From:	Mike Lee
To:	Jeanene Woodruff
Subject:	FW: Third Annual Monitoring Report, Bledsoe County Correctional Complex
Date:	Friday, October 31, 2014 2:06:42 PM
Attachments:	Third Year Monitoring Report Final 10-28-14.pdf

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From: Ron Dow [mailto:rdow@Ensafe.com]
Sent: Friday, October 31, 2014 1:15 PM
To: Mike Lee
Subject: Third Annual Monitoring Report, Bledsoe County Correctional Complex

Hi Mike –

Hope all is well –

Please find attached the Third Annual Monitoring Report for the Bledsoe County Correctional Complex. A hard copy is also being delivered via the mail.

In general, it looks like the site is improving considerably.

Please feel free to let me know if you have any questions or would like any additional information.

Thanks again,
Ron

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October 31, 2014

Mike Lee
Division of Water Resources
11th Floor
312 Rosa L. Parks Avenue
Nashville, Tennessee 37243

RE: Third Year Wetland and Stream Monitoring Report
Bledsoe County Correctional Complex
Pikeville, Tennessee

Dear Mr. Lee:

Enclosed for your review is the third annual wetland and stream monitoring report for the Bledsoe County Correctional Complex (BCCX) located in Pikeville, Tennessee (DOA File/Permit Number 200502425, TDEC §401 Water Quality Certification Number NRS 09.009). This document has been prepared in response to the above-cited permits. The report generally follows the format provided in the Corps' October 2008 Regulatory Guidance Letter 08-03; however, due to the complexity of the project we have exceeded the recommended page limits in a number of sections

Thank you for your time and consideration regarding this project. If you have any questions, require additional information, or would like to plan a site visit, please feel free to contact me at (615) 252-2834.

Sincerely

EnSafe Inc.

By: Ronald T. Dow, P.G.
Project Manager

Attachment

cc: Steve Westerman, TDOC
Mark Carnes, USCOE
Laura Waynick, TNDGS

Third Year Wetland and Stream Mitigation Monitoring Report
Bledsoe County Correctional Complex
Pikeville, Bledsoe County, Tennessee
(DOA File/Permit 200502425)
(TDEC §401 Water Quality Certification 09.009)

October 28, 2014

Submitted To:

U.S. Army Corps of Engineers, Nashville District
&
Tennessee Department of Environment and Conservation

Prepared By:

Water Resources, LLC
4208 Eiffel Lane
Knoxville, TN 37938

Under Subcontract to:

EnSafe, Inc.
220 Athens Way
Suite 410
Nashville, TN 37228

Section 1

Project Overview

Mitigation Site Name: Bledsoe County Correctional Complex (BCCX), Pikeville, TN

DOA Permit Number: 200502425

TDEC Permit Number: NRS 09.009

Party Responsible for Monitoring: Paul C. Durr/Water Resources, LLC under subcontract to EnSafe, Inc.

Monitoring Dates: September 23-26, 2014. Please note that although this is the third monitoring effort, monitoring did not occur during the 2012 calendar year. Initial (year 1) site monitoring was conducted on September 26-30, 2011.

Project Description: In February 2010 the Tennessee Department of Environment and Conservation (TDEC) granted the Tennessee Department of Finance and Administration a §401 Water Quality Certification to allow the filling of 1.96 acres of jurisdictional wetlands and alteration of 560 linear ft of streams and 715 ft of wet weather conveyances. Impacts to these aquatic resources were determined to be necessary to facilitate the development of a major prison expansion project. In June 2010 U.S. Army Corps of Engineers-Nashville District (USACE) granted a §404 permit for the same project. After minor modification, the final TDEC permit was reissued in December of that year.

Mitigation for the wetland and stream impacts was initiated in early October 2010. Wetland mitigation occurred entirely onsite and involved the creation (establishment) of 4.18 acres of palustrine wetlands (4:1 ratio) and the enhancement of 6.12 acres of existing degraded wetlands (5:1 ratio). The entire wetland mitigation site was then planted with water-tolerant tree species which are indigenous to the local watershed. Planting was done at an approximate rate of 435 stems/acre. Stream mitigation was also undertaken onsite. It involved Level 1 enhancement of 2,660 ft of intermittent headwater tributaries to Bee Creek. Riparian zones of four tributary segments were planted with native shrubs. Twenty-five foot-wide upland buffers lying on either side of the streams and wetlands were also planted. Additional details can be found in the document titled: *Aquatic Resources Mitigation Plan, Bledsoe County Correctional Complex Bee Creek Mile 11.4, Right Bank, Pikeville, Tennessee* drafted by Water Resources, LLC.

Particularly intense rainfall events in November 2010 and March 2011 caused flooding and attending erosion within the wetland creation area. In April 2011 efforts were made to lessen further damage by controlling the rate of inflow to the site by re-contouring the splitter pond, reinforcing and reconstructing spreader berms, and placing coir log erosion barriers in areas shown to be especially prone to erosion. While these actions were partly successful, they did not control the erosion of soil to the extent desired. Soil loss, the presence of a shallow fragipan on northern portions of the creation area, and a protracted drought during the summer of 2011, were thought to be largely responsible for low survivorship of planted trees and shrubs. Failure to meet desired performance standards were documented in the first year monitoring report.

In response to the reported failure, the USACE and TDEC requested that the permittee submit a revised work plan. The revised plan was submitted on October 1, 2012. The plan recommended a variety of corrective actions most important of which were the installation of more than 2,500 ft of coir log erosion dams and the replanting of 5,650 wetland-adapted trees and shrubs. (See below for dates of corrective/maintenance actions).

Project Location: The mitigation site is centered approximately 1,100 ft north-northeast of the intersection of SR 285 and SR 301 in rural Bledsoe County, Tennessee (N35.7508, W85.2359). (See Section 4 for a general location map).

Dates When the Mitigation Project Began and Was Completed: Initial mitigation construction began in September, 2010 and was completed in October, 2011. Initial wetland and riparian buffer vegetation planting was completed on December 11, 2010.

Performance Standards: **Created (Established) Wetlands** - The site's performance standards for hydrology have been met, but have not yet been met for soils or herbaceous layer vegetation. They have been conditionally met for planted woody vegetation in terms of average density, but more than one individual species exceeds 20% of the stocking density. **Enhanced Wetlands** -Performance standards have been met for planted woody vegetation, herbaceous-layer vegetation, hydrology, and soils. **Streams** – Performance standards have been conditionally met with respect to planted woody vegetation. Because it was often not possible to distinguish planted individuals from naturally occurring ones, it was especially difficult to assess performance in terms of stem density or survival. Furthermore, since many of the species develop a multi-stemmed growth form as they mature and merge together into a colony which may support hundreds of distinct stems, actual individual population densities were not possible to discern (See further discussion in Section 2, pages 4 & 5). Irrespective of these technical issues, it is clear that the mitigated stream reaches are highly stable and that the combination of planted and naturally invading colonial species are beginning to provide significant cover for these formerly degraded waterways. **Other** - Signs designating the area as a protected wetland have not yet been installed. The declaration of restriction for protecting the site in perpetuity has been prepared but has not yet been executed. In the mean time, the danger of disturbance is very low since the site lies on state-owned property.

Dates of Corrective Actions or Maintenance: Fall 2011: Excess water coming from the splitter pond was diverted to the western half of the mitigation site. Also repairs were made to breaches in the rock spreader berm. October 22, 2012: The entire enhancement area was mown to prepare for tree planting. January 8-9, 2013: Coir log erosion dams were installed in the creation area and both the enhancement and creation areas were replanted.

Recommendations for Additional Corrective Actions:

As has been noted, performance standards for woody vegetation in the creation area and along a number of the streams are being conditionally met (i.e. contain the target density of stems/acre but survival rates of planted species can't specifically be determined because of the influx of seedlings from adjacent seed sources, or, the species mix may be skewed too heavily towards one or more taxa). We recommend an onsite meeting with personnel from the USACE and TDEC to determine what steps need to be taken to satisfy the oversight agencies.

Because of the occurrence of invasive glossy false buckthorn shrubs in several of the stream mitigation zones we strongly recommend that a regimen of herbicide applications begin in the spring of 2015. The buckthorn is capable of rapidly colonizing open, moist or wet areas and supplanting desirable native vegetation. Since current population size is estimated at only a few dozen plants, control should be readily achievable, but it is likely that several treatments will be required. Two other invasive woody species have also been identified on the mitigation site. These include autumn-olive and multiflora rose. Although both have the ability to spread rapidly, they are not considered wetland species and would be most problematic in uplands and buffer zones adjacent to the mitigation areas. Because of this they would not be primary targets for control, but spraying with herbicide should be given consideration.

In the near future, once it is clear that all performance standards have been attained and are sustainable, the state should execute the declaration of restrictions for the mitigation site. The installation of signs, identifying protected aquatic resources, should also occur during this same time frame. These steps, especially deed restrictions, will be critical for the perpetual protection of these sensitive aquatic resources.

Finally, while not a corrective action per se, we would like to strongly recommend to the Department of Correction that all future site monitoring be scheduled at approximately the same time each year. Herbaceous plant communities grow and reach maturity at different times throughout the growing season so unless sampling is conducted at the same time from one year to the next, comparisons of herbaceous population data cannot be made in a meaningful way. The optimal time to sample wetlands on the Cumberland Plateau in Tennessee is in June or early July. This is when wetland herb species diversity reaches a maximum. Also, sampling earlier in the growing season makes it far easier to locate planted woody seedlings among the herbs. This year, for example, plant inventories took place in September when many of the autumn-flowering herbs and grasses were head-high in many locations. As a consequence it is very likely that populations of planted trees were underestimated because of poor visibility.

