2018 Restoration Maintenance Work Plan

Bloody Brook Onondaga County, New York

October 2018

Prepared for:

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2018 RESTORATION MAINTENACE WORK PLAN BLOODY BROOK ONONDAGA COUNTY, NEW YORK

CERTIFICATION STATEMENT

I, Nickcole M. Evans, certify that I am currently a NYS registered professional engineer as defined in 6 NYCRR Part 375 and that this 2018 Restoration Maintenance Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) and that all activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.



Nickcole M. Evans, P.E. License Number 085978

In accordance with New York State Education Law, it is a violation for any person, unless he is acting under the direction of a licensed professional engineer, to alter this Work Plan in any way.

Contents

1.0	Introd	iction		1	
	1.1	Site Description		2	
2.0	Summ	ary of 2018 Res	toration Monitoring Results	3	
	2.1	Wooded Area and 2.1.1 Target V 2.1.2 Invasive	d Wetland Restoration /egetation 9 Species Control		
	2.2	Residential and C	Commercial Areas	4	
	2.3	Erosion		4	
3.0	Propo	ed Restoration	Maintenance Activities	5	
	3.1	Wooded Area and 3.1.1 Vegetation 3.1.2 Invasive	d Wetlands Maintenance ion Maintenance 9 Species Control	5 5 5	
	3.2	3.2 Residential and Commercial Areas			
	3.3	Erosion Control3.3.1Location3.3.2Location3.3.3Location3.3.4Location3.3.5Location3.3.6Location3.3.7Location3.3.8Location3.3.9Location3.3.10Location	n 1 ns 2 and 3 n 4 n 5 ns 6 and 7 ns 8 and 9 n 10 n 11 n 12 n 13 n 14		
4.0	Sched	ule		10	
5.0	Refere	nces		11	

List of Tables

Table 1 Current Tree and Shrub Counts from June 2018

Table 2 Summary of 2018 Maintenance Activities

List of Figures

Figure 1 Site Location Map

Figure 2 Site Area Map

Figure 3 Wetland Habitats

Figure 4A Erosion Locations 1 through 7

Figure 4B Erosion Locations 8 through 12

Figure 4C Erosion Locations 13 and 14

List of Attachments

Attachment A Planting Locations in Wooded Area/Wetland Habitat AreasAttachment B Photos of Erosion Locations 1 through 14 from 2018 InspectionAttachment C Seed MixturesAttachment D Bloody Brook Invasive Species Control Procedure

1.0 Introduction

This 2018 *Restoration Maintenance Work Plan* (RMWP) has been prepared to address the areas of concern identified in the *Annual Post-Construction Restoration Monitoring Summary Report* dated August 2018. The results of the monitoring activities completed in May and June 2018 included an evaluation of the success of the vegetation planting and established hydraulic regimes and an inspection for areas of erosion at the Bloody Brook site. The remediation, including construction and restoration activities completed from June 2014 through July 2017, was conducted in accordance with a Voluntary Cleanup Agreement (VCA) between Lockheed Martin and the New York State Department of Environmental Conservation (NYSDEC) (Index #: D7-0001-01-09, effective July 20, 2002). The remediation included the West Branch of Bloody Brook (WBBB) and Bloody Brook from below the confluence of the West and Middle Branches of Bloody Brook and adjacent property located between the New York State Thruway (Thruway) and Onondaga Lake Parkway (approximately 5,000 foot long section of stream) in the Town of Salina and a portion of the Village of Liverpool, Onondaga County, New York, as shown on Figure 1.¹ The NYSDEC "Release and Covenant Not to Sue" was received by Lockheed Martin for the Bloody Brook site on March 21, 2018.

In compliance with the NYSDEC approved February 2018 *Site Management Plan* (SMP) for Bloody Brook, annual restoration inspections are to be completed for five years following completion of restoration activities to ensure no erosion of the channel and banks is occurring and that the vegetation is growing as intended. The annual inspections are to be completed in accordance with the March 2014 Decision Document prepared by NYSDEC, property-specific owner restoration agreements, and the February 2018 SMP. The first of these monitoring events was completed in May 2017 for the majority of the Bloody Brook site and summarized in the NYSDEC approved *Annual Post-Construction Restoration Monitoring Summary Report* dated July 2017 and updated in a response letter to NYSDEC dated September 21, 2017. Site restoration was still in progress at the areas listed below and identified on Figure 2 during the 2017 inspection. Consequently, these areas were not monitored as part of the 2017 annual inspection. The first of the annual inspections for these areas was completed in 2018.

- Apartment complex area including the stream side banks and bottom
- Portion of the commercial property outside of the stream side banks and located between the Old Liverpool Road culvert and the railroad tracks
- Construction access area at Onondaga Lake Parkway

¹ The term "site" in the VCA is defined as: a portion of the banks, surface waters and sediments of the West and Middle Branches of Bloody Brook located in the Town of Salina with a portion of the site located in the Village of Liverpool and commences downstream of Interstate 90, the New York State Thruway, and extends generally southward past the confluence of the West Branch and the Middle Branch of Bloody Brook creating Bloody Brook, and ends on the upstream side of Onondaga Lake Parkway. After examining data developed during remedial investigation work in the Middle Branch, NYSDEC determined that no further action was required for that branch of Bloody Brook. For this reason, the "site" in this document relates only to those areas within the VCA site where the remedial program has been implemented.

The May/June 2018 monitoring activities were completed in accordance with Appendix J (*Restoration Monitoring Plan*) of the SMP and included the following:

- Inspection of the brook channel side banks and channel bottom for signs of erosion;
- Inspection of vegetation planted during restoration activities on the residential, commercial, and other upland properties; and
- Inspection of the wetland areas to evaluate development of the restored wetlands.

1.1 Site Description

The Bloody Brook site was broken into four distinct areas based on land use and characteristics as shown on Figure 2 and described below.

- Wooded Area This portion of the site extends from the Thruway south (downstream) approximately 1,050 feet. This undeveloped area is irregularly shaped and relatively wide (i.e., greater than 150 feet) and includes three wetlands. The wooded area is entirely within the Onondaga County Bloody Brook Drainage District (Drainage District) easement and is owned by the Town of Salina. The Drainage District easement provides Onondaga County personnel permanent access for various projects to improve and maintain drainage. Storm water drainage from the surrounding development enters the WBBB from the west via a drainage channel at the southern end of the wooded area.
- Residential Area The residential area surrounds the wooded area commencing at the Thruway and extending downstream of the wooded area with residential properties abutting the Drainage District easement along the WBBB to the downstream side of Floradale Road.
- Apartment Complex Area The apartment complex area is located on Pearl Street and Town Gardens Drive between the residential properties along Floradale Road and the commercial properties along Old Liverpool Road. Construction activities outside of the drainage district easement were completed in the apartment complex area during the spring of 2017, therefore the first inspection for this portion of the site was conducted as part of 2018 annual monitoring event.
- Commercial Area The commercial area extends from commercial properties located along Old Liverpool Road to Onondaga Lake Parkway. Construction activities were completed in portions of this area during the spring of 2017, therefore the first inspection of these areas was conducted as part of the 2018 annual monitoring event.

