank Slope	[ ] Steep [X] Moderate [ ] Shallow	[ ] Steep [X] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [X] young [X] mature [ ] old tree diversity [X] Y [ ] N	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [X] young [X] mature [ ] old tree diversity [X] Y [ ] N
Bank Erosion and Failure Location	location of erosion [X] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [X] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [X] fluvial [ ] geotechnical

GEOSYNTEC CONSULTANTS

Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0680, Mills Creek at MP 152.87 (AP-1)

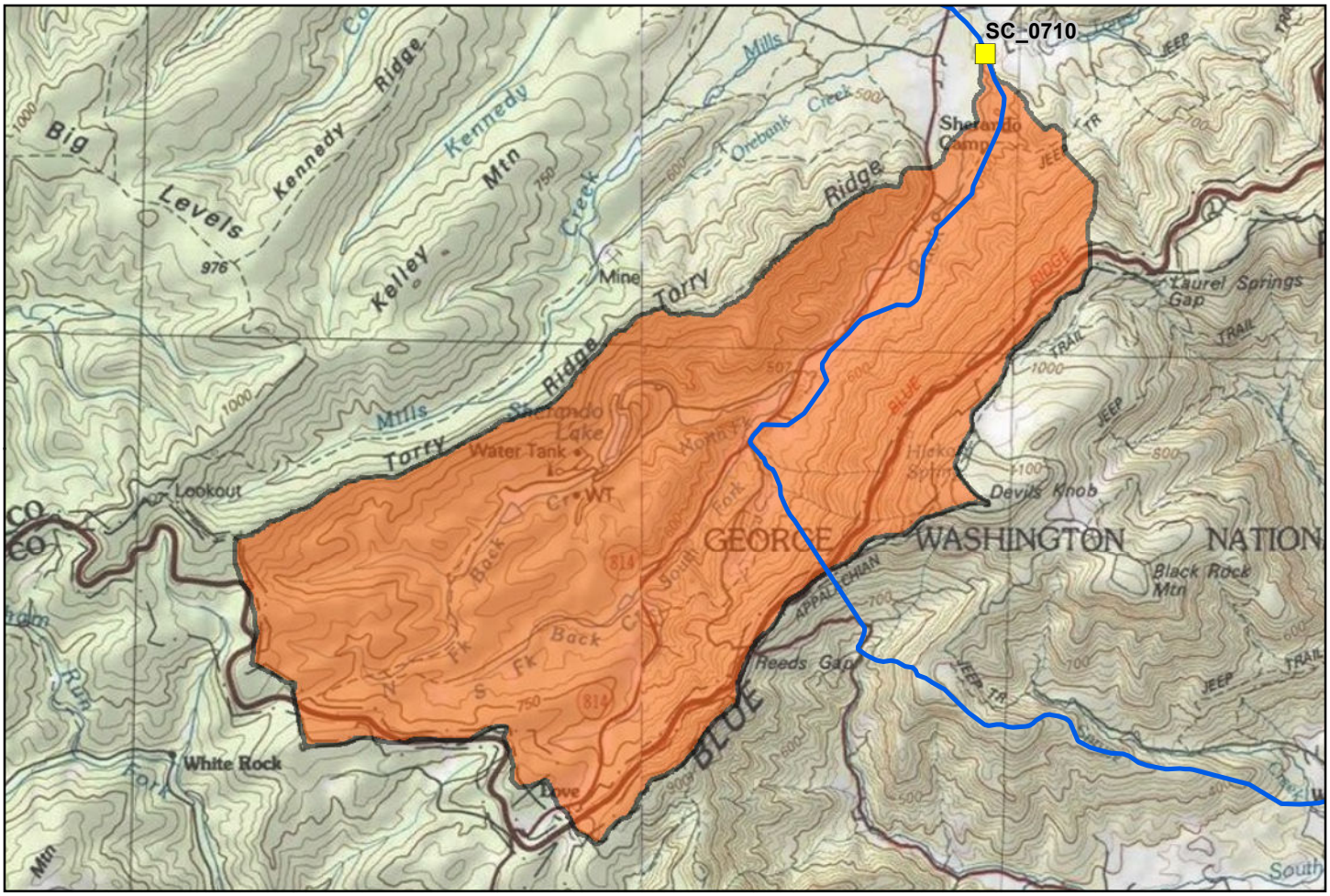
Photograph 1 (IMG_1149.JPG) Date: 27 September 2016 Direction: Upstream Description: View of coarse gravel and cobble-lined Mills Creek (dry) surveyed about 0.75 miles upstream of pipeline crossing. Stream is located in densely forested floodplain.	
Photograph 2 (IMG_1155.JPG) Date: 27 September 2016 Direction: Downstream Description: View of pool where thalweg is 1.5 ft deeper than channel edge at bank toe.	