Wetlands

Performance Standards	Year 3 Monitoring & Monitoring Conditions		Performance Standards Met?		Data References (see Sections 3 & 4)
Onsite mitigation will involve the creation of 4.18 acres of wetlands and the enhancement of 6.12 acres of wetlands in the headwaters of Bee Creek. Bare root seedlings will be planted at the rate of 435 stems/acre. No one species shall comprise more than 20% of the total. The entire wetland mitigation is to be protected in perpetuity through deed restriction and signage erected to indicate the protected status of the property. The specific performance standards associated with the mitigation action are summarized below.	Vegetation demographics were determined from 0.05-acre fixed area sample plots (for woody species) and 1-yd^2 plots (for herbs). Sampling methods are described in the site's final Aquatic Resource Mitigation Plan. Because native hydric soils were not known within the creation area prior to mitigative actions, soil profiles will be taken annually at each of the vegetation monitoring plots in order to document the transition to the hydric condition. The principal means used to judge the successful restoration of positive wetland hydrology will be the establishment of wetland vegetation. Other primary and secondary hydrologic indicators will be noted during monitoring.				
<u>Creation</u> <u>Area</u>: Success will be measured as a function of wetland plant dominance and the presence of positive wetland hydrology. At the end of five years, approximately 70% of herbaceous plant cover must be comprised of wetland-adapted species and survival rates for planted woody species must be at least 75% (326 stems/ac). Areal coverage of exotic invasive species must be less than 5%. While the development of hydric soils is a desired goal, it is understood that hydric soil formation may take greater than 5 years to occur.	Vegetation:	Total herbaceous plant cover is **87.44%.** This is a significant increase since the last monitoring effort when cover was determined to be just 65.81%. **61.90%** of the cover is comprised of wetland-adapted species. Although this falls somewhat below the targeted goal of 70% (at the end of 5 years), good progress is being made. Encouraging is that fact that 42 discernible taxa were identified. This indicates that species diversity is higher in the creation area than in the enhancement area (see next page). **Also interesting is the occurrence this year of the dwarf sundew. This insectivorous plant has been designated by TDEC's Division of Natural Areas as a "Threatened" species. Its listing as an "S2" species indicates that there are <u>≤</u> 20 known occurrences statewide.** Current density of planted woody species is **340 stems/ac**. 85.71% of the species are considered wetland-adapted. Two species exceed 20% of the stocking density (buttonbush 35.82% and sweetgum 31.34%).	Herbaceous Vegetation: Woody Vegetation:	No Conditionally Yes	Section 3: Table 1 Table 3 Section 3: Photos 1-8, 34 Section 4: Maps 1 & 2

Performance Standards	Year 3 Monitoring & Monitoring Conditions		Performance Standards Met?		Data References (see Sections 3 & 4)
	Soils:	Soils in the creation area have been mapped by the Natural Resources Conservation Service as containing Lily loam and Morehead-Bonair complex. The latter contains inclusions of hydric Bonair soils in low-lying areas and depressions. Indeed, residual hydric soils with depleted matrices were confirmed in 75% of the samples.	Soils:	Yes	Section 3: Table 6
	Hydrology:	A variety of primary and secondary hydrologic indicators are present in the creation area. These include sediment deposits, algal crust, surface soil cracks, sparsely vegetated concave surfaces, drainage patterns, crayfish burrows, geomorphic position, and a shallow aquitard.	Hydrology:	Yes	
Enhancement Area: The same performance standards described above for the creation area shall also apply for the enhancement area. However, because the enhancement area is already a jurisdictional wetland and contains hydric soils, it will not be monitored for that parameter.	Vegetation:	Herbaceous plant cover is **95.58%**. This is distributed among 33 distinct taxa. **87.88%** of the cover is comprised of wetland-adapted species. If just the most-dominant species are considered (based on sampling frequency and cover), then 100% are wetland adapted. During the last sampling effort we reported **two small populations of sedge species that are listed as "Endangered" by TDEC's Division of Natural Areas. These include brown bog sedge and southern long sedge. Brown bog sedge is considered an "S1" species meaning that there are five or fewer known occurrences in the state. The southern long sedge is an "S2" species indicating ≤ 20 known occurrences. Both of these populations were relocated this year and are still intact.** Combined density of planted and naturally-invasive woody species is **600 stems/acre** This demographic has remained essentially unchanged since last year. Nearly half of the density is the result of the encroachment of swamp rose, a native wetland shrub. When considered in the absence of swamp rose, planted vegetation occurs at the rate **360stems/acre** Of the 12 woody taxa	Herbaceous Vegetation: Woody Vegetation:	Yes Yes	Section 3: Table 2 Table 4 Section 3: Photos 9-16, 27, 29-32 Section 4: Maps 1 & 2

Performance Standards	Year 3 Monitoring & Monitoring Conditions		Performance Standards Met?		Data References (see Sections 3 & 4)
		identified, all are wetland-adapted. Most tree seedlings appear to have been planted except perhaps red maple and sweetgum which have seed sources in the vicinity.			
	Soils:	Morehead-Bonair complex. This series is recognized as containing inclusions of hydric Bonair soils in low areas and depressions. Hydric soils were confirmed by the USACE during a jurisdictional determination visit to the site in November 2008.	Soils:	Yes	
	Hydrology:	Several hydrologic indicators were observed during the monitoring survey. These include scattered soil saturation and shallow inundation, sediment deposits, drift lines, drainage patterns, crayfish burrows, and geomorphic position.	Hydrology:	Yes	
Upland Buffer Area: 25 ft-wide buffers, external to riparian buffers (see next page) are to be planted with upland oaks in order to provide extra protection to the restored streams. Initial planting is to be at 435 stems/ac but no performance standards for seedling survival are stipulated.	Vegetation:	Total stocking density within upland buffer zones is **212.5** stems/acre Density of planted oak species alone is **110 stems/acre** With the exception of a few silky dogwoods that were inadvertently placed in upland areas, the remaining species are all naturally invasive.	Vegetation:	Not Applicable	Section 3: Table 5 Section 3: Photo 17 & 28 Section 4: Maps 1 & 2
	Soils:		Soils:	Not Applicable	
	Hydrology:		Hydrology:	Not Applicable	
Gooseberry Transplant Area: Multi-stemmed granite gooseberry shrubs are to be removed from the prison expansion footprint and transplanted to an upland area on the stream and wetland mitigation property. This effort will be undertaken in an attempt to preserve this exceptionally rare shrub. No performance standards for shrub survival are stipulated. (This action was completed in March 2009.)	Vegetation:	Because of its highly colonial nature, it was not possible to make an accurate count of individual stems. Instead, an estimate of the plants' areal coverage was obtained by measuring the major and minor axes of all shrubs that could be located within the transplant area. This year **24 shrubs covering a total of 2,985 ft^2** were tallied. Unfortunately, invasive Japanese honeysuckle vines are threatening to overtake many of the transplants.	Vegetation:	Not Applicable	Section 3: Photo 18 & 33
	Soils:		Soils:	Not Applicable	
	Hydrology:		Hydrology:	Not Applicable	

Streams

Performance Standards	Year 3 Monitoring & Monitoring Conditions		Performance Standards Met?		Data References (see Sections 3 & 4)
Stream mitigation will involve the enhancement of 2,660 ft of headwater tributaries to Bee Creek. Four individual segments are to be treated. Riparian shrub vegetation shall be planted 25-ft along both banks. Plantings shall be at least three rows deep along each channel staggered on 10-ft centers. Bare root or containerized stock is permissible. No one species can comprise more than 20% of the total. Stream mitigation areas are to be protected in perpetuity through deed restriction and signage erected to indicate the protected status of the properties. The performance standards for the mitigation actions are described briefly below.	Pre-construction stream habitat conditions were documented in 2008 using EPA/TDEC habitat assessment methodologies. Post-construction conditions were determined by employing Level I protocols set forth by TDEC in the *Stream Mitigation Guidelines for the State of* Tennessee (TDEC 2004). Riparian zone vegetation surveys made use of staggered 200 x 25 ft fixed area sample plots spaced 200 ft apart on each of the stream segments in order to determine survivorship of planted material and establishment of naturally invading woody species.				
<u>Enhancement of Unnamed Tributary to Bee Creek Stream Segment 1 (1,793 ft)</u>: Success will be determined by the establishment of a waterway that is stable, has a discernible bed and bank, and has typical in-stream habitat. The banks must be stable and non-eroding with adequate vegetative cover to prevent eroding sediments from entering the stream. This includes a 75% survival rate for planted trees and shrubs for five consecutive years (64 stems/100 ft of stream channel).	Channel Conditions:	As in previous years, channel conditions have remained stable. The drainage way contains well-defined bed and bank, and while some limited portions of the reach have eroded down to bedrock, most areas are silt and mud-dominated. Relatively flat terrain has given rise to a stream that contains only scattered riffle-run sequences. Stream depths at the time of the survey ranged from about 4 in. in upstream areas to over 3 ft in several pools near the middle and downstream end.	Channel:	Yes	Section 3: Table 7 Section 3: Photos 19-23 Section 4: Maps 1 & 2
	Vegetation:	Combined density of planted and naturally-occurring woody species within riparian zones is estimated at **372 stems per 100 ft of stream bank length**. Planted densities alone contain an estimated **180.6 stems per 100 ft**. Since most of the shrub species are multi-stemmed and highly colonial, individual stem counts could not be made. Instead, they had to be inferred from sample averages. Several 10 ft-long clumps of silky dogwoods for example, were found to contain an average of 35 stems each. By measuring the linear extent of all silky dogwoods within a given sample plot, the total number of stems within the plot could be extrapolated. (See bottom of Table 7 for	Vegetation:	Conditionally Yes	