2.0 Summary of 2018 Restoration Monitoring Results

Restoration monitoring for the wooded, residential, apartment complex, and commercial areas was completed during May and June 2018 in accordance with the February 2018 SMP. Monitoring activities included vegetation and wetland inspections completed by a biologist, and an erosion inspection completed by an engineer. Results for the monitoring in each area is summarized in the sections below to the extent needed to describe the proposed maintenance activities. Current planting locations for each of the habitat areas based on the June 2018 wetlands monitoring, initially submitted as part of the 2018 Annual Post-Construction Restoration Monitoring Summary Report, are provided in Attachment A of this work plan. Table 1 includes a current tree and shrub count for each of these areas. For a complete discussion of the monitoring results in each of the separate habitat areas, see the 2018 Annual Post-Construction Restoration Monitoring Summary Report.

2.1 Wooded Area and Wetland Restoration

2.1.1 Target Vegetation

In accordance with the NYSDEC and USACE permitting for the remediation construction activities in the WBBB and its floodplain, Lockheed Martin upgraded the stream habitat of WBBB by constructing replacement wetland habitat and replanting all disturbed areas of upland habitat within the project footprint. A total of 1.57 acres of wetland have been delineated (Figure 3). Following an adaptive management approach to the development of the wetlands, the habitat areas appear to be developing as anticipated with some exceptions, as discussed in the sections below (Figure 3).

Vegetation monitoring in the wooded area, which includes three habitats: the wetlands previously discussed, upland habitat areas, and riparian areas (transitional areas between wetland and upland areas and areas along the stream channel), was completed in accordance with Appendix J of the SMP (*Restoration Monitoring Plan*). The information collected during the inspection was used to calculate the percent survival of the targeted plant species and the percent vegetation cover in the different habitat areas in order to assess the progression of development and natural sustainability of the wetlands and habitat areas. Target plant species include all planted shrubs and trees.

The site vegetation inspections in the wooded area included inspections of the vegetative cover (e.g., planted seed mixes and emergent plants), trees, and shrubs for each of the wetland, upland, and riparian habitat types. The vegetative cover in these areas was inspected to ensure that germination is covering all areas and that no large bare spots (larger than 1 square foot) exist. The upland and riparian habitat is developing essentially as designed, with tree and shrub survival satisfying the NYSDEC approved target numbers (Table 1). The wetland habitat areas appear to be developing based on the adaptive management approach applied for the 2017 maintenance activities that adjusted some of the originally designed habitat area boundaries to account for more saturated conditions related to groundwater seepage in some areas (Figure 3).

While the target emergent vegetation, trees, and shrubs are surviving and developing as intended, the 2018 monitoring event did identify areas remaining within two habitat areas, W-11 and MOW-1, where the applied seed mixtures have not germinated well. W-11, shown on Figure 3, has developed a strong population of emergent vegetation. However, there are still large bare spots where the

wetland seed mix did not germinate. Additionally, for the majority of MOW-1 and MOW-2 (Figure 3), the seed mixture placed during restoration activities has been successful. However, there are large bare spots in MOW-1 where the temporary construction staging area was setup.

2.1.2 Invasive Species Control

During the 2018 monitoring activities, there were two primary invasive species of plants noted, *Phragmites* and purple loosestrife. Manual removal has been successful at reducing the population of *Phragmites* and purple loosestrife and will continue to be implemented at the site with monthly invasive species inspections and removal activities as discussed in further detail below in Section 3.1.2.

The vibrurnum leaf beetle was documented during the 2018 monitoring activities to be causing damage to the northern arrowwood shrubs planted at the site. Experts were consulted and indicated the shrubs should survive this initial infestation. The beetle population causing damage to the northern arrowwood shrubs should decline as predator populations develop (Eshenaur, 2018 and Weston, 2018).

2.2 Residential and Commercial Areas

No major issues were identified on the private properties during the monitoring event. Results and recommendations for these inspections completed on private properties will be discussed as needed with the property owner.

2.3 Erosion

There were no major areas of concern along the brook channel noted during the 2018 site inspection. The stream bottom and side banks were intact and showed little signs of damage during the May 2018 erosion inspection. However, several areas were noted as requiring overseeding, placement of additional rip rap, or adjustment of the rip rap currently present. The inspection identified 14 separate areas that should be addressed as part of the 2018 maintenance activities (Figures 4A through 4C). Photos taken of these areas during the inspection are provided in Attachment B.

Following completion of the 2018 monitoring activities, AECOM was notified by Onondaga County Department of Water Environment Protection (OCDWEP) that armor material had washed away from a portion of the channel bank below Old Liverpool Road following a heavy rain event. This location had been identified as Location 13 during the earlier May 2018 inspection and was noted as being an area with some rip rap erosion requiring installation of additional armor material. As an interim corrective measure, the armor material was placed by hand onto the channel slope. This area was and will be monitored at least monthly and after significant rainfall events until the permanent corrective measure proposed in this work plan can be implemented during the 2018 maintenance activities. Photos of this area before and after the interim repair are provided in Attachment B.

3.0 **Proposed Restoration Maintenance Activities**

Section 2 of this work plan summarized the areas of concern that warrant restoration maintenance activities, as recommended in the August 2018 *Annual Post-Construction Restoration Monitoring Summary Report,* to support the establishment of diverse habitats and to prevent erosion of the cover. The maintenance activities will include overseeding, invasive species control, and the implementation of erosion control measures, to be completed either during fall 2018 or spring 2019, depending on weather conditions. The following sections outline the proposed restoration maintenance activities, and Table 2 summarizes all of these activities.

3.1 Wooded Area and Wetlands Maintenance

3.1.1 Vegetation Maintenance

As discussed in Section 2, the wetlands are beginning to develop as designed based on the adaptive management approach. Based on the 2018 wetland inspection, no tree or shrub plantings are recommended during the fall 2018 maintenance activities. There are however two habitat areas where additional seeding is proposed. The wetland inspection was completed during June 2018. Site conditions may have changed slightly since the inspection was conducted. Subsequently, the maintenance activities described below may be slightly modified based on site conditions at the time of implementation.

