

**Riparian Area Impact Assessment and
Restoration Plan
Atlantic Sunrise Project
Columbia County**

November 2016

Prepared for:

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC

Prepared by:

ECOLOGY AND ENVIRONMENT, INC.

368 Pleasant View Drive
Lancaster, New York 14086

Table of Contents


Section	Page
1	Introduction 1-1
2	Riparian Area Existing Conditions and Functions in the Project Area 2-1
3	Riparian Buffer Impacts 3-1
3.1	Riparian Buffer Waiver Requests 3-8
4	Riparian Area Restoration 4-1
4.1	Riparian Forest Buffer Replanting 4-2
5	Replanting Plan 5-1
5.1	Plant Species 5-1
5.2	Plant Density and Placement 5-1
5.3	Planting Methods 5-2
5.4	Wildlife Damage Control 5-2
5.5	Invasive Species Management 5-2
5.6	Performance Standards and Monitoring 5-2
6	References 6-1
Appendix	
A	Riparian Buffer Replanting Area Diagrams A-1
B	Tree and Shrub Planting List B-1
C	Typical Planting Details C-1



List of Tables



Table		Page
2-1	Summary of Riparian Areas in Project Workspace: Columbia County	2-2
3-1	Comparison of Pre- and Post-Construction Riparian Area Conditions	3-2
3-2	Project-related Conversion of Riparian Forest Buffer	3-5
3-3	Proposed Riparian Buffer Waiver Requests in Columbia County.....	3-8
4-1	Summary of Impacts on Riparian Buffers and Proposed Replanting.....	4-2



List of Abbreviations and Acronyms

BMP	best management practice
EV	exceptional value
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
HQ	high quality
PADEP	Pennsylvania Department of Environmental Protection
Project	Atlantic Sunrise Project
ROW	right-of-way

1

Introduction

Transco submitted an application to the Pennsylvania Department of Environmental Protection (PADEP) on August 28, 2015, for a Chapter 105 Water Obstruction and Encroachment Permit for the portion of the proposed Atlantic Sunrise Project (Project) located within Columbia County, Pennsylvania (PADEP Application No. E58-315). The PADEP issued a technical deficiency letter for the application on July 29, 2016. The deficiency letter included the following comment:

Revise Enclosures C&D to assess the condition of, and impacts to forested and scrub shrub riparian areas and the habitat, water quality, and other impacts on watercourses for each watercourse crossing. In general, the DEP recommends evaluating the riparian areas from the top of bank landward 100 ft., and if the area utilized is less than 100 ft., justification should be given as to why. The application should be revised to replant the vegetation lost in both permanent and temporary ROW and workspaces. Alternatively, where it cannot be replaced and provided permanent protection, provide details on why it cannot be replaced and provide compensatory mitigation for the impacts and discuss the impacts to the watercourses in the Environmental Assessment, including water quality impacts.

The purpose of this report is to describe the condition of existing riparian areas located in Project workspace; evaluate riparian area functions; quantify riparian area impacts from construction and operation of the Project; present best management practices (BMPs) proposed to avoid and minimize impacts on riparian areas; and present plans for voluntary replanting of riparian forest buffers.

For the purpose of this report, riparian area is defined as the land bordering a watercourse. The PADEP requested that Transco evaluate riparian areas from the top of bank landward for a minimum of 100 feet. This is consistent with the PADEP Riparian Buffer Guidance document, which states, "...100 feet is the average minimum riparian buffer width that DEP recommends for regulatory, voluntary, and grant activities" (PADEP 2010a). The PADEP guidance document also states that the average width should be extended to a minimum of 150 feet along waters designated as high quality (HQ) or exceptional value (EV), consistent with the riparian buffer protection width in Chapter 102.14 of the Pennsylvania Code. Based on this guidance, Transco evaluated riparian areas using a 100-foot buffer from the top of bank of non-HQ/EV waters, and a 150-foot buffer from the top of bank for HQ/EV waters.

The PADEP defines a riparian buffer as a BMP comprised of permanent vegetation located along surface waters, consisting of herbaceous vegetation, shrubs, trees, or a combination thereof (PADEP 2010a). Certain riparian forest buffers in Pennsylvania are protected under Chapter 102.14 of the Pennsylvania Code (PADEP 2010b). The PADEP defines riparian forest buffers as a type of riparian buffer that consists of permanent vegetation that is predominantly native trees and shrubs (PADEP 2010b).

As stated in Chapter 102.14 of the Pennsylvania Code, unless authorized by exceptions, earth disturbance activities are not permitted within 150 feet of a perennial or intermittent river, stream, or creek; or lake, pond, or reservoir when the project site is located in an EV or HQ watershed (PADEP 2010b). Linear pipeline projects, such as the proposed Project, may request a waiver from the Chapter 102.14 requirements, provided the existing riparian buffer is undisturbed to the extent practicable, and the activity will otherwise meet the requirements of the chapter.

2

Riparian Area Existing Conditions and Functions in the Project Area

Field survey results were used in conjunction with aerial imagery to determine the current condition of riparian areas crossed by the Project. This assessment placed the riparian areas into three categories:

1. Riparian Forest Buffer – Native trees, shrubs, and forbs comprise no less than 60% of canopy cover (PADEP 2010b).
2. Riparian Herbaceous Buffer – Areas dominated by grasses, forbs, or cultivated crops with woody plants comprising less than 60% of the canopy cover.
3. Unvegetated – Previously disturbed areas devoid of vegetative cover, such as roads.

The Project crosses 101 riparian areas within Columbia County, covering 46.56 acres. Table 2-1 summarizes the riparian areas by vegetation cover type within the Project workspace. Of the 46.56 acres of riparian area, 45.23 acres are vegetated and considered riparian buffers. Additional information on riparian areas associated with individual stream crossings is provided in Section 3. Detailed information on each stream crossed by the Project in Columbia County, including stream datasheets providing information on physical characteristics and habitat, as well as photographs of each stream crossing, are provided in the September 2016 version of the Columbia County Wetland Delineation Report, submitted to the PADEP as part of the updated Chapter 105 permit application package.

Riparian buffers provide various functions, including stormwater and flood flow velocity reduction, volume reduction, excess sediment and nutrient removal, and terrestrial and aquatic habitat. During storm events, riparian buffers reduce peak stream-flow velocity, minimize increased flood-flow velocities, and minimize channel erosion, leading to a more stable channel and floodplain (Baird and Wetmore 2006). Riparian herbaceous buffers tend to have a greater stem density than forested riparian buffers and may be more effective in terms of slowing runoff velocities and providing a greater surface area for sediment retention; however, forested riparian buffers have large woody debris that function to slow these velocities as well (Klapproth and Johnson 2000).

2 Riparian Area Existing Conditions and Functions in the Project Area

Table 2-1 Summary of Riparian Areas in Project Workspace: Columbia County

Number of Riparian Areas Crossed by Project	Riparian Buffer Types (acres) ¹			Total
	Riparian Forest Buffer	Riparian Herbaceous Buffer	Unvegetated	
101	32.23	13.02	1.33	46.58

Note:

¹ Riparian areas crossed in Columbia County are a combination of HQ/EV and non-HQ/EV waters; a 150-foot and 100-foot-wide area was used to determine riparian area size within the full temporary workspace for HQ/EV and non-HQ/EV waters, respectively. Temporary workspace width within riparian areas varies from 75 to 90 feet wide.

Both forested and riparian herbaceous buffers are effective in nutrient removal and sediment retention (Klapproth and Johnson 2000). Excessive amounts of nitrogen within streams leads to increased algal and plant growth, resulting in lower dissolved oxygen and increased eutrophication (Baird and Wetmore 2006). Nitrogen is reduced within riparian buffers via plant uptake and denitrification (Baird and Wetmore 2006). Fluctuating aerobic and anaerobic conditions, readily available organic carbon, and perched or high water table as occurs in riparian buffers create the ideal environment in which denitrification can occur (Klapproth and Johnson 2000). While herbaceous and forested riparian buffers are effective at removing nitrogen, forested riparian buffers tend to be more effective as woody vegetation will remove nitrogen year round as opposed to grasses, which tend to be effective on a seasonal basis. In addition, organic carbon is more readily available in a forested riparian buffer (Klapproth and Johnson 2000).

The amount of sediment retained within a riparian buffer is based on the density of vegetation present, as stormwater flows downgradient through the vegetation (Klapproth and Johnson 2000). Grasses tend to offer greater stem density and more surface area for sediments to be deposited (Klapproth and Johnson 2000). Woody debris, roots, and grasses located in riparian buffers trap sediment and effectively preventing it from entering surface waters; however, neither type of riparian buffer is effective at such where the storm flows or water volume is large (Klapproth and Johnson 2000). As a function of the sediment deposition, phosphorus attached to sediment is removed within riparian buffers (Brinson et al. 1984; Walbridge and Struthers 1993). Additional phosphorus can be removed by adsorption to clay particles as a result of infiltration and also plant uptake (Cooper and Gilliam 1987). As mentioned above, riparian buffers increase channel stability and are able to hold soils in place due to the root structures, decreasing sediment loads, and nutrient inputs from eroding banks (Baird and Wetmore 2006).

Riparian buffers in the Project area provide habitat for aquatic and terrestrial species. The root structure of a forested riparian buffer allows for undercut banks within waterways, which can provide cover for fish, reptiles, and amphibians (Baird and Wetmore 2006). Forested riparian buffers provide overhead cover within the stream channel and moderate stream temperatures (PADEP 2010a).



2 Riparian Area Existing Conditions and Functions in the Project Area

Vegetation within the riparian buffers supports the local food chain as macroinvertebrates and small fish (utilized as a food source by wildlife, birds, reptiles, and amphibians) rely on leaf litter and decaying matter for food (Baird and Wetmore 2006). Riparian buffers in the Project area also provide valuable habitat for terrestrial organisms; they are used as travel corridors for migration and harbor a variety of plant and animal species (Baird and Wetmore 2006). The forested riparian buffers provide more cover than the riparian herbaceous buffers and provide a more complex habitat structure (Klapproth and Johnson 2000).

3

Riparian Buffer Impacts

Transco proposes to use a temporary construction right-of-way (ROW) ranging from 75 to 100 feet wide at riparian areas in Columbia County. Following construction, Transco will maintain a 50-foot-wide permanent ROW in the greenfield portion of the pipeline. Where the proposed pipeline follows Transco's existing Leidy Line system in Columbia County, Transco proposes to maintain an additional 25-foot-wide permanent ROW adjacent to the existing ROW. In this area, 25 feet of the existing Transco ROW will also be used for operation of the pipeline.