Performance Standards	Year 3 Monitoring & Monitoring Conditions		Performance Standards Met?		Data References (see Sections 3 & 4)
		further information). Additionally, given that it was often not possible to discern planted individuals from native ones, it was also not possible to determine survivorship levels. Irrespective of these sampling issues, it is clear that the intent of the performance standards is being met. Woody stem populations along these formerly degraded reaches are thriving, and in doing so, are providing bank stabilization, cooling shade for the creek, and dietetic diversity for local wildlife.			
	Aquatic Biota:	No formal surveys for aquatic organisms were undertaken. Nonetheless, a variety of organisms were observed in or around the channel. These include fish (undetermined species), green frogs and snapping turtles	Aquatic Biota:	Not Applicable	
<u>Enhancement of Unnamed Tributary to Bee Creek Stream Segment 2 (224 ft)</u>: The same performance standards described above for Stream Segment 1 shall apply to this unnamed tributary.	Channel Conditions:	Stream Segment 2 was not impacted by wetland creation efforts so its channel and riparian zones are stable. Bed and banks are well-defined. Riffles and runs are very widely scattered because of low gradients and flow regimes.	Channel:	Yes	Section 3: Table 7 Section 3: Photo 24 Section 4: Maps 1 & 2
	Vegetation:	Combined density of planted and naturally-occurring woody species within riparian zones is estimated at **274 stems per 100 ft of stream bank length**. **Planted densities alone average 136 stems per 100 ft**. Again, since riparian shrub counts involved highly colonial, intergrading populations, it was difficult to assess survivorship. It should also be noted that silky dogwood constitute 44% of total stem density which exceeds the performance standard of 20%. However, because stream banks are stable and well vegetated with a variety of species (12), we suggest that performance standards are conditionally being met.	Vegetation:	Conditionally Yes	
	Aquatic Biota:	Fish and green frogs were observed in a pool located just to the east of SR 301. A great blue heron was also seen feeding here.	Aquatic Biota:	Not Applicable	

Performance Standards	Year 3 Monitoring & Monitoring Conditions		Performance Standards Met?		Data References (see Sections 3 & 4)
Enhancement of Unnamed Tributary to Bee Creek Stream Segment 3 (388 ft): The same performance standards described above for Stream Segment 1 shall apply to this unnamed tributary.	Channel Conditions:	See comments for Stream Segment 2 above.	Channel:	Yes	Section 3: Table 7 Section 3: Photo 25 Section 4: Maps 1 & 2
	Vegetation:	Density of planted woody species is **68 stems per 100 ft of stream bank length**. As with Stream Segment 2, one of the planted species (buttonbush) exceeds the performance standard of 20% of the stocking density. Again, because stream banks are stable and well vegetated with a variety of species (10), we suggest that performance standards are conditionally being met.	Vegetation:	Conditionally Yes	
	Aquatic Biota:	Fish and green frogs were observed in a pool located just to the east of SR 301.	Aquatic Biota:	Not Applicable	
Enhancement of Unnamed Tributary to Bee Creek Segment 4 (255 ft): The same performance standards described above for Segment 1 shall apply to this unnamed tributary.	Channel Conditions:	See comments for Segment 2 above. Flow regimes and riffle/run complexes could not be judged since the creek was dry.	Channel:	Yes	Section 3: Table 7 Section 3: Photo 26 Section 4: Maps 1 & 2
	Vegetation:	Combined density of planted and naturally-occurring woody species within riparian zones is an estimated **455 stems per 100 ft of stream bank length**. **Planted densities alone average 98 stems per 100 ft**. Notable here was the extremely strong presence of indigenous swamp rose which, in the absence of disturbance, has almost completely colonized the entire length of Segment 4 along both banks.	Vegetation:	Conditionally Yes	
	Aquatic Biota:	Because the stream appears to have been dry for at least several weeks, no aquatic organisms were detected during our non-formal survey. The pond immediately above Segment 4, however, supports numerous fish, frogs, aquatic insects, snapping turtles, and water-dependent birds.	Aquatic Biota:	Not Applicable	

Note: Multiflora rose (*Rosa multiflora*) and autumn-olive (*Elaeagnus umbellata*) are Asiatic shrubs that are becoming invasive in upland buffers and adjacent to one or more of the stream enhancement areas. Multiflora rose is particularly evident near the lower (south) end of Stream Segment 1. While not yet a problem, they have the potential to rapidly overtake open, sunny areas such as those found on the mitigation site. Consideration should be given to controlling these species before they have a chance to spread further. The Tennessee Exotic Pest Plant Council offers suggestions for mechanical, biological, and chemical control on its website (http://www.tneppc.org/invasive_plants/67). We have also noted the establishment of a small number of glossy false buckthorns (*Frangula alnus*) along several of the mitigated stream segments. Unfortunately this shrub was improperly included in the plant species mix received from the nursery and was probably confused with stream alder (*Alnus serrulata*). Though known in Tennessee from only one other county, this Eurasian species is a well-documented pest plant in other parts of the US and should be eradicated as soon as possible. Several plants were pulled up during the sampling effort, but other larger individuals will have to be sprayed with herbicide next growing season.

Section 3

Summary Data
Tables & Photographs

Table 1. Substrate/Herbaceous Species Frequency and Average Cover Percent, BCCX Wetland Creation Area, Pikeville, TN, September 2014.

Substrate/Herbs	Wetland Indicator Status	Percent Frequency	Average Percent Cover	Change in Average Cover Since Previous Monitoring
Bare Soil [1]	**---**	**56.25**	**8.63**	**-20.81**
Open Water	---	0.00	0.00	-1.81
Twig/Leaf Litter	**---**	**100.00**	**3.94**	**1.00**
red maple (*Acer rubrum*)	Fac	0.00	0.00	-0.50
purple false foxglove (*Agalinis purpurea*)	Facw	25.00	1.06	0.75
common ragweed (*Ambrosia artemisiifolia*)	Facu	50.00	0.94	-1.06
broomsedge (*Andropogon virginicus*)	**Facu**	**100.00**	**14.50**	**10.00**
sweet vernal grass (*Anthoxanthum odoratum*)	Facu	0.00	0.00	-0.06
bearded beggar-ticks (*Bidens aristosa*)	Facw	37.50	2.31	1.81
devil's beggar-ticks (*Bidens frondosa*)	Facw	6.25	0.31	0.06
hirsute sedge (*Carex complanata*)	Facu	0.00	0.00	-0.94
fox sedge (*Carex vulpinoidea*)	Obl	12.50	0.25	-0.06
mistflower (*Conoclinium coelestinum*)	Fac	6.25	0.13	0.13
orchard grass (*Dactylis glomerata*)	Facu	0.00	0.00	-0.13
Queen Anne's-lace (*Daucus carota*)	Upl	18.75	0.31	0.13
tapered rosette grass (*Dichanthelium acuminatum*)	Fac	0.00	0.00	-10.50
deer-tongue grass (*Dichanthelium clandestinum*)	Fac	12.50	0.44	-0.06
cypress witch grass (*Dichanthelium dichotomum*)	**Fac**	**93.75**	**16.69**	**15.44**
open-flower rosette grass (*Dichanthelium laxiflorum*)	Facu	31.25	1.25	0.13

[1] Bolded entries indicate dominant species or substrates (i.e. cover contributions exceed 3% and frequency values are greater than 10%).

Table 1 (continued)

Substrate/Herbs	Wetland Indicator Status	Percent Frequency	Average Percent Cover	Change in Average Cover Since Previous Monitoring
broom rosette grass (*Dichanthelium scoparium*)	**Facw**	**50.00**	**7.81**	**4.94**
smooth crab grass (*Digitaria violascens*)	Fac	12.50	0.19	0.19
Virginia buttonweed (*Diodia virginiana*)	Facw	43.75	1.44	-0.81
dwarf sundew (*Drosera brevifolia*)	Obl	6.25	0.13	0.13
slender spikerush (*Eleocharis tenuis*)	Facw	25.00	1.69	-1.44
prairie fleabane (*Erigeron strigosus*)	Facu	6.25	0.63	0.56
creeping eryngo (*Eryngium prostratum*)	Obl	0.00	0.00	-0.31
boneset (*Eupatorium perfoliatum*)	Facw	25.00	0.75	0.63
late-flowering thoroughwort (*Eupatorium serotinum*)	Fac	12.50	0.88	-0.25
slender fimbry (*Fimbristylis autumnalis*)	Facw	6.25	0.13	0.13
purple-head sneezeweed (*Helenium flexosum*)	Fac	31.25	2.75	2.75
velvet grass (*Holcus lanatus*)	Fac	0.00	0.00	-0.19
orangegrass (*Hypericum gentianoides*)	Upl	12.50	0.44	0.44
dwarf St. John's-wort (*Hypericum mutilum*)	Facw	6.25	0.13	-0.19
St. Andrew's-cross (*Hypericum stragulum*)	Facu	6.25	0.75	0.75
taper-tip rush (*Juncus acuminatus*)	Obl	0.00	0.00	-0.25
greater poverty rush (*Juncus anthelatus*)	Facw	43.75	2.38	-1.00
soft rush (*Juncus effusus*)	Facw	0.00	0.00	-0.13
grass-leaved rush (*Juncus marginatus*)	Facw	0.00	0.00	-0.88
Japanese-clover (*Kummerowia striata*)	**Facu**	**93.75**	**11.19**	**-3.00**
annual rye grass (*Lolium multiflorum*)	Upl	0.00	0.00	-0.13

