



2017

# Evaluation and Recommendations for a Portion of the East Brook

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## Recommended Citation

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An independent study project report by The Alice & J. Liddon Pennock, Jr. Endowed Horticulture Intern

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# Evaluation and Recommendations for a Portion of the East Brook

## **Abstract**

The East Brook is a small stream that runs southeast to northwest within the Morris Arboretum where it then feeds into the Wissahickon Creek. This stream is used by Arboretum staff to educate the public through interpretative signage and it provides many views valuable to the Arboretum. A portion of the East Brook, specifically the northwestern portion from the log cabin bridge to where it meets the Wissahickon Creek was focused on because there was a more immediate need for stabilization improvements as there are large eroded sections of the stream bank due to the absence of an adequate wall, stone, or natural plant root protection. Climate models have predicted an increase in precipitation for the Mid-Atlantic region that will increase stream bank degradation. Six spots along the stream were identified that could benefit from some type of erosion control. Additionally, areas along the stream are improved by continual removal of invasive species and weeds. A few native plantings will be added to be barriers for the stream, add seasonal interest, and for potential erosion control. Recommendations for bamboo control and path reestablishment were also noted. Evaluation of the erosion issues concluded that the problems were more numerous and serious than originally thought. Experts were consulted to assess the erosion problems and assist in the effort to start developing improvement plans. Once completed and an estimated budget developed, the Arboretum will be able to initiate fundraising efforts to cover repair costs, hopefully to be completed in the next 5-10 years.

## **Disciplines**

Horticulture

## **Comments**

An independent study project report by The Alice & J. Liddon Pennock, Jr. Endowed Horticulture Intern

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*The Alice & J. Liddon Pennock, Jr. Endowed Horticulture Intern*

**DATE:** April 2017

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The East Brook is a small stream that runs southeast to northwest within the Morris Arboretum where it then feeds into the Wissahickon Creek. This stream is used by Arboretum staff to educate the public through interpretative signage and it provides many views valuable to the Arboretum. A portion of the East Brook, specifically the northwestern portion from the log cabin bridge to where it meets the Wissahickon Creek was focused on because there was a more immediate need for stabilization improvements as there are large eroded sections of the stream bank due to the absence of an adequate wall, stone, or natural plant root protection. Climate models have predicted an increase in precipitation for the Mid-Atlantic region that will increase stream bank degradation. Six spots along the stream were identified that could benefit from some type of erosion control. Additionally, areas along the stream are improved by continual removal of invasive species and weeds. A few native plantings will be added to be barriers for the stream, add seasonal interest, and for potential erosion control. Recommendations for bamboo control and path reestablishment were also noted. Evaluation of the erosion issues concluded that the problems were more numerous and serious than originally thought. Experts were consulted to assess the erosion problems and assist in the effort to start developing improvement plans. Once completed and an estimated budget developed, the Arboretum will be able to initiate fundraising efforts to cover repair costs, hopefully to be completed in the next 5-10 years.

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## INTRODUCTION/HISTORY

The East Brook (EB), known more formally as the Hillcrest Run by the Wissahickon Watershed Association, is a small stream approximately 0.8 miles long that runs southeast to northwest where it then feeds into the Wissahickon Creek. It runs through wooded, residential, and recreational (Morris Arboretum) areas (Philadelphia Water Department Office of Watersheds, 2010). What we know as the EB now, an essential part of the Morris Arboretum (Arboretum), where it seems uninterrupted and peaceful, was not always that way. The entire stretch of the EB currently in the Arboretum was actually purchased in pieces. Because John and Lydia Morris did not originally own all the land that the Arboretum currently occupies, four additional land purchases in 1892, 1897, 1901, and 1905 were necessary before they had acquired the land that encompasses the full portion of the EB contained in the Arboretum today. On the Arboretum property, the EB covers a distance of approximately 1,800 feet, extending from Hillcrest Avenue near the Springhouse and working its way to the Swan Pond, where it continues through the property and feeds into the Wissahickon Creek. The portion of the EB that this project focused on (Fig.1.) is approximately 600 ft, or one-third of the EB in the Arboretum, and includes the northwestern portion of the brook that begins after the log cabin bridge and extends to where it meets the Wissahickon Creek. The depth of the brook in the project area has a range of less than one foot to almost three feet. The width of the brook in this portion ranges from three to five ft.