- W-11, shown on Figure 3, has developed a strong population of emergent vegetation. However, there are still large areas where the wetland seed mix did not germinate. These bare spots will be overseeded again this fall with PA New England Province FACW Mix (ERNMX-251) (Attachment C). If the 2019 monitoring results indicate the seed mixture again failed to germinate, other options will be evaluated.
- For the majority of MOW-1 and MOW-2 (Figure 3), the seed mixture placed during restoration activities has been successful. However, there are large bare spots in MOW-1 where the temporary construction staging area was located. Those bare spots will be hand raked to loosen the ground surface and reseeded with the upland meadow seed mix (Northeastern U.S. Road Native Mix [ERNMX-105]) (Attachment C). The placement of additional topsoil may be needed prior to overseeding. If topsoil is placed, it will be bagged topsoil purchased from a local retail store.

3.1.2 Invasive Species Control

There were two primary invasive species of plants noted, *Phragmites* and purple loosestrife. Manual removal was successful at reducing the population of these species and will continue to be implemented at the site with monthly invasive species inspections and removal activities completed during the growing season. The presence of purple loosestrife leaf beetles has been observed, but due to the persistence of the purple loosestrife at the site, manual removal will continue to be implemented. The Bloody Brook Invasive Species Control Procedure for *Phragmites* and purple loosestrife is included in this work plan as Attachment D.

Monthly inspections will include documentation of the extent of invasive species, identification of the plant species, and manual removal of invasive species attributing to 5 percent or more of ground cover. Manual removal will be completed weekly (about one to two days per week) using hand tools (i.e., spading forks and "Uprooter") in order to prevent inadvertently spreading seeds or root material to surrounding areas and will include as much subsurface root material as possible to slow the spread of the invasive species. In addition, two, 5- to 10- day removal efforts will also be completed in the fall and spring. All plant material will be placed in trash bags and removed for offsite disposal. Monthly inspection documents will be retained in the project files and summarized in the site Periodic Review Report (PRR) to be submitted to NYSDEC per the reporting schedule in the 2018 SMP.

As discussed in Section 2.1.2, the vibrurnum leaf beetle was documented during the 2018 monitoring activities to be causing damage to the northern arrowwood shrubs planted at the site however, the beetle population causing the damage should decline as predator populations develop (Eshenaur, 2018 and Weston, 2018). The impact of this pest will be monitored during the monthly invasive species inspections during the growing season and during the annual restoration monitoring.

3.2 Residential and Commercial Areas

No major issues were identified on the private properties during the monitoring event. Results and recommendations for these inspections completed on private properties will be discussed as needed with the property owner.

3.3 Erosion Control

As discussed in Section 2.3, there are 14 areas requiring overseeding, planting of live stakes, placement of additional rip rap, and/or adjustment of the rip rap currently present. Locations 1 through 7 are shown on Figure 4A, Locations 8 through 10 are shown on Figure 4B, and Locations 11 through 14 are shown on Figure 4C. The corrective measures that will be implemented to address the areas of concern noted during the 2018 erosion inspection are described in the following sections. Photos taken during the 2018 inspection are provided in Attachment B.

As discussed in the following sections, lives stakes will be planted in some areas along the bank to improve bank stability and help protect the bank against future erosion. Live stakes will be planted in accordance with the 2014 Revised Restoration Work Plan (AECOM 2014). The live stakes will be planted through the rip rap. At least half the length of each live stake will be inserted into the soil beneath the rip rap. The live stakes will be cut to a point on the basil end prior to insertion. An iron bar or similar hand tool will be used to make a pilot hole to prevent damaging the live stakes during planting. The lives stakes will be planted by hand into the pilot holes. A minimum of two live buds will be exposed above the rip rap. Any damaged portions of the live stakes will be cut back to undamaged condition.

Some of the erosion locations discussed below are in transition areas, where the rip rap and vegetative ground cover meet. In these transition areas, the vegetation is not establishing as well as the other areas, and erosion of the soil along the edge of the rip rap has been observed. To promote the growth of vegetation, these areas will be addressed by adding a mixture of bagged topsoil and bagged compost prior to seeding. Straw will be placed over top to hold the seed in place until germination.

In addition to the maintenance activities to address the specific erosion locations identified below, the channel will be walked, and any ground cover netting remaining from temporary erosion control materials will be removed and disposed of.

3.3.1 Location 1

Location 1 is located in the upland forested area adjacent to the New York State Thruway property (Figure 4A). At the time of the May 2018 inspection, minor vegetation loss within the area disturbed by remedial activities was noted for this location. However, the area had just been recently overseeded; therefore only monitoring will be conducted at this time.

3.3.2 Locations 2 and 3

Locations 2 and 3 are located in the riparian area just upstream of Weir 1 (Figure 4A). Minor vegetation loss and erosion within the areas disturbed by remedial activities was noted for these locations during the 2018 inspection (Attachment B). These locations will be overseeded with PA New England Province Riparian Mix (ERNMX-253) (Attachment C), and live stakes may be planted at Location 2 to improve bank stability. At Location 3, live stakes will be planted, and rip rap will be placed, if needed, to stabilize the ground to allow the live stakes to take root. The use of rip rap at this location will be minimized.

3.3.3 Location 4

Location 4 is located in the riparian area adjacent to Weir 1 (Figure 4A). Minor vegetation loss within the area disturbed by remedial activities was noted for this location during the 2018 inspection (Attachment B). This location will be overseeded with PA New England Province Riparian Mix (ERNMX-253) (Attachment C), and live stakes may be planted in some areas to improve bank stability.

3.3.4 Location 5

Location 5 is located in the riparian area downstream from Weir 1 (Figure 4A). During the 2018 inspection, portions of the side bank were noted as having sparse vegetation growth and minor riprap erosion (Attachment B). This location will be overseeded with PA New England Province Riparian Mix (ERNMX-253) (Attachment C), and live stakes may be planted in some areas to improve bank stability. The rip rap will also be adjusted in this area to prevent future erosion.

3.3.5 Locations 6 and 7

Location 6 is located along the side bank adjacent to the empty lot on Midwood Drive, and Location 7 is located on the opposite bank just downstream from Location 6 (Figure 4A), both in a residential area. During the 2018 inspection, portions of the side bank showed signs of minor rip rap erosion at both of these locations (Attachment B). Rip rap adjustment will be needed at both areas to help prevent future erosion, and the areas will be overseeded as needed with Northeastern U.S. Road Native Mix [ERNMX-105]) (Attachment C) to help improve bank stability.

3.3.6 Locations 8 and 9

Locations 8 and 9 are located in a residential area along the side bank between Brookview Lane and Sunflower Drive (Figure 4B). During the 2018 inspection, portions of the side bank showed signs of minor rip rap erosion (Attachment B). Rip rap adjustment will be needed at both areas to help prevent

future erosion, and the areas will be overseeded as needed with Northeastern U.S. Road Native Mix [ERNMX-105]) (Attachment C) to help improve bank stability. The placement of additional topsoil may be needed prior to overseeding. If topsoil is placed, it will be bagged topsoil purchased from a local retail store.