Table 1 (continued)

Substrate/Herbs	Wetland Indicator Status	Percent Frequency	Average Percent Cover	Change in Average Cover Since Previous Monitoring
marsh seedbox (*Ludwigia palustris*)	Obl	0.00	0.00	-0.19
lance-leaf yellow loosestrife (*Lysimachia lanceolata*)	Fac	6.25	0.31	0.31
beaked panic grass (*Panicum anceps*)	Fac	50.00	2.25	1.88
smooth paspalum (*Paspalum laeve*)	Fac	43.75	1.44	1.44
English plantain *(Plantago lanceolata)*	Upl	18.75	0.44	-0.63
common cinquefoil (*Potentilla simplex*)	**Facu**	**68.75**	**3.75**	**0.75**
heal-all (*Prunella vulgaris*)	Facu	25.00	0.56	0.06
clustered mountain-mint (*Pycnanthemum muticum*)	Facw	0.00	0.00	-0.13
yellow foxtail grass (*Setaria pumila*)	Fac	37.50	0.75	0.75
tall fescue (*Schedonorus arundinaceus*)	Facu	0.00	0.00	-0.75
Georgia bulrush (*Scirpus georgianus*)	Obl	6.25	0.63	-0.13
horse-nettle (*Solanum carolinense*)	Facu	25.00	0.56	0.31
tall goldenrod (*Solidago altissima*)	Facu	6.25	0.19	0.19
late goldenrod (*Solidago gigantea*)	Facw	25.00	1.50	0.63
gray goldenrod (*Solidago nemoralis*)	Upl	6.25	0.19	0.19
wrinkle-leaf goldenrod (*Solidago rugosa*)	Fac	0.00	0.00	-0.13
blue-eyed-grass (*Sisyrinchium angustifolium*)	Facw	25.00	0.69	-1.63
panicled American-aster (*Symphyotrichum lanceolatum*)	Facw	0.00	0.00	-0.31
downy American-aster (*Symphyotrichum pilosum*)	**Fac**	**56.25**	**4.31**	**3.69**
common dandelion (*Taraxacum officinale*)	Facu	6.25	0.13	0.13
yellow clover (*Trifolium campestre*)	Upl	0.00	0.00	-0.63

Table 1 (continued)

Substrate/Herbs	Wetland Indicator Status	Percent Frequency	Average Percent Cover	Change in Average Cover Since Previous Monitoring
alsike clover (*Trifolium hybridum*)	Facu	0.00	0.00	-0.13
red clover (*Trifolium pratense*)	Facu	18.75	0.31	-0.13
white clover (*Trifolium repens*)	Facu	0.00	0.00	-1.00
			∑= 100.00	

Table 2. Substrate/Herbaceous Species Frequency and Average Cover Percent, BCCX Wetland Enhancement Area, Pikeville, TN, September 2014.

Substrate/Herbs	Wetland Indicator Status	Percent Frequency	Average Percent Cover	Change in Average Cover Since Previous Monitoring
Bare Soil	---	0.00	0.00	-0.42
Open Water	---	0.00	0.00	-2.92
Twig/Leaf Litter [2]	**---**	**100.00**	**4.42**	**-5.92**
red maple (*Acer rubrum*)	Fac	0.00	0.00	-0.08
small-flowered agrimony (*Agrimonia parviflora*)	Facw	8.33	0.58	0.58
redtop *(Agrostis gigantea*)	Facw	0.00	0.00	-0.17
hog-peanut (*Amphicarpaea bracteata*)	Fac	0.00	0.00	-0.83
sweet vernal grass (*Anthoxanthum odoratum*)	Facu	0.00	0.00	-1.42
groundnut (*Apios americana*)	Facw	8.33	1.25	0.83
yellow-fruited sedge (*Carex annectens*)	Facw	0.00	0.00	-0.25
prickly bog sedge (*Carex atlantica*)	Facw	8.33	0.58	-0.42
hirsute sedge (*Carex complanata*)	Facu	0.00	0.00	-0.17
sallow sedge (*Carex lurida*)	Obl	0.00	0.00	-0.92
pointed broom sedge (*Carex scoparia*)	Facw	0.00	0.00	-4.17
blunt broom sedge (*Carex tribuloides*)	Facw	0.00	0.00	-0.67
fox sedge (*Carex vulpinoidea*)	Obl	16.67	0.83	-0.58
mistflower (*Conoclinium coelestinum*)	Fac	16.67	0.58	0.50
straw-color flatsedge (*Cyperus strigosus*)	Facw	8.33	1.00	1.00
deer-tongue grass (*Dichanthelium clandestinum*)	Fac	8.33	3.33	1.67

[2] Bolded entries indicate dominant species or substrates (i.e. cover contributions exceed 3% and frequency values are greater than 10%).

Table 2 Continued

Substrate/Herbs	Wetland Indicator Status	Percent Frequency	Average Percent Cover	Change in Average Cover Since Previous Monitoring
cypress witch grass (*Dichanthelium dichotomum*)	Fac	8.33	1.67	1.50
broom panic grass (*Dichanthelium scoparium*)	Facw	16.67	1.42	0.33
Virginia buttonweed (*Diodia virginiana*)	Facw	8.33	0.17	-0.33
slender spikerush (*Eleocharis tenuis)*	Facw	0.00	0.00	-0.67
purple-leaf willowherb (*Epilobium coloratum)*	Facw	8.33	0.42	0.42
trumpetweed (*Eutrochium fistulosum*)	Facw	8.33	0.58	0.58
marsh bedstraw (*Galium tinctorium*)	Obl	16.67	0.83	0.42
velvet grass (*Holcus lanatus*)	Fac	16.67	0.42	-8.33
taper-tip rush (*Juncus acuminatus*)	Obl	0.00	0.00	-0.17
greater poverty rush (*Juncus anthelatus*)	Facw	16.67	0.83	-0.83
soft rush (*Juncus effusus*)	Facw	25.00	1.58	-9.92
grass-leaved rush (*Juncus marginatus*)	Facw	0.00	0.00	-0.08
rice cut grass (*Leersia oryzoides*)	**Obl**	**33.33**	**7.33**	**6.33**
marsh seedbox (*Ludwigia palustris*)	Obl	0.00	0.00	-0.83
beaked panic grass (*Panicum anceps*)	Fac	8.33	1.25	1.25
fall panic grass (*Panicum dichotomiflorum*)	Facw	8.33	0.42	0.42
redtop panic grass (*Panicum rigidulum*)	**Facw**	**83.33**	**44.50**	**21.42**
swamp smartweed (*Persicaria hydropiperoides*)	Obl	0.00	0.00	-0.83
dotted smartweed (*Persicaria punctata*)	Obl	16.67	0.50	0.50
green fringed orchid (*Platanthera lacera*)	Facw	0.00	0.00	-0.08
rough blue grass (*Poa trivialis*)	Facw	0.00	0.00	-1.50
common cinquefoil (*Potentilla simplex*)	Facu	8.33	0.17	-1.33

Table 2 Continued

Substrate/Herbs	Wetland Indicator Status	Percent Frequency	Average Percent Cover	Change in Average Cover Since Previous Monitoring
clustered mountain-mint (*Pycnanthemum muticum*)	Facw	0.00	0.00	-2.08
Maryland meadow-beauty (*Rhexia mariana*)	**Obl**	**66.67**	**10.75**	**8.17**
brownish beaksedge (*Rhynchospora glomerata*)	Obl	8.33	0.42	0.42
swamp rose (*Rosa palustris*)	Obl	8.33	1.67	0.42
common blackberry (*Rubus argutus*)	Facu	8.33	0.58	0.58
tall fescue (*Schedonorus arundinaceus*)	Facu	8.33	1.25	-0.17
wool-grass (*Scirpus cyperinus*)	**Facw**	**16.67**	**7.00**	**2.83**
Georgia bulrush (*Scirpus georgianus*)	Obl	8.33	0.42	-4.33
helmet flower (*Scutellaria integrifolia*)	Facw	8.33	0.58	0.00
blue-eyed-grass (*Sisyrinchium angustifolium*)	Facw	0.00	0.00	-0.33
horse-nettle (*Solanum carolinense*)	Facu	33.33	1.25	1.25
sphagnum moss (*Sphagnum sp.*)	---	0.00	0.00	-0.58
tall ironweed (*Vernonia gigantea*)	Fac	0.00	0.00	-1.58
New York ironweed (*Vernonia novaboracensis*)	Facw	8.33	1.42	1.42
			∑= 100.00	

Table 3. Average Density and Frequency of Planted (P) and Naturally-Invading Woody Seedlings, BCCX Wetland Creation Area, Pikeville, TN, September 2014.