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0680, Mills Creek at MP 152.87 (AP-1)

Photograph 3 (IMG_1157.JPG) Date: 27 September 2016 Direction: Downstream Description: View of erosion around tree roots on the right bank and progressive migration to the right. Channel is located on a historic alluvial fan and is showing signs of lateral and vertical migration.	
Photograph 4 (IMG_1159.JPG) Date: 27 September 2016 Direction: Downstream Description: Scour at tight (close to 90-degrees) bend where we measured about 2.6 ft of scour from the gravel channel bed (riffle immediately upstream).	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0710	nhd_va_a_001	AP-1	153.79	Virginia	Augusta

Attribute	Value
Stream Name	Back Creek
Physiographic Province[1]	Blue Ridge
Drainage Area (square miles)[2]	13.729
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	25
Slope At Crossing Over 200ft Long Reach (%)[4]	0.494
Proposed Construction Method[5]	1) Flume 2) Dam and Pump

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:100,000

0 2,250 4,500 9,000 Feet

0 2 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0710

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

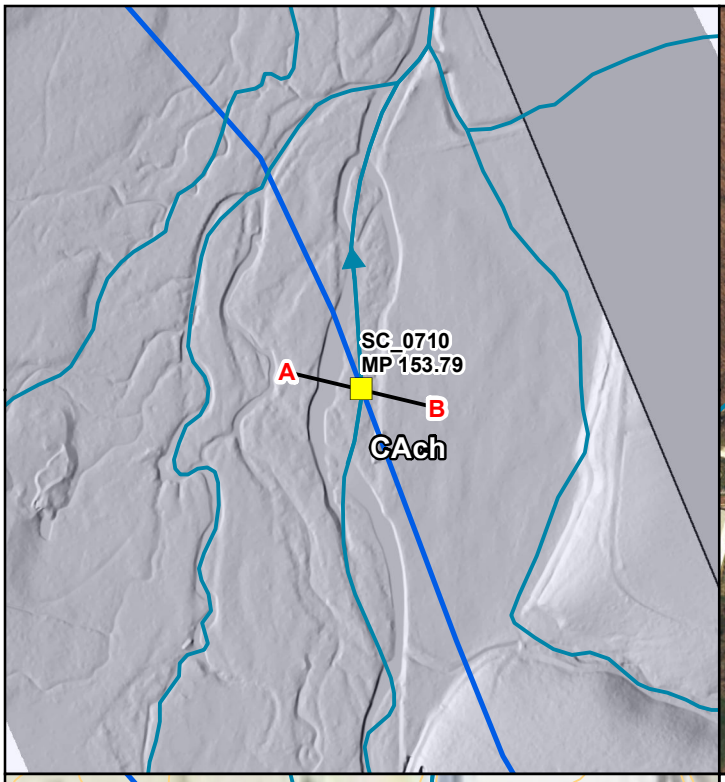
Notes:

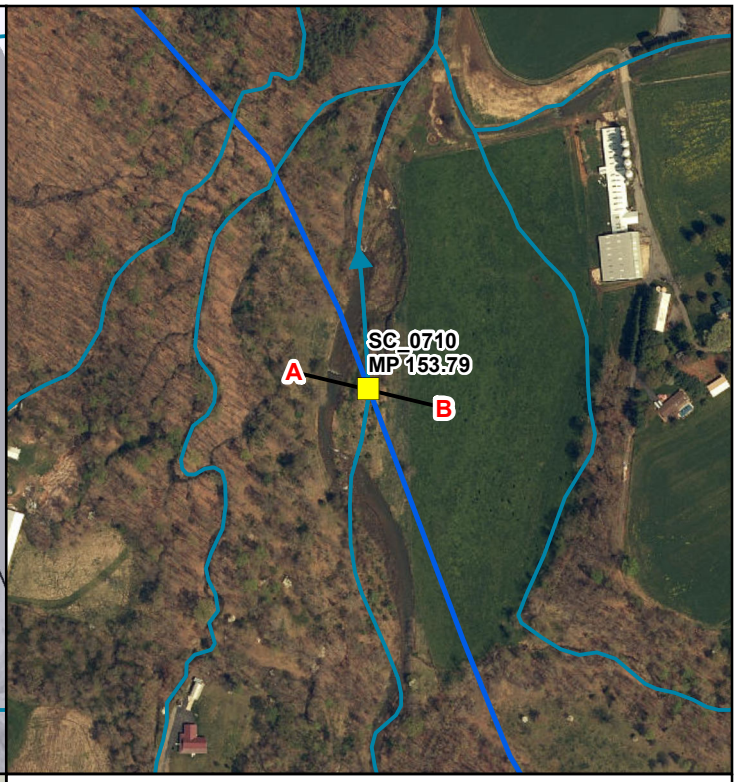
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