3.3.7 Location 10

Location 10 is located in the residential area between Sunflower Drive and Floradale Road (Figure 4B). During the 2018 inspection, portions of the side bank showed signs of minor rip rap erosion (Attachment B). This bank area will be addressed by adjusting the rip rap to help prevent future erosion.

3.3.8 Location 11

Location 11 is located along the side bank within the apartment complex area (Figure 4B). During the 2018 inspection, portions of this side bank showed signs of soil erosion (Attachment B). This bank area will be addressed by placing additional topsoil (i.e., bagged topsoil purchased from local retail store) and overseeding with Northeastern U.S. Road Native Mix [ERNMX-105]) (Attachment C) to help improve bank stability. The need for an erosion mat will be evaluated at the time of the maintenance.

3.3.9 Location 12

Location 12 is located along the side bank within a commercial property across from the apartment complex area (Figure 4B). During the 2018 inspection, portions of this side bank showed signs of minor rip rap erosion (Attachment B). This bank area will be addressed by adjusting the rip rap to help prevent future erosion.

3.3.10 Location 13

Location 13 is located in the commercial-light industrial area along the side bank below Old Liverpool Road (Figure 4C). As discussed in Section 2.3, OCDWEP notified AECOM in July 2018 that armor material had washed away from a portion of the channel bank below Old Liverpool Road following a heavy rain event. In May 2018, this location had been identified as Location 13 during the inspection and was noted as being an area with some rip rap erosion requiring installation of additional armor material.

In November/December 2017, repairs were made to the bank armor material just upstream from Location 13 in accordance with the NYSDEC approved October 2017 Restoration Maintenance Work Plan. These repairs were successful at stabilizing the armor material and are therefore being extended to address the new erosion area. The repairs at Location 13 will consist of installing additional rip rap to continue the bank armoring from the stable upstream side bank to the stable downstream side bank using similar rip rap used upstream during the repair activities in 2017 and will be completed as follows:

Similar to the installation of rip rap located upstream and downstream of Location 13, soil will be
removed to a depth of one foot from the top of the stream side bank to match the angle and
anchoring of rip rap. Approximately 2.5 cubic yards of soil will be removed. The removed soil will
remain onsite to be used for filling in the transitional areas between the rip rap and the existing
ground cover as well as to repair/reseed the access areas used to complete the repairs.

- Install demarcation fabric (Mirafi FW700 or equivalent) similar to the original restoration and restoration completed for the remainder of the site.
- Over demarcation layer, lay 24- to 36-inch rip rap at the bottom of the stream side bank and 6- to 12-inch stones around the larger stones and at the top of the bank. The rip rap will be placed with two larger stones staggered on top of one another with the smaller stones filling in the gaps, and additional smaller stones placed at the top of the stream side bank.

The work will be done using an excavator to remove soil and place the rip rap. The channel will be accessed from 911 Old Liverpool Road and crane mats will be used as needed to stabilize the work area and minimize damage caused by equipment. The maintenance activities are to replace eroded rip rap and will not change the stream dimensions. All intrusive work (including soil removal) will be completed outside of the brook. Additionally to minimize turbidity concerns, removal of rip rap currently in place along the bottom of the side bank will be completed by hand.

Following armor repairs, the area will be restored by overseeding with Northeastern U.S. Road Native Mix [ERNMX-105]) (Attachment C).

3.3.11 Location 14

Location 14 is located in the commercial-light industrial area upstream from the CSX property (Figure 4C). During the 2018 inspection, vegetation loss was noted for a portion of the side bank. To address this issue, the area will be overseeded with Northeastern U.S. Road Native Mix [ERNMX-105]) (Attachment C) to help improve bank stability.

4.0 Schedule

The proposed maintenance activities will be initiated immediately following receipt of NYSDEC's approval of this work plan. It is that anticipated these activities, including seeding and erosion repair activities, will occur in late October and November 2018, weather permitting. Any maintenance activities not completed in 2018 will be completed during spring 2019. Within 60 days of completing the maintenance activities, a summary report will be prepared and submitted to the NYSDEC.

5.0 References

Brian Eshenaur, NY, Cornell Cooperative Extension, Cornell University, Ithaca, NY. 2018. Personal communication with R. Montione, TAMS Consultants, Inc., Latham, NY. Discussion of Viburnam Leaf Beetle infestations based on recent research. June.

Weston, Paul, Charles Sturt University, Wagga Wagga, NSW, Australia. 2018. Personal communication with R. Montione, AECOM, Latham, NY. Discussion of Viburnam Leaf Beetle infestations based on his previous research. June.

TABLES

Wetland Habitat Area	Area (square feet)	Total Number of Target Trees/Shrubs ¹	Species	Total Number of Trees/Shrubs Counted during 2018 Monitoring
PSS-1 Trees	1,726	4		4
	•	•	Pin Oak	3
			Red Maple	1
PSS-1 Shrubs	1,726	17		17
			Grey Dogwood	3
			Nannyberry	3
			Northern Arrowwood	6
	0.040		Steeplebush	5
PSS-2 Shrubs	6,940	69	O an alla an M/illiann	68
			Sandbar Willow	3
			Elderborn	0
			Red Chokeberry	3
			Buttonbush	13
			Steeplebush	13
			Sweet Gale	13
			Northern Arrowwood	14
PFO-1 Trees	10.817	33		37
	- / -		Red Maple	3
			Pin Oak	7
			Black Willow	13
			River Birch	7
			Swamp White Oak	7
PFO-1 Shrubs	10,817	4		4
			Elderberry	4
RIP-1 Trees	31,515	96		96
			Red Maple	29
			Sugar Maple	20
			Pin Oak	18
			Eastern Hemlock	11
			White Pine	6
			Swamp white Oak	1
			Silver Maple	10
RIP-1 Shrubs	31 515	31/		313
	51,515	514	Northern Arrowwood	128
			Nannyherry	50
			Grev Dogwood	91
			Highbush Cranberry	12
			Steeplebush	6
			Sweet Gale	8
			Buttonbush	10
			Speckled Alder	8
USS-1 Shrubs	3,291	39		39
			Grey Dogwood	19
			Nannyberry	20
UPF-1 Trees	8,675	26		27
			Sugar Maple	11
			American Beech	9
			Black Cherry	
			Silver Maple	1
LIDE 1 Shruha	9 675	06	Eastern Herniock	0
UPF-1 Shrubs	8,075	00	Northarp Arrowwood	83
			Nanyberny	<u>∠0</u> 1 <i>1</i>
			Grey Dogwood	35
			Highbush Cranberry	8
UPF-2 (Woodland) Trees	11,300	21	.g	21
2.1 2 (1.000iunu) 11005	.1,000	<u> </u>	Sugar Maple	4
			White Pine	3
			Red Maple	8
			Eastern Hemlock	6
UPF-2 (Woodland) Shrubs	11,300	83		82
, , , , , , , , , , , , , , , , , , , ,			Northern Arrowwood	40
			Grey Dogwood	28
			Nannyberry	11
			Elderberry	3

Table 1. Current Tree and Shrub Counts from June 2018

Notes:

1) Target trees and shrubs refer to the trees and shrubs planted in accordance with NYSDEC approved restoration activities.