Species	Wetland Indicator Status	Average Frequency (%)	Average Density (stems/acre)
red maple **(P in part)** (*Acer rubrum*)	Fac	100.0	55.0
common serviceberry **(P)** (*Amelanchier arborea*)	Fac	50.0	15.0
false indigobush **(P)** (*Amorpha fruticosa*)	Facw	75.0	20.0
buttonbush **(P)** (*Cephalanthus occidentalis*)	Obl	100.0	120.0
sweetgum **(P in part)** (*Liquidambar styraciflua*)	Fac	100.0	105.0
yellow-poplar **(P)** [3] (*Liriodendron tulipifera*)	Facu	25.0	5.0
blackgum **(P)** (*Nyssa sylvatica*)	Fac	50.0	20.0
			∑ = **340.0**

Table 4. Average Density and Frequency of Planted (P) and Naturally-Invading Woody Seedlings, BCCX Wetland Enhancement Area, Pikeville, TN, September 2014.

Species	Wetland Indicator Status	Average Frequency (%)	Average Density (stems/acre)
red maple **(P in part)** (*Acer rubrum*)	Fac	83.33	80.00
common serviceberry **(P)** (*Amelanchier arborea*)	Fac	16.67	6.67
false indigobush **(P)** (*Amorpha fruticosa*)	Facw	83.33	43.33
black chokeberry **(P)** (*Aronia melanocarpa*)	Fac	16.67	3.33
buttonbush **(P)** (*Cephalanthus occidentalis*)	Obl	83.33	76.67
winterberry holly **(P)** (*Ilex verticillata*)	Facw	16.67	3.33
sweetgum **(P in part)** (*Liquidambar styraciflua*)	Fac	100.00	123.33
blackgum **(P)** (*Nyssa sylvatica*)	Fac	33.33	6.67
Shumard oak **(P)** (*Quercus shumardii*)	Fac	16.67	3.33
swamp rose (*Rosa palustris*)	Obl	16.67	240.00
elderberry **(P)** (*Sambucus canadensis*)	Fac	16.67	6.67
hardhack **(P)** (*Spiraea tomentosa*)	Facw	16.67	6.67
			∑ = **600.00**

[3] Yellow-poplar was included on the site planting list since, at the time the mitigation area was designed, it was considered a wetland indicator (Fac). Because the USACE-Nashville District has adopted the National Wetland Plant List, it no longer classifies as a wetland species.

Table 5. Average Density and Frequency of Planted (P) and Naturally-Invading Woody Seedlings, BCCX Upland Buffer Areas, Pikeville, TN, September 2014.

Species	Wetland Indicator Status	Average Frequency (%)	Average Density (stems/acre) [4]
red maple (*Acer rubrum*)	Fac	50.0	15.0
silky dogwood **(P)** [5] (*Cornus amomum*)	Facw	50.0	7.5
autumn-olive (*Elaeagnus umbellata*)	Upl	25.0	2.5
eastern redcedar (*Juniperus virginiana*)	Facu	25.0	2.5
Virginia pine (*Pinus virginiana*)	Upl	25.0	7.5
black cherry (*Prunus serotina*)	Facu	50.0	12.5
white oak **(P)** (*Quercus alba*)	Facu	75.0	40.0
red oak **(P)** (*Quercus rubra*)	Facu	100.0	70.0
multiflora rose (*Rosa multiflora*)	Facu	25.0	55.0
			∑ = **212.5**

[4] Performance standards for tree survival in upland buffer areas were not stipulated by the oversight agencies.

[5] On rare occasions wetland species were inadvertently planted in buffer areas.

Table 6. Soil Profile Descriptions from the BCCX Wetland Creation Area, Pikeville, TN, September 2014.

Sample Location	Depth (Inches)	Matrix Color (Munsell Moist)	Mottle Color (Munsell Moist)	Mottle Abundance/ Contrast	Texture, Structure, etc.
Plot C-1	0-2	10YR 5/3			sandy loam
	2-6	10YR 4/2	10YR 5/3	10%	sandy loam, compacted layer at 6 in.
	6-14	2.5Y 6/4	10YR 4/3 10YR 5/8	5% 15%	sandy loam
	14-20	10YR 6/3	10YR 5/8	25%	sandy loam
Plot C-2	0-6	10YR 4/3	2.5Y 5/6	5%	sandy loam, compacted layer at 6 in.
	6-20	2.5Y 6/3	10YR 4/3 10YR 5/8	5% 25%	sandy loam
Plot C-3	0-1	10YR 5/4			sandy loam
	1-10	10YR 4/2	2.5Y 5/6	25%	sandy clay loam
	10-20	2.5Y 6/2	10YR 5/6	35%	sandy loam, compacted layer at 10 in.
Plot C-4	0-6	2.5Y 4/2			silt loam
	6-16	2.5Y 5/6	10 YR 5/8	25%	sandy loam, compacted layer at 6 in.
	16-20	10YR 6/1	10YR 5/8	40%	sandy loam

Table 7. Occurrence of Planted (P) and Naturally-Invading Woody Species Within Riparian Zones. BCCX Stream Enhancement Area, Pikeville, TN, September 2014. Unnamed Tributary to Bee Creek, Stream Segment 1

Species	Wetland Indicator Status	Average Number of Live Stems per 100 ft of Stream
red maple **(P in part)** (*Acer rubrum*)	Fac	4.0
common serviceberry **(P)** (*Amelanchier arborea*)	Fac	0.2
false indigobush **(P)** (*Amorpha fruticosa*)	Facw	7.2
black chokeberry **(P)** (*Aronia melanocarpa*)	Fac	0.4
buttonush **(P in part)** (*Cephalanthus occidentalis*)	Obl	8.6
silky dogwood **(P in part)** (*Cornus amomum*)	Facw	80.8
hawthorn (*Crataegus sp.*)	?	0.2
glossy false buckthorn **(P)** (*Frangula alnus*)	Fac	2.4
winterberry holly **(P)** (*Ilex verticillata*)	Facw	0.8
spicebush **(P)** (*Lindera benzoin*)	Fac	0.2
sweetgum **(P)** (*Liquidambar styraciflua*)	Fac	4.8
white oak **(P)** (*Quercus alba*)	Facu	0.8
Shumard oak **(P)** (*Quercus shumardii*)	Fac	2.0
multiflora rose (*Rosa multiflora*)	Upl	84.2
swamp rose (Rosa *palustris*)	Obl	73.2
black willow (*Salix nigra*)	Obl	20.0
elderberry **(P in part)** (*Sambucus canadensis*)	Fac	68.0
hardhack (*Spiraea tomentosa*)	Facw	13.8
highbush blueberry **(P)** (*Vaccinium corymbosum*)	Facw	0.4
		∑ (P)= 180.6 [6]
		Grand ∑= 372.0

[6] Totals presented here are for those species which were included on the planting manifest. Because a number of these same species occur naturally along the mitigated stream segments, it was frequently impossible to discern planted individuals from native ones. Also because of the highly clumped nature of some of the shrubs, it was not possible to count individual stems. Instead, an average number of stems per 10 ft of shrub length was determined and these numbers were extrapolated to determine average number of stems per 100 ft of stream (i.e. Sambucus = 50 stems/10 ft of plant length, Rosa palustris, Rosa multiflora, and Cornus= 35 stems/10 ft of plant length, and Spiraea= 25 stems/10 ft of plant length.)

Table 7 (continued)

Unnamed Tributary to Bee Creek, Stream Segment 2

Species	Wetland Indicator Status	Average Number of Live Stems per 100 ft of Stream
red maple **(P in part)** (*Acer rubrum*)	Fac	2.0
false indigobush **(P)** (*Amorpha fruticosa*)	Facw	1.0
black chokeberry **(P)** (*Aronia melanocarpa*)	Fac	2.0
buttonush **(P in part)** (*Cephalanthus occidentalis*)	Obl	4.0
silky dogwood **(P in part)** (*Cornus amomum*)	Facw	120.0
glossy false buckthorn **(P)** (*Frangula alnus*)	Fac	1.0
Shumard oak **(P)** (*Quercus shumardii*)	Fac	3.0
winged sumac (*Rhus copallinum*)	Facu	32.0
multiflora rose (*Rosa multiflora*)	Facu	17.0
swamp rose (Rosa *palustris*)	Obl	84.0
black willow (*Salix nigra*)	Obl	5.0
elderberry **(P in part)** (*Sambucus canadensis*)	Fac	3.0
		∑ (P)= 136.0
		Grand ∑= 274.0

Table 7 (continued)

Unnamed Tributary to Bee Creek, Stream Segment 3

Species	Wetland Indicator Status	Average Number of Live Stems per 100 ft of Stream
false indigobush **(P)** (*Amorpha fruticosa*)	Facw	6.0
buttonush **(P in part)** (*Cephalanthus occidentalis*)	Obl	33.0
silky dogwood **(P in part)** (*Cornus amomum*)	Facw	6.0
glossy false buckthorn **(P)** (*Frangula alnus*)	Fac	1.0
spicebush **(P)** (*Lindera benzoin*)	Fac	1.0
Shumard oak **(P)** (*Quercus shumardii*)	Fac	3.0
multiflora rose (*Rosa multiflora*)	Facu	1.0
swamp rose (Rosa *palustris*)	Obl	4.0
elderberry **(P in part)** (*Sambucus canadensis*)	Fac	16.0
highbush blueberry **(P)** (*Vaccinium corymbosum*)	Facw	2.0
		∑ (P)= 68.0
		Grand ∑= 73.0

Table 7 (continued)

Unnamed Tributary to Bee Creek, Stream Segment 4

Species	Wetland Indicator Status	Average Number of Live Stems per 100 ft of Stream
red maple **(P in part)** (*Acer rubrum*)	Fac	5.0
black chokeberry **(P)** (*Aronia melanocarpa*)	Fac	3.0
buttonush **(P in part)** (*Cephalanthus occidentalis*)	Obl	8.0
silky dogwood **(P in part)** (*Cornus amomum*)	Facw	20.0
glossy false buckthorn **(P)** (*Frangula alnus*)	Fac	1.0
black cherry (*Prunus serotina*)	Facu	4.0
white oak **(P)** (*Quercus alba*)	Facu	2.0
Shumard oak **(P in part)** (*Quercus shumardii*)	Fac	4.0
multiflora rose (*Rosa multiflora*)	Facu	2.0
swamp rose (Rosa *palustris*)	Obl	351.0
elderberry **(P in part)** (*Sambucus canadensis*)	Fac	55.0
	∑ (P)=	**98.0**
	Grand ∑=	**455.0**

Site Photos

(September 26, 2014)

Wetland Creation and Enhancement
Photo Reference Points

Photo 1.