During operation of the pipeline, Transco will maintain herbaceous cover within a 10-foot-wide corridor centered over the pipeline. Outside of this 10-foot-wide area, Transco will allow shrubs to regrow within the permanent ROW; maintenance will be limited to selective trimming and clearing of large trees (greater than 15 feet in height) within 15 feet of the pipeline. In all cases, the temporary construction workspace will be allowed to revert to original pre-construction conditions.

Shrub regrowth will be such that areas outside of the 10-foot-wide herbaceous corridor will function and continue to be defined as forested riparian buffers. Consequently, permanent conversion of forested riparian buffers will be limited to the 10-foot-wide maintenance corridor over the pipeline.

Impacts on riparian buffers have been avoided to the extent practicable through early routing efforts, which focused on siting the proposed pipeline to avoid paralleling streams and crossing streams at 90-degree angles. In addition, the following minimization practices were incorporated into the Project design:

- Reduced the construction workspace ROW width by up to 25 feet (from originally proposed 90 feet [CPL North] and 100 feet [CPL South]), depending on site-specific conditions (please refer to Attachment P, Appendix P-1 of Transco's revised Chapter 105 permit application for a detailed summary of workspace modifications to avoid and minimize impacts at stream and wetland crossings);
- Located additional temporary workspaces 50 feet from stream boundaries, except where specific conditions warrant otherwise; and

- Vegetation will be cut just above ground level, leaving existing root systems in place, and limiting the pulling of stumps and grading activities to directly over the trench line except where the Chief Inspector and Environmental Inspector determine that these activities are required for safety reasons.

As an additional reestablishment measure, Transco is proposing voluntary replanting of riparian forest buffers crossed by the Project. Replanting will occur within the regulated floodplain (Federal Emergency Management Agency [FEMA] mapped 100-year floodplain, or 50-foot-wide floodway if no FEMA-mapped floodplain is present, whichever is greater). Additional details regarding proposed replanting are provided in Sections 4 and 5.

Table 3-1 shows the pre-construction condition of each riparian area crossed by the Project, and post-construction conditions during operation of the Project. Table 3-2 presents a summary of permanent conversion of forested riparian buffers to herbaceous buffers for each crossing. The Project will not result in the permanent loss of riparian buffers, but will result in the conversion of forested buffer to herbaceous cover within the maintained portion of the permanent ROW.

Table 3-1 Comparison of Pre- and Post-Construction Riparian Area Conditions

Stream ID	Pre-Construction Riparian Area Condition ¹ (acres)			Post-Construction Riparian Area Condition: Operation ² (acres)		
	Forest	Herbaceous Agricultural	Other-Impervious	Forest	Herbaceous Agricultural	Other-Impervious
WB-T35-11001	0.56	<0.01	<0.01	0.52	0.04	<0.01
WW-RS-12002	0.34	0.25	0.00	0.32	0.27	0.00
WW-RS-80012	0.54	<0.01	0.00	0.49	0.05	0.00
WW-RS-99103	0.27	<0.01	<0.01	0.25	0.02	<0.01
WW-RS-99104	0.01	<0.01	<0.01	0.01	<0.01	<0.01
WW-RS-99108	0.00	0.00	0.05	0.00	0.00	0.05
WW-T01-12002	0.06	<0.01	<0.01	0.06	<0.01	<0.01
WW-T01-12005	0.64	<0.01	0.00	0.58	0.06	0.00
WW-T01-12006	0.50	0.10	0.00	0.47	0.13	0.00
WW-T01-13002	0.61	0.15	0.00	0.56	0.2	0.00
WW-T01-13003	0.52	0.02	0.10	0.48	0.06	0.10
WW-T01-13004	0.00	0.77	0.00	0.00	0.77	0.00
WW-T02-14001	0.11	0.00	0.00	0.11	0.00	0.00
WW-T02-15002	0.32	0.18	0.00	0.31	0.19	0.00
WW-T02-15004	0.53	0.18	0.00	0.44	0.27	0.00
WW-T02-15005	0.11	0.11	0.00	0.07	0.15	0.00
WW-T02-15006	0.30	0.10	0.07	0.26	0.14	0.07
WW-T02-15007	0.51	0.08	0.04	0.47	0.12	0.04
WW-T02-15008	0.27	0.18	0.00	0.27	0.18	0.00
WW-T02-15009	0.25	0.21	<0.01	0.24	0.21	<0.01
WW-T02-15010	0.30	0.13	0.02	0.25	0.18	0.02
WW-T02-15011	0.47	0.18	0.00	0.39	0.26	0.00
WW-T02-15012	0.46	0.44	0.01	0.45	0.45	0.01
WW-T02-15012C	0.03	0.10	0.03	0.02	0.10	0.03

Table 3-1 Comparison of Pre- and Post-Construction Riparian Area Conditions

Stream ID	Pre-Construction Riparian Area Condition ¹ (acres)			Post-Construction Riparian Area Condition: Operation ² (acres)		
	Forest	Herbaceous Agricultural	Other-Impervious	Forest	Herbaceous Agricultural	Other-Impervious
WW-T02-15013	0.36	0.14	0.00	0.32	0.18	0.00
WW-T02-15014	0.35	0.15	<0.01	0.30	0.20	<0.01
WW-T02-15015	0.18	0.14	0.00	0.17	0.15	0.00
WW-T04-11001	1.18	0.07	0.00	1.10	0.15	0.00
WW-T04-11001A	0.16	<0.01	<0.01	0.15	0.01	<0.01
WW-T04-11002	0.05	2.04	0.00	0.04	2.05	0.00
WW-T04-12001	0.24	0.01	<0.01	0.19	0.06	<0.01
WW-T04-12002	0.86	<0.01	<0.01	0.80	0.06	<0.01
WW-T04-12003	0.39	<0.01	<0.01	0.34	0.05	<0.01
WW-T04-12004	0.17	<0.01	<0.01	0.16	0.01	<0.01
WW-T04-12005	0.62	<0.01	<0.01	0.55	0.07	<0.01
WW-T04-12005A	0.40	<0.01	<0.01	0.37	0.03	<0.01
WW-T04-12006	0.83	<0.01	0.00	0.75	0.08	0.00
WW-T06-13001	0.00	0.75	0.00	0.00	0.75	0.00
WW-T06-13002	0.54	<0.01	0.04	0.48	0.06	0.04
WW-T06-13002A	0.10	<0.01	0.00	0.01	0.01	0.00
WW-T06-13002B	0.02	0.00	0.00	0.01	0.01	0.00
WW-T06-13003	0.04	0.06	0.00	0.03	0.06	0.00
WW-T06-13004	0.38	0.01	0.00	0.33	0.06	0.00
WW-T06-14001	0.58	<0.01	0.00	0.53	0.05	0.00
WW-T06-14002	0.56	<0.01	0.00	0.51	0.05	0.00
WW-T15-14002	0.22	<0.01	0.00	0.18	0.04	0.00
WW-T15-14003	0.29	0.26	0.08	0.27	0.28	0.08
WW-T15-14005	0.39	0.18	<0.01	0.35	0.22	<0.01
WW-T15-14006	0.11	<0.01	<0.01	0.10	0.01	<0.01
WW-T15-14007	0.38	0.21	0.00	0.34	0.25	0.00
WW-T15-14007A	0.08	0.00	<0.01	0.07	<0.01	<0.01
WW-T15-14008	0.49	<0.01	0.12	0.44	0.05	0.12
WW-T16-14001	0.48	<0.01	0.00	0.43	0.05	0.00
WW-T16-14002	0.39	0.19	0.04	0.35	0.23	0.04
WW-T16-14002A	0.16	<0.01	<0.01	0.15	0.01	<0.01
WW-T16-14003	0.37	0.14	0.00	0.34	0.17	0.00
WW-T17-14001	0.74	<0.01	0.08	0.67	0.07	0.08
WW-T17-14002	0.27	0.57	0.00	0.24	0.60	0.00
WW-T17-14003	0.12	0.78	0.19	0.11	0.79	0.19
WW-T21-13001	0.16	0.47	0.00	0.14	0.49	0.00
WW-T21-13001A	0.00	0.70	0.00	0.00	0.70	0.00
WW-T28-12002	0.08	<0.01	0.00	0.08	<0.01	0.00
WW-T28-12004	0.51	<0.01	0.03	0.46	0.05	0.03
WW-T28-12005	0.51	<0.01	0.00	0.46	0.05	0.00
WW-T31-11001	0.84	<0.01	0.00	0.76	0.08	0.00
WW-T35-11001	0.45	0.07	0.00	0.40	0.12	0.00
WW-T35-13001	0.69	0.13	<0.01	0.61	0.21	<0.01
WW-T35-13002	0.46	<0.01	0.00	0.41	0.05	0.00
WW-T44-11001	0.97	<0.01	0.09	0.90	0.07	0.09

Table 3-1 Comparison of Pre- and Post-Construction Riparian Area Conditions

Stream ID	Pre-Construction Riparian Area Condition ¹ (acres)			Post-Construction Riparian Area Condition: Operation ² (acres)		
	Forest	Herbaceous Agricultural	Other-Impervious	Forest	Herbaceous Agricultural	Other-Impervious
WW-T44-11001B	0.03	<0.01	0.00	0.03	0.00	0.00
WW-T45-11001	0.86	<0.01	<0.01	0.79	0.07	<0.01
WW-T47-11001	0.10	0.29	<0.01	0.09	0.30	<0.01
WW-T47-11001A	0.00	0.11	0.00	0.00	0.11	0.00
WW-T47-12001	0.00	0.02	0.00	0.00	0.02	0.00
WW-T51-11001	0.35	0.01	0.08	0.32	0.04	0.08
WW-T52-13001	0.66	<0.01	0.00	0.60	0.06	0.00
WW-T52-13001B	0.03	0.00	0.00	0.03	0.00	0.00
WW-T52-13001C	<0.01	0.00	0.00	<0.01	0.00	0.00
WW-T67-13001	0.06	0.07	0.06	0.06	0.07	0.06
WW-T67-13002	0.11	0.01	0.00	0.11	0.01	0.00
WW-T67-14001	<0.01	0.01	0.01	<0.01	0.01	0.01
WW-T70-12001	0.43	<0.01	0.00	0.43	<0.01	0.00
WW-T70-12003	0.45	<0.01	0.00	0.40	0.05	0.00
WW-T70-12003A	0.30	<0.01	<0.01	0.20	0.02	<0.01
WW-T70-12005	0.02	0.06	0.00	0.02	0.06	0.00
WW-T70-12005A	0.02	<0.01	<0.01	0.02	0.00	<0.01
WW-T70-12006	0.00	0.09	0.00	0.00	0.09	0.00
WW-T70-12010	0.53	0.11	0.00	0.48	0.16	0.00
WW-T70-12010-1	0.32	0.07	0.03	0.27	0.12	0.03
WW-T70-12011	0.44	0.45	0.07	0.40	0.49	0.07
WW-T70-12012	0.45	0.07	0.06	0.41	0.11	0.06
WW-T90-13001	0.29	<0.01	0.00	0.26	0.03	0.00
WW-T90-14001	0.13	<0.01	0.00	0.13	<0.01	0.00
WW-T90-14003	0.03	0.56	0.00	0.02	0.56	0.00
WW-T90-14005	0.01	0.00	0.00	<0.01	<0.01	0.00
WW-T91-15001	0.17	0.19	0.00	0.15	0.21	0.00
WW-T91-15004	0.64	<0.01	0.00	0.57	0.07	0.00
WW-T92-15001	0.01	0.00	<0.01	<0.01	<0.01	<0.01
WW-T92-15001B	0.25	0.10	0.00	0.21	0.14	0.00
WW-T92-15002	0.51	0.31	0.03	0.49	0.33	0.03
WW-T93-15001	0.17	0.20	0.00	0.17	0.20	0.00
Grand Total	32.25	12.98	1.33	29.08	15.92	1.33