Table 2. Summary of 2018 Maintenance Activities

Location of Needed	
Maintenance Activity	Needed Activities
Full site, as needed (Figure 3)	 Remove any remaining groundcover netting from temporary erosion control.
All wetland areas, as needed	
(Figure 3)	Invasive species control
W-11 (Figure 3)	 Overseeding (potential topsoil placement prior to)
MOW-11 (Figure 3)	•Overseeding
Location 1 (Figure 4A)	Monitoring only
	•Overseeding
Location 2 (Figure 4A)	Potential live stake planting
	•Overseeding
	•Live stake planting
	•Placement/adjustment of armor material (rip-rap) only as needed for stability
Location 3 (Figure 4A)	while live stakes root.
	•Overseeding
Location 4 (Figure 4A)	Potential live stake planting
	•Overseeding
	•Live stake planting
Location 5 (Figure 4A)	•Adjustment of armor material (rip-rap)
	•Overseeding
Location 6 (Figure 4A)	•Adjustment of armor material (rip-rap)
	•Overseeding
Location 7 (Figure 4A)	•Adjustment of armor material (rip-rap)
	 Overseeding (potential topsoil placement prior to)
Location 8 (Figure 4B)	•Adjustment of armor material (rip-rap)
	 Overseeding (potential topsoil placement prior to)
Location 9 (Figure 4B)	•Adjustment of armor material (rip-rap)
Location 10 (Figure 4B)	•Adjustment of armor material (rip-rap)
	Placement of topsoil
	•Overseeding
Location 11 (Figure 4B)	•Assess need for erosion mat
Location 12 (Figure 4B)	•Adjustment of armor material (rip-rap)
Location 13 (Figure 4C)	•Major armor material erosion repair; see Section 3.3.10 for details
Location 14 (Figure 4C)	•Overseeding

Note:

Maintenance activities completed on private properties will be discussed, as needed, with the property owner. No major issues have been identified.

FIGURES



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P



Legend

----- CURRENT BROOK ALIGNMENT

- WOODED AREA
- RESIDENTIAL AREA

APARTMENT COMPLEX AREA

COMMERCIAL -LIGHT INDUSTRIAL AREA

COMMERCIAL AREAS EXCLUDED FROM MAY 2017 MONITORING





	13	14	15		16
					л Ц Ц Ц Ц Ц Ц Ц Ц Ц Ц Ц Ц
) (D DRIVE				
380	386	385 DECK DECK 387 DECK 380 380 380 380 380 380 380 380	LAV 15+50	0085 ///////////////////////////////////	НОТО-6
2] 13+00	13+50 	MOW-2			PLANTER
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365 	LEGEND BLOODY BROOK DF PROPERTY BORDE TOPOGRAPHIC COR PROPOSED BLOOD STREAM/WATER ED UNDERGROUND DF OVERHEAD WIRES RETAINING WALL GUARD RAIL UTILITY MANHOLE DRAINAGE MANHOL	RAINAGE DISTRICT EASEMENT R NTOUR LINE (PRE-EXCAVATION) Y BROOK CENTERLINE OGE RAIN LINE	PE PE UP US MO RII LAV PHOTO-1 D+	S PALU M PALU PALU PALU F FOR S SHR W UPL/ C RIPA VN LAW VN LAW VN WET →B WET	USTRINE SHRUB / SCRUB USTRINE EMERGENT USTRINE FORESTED ESTED UPLAND UB / SCRUB UPLAND AND MEADOW RIAN N LAND LAND MONITORING TOGRAPH LOCATION .TIPLE VIEWS)
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=, 1,131,0 BI -115	00 NYS PLANE COORD				
7+50 	CHANNEL CENTERI				
367.4 > ** **	TOPOGRAPHIC SPO CONIFEROUS TREE DECIDUOUS TREE LIGHT POLE		, 	o' APP	50' 100' ROXIMATE SCALE
	UTILITY POLE / GUY	WIRE			AECOM
PZ-1 -	RIP RAP EXISTING WETLANE WETLAND PIEZOME WETLAND MONITOR) TER LOCATION RING STAFE GAUGE	20	LOCKHE	ED MARTIN CORPORATION ATION MAINTENANCE WORK PLAN WETLAND HABITATS BLOODY BROOK INDAGA COUNTY, NEW YORK
-			FILE N 2018	MAME: Plant Plan Rev 4.	DRN PROJECT NO. DATE FIGURE NO. dwg RNB 60572195 9 / 2018 3







45 46		47	48	

<u>LEGEND</u>

	BLOODY BROOK DRAINAGE DISTRICT EASEMENT
	PROPERTY BORDER
	TOPOGRAPHIC CONTOUR LINE
	CENTERLINE OF CHANNEL
	STREAM/WATER EDGE
	UNDERGROUND DRAIN LINE
	OVERHEAD WIRES
RW	RETAINING WALL
-0-0-0-0-	GUARD RAIL
имн 🛞	UTILITY MANHOLE
DMH O	DRAINAGE MANHOLE
SMH 🔘	SANITARY MANHOLE
++++	RAILROAD TRACKS
св 🗸	CATCH BASIN
OZG []2G	DRAINAGE STRUTURES
FP O	FLAG POLE
[]]]]]	CULVERT
E 924,000	NYS PLANE COORDINATE SYSTEM EASTING
N 1,131,000	NYS PLANE COORDINATE SYSTEM NORTHING
BL-115 🛆	AERIAL SURVEY GROUND CONTROL POINT
7+50 +	CHANNEL CENTERLINE SURVEY STATION
367.4 ×	TOPOGRAPHIC SPOT ELEVATION
*	CONIFEROUS TREE
¢	DECIDUOUS TREE
<u>~</u> @	LIGHT POLE
è	UTILITY POLE / GUY WIRE

E 922,500



ARTINAL

EROSION LOCATION

LOCATION HISTORIC BROOK ALIGNMENT LIMITS OF REMEDIAL ACTION (2FT MAX. DEPTH BGS) LIMITS OF REMEDIAL ACTION WITHIN EXISTING BROOK CHANNEL



AECOM
LOCKHEED MARTIN CORPORATION
RESTORATION MAINTENANCE WORK PLA ON AREAS FROM MAY 2018 EROSION INSPECTI SHEET 3 OF 3

WEST BRANCH OF BLC
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 PROJECT NO.
 DATE
 FIGURE NO.

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 60338140
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 4C
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ATTACHMENT A



NOTES

1.