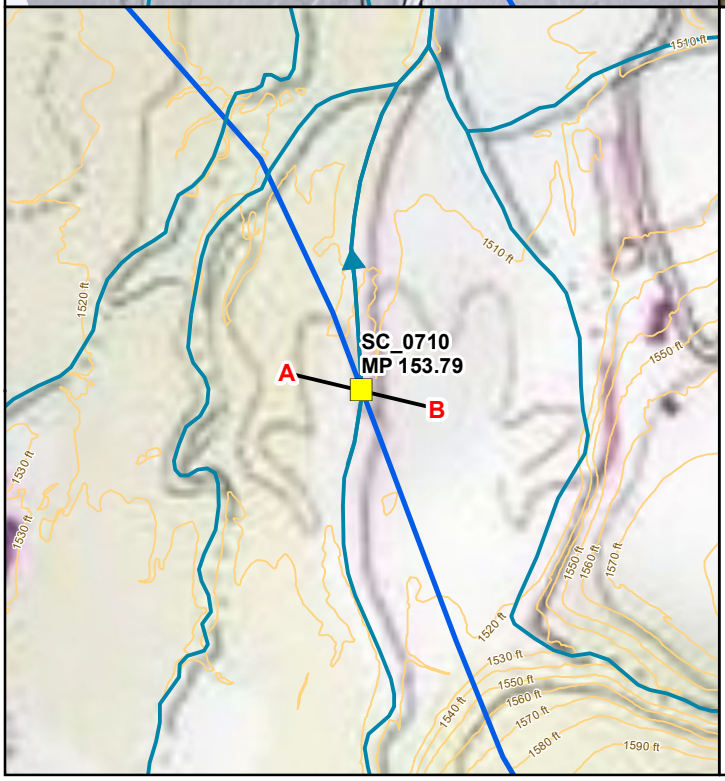
Dominion

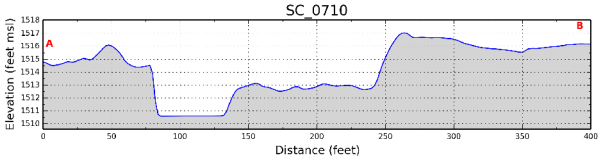
Geosyntec consultants

TESSELLATIONS









Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: nhd_va_a_001

TID_SC: SC_0710

Stream Name: Back Creek

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0710

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

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TESSELLATIONS

Geosyntec consultants

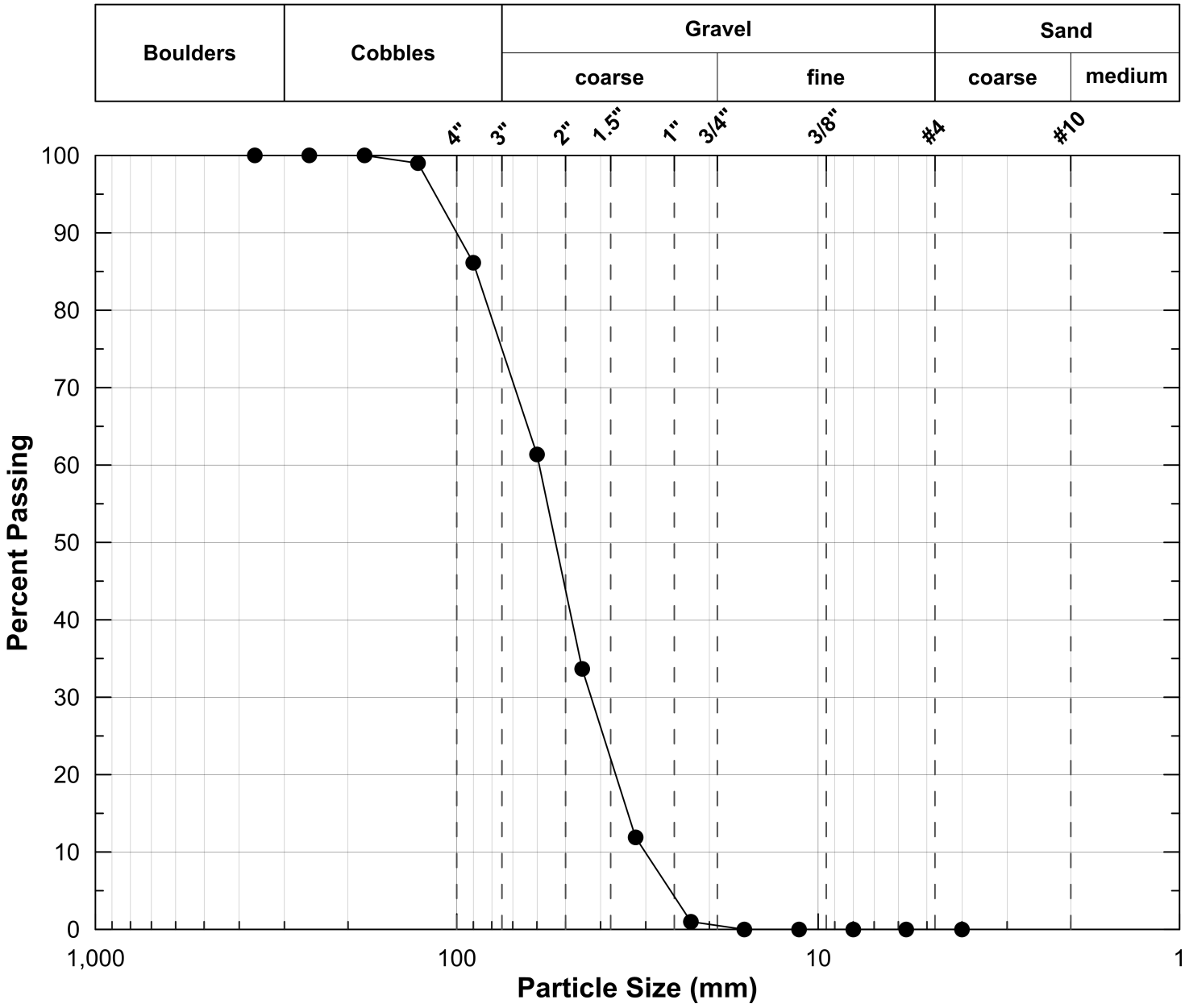
TID	SC_0710	**ACP Segment**	AP-1
Stream Name	Back Creek	**MP**	153.79
Survey Date	13-May-2016	**Start Time**	0910 hrs

- Stream possesses a riffle-pool morphology.
- Stream channel is comprised of point and mid-channel bars and upstream braids in channel.
- Cobble bed with gravels and sub-angular to rounded boulders.
- Wolman pebble count conducted; D50 is 53 mm (coarse gravel).
- Silty sand below armoring layer (approximately 4 inches) and within banks.
- Steeper banks on left bank, left bank height at crossing 4.7 feet.
- Deciduous riparian buffer that is greater than five channel widths on right bank and less than one on the right bank.
- Agricultural flood plain beyond right bank, with tributary entering right bank of main channel downstream of crossing.
- Wetland/heavily forested floodplain off left bank with tributary entering left bank of main channel just downstream of crossing (pipeline also crosses this tributary).
    - Deep pool at confluence, greater than 5 pool depth below water surface.
    - Beaver (dam materials) just downstream of confluence.
- Several head cuts observed above and below crossing location.
- Bankfull channel width is 25 feet and bankfull depth is 1.9 feet.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Evaluate scour depth for pipeline burial depth. Lateral migration does not appear to be a significant hazard as landowners will likely strive to maintain current stream course. Place sag bends outside of riparian buffer on right bank (approximately three river widths wide). Location of sag bend beyond left bank to be determined by additional investigation.