Creation Area, Photo Reference Point C2: North

Dominant Vegetation: sweetgum (Fac), red maple (Fac), broom rosette grass (Facw), broomsedge (Facu)

Comments: Corrective actions such as installing coir logs has helped a great deal to trap eroding soils and by doing so, provide a growth medium for planted and invasive vegetation.

Photo 2.

Creation Area, Photo Reference Point C2: South

Dominant Vegetation: buttonbush (Obl), cypress witch grass (Fac), broom rosette grass (Facw), soft rush (Facw), late flowering thoroughwort (Fac), tall goldenrod (Facu)

Comments: Because of this soil building, total herbaceous cover is now more than 87% in the creation area. This is a 33% increase since just last year.

Photo 3.

Creation Area, Photo Reference Point C2: East

Dominant Vegetation: buttonbush (Obl), broom rosette grass (Facw), soft rush (Facw), broomsedge (Facu), Japanese-clover (Facu) deer-tongue grass (Fac)

Comments: Soil accretion has helped to increase herb populations but planted woody species have struggled somewhat because of low soil fertility. Although they occur at an average rate of 340 stems/acre, many are still small in stature and sometimes difficult to find in the dense herbs.

Photo 4.

Creation Area, Photo Reference Point C2: West

Dominant Vegetation: buttonbush (Obl), sweetgum (Fac), broom rosette grass (Facw), broomsedge (Facu), wrinkle-leaf goldenrod (Fac)

Comments: Sampling was delayed this year until early fall. Therefore, certain species that were dominant last year (when sampling was conducted in June) have been replaced by fall-flowering/fruiting species, especially grasses. Broomsedge, a non-wetland grass was very prevalent in some areas.

Photo 5.

Creation Area, Photo Reference Point C4: North

Dominant Vegetation: red maple (Fac), buttonbush (Obl), Japanese-clover (Facu), bearded beggar-ticks (Facw), downy American-aster (Fac)

Comments: Stunted vegetation in this part of the site is primarily the result of low soil fertility, but seasonal ponding of concave surfaces also plays a role.

Photo 6.

Creation Area, Photo Reference Point C4: South

Dominant Vegetation: sweetum (Fac), broomsedge (Facu), Japanese-clover (Facu), cypress witch grass (Fac)

Comments: Parts of the creation area are wet in winter through early summer. By mid-summer and fall they dry significantly. Such locations typically contain a mixture of wetland and non-wetland species.

Photo 7.

Creation Area, Photo Reference Point C4: East

Dominant Vegetation: sweetgum (Fac), Japanese-clover (Facu), bearded beggar-ticks (Facw), downy American-aster (Fac), purple-head sneezeweed (Fac)

Comments: Despite dry fall conditions evidence of early-season surface ponding in this area included soil cracking, silt accumulation, and algal mats.

Photo 8.

Creation Area, Photo Reference Point C4: West

Dominant Vegetation: sweetgum (Fac), Japanese-clover (Facu), broomsedge (Facu), bearded beggar-ticks (Facw), cypress witch grass, purple-head sneezeweed (Fac)

Comments: Crayfish burrows were noted here as well as in several other places scattered throughout the mitigation site.

Photo 9.

Enhancement Area, Photo Reference Point E1: North

Dominant Vegetation: Shumard oak (Fac), red maple (Fac), redtop panic grass (Facw), deer-tongue grass (Fac), Maryland meadow-beauty (Obl), mistflower (Fac)

Comments: Dense stands of native and introduced grasses were found throughout each of the enhancement areas.

Photo 10.

Enhancement Area, Photo Reference Point E1: South

Dominant Vegetation: sweetgum (Fac), redtop panic grass (Facw), Maryland meadow-beauty (Obl)

Comments: Enhancement areas contain over 360 planted tree and shrub seedlings per acre but the establishment of the seedlings has proven difficult because of root competition from the sod-forming grasses. A number of sweetgum trees can be seen in this view.

Photo 11.

Enhancement Area, Photo Reference Point E1: East

Dominant Vegetation: sweetgum (Fac), swamp rose (Obl), redtop panic grass (Facw), Maryland meadow-beauty (Obl)

Comments: Residual wetland shrubs contributed considerably to woody plant densities. In addition to the 360 stems/acre of planted woody species, swamp rose alone contributed an additional 240 stems/acre

Photo 12.

Enhancement Area, Photo Reference Point E1: West

Dominant Vegetation: sweetgum (Fac), common serviceberry (Fac), redtop panic grass (Facw), Maryland meadow-beauty (Obl), New York ironweed (Facw)

Comments: This is a favored hunting area for northern harriers (marsh hawks).

Photo 13.

Enhancement Area, Photo Reference Point E3: North

Dominant Vegetation: red maple (Fac), redtop panic grass (Facw), cypress witch grass

Comments: Redtop panic grass is a native wetland species that produces seed in the fall. While very dominant in enhancement areas, it has not yet begun to colonize adjoining created wetlands.

Photo 14.

Enhancement Area, Photo Reference Point E3: South

Dominant Vegetation: redtop panic grass (Facw), soft rush (Facw), wool-grass (Facw), boneset (Facw)

Comments: Redtop panic grass tends to thrive in damp or wet soils with adequate sunlight. It will eventually be outcompeted by woody vegetation and more shade-tolerant herb-layer species.

Photo 15.

Enhancement Area, Photo Reference Point E3: East

Dominant Vegetation: buttonbush (Obl), redtop panic grass (Facw), clustered mountain-mint (Facw), cypress witch grass, rice cut grass (Obl)

Comments: The tall, dense vegetation on the middle and southern portions of the enhancement area provide favored habitat for white-tail deer. Despite the wetness, numerous “deer beds” were observed.

Photo 16.

Enhancement Area, Photo Reference Point E3: West

Dominant Vegetation: red maple (Fac), sweetgum (Fac), redtop panic grass (Facw), boneset (Facw)

Comments: Small inundated depressions, hidden by the dense herb layer, are also occasionally used by foraging snapping turtles. These turtles likely reside in an abandoned farm pond lying near the southeastern boundary of the mitigation area.

Photo 17. **Upland Buffer Zones:** Twenty-five ft-wide buffers, external to riparian buffers, were planted with upland oak species in order to provide extra protection to the restored streams. Areas were first mown to make planting easier. Current oak survivorship averages about 110 stems/acre. Naturally-invading woody species contribute just over an additional 110 stems/acre.

Photo 18. **Gooseberry Transplant Area:** Rare granite gooseberry shrubs, rescued from the prison construction site, and transplanted to the mitigation area in 2009, have survived and thus far appear to be doing relatively well. This year, however, we have noticed that invasive Japanese honeysuckle vines are beginning to strongly compete with some of the shrubs. Because they have become so entwined, there is little that can be done to release the gooseberries from the vines that threaten to overtake them. We will continue to monitor the situation. (In the photo above the gooseberries have red leaves and the Japanese honeysuckles have bright green leaves).

Stream Enhancement
Photo Reference Points

(Photo-reference points were taken at the start of each 200 ft-long monitoring plot looking downstream)

Photo 19.

Stream 1 Enhancement Area, Photo Reference Point 1:

Dominant Vegetation: redtop panic grass (Facw), soft rush (Facw), rice cut grass (Obl), boneset (Facw)

Comments: At its upper end, Stream 1 bisects a portion of one of the site's wetland enhancement areas. Because of extreme wetness, planted woody vegetation is somewhat scattered.

Photo 20.

Stream 1 Enhancement Area, Photo Reference Point 2:

Dominant Vegetation: elderberry (Fac), redtop panic grass (Facw), soft rush (Facw), swamp rose (Obl)

Comments: One of the site's elderberries is visible here. It has expanded greatly in size since it was originally planted in December 2010. The dense riparian vegetation hides the channel from view.

Photo 21.

Stream 1 Enhancement Area, Photo Reference Point 3:

Dominant Vegetation: silky dogwood (Facw), deer-tongue grass (Fac), small-flowered agrimony (Fac)

Comments: As was often the case, this site contains both planted and naturally-occurring silky dogwood. Distinguishing between the two was not always possible in some areas.

Photo 22.

Stream 1 Enhancement Area, Photo Reference Point 4:

Dominant Vegetation: silky dogwood (Facw), deer tongue grass (Fac), small-flowered agrimony (Fac)

Comments: Also, because of the colonial nature of many of the planted shrubs, it was very difficult to determine whether performance standards were being met given the high number of live stems present. Counting individual stems was impractical so counts were based on average number of live sprouts per 10 ft of plant length. Silky dogwoods, for example, were found to contain an average of 35 sprouts per 10 ft of shrub length.

Photo 23.

Photo 24.