LEGEND

PZ-1 🔶 WETLAND PIEZOMETER LOCATION

SG-1 🔘 WETLAND MONITORING STAFF GAUGE

PSS PALUSTRINE SHRUB / SCRUB

PEM PALUSTRINE EMERGENT

RIP RIPARIAN

EXISTING WETLAND

EXISTING TREES

.

- **PIN OAK**
- RED MAPLE

EXISTING SHRUBS

- BUTTONBUSH
- GREY DOGWOOD
- NANNYBERRY
- NORTHERN ARROWWOOD
- RED OSIER DOGWOOD
- A STEEPLE BUSH

PLANT STATUS BASED ON JUNE 2018 INSPECTION

- Ο LIVING TREES
- STRESSED \mathbf{N}
- NUMBER OF LIVING SHRUBS 3

THE WETLAND BOUNDARIES BASED ON THE MAY 2017 INSPECTION ARE SHOWN.

			OM		
	ANNUAL P	OST- NITO	IN CORPC CONSTRU RING SUM	CTION	FPORT
15' 30'	PLANTING LOCAT		FOR PSS Y BROOK	-1 AND P	EM-3
	ONONDAC FILE NAME: 2018 Plant Plan rev 4.dwg	GA COU DRN RNB	JNTY, NEW Y PROJECT NO. 60572195	ORK DATE 7 / 2018	FIGURE 4



PSS	PALUSTRINE SHRUB / SCRUB			
PEM	PALUSTRINE EMERGENT			
PFO	PALUSTRINE FORESTED			
USS	SHRUB / SCRUB UPLAND			
RIP	RIPARIAN			
W	WETLAND			
	EXISTING WETLAND			

EXISTING SHRUBS

	BUTTONBUSH
	ELDERBERRY
	RED CHOKEBERRY
	SANDBAR WILLOW
	NORTHERN ARROWWOOD
A	STEEPLE BUSH
A	SWEET GALE

<u>NOTES</u>

1. THE WETLAND BOUNDARIES BASED ON THE MAY 2017 INSPECTION ARE SHOWN.





PZ-3	÷	WETLAND PIEZOMETER LOCATION
	•	

- SG-3
 WETLAND MONITORING STAFF GAUGE
 - PSS PALUSTRINE SHRUB / SCRUB
 - PEM PALUSTRINE EMERGENT
 - PFO PALUSTRINE FORESTED
 - USS SHRUB / SCRUB UPLAND
 - MOW UPLAND MEADOW
 - RIPARIAN
 - LAWN LAWN

RIP

- W WETLAND
 - EXISTING WETLAND

EXISTING TREES

- BLACK WILLOW
- PIN OAK
- RED MAPLE
- RIVER BIRCH
- SWAMP WHITE OAK

<u>SHRUBS</u>

▲ ELDERBERRY

PLANT STATUS BASED ON JUNE 2018 INSPECTION

- O LIVING TREES
- ∖ STRESSED

NOTES

1. THE WETLAND BOUNDARIES BASED ON THE MAY 2017 INSPECTION ARE SHOWN.





ilename: C:\CIVIL 3D PROJECTS\BLOODY BROOK\MONITORING\2018 PLANT PLAN FIG7.DWG

LEGEND

PSS

PEM

PFO

USS

MOW

. .



PALUSTRINE EMERGENT

PALUSTRINE FORESTED

UPF FORESTED UPLAND

SHRUB / SCRUB UPLAND

UPLAND MEADOW

EXISTING WETLAND



RIPARIAN

LAWN

WETLAND

EXISTING TREES

	BLACK WILLOW
_	

- EASTERN HEMLOCK
- PIN OAK
- RED MAPLE
- SILVER MAPLE
- SUGAR MAPLE
- SWAMP WHITE OAK WHITE PINE

- **EXISTING SHRUBS BUTTON BUSH** GREY DOGWOOD NANNYBERRY NORTHERN ARROWWOOD SPECKLED ALDER HIGH BUSH CRANBERRY SWEET GALE **BUTTON BUSH/HIGH BUSH CRANBERRY** GREY DOGWOOD/SPECKLED ALDER HIGH BUSH CRANBERRY/GREY DOGWOOD HIGH BUSH CRANBERRY/SWEET GALE SPECKLED ALDER/HIGH BUSH CRANBERRY <u>G</u> SWEET GALE/GREY DOGWOOD S/D STEEPLE BUSH/GREY DOGWOOD G/B
 - SWEET GALE/BUTTON BUSH



LOCKHEED MARTIN CORPORATION

ANNUAL POST-CONSTRUCTION RESTORATION MONITORING SUMMARY REPORT PLANTING LOCATIONS FOR RIP-1

> BLOODY BROOK ONONDAGA COUNTY, NEW YORK

FILE NAME:	DRN	PROJECT NO.	DATE	FIGURE
2018 Plant Plan Fig7.dwg	RNB	60540930	7 / 2018	7





PALUSTRINE SHRUB / SCRUB

PALUSTRINE EMERGENT

PALUSTRINE FORESTED

SHRUB / SCRUB UPLAND

UPLAND MEADOW

EXISTING WETLAND

EXISTING SHRUBS



GREY DOGWOOD NANNYBERRY

NOTES

1. THE WETLAND BOUNDARIES BASED ON THE MAY 2017 INSPECTION ARE SHOWN.





PEM
UPF
MOW
RIP
W
· · · · ·

PALUSTRINE EMERGENT

FORESTED UPLAND

UPLAND MEADOW

RIPARIAN

WETLAND

EXISTING WETLAND

EXISTING TREES

- AMERICAN BEECH
- BLACK CHERRY
- EASTERN HEMLOCK
- SILVER MAPLE
- SUGAR MAPLE

EXISTING SHRUBS

- ▲ GREY DOGWOOD
- NANNYBERRY
- ▲ NORTHERN ARROWWOOD
- A HIGHBUSH CRANBERRY

PLANT STATUS BASED ON JUNE 2018 INSPECTION

- O LIVING TREES
- ∖ STRESSED

15'

3 NUMBER OF LIVING SHRUBS





UPF

MOW

RIP

LAWN

. . . .