Wolman Pebble Count at SC_0710



Geosyntec consultants

engineers | scientists | innovators

Wolman Pebble Count

Phase 2 Hydrotechnical Characterization Program
Virginia and West Virginia
Atlantic Coast Pipeline
February 2017 Dominion Transmission Inc.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	13-May-16	Stream Name:	Back Creek
Crossing ID:	SC_0710		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

- [x] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [x] Rural
- [ ] Industrial
- [ ] Cattle grazing

Part 2: River Valley Conditions

Vegetation

- [ ] None
- [ ] Grass
- [x] Pasture
- [ ] Crops
- [ ] Shrubs
- [x] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Valley Side Features

- [x] None
- [ ] Occasional
- [ ] Frequent

Failure Locations

- [ ] None
- [ ] Away from river
- [ ] Along river

Part 3: Floodplain

Floodplain Width

- [ ] None
- [ ] 1 < river widths
- [ ] 1-5 river widths
- [ ] 5-10 river widths
- [x] > 10 river widths

Land Use

- [x] Natural
- [x] Agricultural
- [ ] Urban
- [ ] Suburban
- [x] Rural
- [ ] Industrial
- [ ] Mining
- [ ] Cattle grazing

Vegetation

- [ ] None
- [ ] Grass
- [x] Pasture
- [ ] Orchards
- [x] Crops
- [ ] Shrubs
- [x] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Riparian Buffer Strip

- [ ] None
- [ ] < 1 river width
- [ ] 1-5 river widths
- [x] > 5 river widths on left bnk

Part 4: Vertical Confinement

Terraces

- [x] None
- [ ] Left bank
- [ ] Right bank

Levees

- [x] None
- [ ] Natural
- [ ] Constructed

Levee Location

- [ ] Along channel bank
- [ ] Set back < 1 river width
- [ ] Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

- [ ] Straight
- [x] Meandering
- [ ] Braided
- [ ] Anastomosed
- [ ] Engineered

Meander Characteristics

- [ ] Mild bends
- [x] Moderate bends
- [ ] Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

- [x] None
- [ ] Occasional
- [ ] Frequent
- [ ] Confined

Control Types

- [x] None
- [ ] Bedrock
- [ ] Boulders

Width Controls

- [x] None
- [ ] Occasional
- [ ] Frequent
- [ ] Confined

Control Types

- [x] None
- [ ] Bedrock
- [ ] Boulders

Other

- [ ] Debris
- [ ] Mining
- [ ] Reservoir
- [ ] Knickpoint

Flow Habit

- [x] Perennial
- [ ] Flashy perennial
- [ ] Intermittent
- [ ] Ephemeral

Channel Width: 25'

M-B Classification

- [ ] Cascade or step-pool
- [x] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material

- [ ] Clay
- [ ] Silt
- [ ] Sand
- [x] Gravel
- [x] Cobbles
- [ ] Boulders
- [ ] Bedrock

Bar Types

- [ ] None
- [ ] Alternate bars
- [x] Point bars
- [ ] Mid-channel bars
- [ ] Diagonal bars
- [ ] Irregular/combination
- [ ] Braided