Stream 1 Enhancement Area, Photo Reference Point 5:

Dominant Vegetation: silky dogwood (Facw), small-flowered agrimony (Fac), rice cut grass (Obl), soft rush (Facw), deer-tongue grass (Fac), black willow (Obl)

Comments: Regardless of the technical aspects of determining stem counts and survival rates of planted vegetation, the overall goal of providing at stable, non eroding channel and floristically diverse riparian zone appears to have been realized.

Stream 2 Enhancement Area, Photo Reference Point 1:

Dominant Vegetation: winged sumac (Facu), black willow (Obl), rice cut grass (Obl), soft rush (Facw)

Comments: Stream Segment 2 is also well-stabilized and supports a high density of herbs as well as planted and naturally invasive woody species. The plunge pool in the foreground lies just downstream of two culverts which pass beneath SR 301. It gives a much exaggerated impression of the size of the waterway.

Photo 25.

Photo 26.

Stream 1 Enhancement Area 3 , Photo Reference Point 1:

Dominant Vegetation: rice cut grass (Obl), small-flowered agrimony (Fac), soft rush (Facw)

Comments: By contrast, Stream Segment 3 had the lowest density at 73 stems/100 ft of stream. Again, the plunge pool gives a false impression about the size of the waterway. Fish, frogs, and snapping turtles were observed at this location.

Stream 1 Enhancement Area 4, Photo Reference Point 1:

Dominant Vegetation: swamp rose (Obl), elderberry (Fac), small-flowered agrimony (Fac), soft rush (Facw)

Comments: Unlike the others, Stream 4 was completely dry at the time of the survey.

Photo Supplement

Photo 27.

Photo Supplement, Wetland Enhancement Area Maintenance:

Comments: During one of the planting efforts, one of the nursery suppliers improperly included glossy false buckthorn among the wetland plants provided. Unfortunately this species has proven to be a noxious weed in other parts of the US. Although only a few dozen were planted, they pose a major threat to the success of the mitigation. They should be identified during next growing season (2015) and treated with herbicide before they spread.

Photo 28.

Photo Supplement, Upland Buffer Zone Area Maintenance:

Comments: Another problem species is autumn-olive. While not an invader of wetlands, a small number of individuals were found adjacent to wetlands within upland oak buffer zones. These could be treated with herbicide in conjunction with false buckthorn. A routine maintenance program started next spring will circumvent the need for a more extensive herbicide spraying regimen in the future.

Photo 29.

Photo Supplement, Wetland Enhancement Area:

Comments: Another potential threat to the mitigation area is rooting by wild hogs. This photo was taken at the edge of a field lying just to the east of the wetland enhancement area. Some disturbance has been observed in the enhancement zone but so far it has been minimal.

Photo 30.

Photo Supplement, Wetland Enhancement Area:

Comments: Because of better soil fertility within the enhancement area, those planted trees that have managed to outcompete the dense layer of herbs, are now approaching 4 ft tall.

Photo 31.

Photo Supplement, Rare Plants:

Comments: The BCCX wetland mitigation property is noteworthy since it contains four species of plants that are very rare in TN. This means that long-term protection of the site is important for the people of the state. The rarest is the grass-like brown bog sedge. It is listed by TDEC as “endangered” and there are fewer than five known occurrences statewide.

Photo 32.

Photo Supplement, Rare Plants:

Comments: Also “endangered” is the southern long sedge. Other than Bledsoe County, it has been documented from only one other TN county (Lincoln).

Photo 33.

Photo Supplement, Rare Plants:

Comments: The granite gooseberry is listed as “threatened”. While relatively common in the immediately vicinity of BCCX, there are five or fewer other known populations in the state. Approximately 20 shrubs were “rescued” from destruction during construction of the BCCX expansion and transplanted to the wetland mitigation area. (See comments under Photo 22.)

Photo 34.

Photo Supplement, Rare Plants:

Comments: The latest addition to the rare plant list is the tiny dwarf sundew; a state “threatened” species. Sundews inhabit nitrogen poor soils and supplement their nutrient intake by capturing insect prey. This is done by trapping insects with sticky hairs that coat the leaf surface (see insert) and then dissolving the prey with specialized enzymes. The nutrients from the insect are then absorbed through the leaves.