The portion of the EB that I am working on was acquired by the Morrises in 1897. As this was over one hundred years ago, how the land is used today is very different than how the land was used then. Most of the land during John and Lydia Morris's time was used as farmland, as shown in both the 1909 and 1914 Compton Atlas. The amount of land total in the 1909 Atlas is significantly smaller than the area now known as English Park was not bought until the following year, and shows up in the 1914 Atlas. Due to the close proximity of a property owned by others, there used to be iron fencing along both sides of the EB to designate that property line. Along the iron fence on the Morris side was a long flower bed with roses, *Lonicera*, *Hibiscus*, and many *Acer rubra* that we now know as *Acer rubrum*, (Red Maple). Additionally, on the Morrises' side of the property, where the Sculpture Garden is now located, strawberry beds were planted. The Morris side contained a gravel road along the EB. The 1914 Atlas also revealed the addition of the English Park and shows some features we are familiar with today, such as the beloved low, historic wall feature that is revealed in the fall when the surrounding ferns are cut back and the lovely stone bridge that was so well received when constructed that it was mentioned in *The Practical Book of Garden Architecture* by Phebe Westcott in 1914. Also noticeable in the 1914 Atlas are many plantings that are long gone, such as iris and daffodil beds and a steel arbor feature where all the roses, *Hibiscus*, and other flowering plants were located. This is in contrast to that same area today in which the landscape surrounding the EB has reverted to a more naturalistic planting.

The EB today may not be a major attraction to the everyday visitor, but it is still a significant feature of the Arboretum and provides many functions. It provides education through interpretive signage about the harmonious relation between trees and streams by the bridge near the Spring House and gives a glimpse of the past for children pretending to pump water like in the olden days at the Log Cabin. It also feeds water to the Swan Pond and allows for interaction with walkable rocks just before the water enters the Swan Pond. The portion of the EB I have worked on may not be as immediately interactive, but has its own charm, with picturesque views

that are equally valuable to the Arboretum such as the view from the Sculpture Garden into the English Park and vice versa, the stone bridge view of the waterfall, the majestic presence of the *Metasequoia glyptostroboides*, (dawn redwood) grove all around and looking straight down the EB from the log cabin bridge, which had recently been highlighted in the Arboretum's seasonal interest video.

### SITE CONDITIONS

Some portions of the EB are very open and accessible to the public, such as the walkable stones northeast of the Swan Pond, and the Log Cabin and surrounding area. After the Log Cabin, the banks of the brook are uneven and in places unsafe. This makes the area difficult to manage and has resulted in several issues. Many different species of weedy and invasive plants were found along the banks of the brook, in addition to the presence of a significant spread of poison ivy (*Toxicodendron radicans*). For the most part, the trees along the project area are deciduous so, in the growing season the areas along the brook are fully shaded. Some stretches, however, get partial sun and one approximate 15-foot stretch east of the *M. glyptostroboides* collection behind the temporary art piece "Waltz in the Woods" sculpture receives full sun. The extent of sun exposure is important because in locations where erosion issues arise, the selection and use of plants to stabilize the bank must take into consideration the amount of light available. The soil conditions in this area of uneven ground are periodically dry loamy soil. Additionally, there are many large mature trees along the EB so one would not have to dig long, if at all, to encounter roots. The EB is subject to fluctuations in flow depth and rate due to rainfall and irregular large single storm events. In cases where large storms pass through, the water rushes through the brook as it makes its way to the Wissahickon Creek and has eroded large sections of the stream bank due to the absence of adequate wall, stone, or natural plant root protection. This has resulted in the development of several sites of concern

### SITES OF CONCERN

Six spots along the brook have been identified that could benefit from some type of erosion control (Fig 2.). These locations were further evaluated to determine how urgent the need for modification is and what type of erosion control method is most appropriate to each individual location. These locations are:

- 1. Low rock after the Log Cabin Bridge:** On the southern bank of the brook immediately after the Log Cabin Bridge is a low area where there are no intentional plantings close to the brook edge and there are exposed rocks.
- 2. *Acer rubrum*:** Along the south bank midway between the Log Cabin Bridge and the historic wall structure is accessioned 1932 1031\* A *Acer rubrum* immediately along the bank. This large, majestic tree has been undercut which means it has had most of the soil washed out of the root area and is in danger of toppling. Soil roughly 1.5 feet in height and 1 foot in depth has been washed away
- 3. Edge of historic wall structure:** There is a piece of concrete wall that seems to have once supported the brook's bank on the southern side just east of the

historic wall structure that has collapsed into the brook. Since its fall, the concrete slab now diverts water directly toward the bank where there is no protection. The rush of water moves in a swirling pattern that has eroded the bank. The resulting erosion has been gradually encroaching on the historic wall.