Notes:

¹ Pre-construction riparian area represents current conditions within the temporary construction right-of-way at each crossing, which ranges from 75 to 90 feet wide. The riparian buffer length is 100 feet for non-EV/HQ waters and 150 feet for EV/HQ waters, as measured landward from the top of both banks.

² Post-construction riparian area (operation) represents conditions following replanting and regrowth of riparian forest buffer in all portions of the riparian buffer outside of the 10-foot-wide maintenance corridor.

Table 3-2 Project-related Conversion of Riparian Forest Buffer

Stream ID	Stream Type (I, P, E)	Chapter 93 Designation	Permanent Conversion to Riparian Herbaceous Buffer ^{2, 3}
WB-T35-11001	Waterbody	TSF, MF	0.04
WW-RS-12002	Perennial	CWF, MF	0.02
WW-RS-80012	Intermittent	CWF, MF	0.05
WW-RS-99103	Perennial	CWF, MF	0.02
WW-RS-99104 ¹	Intermittent	CWF, MF	0.00
WW-RS-99108 ¹	Perennial	WWF, MF	0.00
WW-T01-12002 ¹	Intermittent	CWF, MF	0.00
WW-T01-12005	Intermittent	CWF, MF	0.06
WW-T01-12006	Intermittent	CWF, MF	0.03
WW-T01-13002	Intermittent	CWF, MF	0.05
WW-T01-13003	Intermittent	CWF, MF	0.04
WW-T01-13004 ¹	Intermittent	CWF, MF	0.00
WW-T02-14001 ¹	Intermittent	CWF, MF	0.00
WW-T02-15002	Perennial	CWF, MF	0.01
WW-T02-15004	Intermittent	CWF, MF	0.09
WW-T02-15005	Perennial	CWF, MF	0.04
WW-T02-15006	Perennial	CWF, MF	0.04
WW-T02-15007	Perennial	CWF, MF	0.04
WW-T02-15008 ¹	Perennial	CWF, MF	0.00
WW-T02-15009	Intermittent	CWF, MF	<0.01
WW-T02-15010	Perennial	HQ-CWF	0.05
WW-T02-15011	Perennial	HQ-CWF	0.08
WW-T02-15012	Perennial	HQ-CWF, MF	0.01
WW-T02-15012C	Perennial	HQ-CWF, MF	<0.01
WW-T02-15013	Perennial	CWF, MF	0.04
WW-T02-15014	Perennial	CWF, MF	0.05
WW-T02-15015	Ephemeral	CWF, MF	0.01
WW-T04-11001	Perennial	HQ-CWF, MF	0.08
WW-T04-11001A	Intermittent	HQ-CWF, MF	0.01
WW-T04-11002	Perennial	TSF, MF	0.01
WW-T04-12001	Perennial	WWF	0.05
WW-T04-12002	Intermittent	CWF, MF	0.06
WW-T04-12003	Intermittent	CWF, MF	0.05
WW-T04-12004	Intermittent	CWF, MF	0.01
WW-T04-12005	Perennial	CWF, MF	0.07
WW-T04-12005A	Intermittent	CWF, MF	0.03
WW-T04-12006	Perennial	CWF, MF	0.08
WW-T06-13001 ¹	Intermittent	CWF, MF	0.00
WW-T06-13002	Perennial	CWF, MF	0.06
WW-T06-13002A	Perennial	CWF, MF	<0.01
WW-T06-13002B	Perennial	CWF, MF	0.01
WW-T06-13003	Perennial	CWF, MF	<0.01

Table 3-2 Project-related Conversion of Riparian Forest Buffer

Stream ID	Stream Type (I, P, E)	Chapter 93 Designation	Permanent Conversion to Riparian Herbaceous Buffer ^{2, 3}
WW-T06-13004	Perennial	CWF, MF	0.05
WW-T06-14001	Perennial	CWF, MF	0.05
WW-T06-14002	Perennial	CWF, MF	0.05
WW-T15-14002	Ephemeral	TSF, MF	0.04
WW-T15-14003	Perennial	TSF, MF	0.02
WW-T15-14005	Intermittent	TSF, MF	0.04
WW-T15-14006	Intermittent	TSF, MF	0.01
WW-T15-14007	Perennial	TSF, MF	0.04
WW-T15-14007A	Perennial	TSF, MF	<0.01
WW-T15-14008	Intermittent	TSF, MF	0.05
WW-T16-14001	Ephemeral	TSF, MF	0.05
WW-T16-14002	Perennial	TSF, MF	0.04
WW-T16-14002A	Perennial	TSF, MF	0.01
WW-T16-14003	Perennial	TSF, MF	0.03
WW-T17-14001	Perennial	CWF, MF	0.07
WW-T17-14002	Intermittent	CWF, MF	0.03
WW-T17-14003	Ephemeral	CWF, MF	0.01
WW-T21-13001	Perennial	TSF, MF	0.02
WW-T21-13001A ¹	Perennial	TSF, MF	0.00
WW-T28-12002 ¹	Intermittent	CWF, MF	0.00
WW-T28-12004	Intermittent	TSF, MF	0.05
WW-T28-12005	Intermittent	TSF, MF	0.05
WW-T31-11001	Intermittent	HQ-CWF, MF	0.08
WW-T35-11001	Perennial	TSF, MF	0.05
WW-T35-13001	Perennial	CWF, MF	0.08
WW-T35-13002	Perennial	CWF, MF	0.05
WW-T44-11001	Perennial	HQ-CWF, MF	0.07
WW-T44-11001B ²	Intermittent	HQ-CWF, MF	0.00
WW-T45-11001	Perennial	HQ-CWF, MF	0.07
WW-T47-11001	Perennial	HQ-CWF, MF	0.01
WW-T47-11001A	Perennial	HQ-CWF, MF	0.00
WW-T47-12001 ²	Intermittent	WWF, MF	0.00
WW-T51-11001	Intermittent	HQ-CWF, MF	0.03
WW-T52-13001	Perennial	CWF, MF	0.06
WW-T52-13001B ¹	Intermittent	CWF, MF	0.00
WW-T52-13001C ¹	Intermittent	CWF, MF	0.00
WW-T67-13001 ¹	Perennial	TSF, MF	0.00
WW-T67-13002 ¹	Perennial	TSF, MF	0.00
WW-T67-14001 ¹	Ephemeral	CWF, MF	0.00
WW-T70-12001 ¹	Perennial	CWF, MF	0.00
WW-T70-12003	Perennial	CWF, MF	0.05
WW-T70-12003A	Perennial	CWF, MF	<0.01

Table 3-2 Project-related Conversion of Riparian Forest Buffer

Stream ID	Stream Type (I, P, E)	Chapter 93 Designation	Permanent Conversion to Riparian Herbaceous Buffer ^{2, 3}
WW-T70-12005 ¹	Intermittent	CWF, MF	0.00
WW-T70-12005A ¹	Ephemeral	CWF, MF	0.00
WW-T70-12006 ¹	Perennial	WWF, MF	0.00
WW-T70-12010	Perennial	CWF, MF	0.05
WW-T70-12010-1	Perennial	CWF, MF	0.05
WW-T70-12011	Perennial	CWF, MF	0.04
WW-T70-12012	Ephemeral	CWF, MF	0.04
WW-T90-13001	Intermittent	CWF, MF	0.03
WW-T90-14001 ¹	Intermittent	TSF, MF	0.00
WW-T90-14003	Intermittent	TSF, MF	<0.01
WW-T90-14005	Intermittent	TSF, MF	<0.01
WW-T91-15001	Intermittent	CWF, MF	0.02
WW-T91-15004	Intermittent	CWF, MF	0.07
WW-T92-15001	Perennial	HQ-CWF	<0.01
WW-T92-15001B	Perennial	CWF, MF	0.04
WW-T92-15002	Intermittent	HQ-CWF, MF	0.02
WW-T93-15001 ¹	Intermittent	CWF, MF	0.00
Grand Total			2.89

Notes:

- ¹ Forest riparian buffer areas do not fall within the 10-foot-wide maintenance corridor associated with these streams.
- ² Calculations are based on the current extent of riparian forest buffer within the 10-foot-wide maintenance corridor.
- ³ There will be no conversion to unvegetated riparian buffer.

Key:

- CWF = coldwater fishery
- MF = migratory fishes
- TSF = trout-stocked fishery
- WWF = warmwater fishery

Converting riparian forest buffers to herbaceous buffers within the 10-foot-wide maintenance corridor will result in an overall decrease in the amount of overhead vegetation and fragment existing forest habitat. Due to the narrow corridor affected and short duration of water passing through the affected area, temperature changes to streams are not likely as a result of the Project (Beschta and Taylor 1988). Effective root masses in the stream banks with forested/scrub-shrub riparian buffers will also be altered through the removal of woody vegetation, but this impact will be negligible as it is isolated to a small fraction of any individual stream reach and the stream banks will be stabilized with approved BMPs once construction is complete. No discernable changes to the sediment and nutrient retention of the existing riparian buffers are expected due to the retention of vegetative cover within and immediately surrounding the riparian buffers.