FORESTED UPLAND

UPLAND MEADOW

RIPARIAN

LAWN

EXISTING WETLAND

EXISTING TREES

EASTERN HEMLOCK

- RED MAPLE
- SUGAR MAPLE
- WHITE PINE

EXISTING SHRUBS



- NANNYBERRY
 NORTHERN AR
 - NORTHERN ARROWWOOD

PLANT STATUS BASED ON JUNE 2018 INSPECTION

- O LIVING TREES
- STRESSED
- ³ NUMBER OF LIVING SHRUBS



ATTACHMENT B

May 2018 Bloody Brook Erosion Inspection Photos Location 1* *See Figures 4A, 4B, and 4C for Photo Locations





May 2018 Bloody Brook Erosion Inspection Photos Location 2* *See Figures 4A, 4B, and 4C for Photo Locations





May 2018 Bloody Brook Erosion Inspection Photos Location 3* *See Figures 4A, 4B, and 4C for Photo Locations



May 2018 Bloody Brook Erosion Inspection Photos Location 4* *See Figures 4A, 4B, and 4C for Photo Locations



May 2018 Bloody Brook Erosion Inspection Photos Location 5* *See Figures 4A, 4B, and 4C for Photo Locations



May 2018 Bloody Brook Erosion Inspection Photos Location 6* *See Figures 4A, 4B, and 4C for Photo Locations



May 2018 Bloody Brook Erosion Inspection Photos Location 7* *See Figures 4A, 4B, and 4C for Photo Locations



May 2018 Bloody Brook Erosion Inspection Photos Location 8* *See Figures 4A, 4B, and 4C for Photo Locations





May 2018 Bloody Brook Erosion Inspection Photos Location 9* *See Figures 4A, 4B, and 4C for Photo Locations



May 2018 Bloody Brook Erosion Inspection Photos Location 10* *See Figures 4A, 4B, and 4C for Photo Locations



May 2018 Bloody Brook Erosion Inspection Photos Location 11* *See Figures 4A, 4B, and 4C for Photo Locations



May 2018 Bloody Brook Erosion Inspection Photos Location 12* *See Figures 4A, 4B, and 4C for Photo Locations



Bloody Brook Erosion Inspection Photos (May and July 2018) Location 13* *See Figures 4A, 4B, and 4C for Photo Locations



May 17, 2018- Before armor material failure



7/13/18 - Before interim corrective measure



7/13/18 - Before interim corrective measure



7/13/18 – After interim corrective measure

May 2018 Bloody Brook Erosion Inspection Photos Location 14* *See Figures 4A, 4B, and 4C for Photo Locations



ATTACHMENT C

PA New England Province Riparian Mix

ERNMX #	ERNMX-253				
Seeding Rate	Approximately 20 lb per acre				
Міх Туре	Wet Meadow & Wetland Sites				
	 14% Little Bluestem, Fort Indiantown Gap-PA Ecotype (Schizachyrium scoparium, Fort Indiantown Gap-PA Ecotype) 				
	 14% Indiangrass, PA Ecotype (Sorghastrum nutans, PA Ecotype) 				
	 10% Riverbank Wildrye, PA Ecotype (Elymus riparius, PA Ecotype) 				
	 10% Virginia Wildrye, PA Ecotype (Elymus virginicus, PA Ecotype) 				
	 9% Deertongue, 'Tioga' (Panicum clandestinum (Dichanthelium c.), 'Tioga') 				
	 8% Big Bluestem, 'Niagara' (Andropogon gerardii, 'Niagara') 				
	 7% Fox Sedge, PA Ecotype (Carex vulpinoidea, PA Ecotype) 				
	 2% Switchgrass, 'Shelter' (Panicum virgatum, 'Shelter') 				
	 2% Boneset, PA Ecotype (Eupatorium perfoliatum, PA Ecotype) 				
	2% Soft Rush (Juncus effusus)				
	 2% Swamp Milkweed, PA Ecotype (Asclepias incarnata, PA Ecotype) 				
	 2% Autumn Bentgrass, PA Ecotype (Agrostis perennans, PA Ecotype) 				
	 2% Wild Senna, VA & WV Ecotype (Senna hebecarpa (Cassia h.), VA & WV Ecotype) 				
	 2% Oxeye Sunflower, PA Ecotype (Heliopsis helianthoides, PA Ecotype) 				
	 2% Blue Vervain, PA Ecotype (Verbena hastata, PA Ecotype) 				
	 2% Partridge Pea, PA Ecotype (Chamaecrista fasciculata (Cassia f.), PA Ecotype) 				
	 1% Wild Bergamot, PA Ecotype (Monarda fistulosa, PA Ecotype) 				
	 1% Redtop Panicgrass, PA Ecotype (Panicum rigidulum (P. stipitatum), PA Ecotype) 				
	 1% Joe Pye Weed, PA Ecotype (Eupatorium fistulosum, PA Ecotype) 				
	1% Flat Topped White Aster, PA Ecotype (Aster umbellatus (Doellingeria umbellata), PA Ecotype)				
	 1% Purplestem Aster, PA Ecotype (Aster puniceus (Symphyotrichum puniceum), PA Ecotype) 				
	 1% Zigzag Aster, PA Ecotype (Aster prenanthoides (Symphyotrichum p.), PA Ecotype) 				
	 1% New England Aster (Aster novae-angliae (Symphyotrichum n.)) 				
	 1% New York Ironweed, PA Ecotype (Vernonia noveboracensis, PA Ecotype) 				
	 1% Many Leaved Bulrush, PA Ecotype (Scirpus polyphyllus, PA Ecotype) 				
	 1% Spotted Joe Pye Weed, PA Ecotype (Eupatorium maculatum (Eupatoriadelphus maculatus), PA Ecotype) 				
	Total: 100%				

Northeastern U.S. Roadside Native Mix

ERNMX # ERNMX-105

Seeding Rate Approximately 20 lb per acre, or 1/2 lb per 1,000 sq ft

Mix Type Upland & Meadow Sites

- 24% Big Bluestem, 'Prairie View'-IN Ecotype (Andropogon gerardii, 'Prairie View'-IN Ecotype)
- 20% Sideoats Grama, 'Butte' (Bouteloua curtipendula, 'Butte')
- 19% Virginia Wildrye, PA Ecotype (Elymus virginicus, PA Ecotype)
- 5% Broomsedge, MO Ecotype (Andropogon virginicus, MO Ecotype)
- 5% Blackeyed Susan, Coastal Plain NC Ecotype (Rudbeckia hirta, Coastal Plain NC Ecotype)
- 4% Partridge Pea, PA Ecotype (Chamaecrista fasciculata (Cassia f.), PA Ecotype)
- 4% Purple Coneflower (Echinacea purpurea)
- 3% Ohio Spiderwort, PA Ecotype (Tradescantia ohiensis, PA Ecotype)
- 2% Swamp Milkweed, PA Ecotype (Asclepias incarnata, PA Ecotype)
- 2% Wild Senna, VA & WV Ecotype (Senna hebecarpa (Cassia h.), VA & WV Ecotype)
- 2% Oxeye Sunflower, PA Ecotype (Heliopsis helianthoides, PA Ecotype)
- 2% Zigzag Aster, PA Ecotype (Aster prenanthoides (Symphyotrichum p.), PA Ecotype)
- 2% Blue False Indigo, Southern WV Ecotype (Baptisia australis, Southern WV Ecotype)
- 2% Flat Topped White Aster, PA Ecotype (Aster umbellatus (Doellingeria umbellata), PA Ecotype)
- 1% Wild Bergamot, PA Ecotype (Monarda fistulosa, PA Ecotype)
- 1% Early Goldenrod, PA Ecotype (Solidago juncea, PA Ecotype)
- 1% New England Aster, PA Ecotype (Aster novae-angliae (Symphyotrichum n.), PA Ecotype)
- 1% Marsh (Dense) Blazing Star (Spiked Gayfeather), PA Ecotype (Liatris spicata, PA Ecotype)