Bar Material

- [ ] Silt
- [ ] Sand
- [ ] Gravel
- [x] Cobbles

Bar Vegetation

- [ ] None
- [x] Grasses
- [x] Reeds/shrubs
- [ ] Trees

Bar Width

- [ ] None
- [ ] Narrow
- [x] Moderate river width
- [x] Wide

Percent sand in bed = <5 %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	*Left Bank*	*Right Bank*
Bank Material	[x] Clay [x] Silt [ ] Gravel [x] Cobbles [ ] Boulders [ ] Bedrock	[x] Clay [x] Silt [ ] Gravel [x] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[x] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[x] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	4.7'	----
Bank Slope	[x] Steep [ ] Moderate [ ] Shallow	[ ] Steep [ ] Moderate [x] Shallow
Bank Vegetation	[ ] None [x] Grasses/annuals [x] Reeds/shrubs [x] Trees: Falling trees? [x] Y [ ] N Tree density [ ] sparse [x] dense Tree health [x] good [ ] poor tree ages [x] young [x] mature [ ] old tree diversity [x] Y [ ] N	[ ] None [x] Grasses/annuals [ ] Reeds/shrubs [ ] Trees: NO Falling trees? [ ] Y [ ] N Tree density [ ] sparse [ ] dense Tree health [ ] good [ ] poor tree ages [ ] young [ ] mature [ ] old tree diversity [ ] Y [ ] N
Bank Erosion and Failure Location	location of erosion [x] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [x] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [x] general type of erosion [x] fluvial [ ] geotechnical

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0710, Back Creek at MP 153.79 (AP-1)

Photograph 1	
Date: 13 May 2016	
Direction: looking upstream	
Description: Deep pool and head cut below riffle, just downstream of crossing.	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0710, Back Creek at MP 153.79 (AP-1)

Photograph 2	
Date: 13 May 2016	
Direction: looking across stream, flow to the right	
Description: two tributary streams entering from left bank (from heavily forested floodplain) and right bank (from agricultural floodplain), both downstream of crossing.	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0710, Back Creek at MP 153.79 (AP-1)

Photograph 3	
Date: 13 May 2016	
Direction: looking upstream	
Description: well established riparian buffer off left bank with tributary inlet entering from left bank at bottom of visible riffle section. Signs of beaver activity and deep depths in pool below riffle/ head cut.	

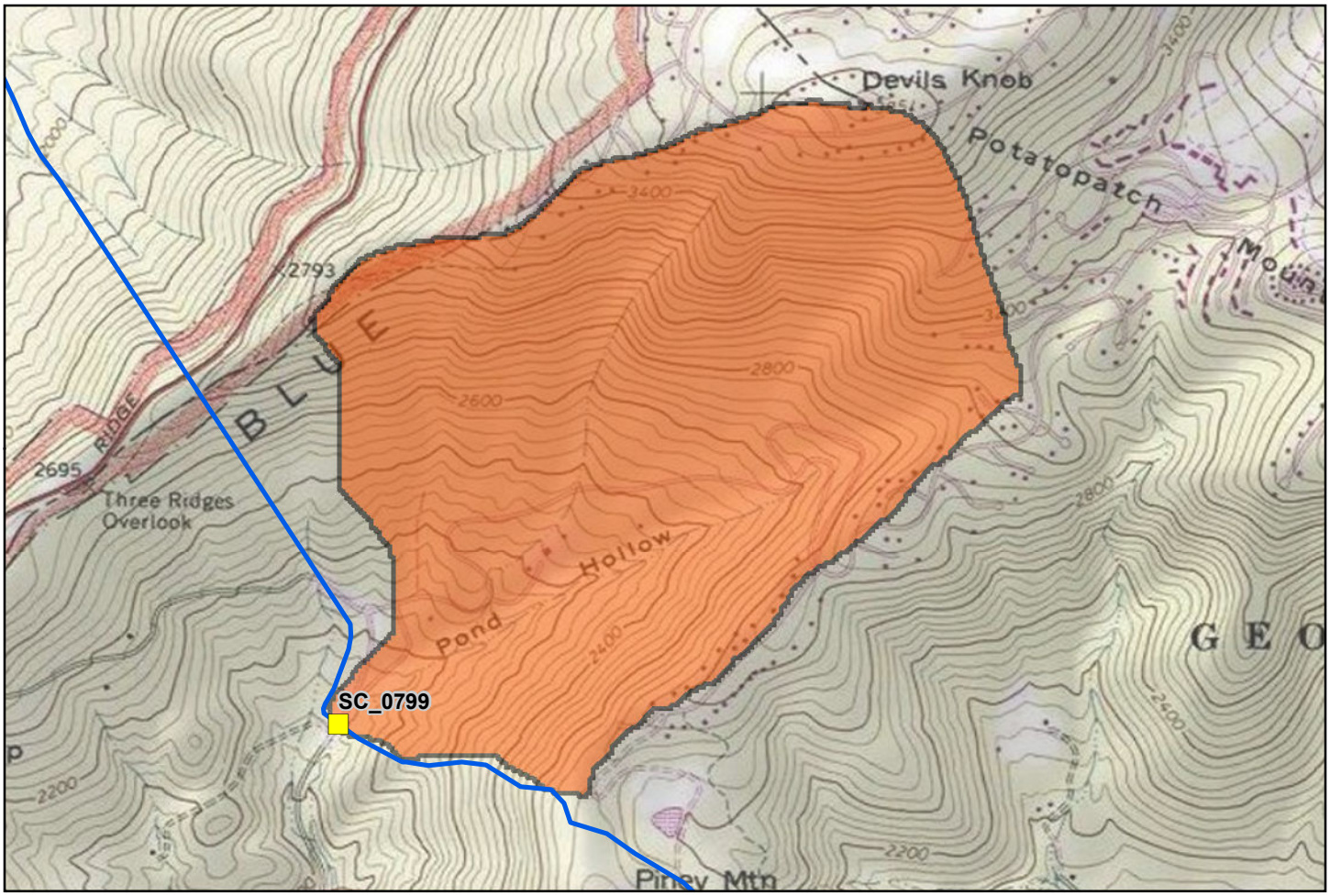
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0710, Back Creek at MP 153.79 (AP-1)