In summary, Transco has developed several BMPs (as described in Section 4) that effectively avoid and minimize riparian buffer impacts to the extent practicable.

In addition, Transco will voluntarily replant riparian forest buffers to expedite re-growth of these areas (as described in Sections 4 and 5). The Project will still result in the permanent conversion of 2.89 acres of riparian forest buffer to a riparian herbaceous buffer. These conversions affect a narrow 10-foot-wide corridor of the overall riparian buffer for each watercourse and represent a small fraction of riparian buffers within the larger watershed. In addition, the remaining riparian herbaceous buffer will continue to provide beneficial functions related to water quality. Therefore, any potential changes in riparian area function will be minor, and will not result in the degradation of the existing stream uses or associated water quality.

3.1 Riparian Buffer Waiver Requests

As noted in Table 3-2, the Project crosses the forested riparian buffers of 15 streams designated as EV or HQ. The PADEP, in a conference call held on January 28, 2016, provided guidance that a riparian buffer waiver request is not required if the pipeline crosses an EV/HQ stream and riparian buffer at an approximate right angle. Furthermore, the PADEP indicated that a riparian buffer waiver request is only required for an EV/HQ stream if:

1. The pipeline or its associated construction workspace, including contractor staging areas, contractor/pipe yards, and/or access roads, do not cross an EV/HQ stream, but are located within the riparian buffer; or
2. Any portion of the pipeline is located parallel to an EV/HQ stream and within the 150-foot riparian buffer located on either side of the EV/HQ stream (so the full 150-foot buffer on each side of the EV/HQ stream and the stream itself must be crossed at a roughly right angle).

Based on this guidance, Transco is requesting seven riparian buffer waivers as part of its Chapter 102 permit application in Columbia County. Table 3-3 provides details on the EV/HQ streams that are being requested for a riparian buffer waiver for the Columbia County portion of the Project.

Table 3-3 Proposed Riparian Buffer Waiver Requests in Columbia County

Stream ID	Chapter 93 Designation	Stream Type	Length of Waiver Request ¹ (feet)	Area of Waiver Request ² (acres)
WW-T91-15001	HQ-CWF, MF	Intermittent	222	0.36
WW-T92-15002	HQ-CWF, MF	Intermittent	355	0.85
WW-T47-11001	HQ-CWF, MF	Perennial	140	0.40
WW-T44-11001	HQ-CWF, MF	Perennial	342	1.06
WW-T04-11001	HQ-CWF, MF	Perennial	381	1.24

Table 3-3 Proposed Riparian Buffer Waiver Requests in Columbia County

Stream ID	Chapter 93 Designation	Stream Type	Length of Waiver Request ¹ (feet)	Area of Waiver Request ² (acres)
WW-T04-11001B	HQ-CWF, MF	Intermittent	Included in WW-T04-11001	Included in WW-T04-11001
WW-T47-11001A ³	HQ-CWF, MF	Perennial	27	0.11

Notes:

¹ Length of waiver request based on length of the waiver request crossed by the pipe centerline.

² Area of waiver requested based on total area of riparian buffer within workspace.

³ The riparian buffer of WW-T10-11004A is contained within WW-T04-11001.

Key:

- CWF = coldwater fishery
- HQ = high quality
- MF = migratory fishes

4

Riparian Area Restoration

All riparian buffers affected by the Project will be stabilized once construction is completed. Transco will implement some or all of the following erosion and sediment BMPs as outlined in Transco's erosion and sediment control plans and post construction stormwater management plans during construction activities within riparian buffers:

Compost Filter Sock/Silt Fence – These BMPs will be placed downslope of disturbed areas to serve as a sediment barrier and filter. This will protect the stream and riparian areas from excessive sedimentation and erosion from storm runoff.

Erosion Control Blanket – Erosion control blankets will be installed at stream crossings to stabilize the stream crossings and riparian areas from storm water runoff. They will extend completely across the disturbed area to protect erodible surfaces and to support vegetation.

Seeding – A riparian seed mix (ERNMX-178) will be utilized throughout the Project to stabilize the riparian areas at stream crossings. All crossings will be monitored until the revegetation of these crossings is considered successful, per permit conditions.

Waterbars – Waterbars will be installed to direct runoff to well vegetated areas in areas with slopes leading into the riparian area. This will provide permanent protection from stormwater flows within the areas.

After the completion of construction and restoration activities, and in accordance with Transco's Upland Erosion Control, Revegetation, and Maintenance Plan (Transco Plan), Transco will conduct follow-up inspections of all disturbed upland areas after the first and second growing seasons to determine the success of restoration. Restoration of upland will be considered successful if, upon visual survey, the ROW vegetation is similar in density and cover to the adjacent undisturbed lands, construction debris is removed, and proper drainage has been restored. For at least two years following construction, Transco will submit quarterly reports to the FERC that document any problems identified by Transco or landowners and describe the corrective actions taken to remedy those problems.

In accordance with Transco’s Wetland and Waterbody Construction and Mitigation Procedures (Transco Procedures), Transco will also monitor the success of wetland restoration annually for the first three years after construction (or as required by the Section 404 permit), or until wetland revegetation is successful.

4.1 Riparian Forest Buffer Replanting

Transco is proposing voluntary replanting of riparian forest buffers crossed by the Project. Replanting in these locations will occur within the regulated floodplain (FEMA-mapped 100-year floodplain or 50-foot-wide floodway if no FEMA-mapped floodplain is present, whichever is greater). Transco is also proposing to replant riparian forest buffers where such buffers overlap with locations where a riparian buffer waiver is being requested. In all instances, replanting will occur in the construction workspace outside of the 10-foot-wide maintenance corridor over the pipeline. A schematic of the proposed replanting areas is provided in Appendix A.

Table 4-1 lists each stream with a riparian buffer affected by the Project; the total area of each riparian forest buffer within the construction workspace; and the proposed replanting area. As shown, Transco is proposing to replant 17.39 acres of riparian forest buffers in Columbia County. Transco’s plan for replanting these areas is described in Section 5.

Table 4-1 Summary of Impacts on Riparian Buffers and Proposed Replanting

Stream ID	Chapter 93 Designation	Riparian Forest Buffer within		Proposed Replanting Area (acres)
		Construction ROW	Waiver Buffer Area (acres)	
WB-T35-11001	TSF, MF	0.56	0.00	0.51
WW-RS-12002	CWF, MF	0.34	0.00	0.31
WW-RS-80012	CWF, MF	0.54	0.00	0.25
WW-RS-99103	CWF, MF	0.27	0.00	0.24
WW-RS-99104	CWF, MF	0.01	0.00	0.01
WW-RS-99108	WWF, MF	0.00	0.00	0.00
WW-T01-12002	CWF, MF	0.06	0.00	0.03
WW-T01-12005	CWF, MF	0.64	0.00	0.22
WW-T01-12006	CWF, MF	0.50	0.00	0.19
WW-T01-13002	CWF, MF	0.61	0.00	0.23
WW-T01-13003	CWF, MF	0.52	0.00	0.16
WW-T01-13004	CWF, MF	0.00	0.00	0.00
WW-T02-14001	CWF, MF	0.11	0.00	0.00
WW-T02-15002	CWF, MF	0.32	0.00	0.14
WW-T02-15004	CWF, MF	0.53	0.00	0.29
WW-T02-15005	CWF, MF	0.11	0.00	0.00
WW-T02-15006	CWF, MF	0.30	0.00	0.19
WW-T02-15007	CWF, MF	0.51	0.00	0.46
WW-T02-15008	CWF, MF	0.27	0.00	0.12

Table 4-1 Summary of Impacts on Riparian Buffers and Proposed Replanting

Stream ID	Chapter 93 Designation	Riparian Forest Buffer within Construction ROW	Waiver Buffer Area (acres)	Proposed Replanting Area (acres)
WW-T02-15009	CWF, MF	0.25	0.00	0.11
WW-T02-15010	HQ-CWF	0.30	0.00	0.12
WW-T02-15011	HQ-CWF	0.47	0.00	0.13
WW-T02-15012	HQ-CWF, MF	0.46	0.00	0.33
WW-T02-15012C	HQ-CWF, MF	0.03	0.00	0.03
WW-T02-15013	CWF, MF	0.36	0.00	0.14
WW-T02-15014	CWF, MF	0.35	0.00	0.13
WW-T02-15015	CWF, MF	0.18	0.00	0.00
WW-T04-11001	HQ-CWF, MF	1.18	1.24	1.09
WW-T04-11001A	HQ-CWF, MF	0.16	0.00	0.15
WW-T04-11002	TSF, MF	0.05	0.00	0.05
WW-T04-12001	WWF	0.24	0.00	0.14
WW-T04-12002	CWF, MF	0.86	0.00	0.13
WW-T04-12003	CWF, MF	0.39	0.00	0.2
WW-T04-12004	CWF, MF	0.17	0.00	0.15
WW-T04-12005	CWF, MF	0.62	0.00	0.42
WW-T04-12005A	CWF, MF	0.40	0.00	0.18
WW-T04-12006	CWF, MF	0.83	0.00	0.35
WW-T06-13001	CWF, MF	0.00	0.00	0.00
WW-T06-13002	CWF, MF	0.54	0.00	0.30
WW-T06-13002A	CWF, MF	0.10	0.00	0.02
WW-T06-13002B	CWF, MF	0.02	0.00	0.00
WW-T06-13003	CWF, MF	0.04	0.00	0.00
WW-T06-13004	CWF, MF	0.38	0.00	0.16
WW-T06-14001	CWF, MF	0.58	0.00	0.46
WW-T06-14002	CWF, MF	0.56	0.00	0.36
WW-T15-14002	TSF, MF	0.22	0.00	0.03
WW-T15-14003	TSF, MF	0.29	0.00	0.12
WW-T15-14005	TSF, MF	0.39	0.00	0.26
WW-T15-14006	TSF, MF	0.11	0.00	0.02
WW-T15-14007	TSF, MF	0.38	0.00	0.20
WW-T15-14007A	TSF, MF	0.08	0.00	0.04
WW-T15-14008	TSF, MF	0.49	0.00	0.24
WW-T16-14001	TSF, MF	0.48	0.00	0.20
WW-T16-14002	TSF, MF	0.39	0.00	0.13
WW-T16-14002A	TSF, MF	0.16	0.00	0.12
WW-T16-14003	TSF, MF	0.37	0.00	0.19
WW-T17-14001	CWF, MF	0.74	0.00	0.22
WW-T17-14002	CWF, MF	0.27	0.00	0.14
WW-T17-14003	CWF, MF	0.12	0.00	0.10
WW-T21-13001	TSF, MF	0.16	0.00	0.15