Total: 100%

PA New England Province FACW Mix

ERNMX # ERNMX-251

Seeding Rate Approximately 20 lb per acre

Mix Type Wet Meadow & Wetland Sites

- 24% Fox Sedge, PA Ecotype (Carex vulpinoidea, PA Ecotype)
- 20% Virginia Wildrye, PA Ecotype (Elymus virginicus, PA Ecotype)
- 10% Lurid (Shallow) Sedge, PA Ecotype (Carex lurida, PA Ecotype)
- 5% Hop Sedge, PA Ecotype (Carex lupulina, PA Ecotype)
- 4% Blue Vervain, PA Ecotype (Verbena hastata, PA Ecotype)
- 3% Green Bulrush, PA Ecotype (Scirpus atrovirens, PA Ecotype)
- 3% Soft Rush (Juncus effusus)
- 2% Swamp Milkweed, PA Ecotype (Asclepias incarnata, PA Ecotype)
- 2% Wood Reedgrass, PA Ecotype (Cinna arundinacea, PA Ecotype)
- 2% Boneset, PA Ecotype (Eupatorium perfoliatum, PA Ecotype)
- 2% Cosmos (Bristly) Sedge, PA Ecotype (Carex comosa, PA Ecotype)
- 2% Oxeye Sunflower, PA Ecotype (Heliopsis helianthoides, PA Ecotype)
- 2% Redtop Panicgrass, PA Ecotype (Panicum rigidulum (P. stipitatum), PA Ecotype)
- 2% Sensitive Fern (Onoclea sensibilis)
- 1% Joe Pye Weed, PA Ecotype (Eupatorium fistulosum, PA Ecotype)
- 1% Pennsylvania Smartweed, PA Ecotype (Polygonum pensylvanicum, PA Ecotype)
- 1% Spotted Joe Pye Weed, PA Ecotype (Eupatorium maculatum (Eupatoriadelphus maculatus), PA Ecotype)
- 1% Northern Long Sedge, PA Ecotype (Carex folliculata, PA Ecotype)
- 1% Slender Mountainmint (Pycnanthemum tenuifolium)
- 1% Flat Topped White Aster, PA Ecotype (Aster umbellatus (Doellingeria umbellata), PA Ecotype)
- 1% Bladder (Star) Sedge, PA Ecotype (Carex intumescens, PA Ecotype)
- 1% Rattlesnake Grass, PA Ecotype (Glyceria canadensis, PA Ecotype)
- 1% Many Leaved Bulrush, PA Ecotype (Scirpus polyphyllus, PA Ecotype)
- 1% Great Blue Lobelia, PA Ecotype (Lobelia siphilitica, PA Ecotype)
- 1% New York Ironweed, PA Ecotype (Vernonia noveboracensis, PA Ecotype)
- 1% Narrowleaf Blue Eyed Grass (Sisyrinchium angustifolium)
- 1% Brown Bulrush, PA Ecotype (Scirpus pendulus, PA Ecotype)
- 1% New England Aster (Aster novae-angliae (Symphyotrichum n.))
- 1% Zigzag Aster, PA Ecotype (Aster prenanthoides (Symphyotrichum p.), PA Ecotype)
- 1% Purplestem Aster, PA Ecotype (Aster puniceus (Symphyotrichum puniceum), PA Ecotype)
- 1% Square Stemmed Monkeyflower, PA Ecotype (Mimulus ringens, PA Ecotype)

Total: 100%

ATTACHMENT D

Standard Operating Procedure for Removal of Invasive Species at Bloody Brook Restoration Site (2018)

Phragmites (Phragmites australis) and purple loosestrife (*Lythrum salicaria*) are invasive species not native to New York, which spread rapidly, displacing other species and causing environmental damage. To the extent practical, we want to eliminate *Phragmites* and purple loosestrife from the Bloody Brook site. These species can reproduce from either seeds or from pieces of root, and in the case of loosestrife, from stems.

Descriptions (<u>http://nyis.info/</u>)

Phragmites

Stems of the non-native *Phragmites* are hollow, usually green with yellow nodes during the growing season, and yellow when dry in the winter. *Phragmites* leaves are blue-green to yellow-green, up to 20 inches long and 1 to 1.5 inches wide at their widest point. They are arranged all along one side of a stem. In late July and August, *Phragmites* is in bloom with purple to gold highly branched panicles of flowers. The seeds are grayish and appear fluffy due to the silky hairs that cover each seed.



Purple Loosestrife

Purple loosestrife is a perennial with a dense, woody rootstock that can produce dozens of stems. Shoot emergence and seed germination occurs as early as late-April, and flowering begins by mid-June. The stalkless stem leaves are 5 to 14 centimeters long, lance-shaped, and opposite. Leaf pairs often grow at 90 degree angles from one another, and leaves near the flowers are sometimes alternate. Stems are upright, angular, and densely hairy. Mature plants can reach up to 4 meters in height, and older plants often appear bush-like, with sometimes dozens of woody stems growing from a single rootstock. The showy purple flowers have 5 to 7 petals and grow in pairs or clusters on 10 to 40 centimeters tall spikes.



Removal Procedures

- 1. If there is a seed head on the plant, this should be cut off and placed in a garbage bag for disposal, taking care not to drop seeds onto the ground.
- 2. The entire plant should then be dug up by:
 - a. Loosening up the ground with a spading fork,
 - b. Grasping the base of plant by hand and pulling the plant out by the roots, or use Uprooter to remove the stem and roots. *Phragmites* produces long horizontal root systems, and purple loosestrife produces a large taproot. If possible, try to gently but firmly pull at the roots to remove as long a piece of root as possible. This will minimize the number of small pieces of root left in the ground (each of which can produce a new plant next year).
- 3. All of the plant is then placed in a garbage bag for disposal.
- 4. Take care not to step on, dig up, or otherwise damage desirable plants, especially any shrubs or trees.

This procedure is based on guidance from the NYSDEC on invasive species (www.dec.ny.gov/docs/lands_forests_pdf/sfinvasivecontrol.pdf) in the Strategic Plan for State Forest Management (www.dec.ny.gov/docs/lands_forests_pdf/spsfmfinal.pdf).

Equipment

Spading forks Uprooter Boots Gloves Plastic disposal bags