Site Maps

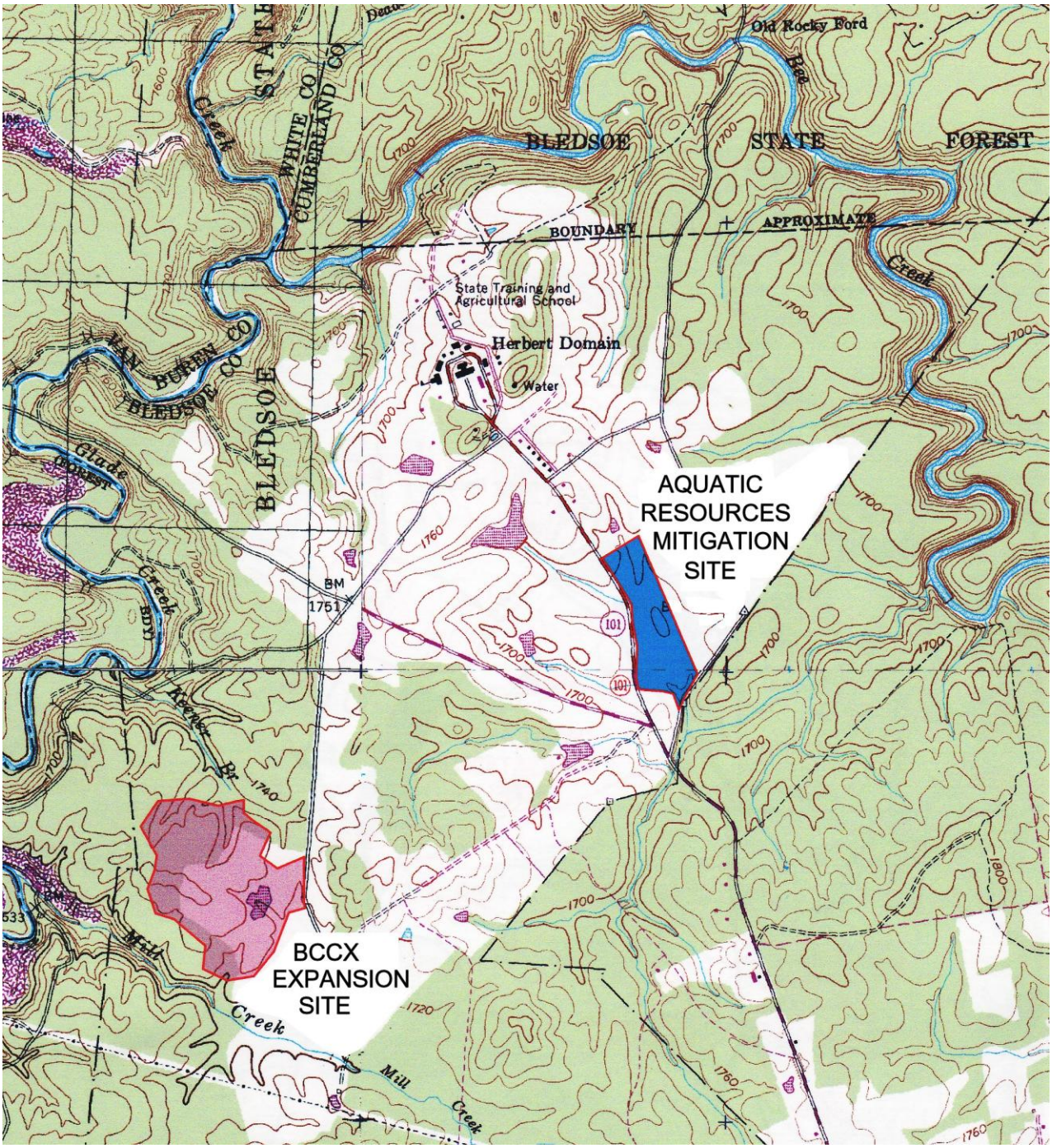


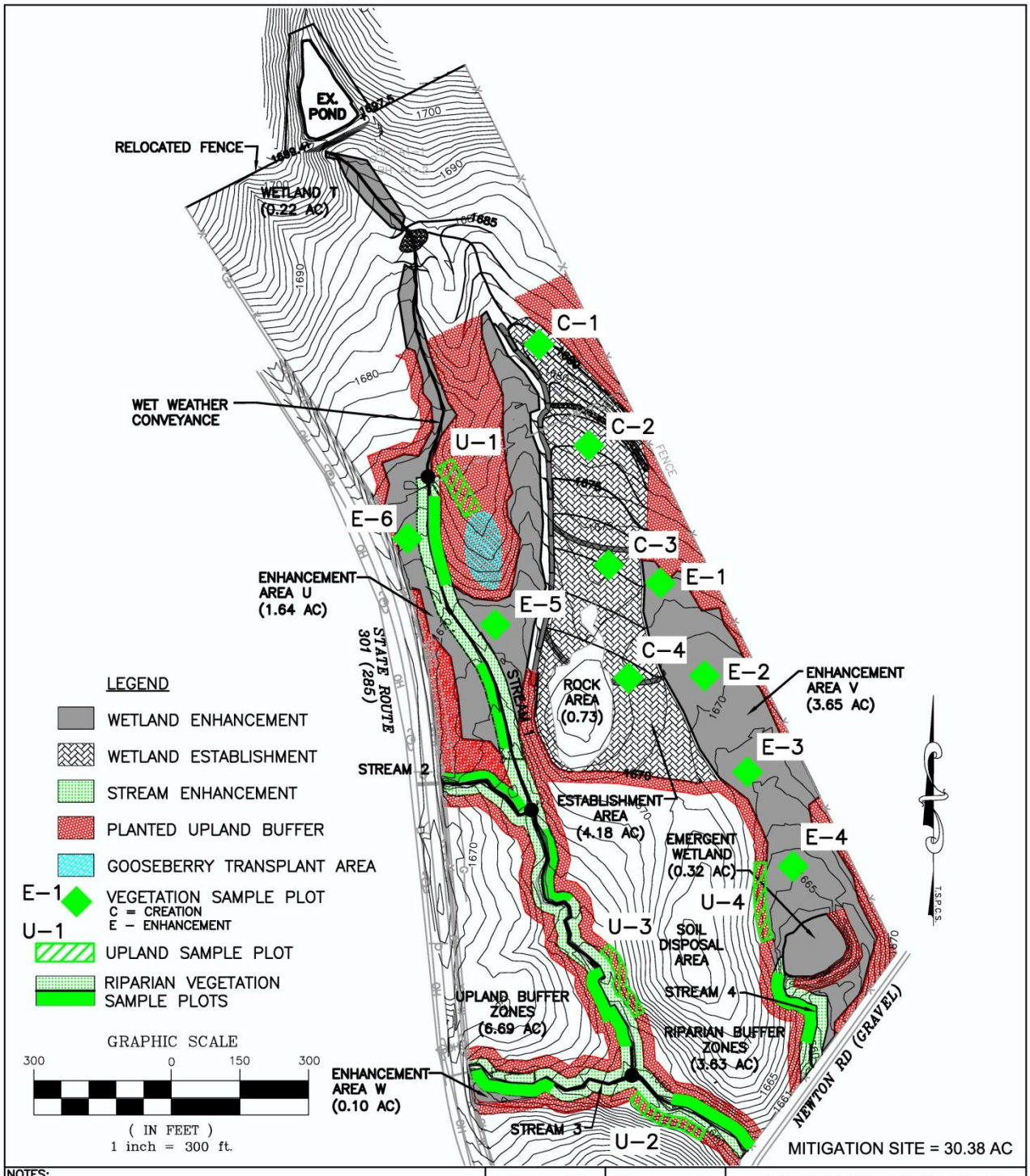
Figure 1. Location Map
DeLorme 3-D TopoQuads™
Herbert Domain (1981), Billingsley Gap (1981), Sampson (1974), Lonewood (1983), Tennessee

SCALE 1 : 24,000

2,000 1,500 1,000 500 0 FT. 2,000

N

WATER RESOURCES



NOTES:

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DESIGNED BY:	KJK
CHECKED BY:	HSH
CADQA BY:	DEH
DRAWN BY:	DEH
SCALE:	1" = 300'
DATE:	10–07–11
REVISION NO.:	1

BLEDSOE COUNTY CORRECTIONAL COMPLEX
MITIGATION SITE
BEE CREEK MILE 11.4 RIGHT BANK
BLEDSOE COUNTY, PIKEVILLE, TENNESSEE
APPLICANT: TDF&A, (USACE FILE NO. 2005-02425)

FIGURE 2:
STREAM AND WETLAND MONITORING MAP

PROJECT NO.: 142.013.09
FILENAME: WM–1.DWG

Conclusions

Wetland Mitigation

Summary Statement: Corrective actions taken during the early winter 2013 involving the replanting of 5,650 wetland-adapted trees and shrubs, and also the installation of more than 2,500 ft of coir log erosion dams, has helped move the mitigation site forward towards meeting its principal goals of replacing historic wetlands by making available a diversity of habitats for water-dependent plants and animals. The mitigation is also providing a variety of important functions such as water storage capacity, soil stabilization, sediment trapping, and groundwater recharge.

Vegetation: Performance standards which call for a 70% coverage of wetland-adapted herbs have not yet been met within the creation area. Wetland herbs currently constitute 61.9% of the cover. We are optimistic however that the trend is in the right direction since last year cover of hydrophytes was only about 58%. We are also happy to report the occurrence of dwarf sundew, a state listed "threatened" species. Planted woody density has been conditionally met with overall site density averaging 340 stems/acre. While planted survival exceeds the required 326 stems/acre, performance standards stipulate that no one species can comprise more than 20% of the total. Two species, buttonbush and sweetgum, both exceed this threshold. Despite this "conditional" result, we remain pleased given the fact that during the first monitoring effort, three years ago, stem density was only 65 stems/acre.

Vegetation standards for enhancement areas have easily been attained. Herbaceous diversity has decreased somewhat since 2013 but this likely relates to the fact that this year's sampling was conducted at the very end of the growing season. Among that diversity are two sedge species that are exceptionally rare and listed by the state as "endangered". Combined density of planted and naturally-invasive woody species is **600** stems/acre while planted vegetation alone occurs at the rate **360** stems/acre.

Soils: Soils in the creation area have been mapped by the Natural Resources Conservation Service as containing Lily loam and Morehead-Bonair complex. The latter contains inclusions of hydric Bonair soils in low-lying areas and depressions. Indeed, residual hydric soils with depleted matrices (NRCS Field Indictor of Hydric Soil, F3) were confirmed in 75% of the samples. Creation areas have been exposed to conditions of augmented hydrology for only a short period of time but are already showing signs of developing hydric characteristics. Although performance standards have not been met within all creation areas, a conversion of the native soils seems to be occurring. As a consequence, we recommend no actions at this time. The rates at which soils evolve hydric indicators vary widely, but hydrologic modification should only be considered if chemical reductions are not observed in non-converted areas after the fifth year of monitoring.

Hydrology: Shallow groundwater monitoring wells were not required as a condition of this permit. Positive wetland hydrology is therefore inferred from the successful establishment of wetland vegetation and a variety of primary and secondary hydrologic indicators. As has been seen, wetland plant dominance occurs throughout the site. Additional hydrologic indicators observed this year in either the creation or enhancement areas include: scattered occurrences of soil saturation and inundation, sediment and drift deposits, surface soil cracks, algal crust, crayfish burrows, geomorphic position, and a shallow aquitard.

Stream Mitigation

Summary Statement: Principal performance goals for the onsite stream segments are to maintain stable, non-eroding embankments and to establish sustainable vegetated riparian and upland buffers for long-term protection. This year's monitoring indicates that stream mitigation efforts have been largely successful.

Channel Conditions: The four enhanced tributaries to Bee Creek each continue to exhibit stable geometries. No problems with erosion were observed despite some very significant rainfall events that have occurred since mitigation was undertaken in 2010.

Vegetation: The relative lack of disturbance has allowed vegetated riparian zones to thrive. The addition of newly planted seedlings, combined with the sprouting from latent root systems of highly colonial species such as swamp rose and silky dogwood, have resulted in robust populations of woody stems in many streamside areas. Because the distinction between planted and naturally-invading species could not consistently be made, it was not possible to determine planted tree survival rates. Nonetheless, observed densities continue to exceed the performance standards in all cases. Since riparian vegetation is functioning to stabilize the embankments and is beginning to provide shade and cover, we do not recommend any additional plantings. Glossy false buckthorn that was inadvertently planted in some of these areas should be controlled with herbicide since it is a well-documented invasive species.

Upland buffer zones lying adjacent to the stream and wetland mitigation have no specific performance requirements associated with them. They currently support, on average, a total of 140 stems/acre, but survival is sporadic. Drought conditions which occurred the summer after planting, along with competition with aggressive pasture grasses, has killed off a significant number of planted red and white oaks. Current density of oaks stands at 110 stems/acre. These are being supplemented in some areas by natural seed rain coming from adjoining forested areas. Red maple, eastern redcedar, and black cherry, for example are now contributing an average of 15 stems/acre. Multiflora rose and autumn-olive are also beginning to appear in the buffer zones. Because they are invasive, alien species, consideration might be given to chemical control.

Granite gooseberry transplant efforts appear to be successful thus far. Transplant populations of this rare, state-listed shrub have increased in areal extent every year since they were planted in March 2009. Unfortunately, Japanese honeysuckle vines have become strongly established this year and threaten to eventually overtake the shrubs. Because they are so entwined there is very little that can be done to remove them. Despite their rarity, granite gooseberries are tenacious and it is possible that some of the plants will survive over the long term.

The permittee's commitment to protect the site in perpetuity via deed restriction has yet to be fulfilled. Neither has the requirement to install signage designating the mitigation site as a protected property. These have been delayed until such time that the permittee is certain that all performance standards have been reached and are sustainable. Because the property is state-owned, there are no immediate outside threats to the mitigation area.

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Weakley, Alan S. 2012. Flora of the southern and mid-Atlantic states, working draft of 30 November 2012 [Internet]. University of North Carolina, Chapel Hill. [cited 2014 October 10]. Available from: http://www.herbarium.unc.edu/flora.htm.

Photo Inserts

(Photo 35) Wikipedia contributors. 2014 Aug 20. Carex buxbaumii [Internet]. Wikipedia, The Free Encyclopedia; [cited 2014 October 12]. Available from: http://en.wikipedia.org/w/index.php?title= Carex_buxbaumii&oldid=622053540.

(Photo 38) Jason Penney. 2009 June 27. Detail of dwarf sundew leaf [Internet Image] [cited 2014 October 12]. Available from: http://www.flickr.com/photos/centavo/3673862061/in/photolist