Table 4-1 Summary of Impacts on Riparian Buffers and Proposed Replanting

Stream ID	Chapter 93 Designation	Riparian Forest Buffer within Construction ROW	Waiver Buffer Area (acres)	Proposed Replanting Area (acres)
WW-T21-13001A	TSF, MF	0.00	0.00	0.00
WW-T28-12002	CWF, MF	0.08	0.00	0.01
WW-T28-12004	TSF, MF	0.51	0.00	0.21
WW-T28-12005	TSF, MF	0.51	0.00	0.21
WW-T31-11001	HQ-CWF, MF	0.84	0.00	0.26
WW-T35-11001	TSF, MF	0.45	0.00	0.4
WW-T35-13001	CWF, MF	0.69	0.00	0.31
WW-T35-13002	CWF, MF	0.46	0.00	0.2
WW-T44-11001	HQ-CWF, MF	0.97	1.06	0.9
WW-T44-11001B	HQ-CWF, MF	0.03	0.00	0.00
WW-T45-11001	HQ-CWF, MF	0.86	0.00	0.41
WW-T47-11001	HQ-CWF, MF	0.10	0.4	0.09
WW-T47-11001A	HQ-CWF, MF	0.00	0.11	0.00
WW-T47-12001	WWF, MF	0.00	0.00	0.00
WW-T51-11001	HQ-CWF, MF	0.35	0.00	0.13
WW-T52-13001	CWF, MF	0.66	0.00	0.55
WW-T52-13001B	CWF, MF	0.03	0.00	0.00
WW-T52-13001C	CWF, MF	<0.01	0.00	0.00
WW-T67-13001	TSF, MF	0.06	0.00	0.04
WW-T67-13002	TSF, MF	0.11	0.00	0.05
WW-T67-14001	CWF, MF	<0.01	0.00	0.00
WW-T70-12001	CWF, MF	0.43	0.00	0.07
WW-T70-12003	CWF, MF	0.45	0.00	0.27
WW-T70-12003A	CWF, MF	0.30	0.00	0.27
WW-T70-12005	CWF, MF	0.02	0.00	0.00
WW-T70-12005A	CWF, MF	0.02	0.00	0.00
WW-T70-12006	WWF, MF	0.00	0.00	0.00
WW-T70-12010	CWF, MF	0.53	0.00	0.48
WW-T70-12010-1	CWF, MF	0.32	0.00	0.24
WW-T70-12011	CWF, MF	0.44	0.00	0.34
WW-T70-12012	CWF, MF	0.45	0.00	0.25
WW-T90-13001	CWF, MF	0.29	0.00	0.04
WW-T90-14001	TSF, MF	0.13	0.00	0.02
WW-T90-14003	TSF, MF	0.03	0.00	0.03
WW-T90-14005	TSF, MF	0.01	0.00	0.01
WW-T91-15001	CWF, MF	0.17	0.36	0.03
WW-T91-15004	CWF, MF	0.64	0.00	0.25
WW-T92-15001	HQ-CWF	0.01	0.00	0.01

Table 4-1 Summary of Impacts on Riparian Buffers and Proposed Replanting

Stream ID	Chapter 93 Designation	Riparian Forest Buffer within Construction ROW	Waiver Buffer Area (acres)	Proposed Replanting Area (acres)
WW-T92-15001B	CWF, MF	0.25	0.00	0.15
WW-T92-15002	HQ-CWF, MF	0.51	0.85	0.49
WW-T93-15001	CWF, MF	0.17	0.00	0.01
Totals		32.25	4.02	17.39

Note:

¹ Replanting for non-waiver crossings covers the portion of the regulated floodplain within temporary construction work-space, outside of the 10-foot-wide maintenance corridor. Replanting area for waiver crossings includes the entire waiver area, excluding the 10-foot-wide maintenance corridor.

Key:

- CWF = coldwater fishery
- HQ = high quality
- MF = migratory fishes

5

Replanting Plan

The following replanting plan has been developed for those areas outlined in Section 4.1. Details related to the replanted species and planting specifications are outlined below.

5.1 Plant Species

Transco will replant the 50-foot-wide permanent ROW by applying a riparian seed mix. The seed mix will include shrubs listed in Appendix B. This seed mix will be in addition to the ERNMX-178 riparian seed mix to be utilized throughout the Project area to stabilize the riparian areas at stream crossings.

Outside of the permanent ROW, to the edge of the construction workspace and within the regulated floodplain, Transco will reestablish the riparian buffer by planting trees and shrubs. The vegetative design of the riparian buffers is a combination of specific native tree and shrub species selected for different hydrologic regimes and different vegetative cover types throughout the Project area. Trees and shrubs selected for replanting will be taken from the PADEP's Riparian Forest Buffer Guidance (PADEP 2010a). The trees and shrubs selected for the Project are listed in Appendix B. At each riparian replanting site, a minimum of two tree and two shrub species will be planted. Plant selection will mirror the site conditions (i.e., wetland plants in riparian wetlands and upland plants in uplands), as indicated by the wetland indicator status of the plants. Plants will be of either bare root, live stake, or containerized species.

5.2 Plant Density and Placement

Within the permanent ROW, the riparian buffer seed mix will be applied in conjunction with a custom shrub seed mix utilizing a mix of shrub seeds from the list in Appendix B. The seed mix will be applied at a rate and density as directed by the nursery.

For replanting areas outside of the permanent ROW, all plants will be planted in clumps of monocultures consisting of three to six plants of the species. Monocultures will be planted randomly with spacing of approximately 8 feet on center for shrubs and small trees species, and 12 feet on center for tree species. Trees and shrubs will be planted at a density of 435 stems per acre. Typical planting details are provided in Appendix C.

5.3 Planting Methods

All seeding will be applied and plantings installed according to acceptable standards of the trade under the supervision of a landscape professional with suitable practical field experience in riparian buffer installation projects. All seed and plant materials will be nursery grown and will be guaranteed to be true to name and healthy upon delivery. During planting operations, the contractor will keep the trees and shrubs out of direct sunlight and maintain moisture on the roots to ensure that the roots do not dry out prior to planting.

Trees and shrubs will be planted by digging a hole twice the size of the width of the root ball down into the substrate at the point of installation. If the plant is in a plastic container, this will be carefully removed to keep the root ball intact. After planting, the area will be backfilled and watered. Trees may be provided with support stakes or tree shelters. Shelters will only be placed on those plants suitable for shelters. Care will be taken when installing support stakes or tree shelters to ensure that the root ball is not disturbed when driving the support stake into the soil. Fertilizer tablets may be placed in the backfilled soil to help the growth of the planted trees and shrubs.

5.4 Wildlife Damage Control

After planting of the site has been completed, tree and shrub shelters will be installed for those plants suitable for shelters. If deemed necessary, other methods of wildlife damage control include the application of rodenticide to each tree/shrub or installing bait boxes for meadow vole control.

5.5 Invasive Species Management

Transco's Invasive Species Management Plan provided in Attachment 11 of the Environmental Construction Plan will be followed in the riparian buffer replanting areas.

5.6 Performance Standards and Monitoring

Transco will monitor the riparian buffer replanting areas in accordance with the Transco Plan and Procedures, as described in Section 4, as well as any permit conditions.

6

References

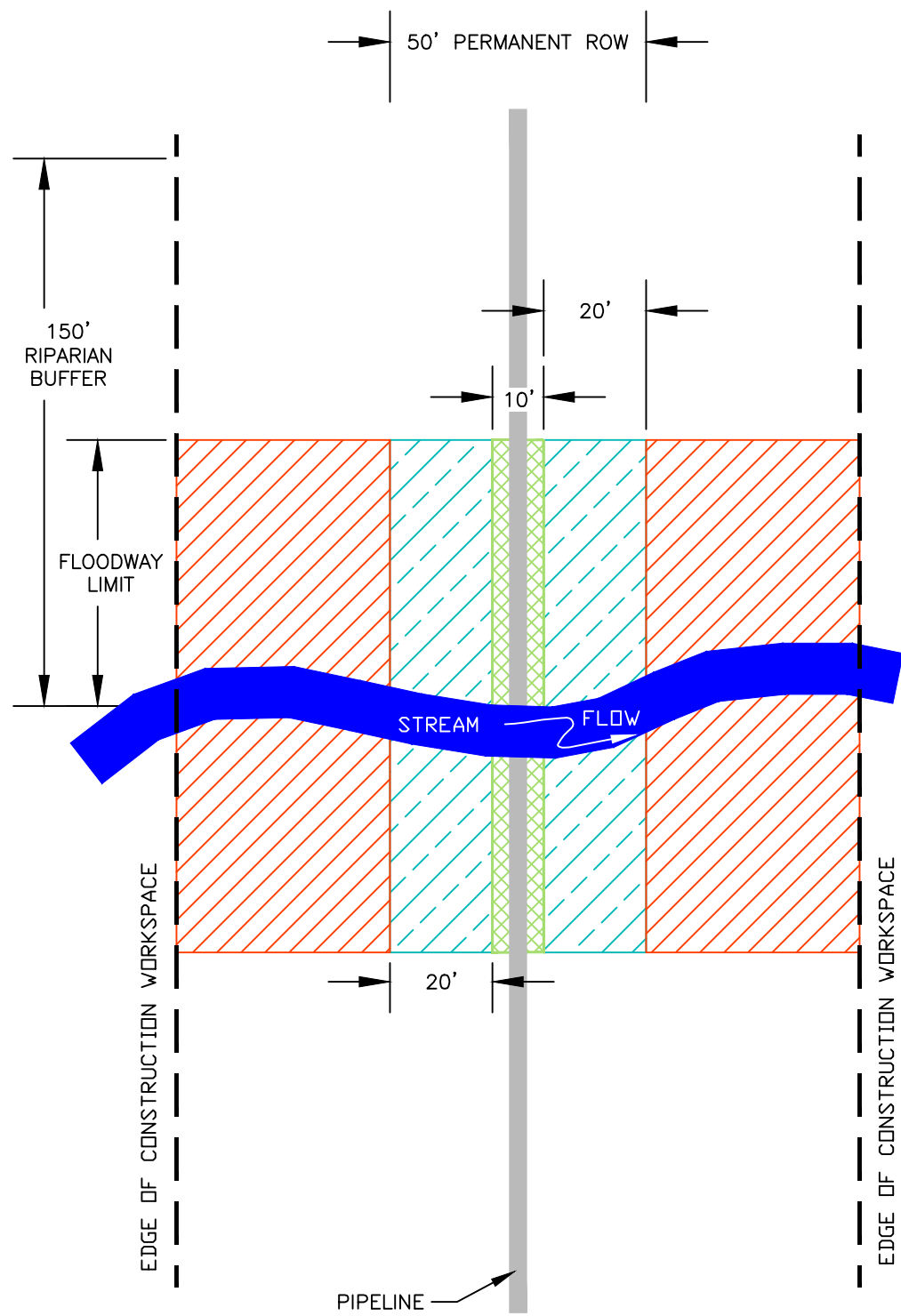
- Baird, A.R.T., and D.G. Wetmore, D.G. 2006. Riparian Buffers Modification and Mitigation Guidance Manual. Virginia Dept. of Conservation and Recreation and Chesapeake Bay Local Assistance. Accessed online at <http://www.deq.virginia.gov/portals/0/deq/water/publications/riparianbuffermanual.pdf>. Accessed September 28, 2016.
- Beschta, R.L. and R.L. Taylor. 1988. Stream Temperature Increases and Land Use in a Forested Oregon Watershed. *Water Resources Bulletin*, 24: 19-25. Accessed online at: http://www.fishsciences.net/reports/1988/Beschta_Taylor_1988.pdf. Accessed on October 3, 2016.
- Brinson, M.M, H.D. Bradshaw, and E.S. Kane. 1984. Nutrient assimilative capacity of an alluvial floodplain swamp. *Journal of Applied Ecology* 21:1041-1057.
- Cooper, J.R. and J.W. Gilliam. 1987. Phosphorus redistribution from cultivated fields into riparian areas. *Soil Science Society of America Journal* 51:1600-1604.
- Federal Energy Regulatory Commission (FERC). 2013. Wetland and Waterbody Construction and Mitigation Procedures. May 2013 Version. Washington, D.C
- Klapproth, J.C. and J.E. Johnson. 2000. Understanding the Science Behind Riparian Forest Buffers: Effects on Water Quality. Virginia Coop. Ext. Publ. Blacksburg, VA: Virginia Tech: 420–451. Accessed online at: <https://pubs.ext.vt.edu/420/420-151/420-151.html>. Accessed on September 28, 2016.
- Pennsylvania Department of Environmental Protection (PADEP), Bureau of Watershed Management. 2010a. Riparian Forest Buffer Guidance, Document Number 394-5600-001. Online at: <http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-82308/394-5600-001.pdf>. Accessed on September 28, 2016.
- _____. 2010b. 025 Pa. Code 102.14. Riparian Buffer Requirements.