Photograph 4	
Date: 13 May 2016	
Direction: looking downstream on tributary stream	
Description: one of two tributary streams entering back creek downstream of crossing. Flowing from agricultural floodplain, narrow riparian buffer visible on right bank of back creek, downstream of culvert.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0799	snea021	AP-1	158.91	Virginia	Nelson

Attribute	Value
Stream Name	Pond Hollow
Physiographic Province[1]	Blue Ridge
Drainage Area (square miles)[2]	0.907
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	13.5
Slope At Crossing Over 200ft Long Reach (%)[4]	8.205
Proposed Construction Method[5]	1) Flume 2) Dam and Pump

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:24,000

0 500 1,000 2,000 Feet

0 0.5 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0799

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

Dominion

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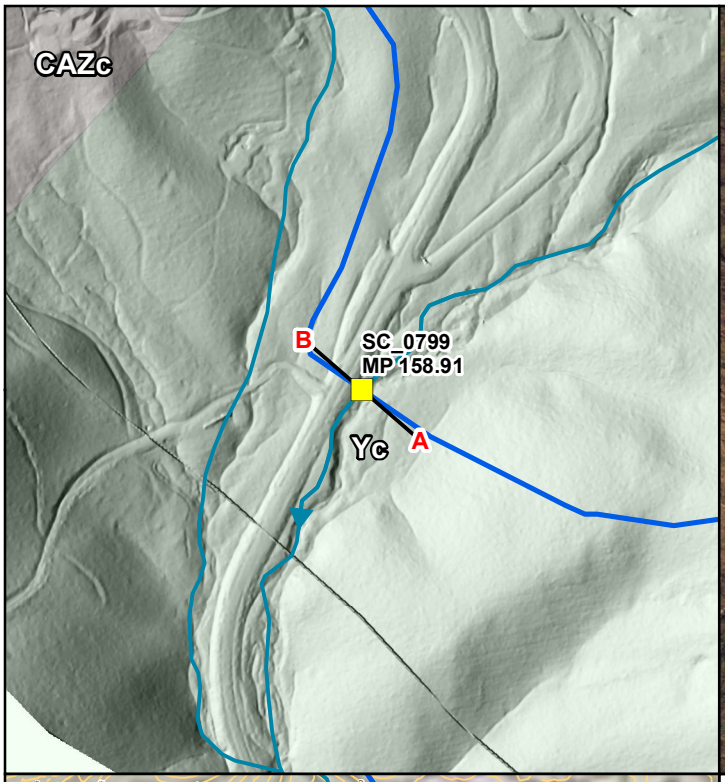
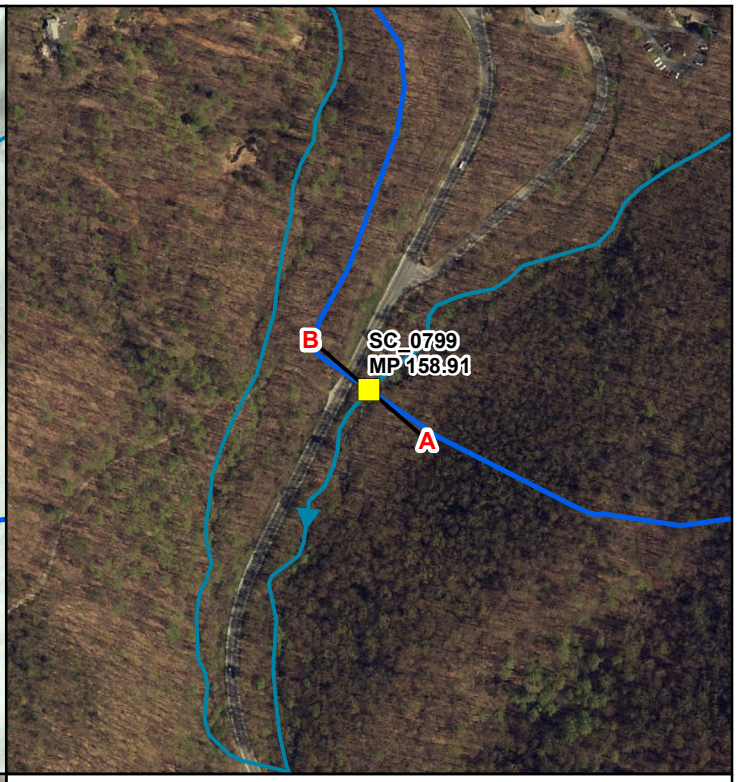
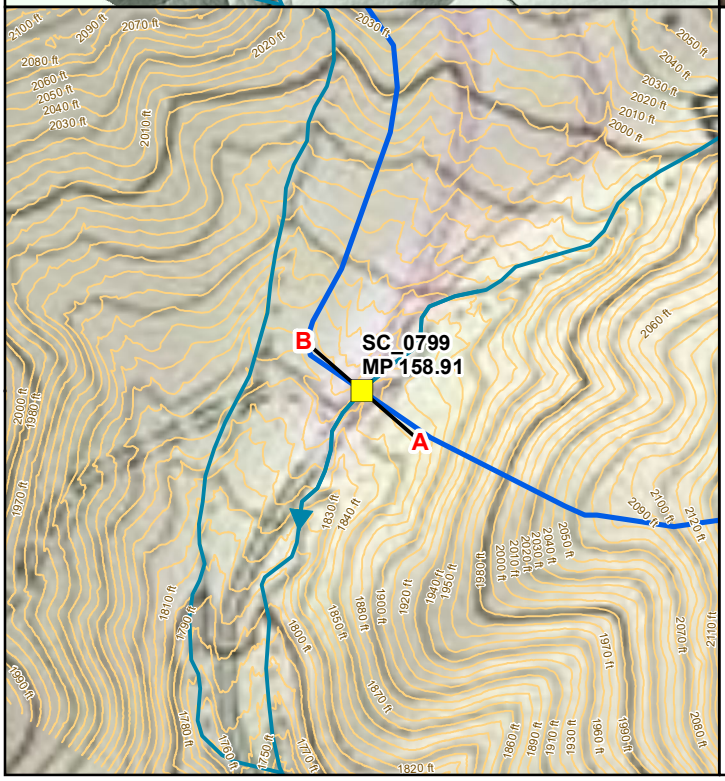
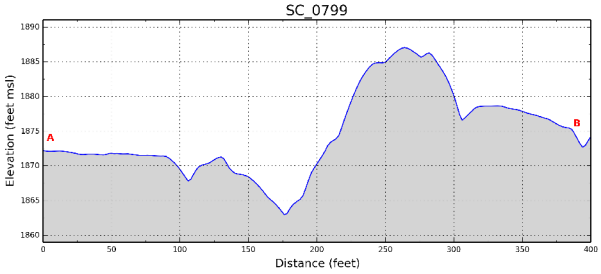
TESSELLATIONS









Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: snea021

TID_SC: SC_0799

Stream Name: Pond Hollow

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0799

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

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