Walbridge, M.R., and J.P. Struthers. 1993. Phosphorus retention in non-tidal palustrine forested wetlands of the mid-Atlantic region. *Wetlands* 13:84-94.

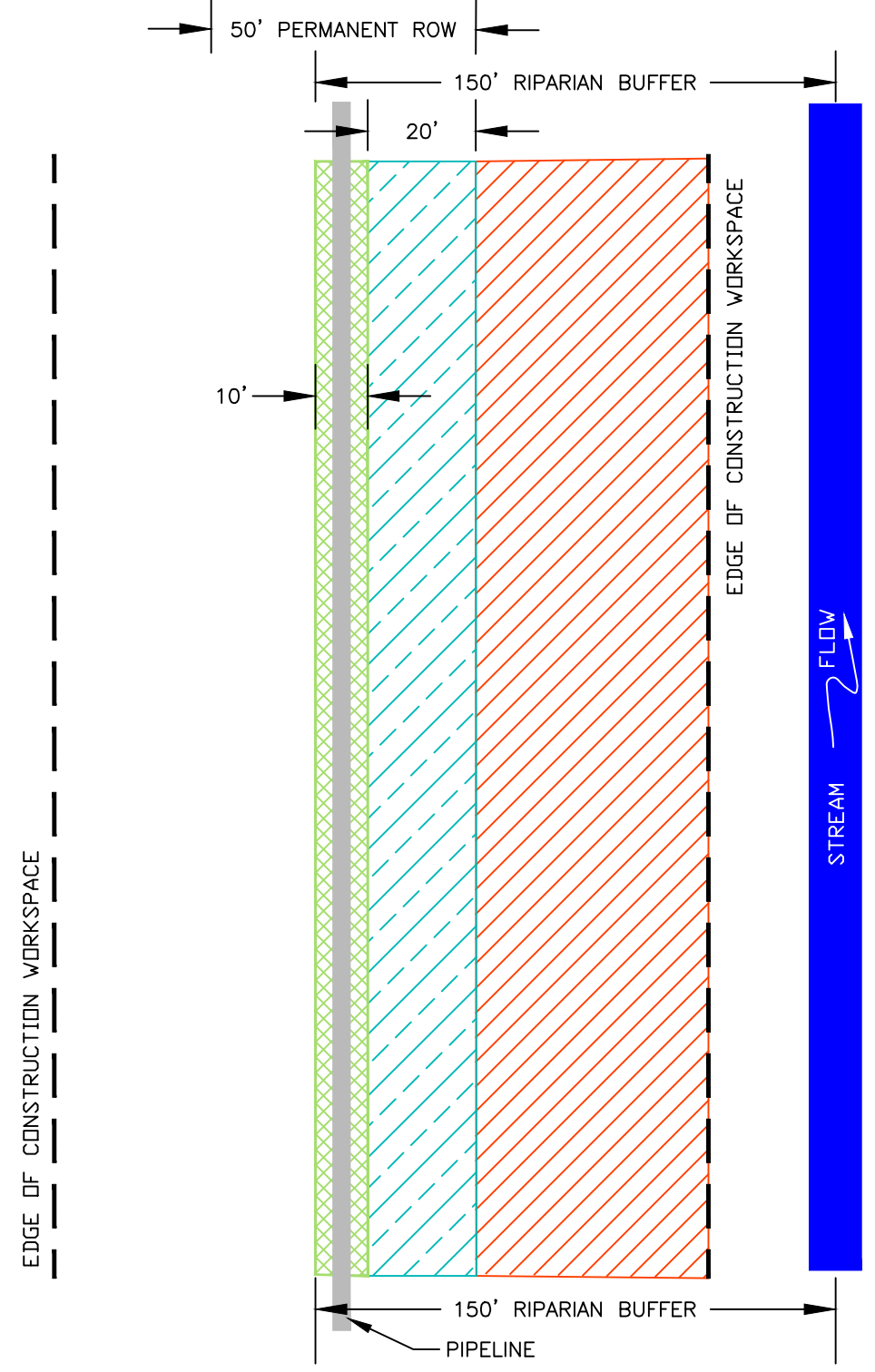
A

Riparian Buffer Replanting Area Diagrams



TYPICAL RIPARIAN FOREST BUFFER PLANTING
NOT TO SCALE

- LEGEND**
- TREE / SHRUB PLANTING AREA AND RIPARIAN SEED MIX
 - SHRUB AND RIPARIAN SEED MIXES
 - RIPARIAN SEED MIX ONLY



TYPICAL RIPARIAN WAIVER AREA PLANTING
NOT TO SCALE



designs, permits, resolutions | consulting, inc.

2525 GREEN TECH DRIVE, SUITE B
STATE COLLEGE, PA 16803

TELEPHONE: (814)-689-1650 FAX: (814)-689-1557

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC

ATLANTIC SUNRISE PROJECT
RIPARIAN BUFFER RESTORATION PLAN

RIPARIAN BUFFER REPLANTING AREAS

PENNSYLVANIA

DATE:	11/09/16
DRAWN BY:	BWH
CHECKED:	RJN
DRAWING NO.	DETAIL
SHEET NO.	APPENDIX A

B

Tree and Shrub Planting List

APPENDIX B
LIST OF APPROVED SPECIES FOR REPLANTING

TREES							
Common/ Scientific Name	Region	¹ Wet Code	Soil pH	Flood Tolerance	Height(ft)	Shade Tolerance	Wildlife Value
Red maple <i>Acer rubrum</i>	P, R, A	FAC	5.5- 7.0	tolerant	75-100	tolerant	food source-fruits and young shoots
*Silver maple <i>A. saccharinum</i>	P, R, A	FACW	4.0- 6.5	tolerant	75-100	intermediate	food source-seeds and young twigs
Sugar maple <i>A. saccharum</i>	R, A	FACU-	4.0- 7.0	intolerant	75-100	very tolerant	food source-seeds and twigs
Serviceberry <i>Amelanchier arborescens/laevis/ canadensis</i>	P, R, A	FAC-	4.5- 7.0	tolerant	20-40	intermediate	food source-fruit, twigs and leaves
Pawpaw <i>Asimina triloba</i>	P, R, A	FACU+	5.0- 7.0	intolerant	20-35	tolerant	food source-fruit and leaves; host plant for zebra swallowtail
**Yellow birch <i>Betula alleghaniensis</i>	P, R, A	FAC	4.5- 7.0	intolerant	60-100	intermediate	food source-seeds, young twigs and shoots and catkins
Black (Sweet) birch <i>B. lenta</i>	R, A	FACU	5.0- 7.0	intolerant	50-75	intermediate	food source-catkins, buds, seeds, leaves and
River birch <i>B. nigra</i>	P, R	FACW	4.5- 7.5	tolerant	40-70	intolerant	food source-seeds, buds, young twigs and foliage
*American hornbeam <i>Carpinus caroliniana</i>	P, R, A	FAC	4.0- 7.5	intolerant	35-50	very tolerant	food source-catkins, buds, seeds, leaves and
**Bitternut hickory <i>Carya cordiformis</i>	P, R, A	FACU+	6.5- 7.5	intermediate	75-100	intolerant	bitter nuts not favored as much as other hickories
**Shagbark hickory <i>C. ovata</i>	P, R, A	FACU-	4.0- 8.0	intolerant	75-100	intermediate	food source-twigs and nuts
*Redbud <i>Cercis canadensis</i>	P, R	FACU-	4.5- 7.0	intolerant	20-35	tolerant	food source-seeds, foliage and flower pollen for honeybees
Hackberry <i>Celtis occidentalis</i>	P, R	FACU	6.0- 8.0	intermediate	75-100	intermediate	food source-fruits and twigs; shelter and nesting sites
Flowering dogwood <i>Cornus florida</i>	R, A	FACU-	5.0- 7.0	very intolerant	35-50	intermediate	food source-fruit
**Persimmon <i>Diospyros virginiana</i>	P	FAC-	5.0- 7.0	intermediate	50-75	tolerant	food source-fruits, twigs and nectar
American beech, <i>Fagus grandifolia</i>	P, R, A	FACU	4.0- 6.5	very intolerant	75-100	very tolerant	food source-nuts
White ash <i>Fraxinus americana</i>	P, R, A	FACU	5.0- 7.5	intermediate	75-100	tolerant	food source-fruit
Red (Green) ash <i>F. pennsylvanica</i>	P, R	FACW	5.0- 8.0	tolerant	50-75	intolerant	minimal food source- twigs and fruits
Honey-locust <i>Gleditsia triacanthos</i>	R, A	FAC-	6.0- 8.0	intermediate	50-75	intolerant	food source-seeds and pods
**Kentucky coffee- tree <i>Gymnocladus dioica</i>	A	FACU-	6.0- 8.0	intermediate	75-100	intolerant	low appeal to wildlife

APPENDIX B
LIST OF APPROVED SPECIES FOR REPLANTING

TREES							
Common/ Scientific Name	Region	¹ Wet Code	Soil pH	Flood Tolerance	Height (ft)	Shade Tolerance	Wildlife Value
Black walnut <i>Juglans nigra</i>	P, R	FACU	5.5- 8.0	intermediate	75-100	intolerant	food source-twigs and nuts
Tuliptree/poplar <i>Liriodendron tulipifera</i>	P, R, A	FACU	4.5- 6.5	intermediate	75-100	intermediate	food source-nectar and seeds
Black-gum <i>Nyssa sylvatica</i>	P, R, A	FAC	4.5- 6.0	intermediate	50-75	intolerant	food source-fruits, twigs and nectar
* **Hop-hornbeam <i>Ostrya virginiana</i>	P, R	FACU-	4.0- 7.5	very intolerant	35-50	very tolerant	food source-buds, catkins and seeds
Eastern white pine <i>Pinus strobus</i>	P, R, A	FACU	4.0- 6.5	intolerant	75-100	intermediate	high value food source- needles and seeds; used for cover
Sycamore <i>Platanus occidentalis</i>	P, R, A	FACW-	5.0- 6.5	intermediate	75-100	intermediate	moderate value for cover and nesting; food source- fruits
Eastern cottonwood <i>Populus deltoides</i>	P, A	FAC	6.5- 7.5	tolerant	75-100	intolerant	food source-bark, twigs, leaves and buds
Large-toothed aspen <i>P. grandidentata</i>	P, R, A	FAC-	5.0- 6.5	intolerant	50-75	very intolerant	food source- bark, twigs, leaves, catkins and buds
Wild black cherry <i>Prunus serotina</i>	P, R, A	FACU	5.0- 7.5	very intolerant	50-75	intolerant	high value food source- fruits, twigs and nectar
White oak <i>Quercus alba</i>	P, R, A	FACU-	4.5- 7.0	intolerant	75-100	intermediate	high value food source- acorns and twigs
Swamp white oak <i>Q. bicolor</i>	P, R	FACW+	4.5- 6.5	tolerant	75-100	intermediate	food source-acorns and twigs
**Chestnut oak <i>Q. montana</i>	P, R	UPL	4.5- 7.0	intolerant	50-75	intermediate	food source-acorns and twigs
Pin oak <i>Q. palustris</i>	P, R, A	FACW	4.5- 6.5	tolerant	50-75	intolerant	food source-acorns and twigs
Northern red oak <i>Q. rubra</i>	P, R, A	FACU-	4.5- 6.5	intermediate	75-100	intermediate	medium value for nesting and food source-acorns
*Black willow <i>Salix nigra</i>	P, R, A	FACW+	5.0- 8.0	very tolerant	35-50	very intolerant	food source-buds, fruit, and twigs
Sassafras <i>Sassafras albidum</i>	P, R, A	FACU-	4.5- 7.0	very intolerant	35-50	intolerant	food source-twigs and fruits
American basswood <i>Tilia americana</i>	P, R, A	FACU	4.5- 7.5	intolerant	75-100	tolerant	food source-twigs, seeds and nectar
Canada hemlock <i>Tsuga canadensis</i>	P, R, A	FACU	4.0- 6.0	intolerant	75-100	very tolerant	food source-seeds, twigs, needles and bark; used for cover
**Red (Slippery) elm <i>Ulmus rubra</i>	P, R, A	FAC	5.5- 7.0	tolerant	50-80	intermediate	food source-seeds and twigs

APPENDIX B
LIST OF APPROVED SPECIES FOR REPLANTING

SMALL TREES/SHRUBS							
Common/ Scientific Name	Region	¹ Wet Code	Soil pH	Flood Tolerance	Height (ft)	Shade Tolerance	Wildlife Value
**Smooth alder <i>Alnus serrulata</i>	P, R, A	OBL	5.0- 7.0	very tolerant	12-20	very intolerant	food source-fruit
Red chokeberry <i>Photinia</i> (<i>Aronia</i>) <i>arbutifolia</i>	P, R, A	FACW	5.5- 7.5	very tolerant	6-12	intermediate	very low wildlife value
Black chokeberry <i>P. melanocarpa</i>	P, R, A	FAC	6.5- 8.0	very tolerant	3-6	intermediate	food source-seeds and twigs
Buttonbush <i>Cephalanthus</i> <i>occidentalis</i>	P, R, A	OBL	5.5- 8.5	very tolerant	6-12	very intolerant	food source-fruit
Summersweet <i>Clethra alnifolia</i>	P	FAC+	4.5- 6.5	very tolerant	6-12	tolerant	food source-fruits and twigs
Silky dogwood <i>Cornus amomum</i>	P, R, A	FACW	5.0- 7.0	very tolerant	6-12	intolerant	food source-fruits
Gray dogwood <i>C. racemosa</i>	P, R, A	FAC-	5.0- 7.0	intermediate	6-12	tolerant	food source-fruits; cover
Red-osier dogwood <i>C. sericea</i>	P, R, A	FACW+	6.0- 8.5	very tolerant	6-12	intermediate	food source-fruits, buds, and twigs
**Amer. hazelnut <i>Corylus americana</i>	P, R, A	FACU-	5.0- 7.0	intolerant	6-12	tolerant	food source-nuts (higher nutritional value than acorns and beechnuts)
Witchhazel <i>Hamamelis</i> <i>virginiana</i>	P, R, A	FAC-	4.5- 6.0	intolerant	20-35	very tolerant	leaves toxic to some animals
Winterberry <i>Ilex verticillata</i>	P, R, A	FACW+	4.5- 7.5	very tolerant	6-15	intermediate	intermediate wildlife value
**Mountain laurel <i>Kalmia latifolia</i>	P, R, A	FACU	4.5- 5.5	intolerant	12-20	very tolerant	high value as food esp. for winter browse for
Common spicebush <i>Lindera benzoin</i>	P, R, A	FACW-	4.5- 6.0	intermediate	6-12	very tolerant	high value as food source- fruits and leaves; host plant for spicebush swallowtail butterfly
Northern bayberry <i>Morella</i> (<i>Myrica</i>) <i>pensylvanica</i>	P, R	FAC	5.5- 8.0	very tolerant	6-12	intolerant	food source-fruits
**Ninebark <i>Physocarpus</i> <i>opulifolius</i>	P, R, A	FACW-	4.5- 6.5	very tolerant	6-12	intolerant	food source-fruit
**Rosebay rhododendron <i>Rhododendron maximum</i>	P, R, A	FAC	4.0- 5.5	tolerant	20-35	intolerant	food source-buds and twigs (winter browse)
**Swamp azalea <i>R. viscosum</i>	P	OBL	4.0- 7.0	very tolerant	6-12	intermediate	food source-nectar for hummingbirds and butterflies
Staghorn sumac <i>Rhus typhina</i>	P, R, A	None	4.5- 7.0	intolerant	35-50	intermediate	food source-fruit
**Swamp rose <i>Rosa palustris</i>	P, R, A	OBL	4.0- 7.0	very tolerant	4-10	intolerant	food source-fruit
*Pussy willow <i>Salix discolor</i>	P, R, A	FACW	4.0- 7.0	very tolerant	20-35	very intolerant	high value as food source
Sandbar willow <i>Salix</i> <i>exigua (interior)</i>	P, R, A	OBL	6.0- 8.5	very tolerant	15-20	very intolerant	food source-fruits and twigs

APPENDIX B
LIST OF APPROVED SPECIES FOR REPLANTING

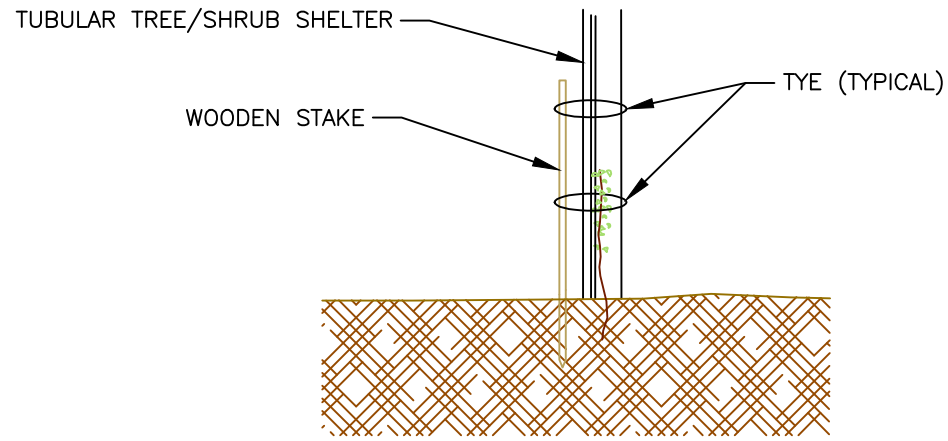
SMALL TREES/SHRUBS							
Common/ Scientific Name	Region	¹ Wet Code	Soil pH	Flood Tolerance	Height(ft)	Shade Tolerance	Wildlife Value
**Silky willow <i>Salix sericea</i>	P, R, A	OBL	5.0- 7.0	very tolerant	up to 12'	intermediate	food source – foliage and nectar
American elder <i>Sambucus canadensis</i>	P, R, A	FACW-	5.0- 7.0	very tolerant	6-12	intermediate	high value food source- fruit, twigs and leaves
Meadowsweet <i>Spiraea latifolia</i>	P, A	FACW+	6.5- 7.5	very tolerant	3-6	intermediate	food source-fruit and twigs
Highbush blueberry <i>Vaccinium corymbosum</i>	P, R, A	FACW-	4.5- 7.5	very tolerant	6-12	tolerant	food source-fruit
**Witherod <i>Viburnum cassinoides</i>	P, R, A	FACW	5.0- 7.0	very tolerant	6-12	tolerant	food source-fruit
Southern arrowwood <i>V. dentatum</i>	P	FAC	5.0- 6.5	tolerant	6-12	tolerant	food source-fruit
Nannyberry <i>V. lentago</i>	P, A	FAC	5.0- 7.0	intolerant	20-35	intermediate	food source – fruit and twigs
Blackhaw <i>V. prunifolium</i>	P, R, A	FACU	5.0- 7.5	very intolerant	20-35	intolerant	food source – fruit
Northern arrowwood <i>V. recognitum</i>	P, R, A	FACW-	5.0- 7.0	tolerant	6-12	tolerant	food source-fruit and nectar and pollen of the flowers

Pennsylvania Department of Environmental, Bureau of Watershed Management. (2010). Riparian Forest Buffer Guidance, Document Number 394-5600-001. Online at: <http://www.elibrarv.den.state.pa.us/dsweb/Get/Document-82308/394-5600-001.pdf> Accessed September 28, 2016.

Key for Appendix B:
 * Short lived: Trees < 100 years Shrubs < 20 years
 ** May be hard to find in a nursery
 P = Piedmont Province
 R = Ridge and Valley Province
 A = Allegheny Plateau Province
 OBL = Obligate Wetland
 FACW = Facultative Wetland
 FACU = Facultative Upland
 UPL = Obligate Upland

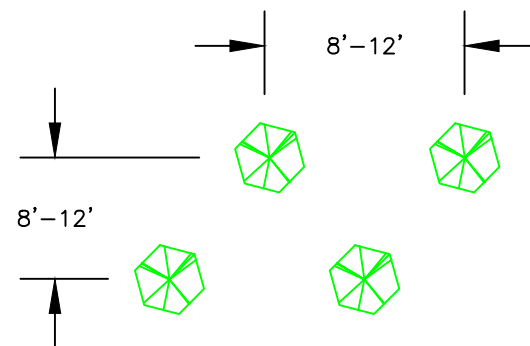
C

Typical Planting Details

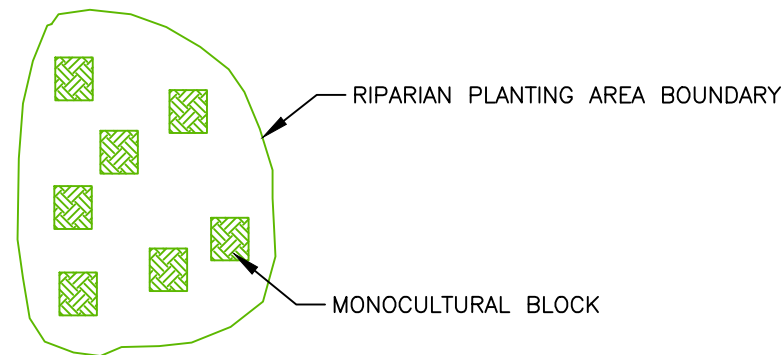


NOTE: TREE/SHRUB SHELTERS ARE TO BE MADE FROM BIODEGRADABLE PLASTIC TUBING. SIZE OF SHELTERS AND WOODEN STAKE TO BE DETERMINED BY PROJECT MANAGER.

TYPICAL TREE/SHRUB SHELTER DETAIL (TSS)
NOT TO SCALE



PLAN VIEW – PLANT SPACING WITHIN MONOCULTURAL BLOCKS

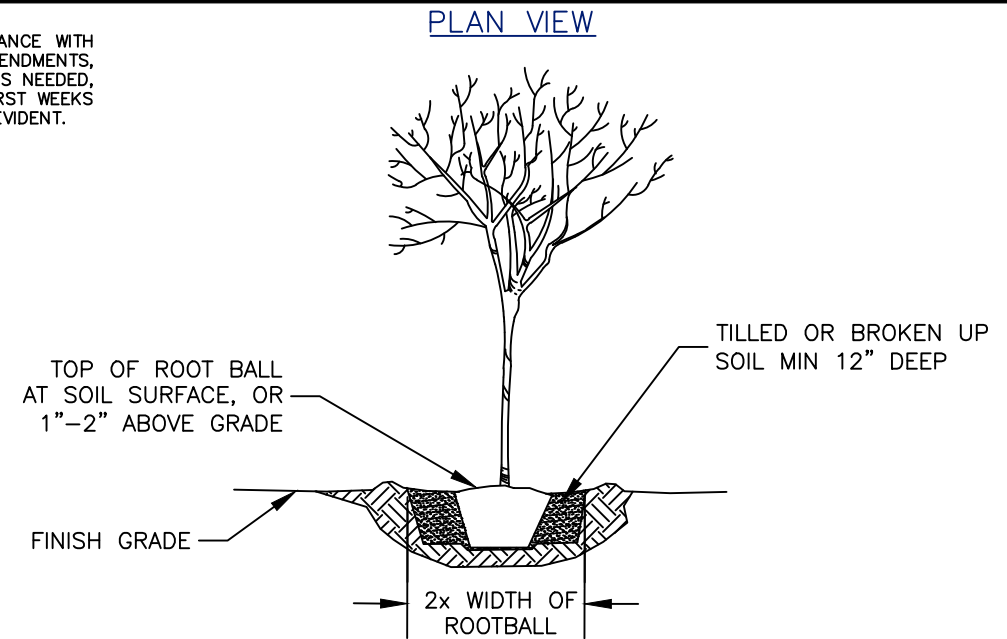


PLAN VIEW – RANDOMLY SPACED MONOCULTURAL PLANTING BLOCKS

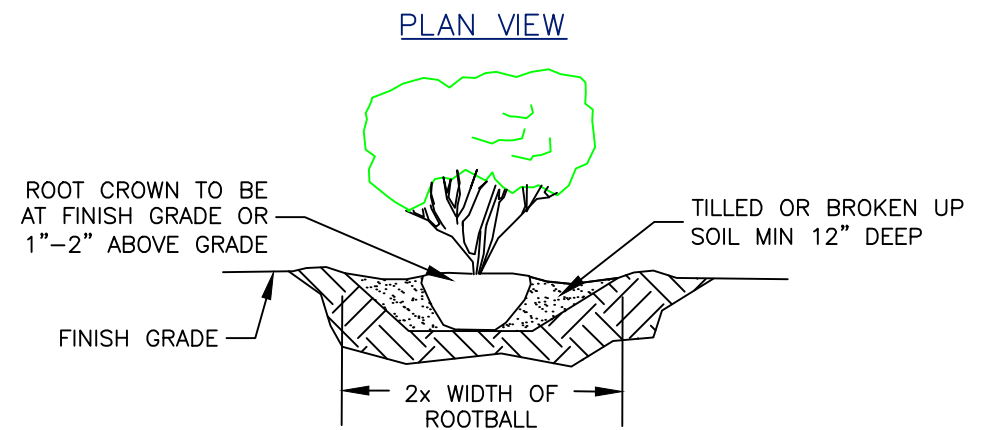
1. TYPICAL SPACING IS APPROXIMATE. PLANTS SHOULD BE LOCATED RANDOMLY TO AVOID THE APPEARANCE OF ORGANIZED ROWS WITHIN THE MONOCULTURAL PLANTING BLOCKS.
2. TREES AND SHRUBS ARE TO BE PLANTED IN THE PLANTING ZONES IDENTIFIED IN THE PLANTING SCHEDULE. MONOCULTURAL BLOCKS SHOULD CONTAIN 3-6 PLANTS IN SHRUB AND TREE ZONES. MONOCULTURAL BLOCKS SHOULD BE APPROXIMATELY 20' BY 20' IN SIZE, OR AS DIRECTED OR MODIFIED BY THE CONSTRUCTION MANAGER.

TYPICAL PLANT SPACING DETAIL (PS)
NOT TO SCALE

* ALL PLANTINGS ARE TO BE PLANTED AND MAINTAINED IN ACCORDANCE WITH NURSERY RECOMMENDATIONS FOR THE FERTILIZER, LIME, SOIL AMENDMENTS, WATER, AND WILDLIFE PROTECTION. WEEKLY INSPECTION, WATERING AS NEEDED, AND OTHER NECESSARY CARE SHOULD BE PROVIDED DURING THE FIRST WEEKS OF THE GROWING SEASON UNTIL SUCCESSFUL TRANSPLANTATION IS EVIDENT.



TREE PLANTING DETAIL (TP)
NOT TO SCALE



SHRUB PLANTING DETAIL (SP)
NOT TO SCALE

NOTES:

1. DIG THE PLANTING HOLE A MINIMUM OF 2x WIDTH OF ROOTBALL FOR AT LEAST THE FIRST 12 INCHES OF DEPTH. BELOW 12 INCHES, DIG HOLE WIDE ENOUGH TO PERMIT ADJUSTING. DO NOT DIG THE HOLE DEEPER THAN ROOT BALL DEPTH.
2. SCARIFY THE SUBGRADE AND SIDES OF THE PLANTING HOLE WHEN PLANTING IN CLAY SOILS (MORE THAN 15% CLAY).
3. LIFT AND SET THE TREE/SHRUB BY ROOT BALL ONLY. DO NOT LIFT USING THE TREE TRUNK AND DO NOT USE TREE TRUNK AS A LEVER.
4. SET THE TOP OF THE ROOT BALL LEVEL WITH THE SOIL SURFACE OR SLIGHTLY HIGHER IF THE SOIL IS PRONE TO SETTLING.
5. BACKFILL WITH EXISTING SOIL THAT HAS BEEN WELL-TILLED OR BROKEN UP. ADD FERTILIZER AND REPELLEX AMENDMENTS TO THE BACKFILL SOIL.
6. INSTALL TREE/SHRUB SHELTER AS OUTLINED IN DETAIL.

2525 GREEN TECH DRIVE, SUITE B
STATE COLLEGE, PA 16803
TELEPHONE: (814)-689-1650 FAX: (814)-689-1557

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC
ATLANTIC SUNRISE PROJECT
RIPARIAN BUFFER RESTORATION PLAN

DETAILS

PENNSYLVANIA

DATE:	11/09/16
DRAWN BY:	BWH
CHECKED:	RJN
DRAWING NO.	DETAIL
SHEET NO.	APPENDIX C