4. **Hole near *Metasequoia glyptostroboides* root:** The supporting concrete structure underneath the *Metasequoia* closest to the stone bridge has had a portion fall out. This has now led to water going into this gap and washing soil out. The dimensions of this hole are roughly 1x1x1 feet.
5. **Waterfall wall:** Underneath English Park are trench drains. The drains continually drip water out of the supporting boulder- packed walls of the large waterfall near the native Azalea collection. This has led to the wall crumbling and deteriorating.
6. **Meeting point with the Wissahickon:** The point where the EB meets with the Wissahickon Creek is complicated and the largest issue in this area. The water from the EB flows into the Wissahickon, while at the same time water from the Wissahickon flows towards the EB, resulting in a swirling motion of the water from the two forces pushing against each other. This has resulted in an alarming rate of bank erosion. Historical measurements are unavailable and, as a result, it is unknown how much of the bank has actually been lost, but according to Staff Horticulturalist Kate Deregibus, an estimated 6 feet of bank has been washed away in a ten year period. Additional erosion has occurred along the bank of the Wissahickon where the Sculpture Garden is located due to the swirling water action where the two flows meet.

## METHODS AND CONSIDERATION

In developing this project, the entirety of the EB located in the Arboretum was evaluated for improvement. The primary considerations for which portion of the brook would be included in the project were the physical condition of the brook at distinct locations and the timeframe available to complete the project. The conditions considered were: 1) the amount of vegetative overgrowth; 2) the presence and density of invasive plant species; and 3) the evidence of and susceptibility to erosion. After evaluation, it was determined that the entire length of the brook was too large an area to work on within the allotted timeframe. Additionally, the northeastern half of the brook, which extends from the Hillcrest Avenue border to the Log Cabin, was determined to not have an acute need for improvement because it was in fairly good condition. The northwestern portion, which extends from the Log Cabin to the Wissahickon Creek, was determined to be in more immediate need of stabilization improvements. Although this area has not been completely neglected in recent years, it has not received dedicated attention in quite some time due to competing priorities by Arboretum staff. In addition to determining that working on the entire EB was not feasible, an evaluation was made as to whether both sides of the brook would receive attention. Initially, only the northern side of the brook was worked on

due to a determination that the north side was less infested with poison ivy. It was also felt that it had more potential benefit as it is used more by visitors due to its proximity to other sites of interest, such as the Sculpture Garden, which is located off the main Arboretum path. Shortly afterwards, however, it was determined that although the southernmost side of the brook has fuller beds of perennials and ferns, and, as a result, visitors tend to stay on the path, this side was later determined to have a fair amount of invasive species and weeds. As a result, it was decided that it would most beneficial to work on both sides of the brook.

As part of the improvement process, it was decided from the beginning that no herbicides would be used in this project. This decision was made because of the relatively small areas that were worked on; the close proximity of the vegetation to the brook and the Wissahickon; the close proximity to accessioned plants; and the general harmful ecological consequences known to result from herbicide use. As a result, only mechanical plant removal was used. Although labor and time intensive, if done in regular short intervals, manual removal was not overwhelming. Prior to beginning the process of plant removal, former Arboretum horticulture intern Emma Erler's weed identification guide was consulted for both species identification and for removal advice. Plants were selected for removal if they were: 1) an invasive, noxious weed; 2) considered a typical garden weed; 3) inappropriate for the location, such as an undesired native species; 4) a species that exhibited reoccurring growth from rootstock after removal; or 5) an unsafe, dangerous plant to humans. The decision was made to remove all invasive species. Not all plants that are considered weedy in a public garden, however, should necessarily be removed because they may serve environmental functions like providing a nutrient source for pollinators or birds. Table 1 contains an initial list of plant species identified for removal, and their reason for removal, as a result of the initial inspection of the brook area.

## **MANAGEMENT PLANS AND CONSIDERATIONS**

Evaluation of the erosion issues concluded that the problems were more numerous and serious than originally thought. Experts from the engineering firm Skelly and Loy were consulted to assess the erosion problems and assist in the effort to start developing improvement plans. Once completed and an estimated budget developed, the Arboretum will be able to initiate fundraising efforts to cover repair costs, hopefully to be completed in the next 5-10 years. As a result, it was determined that immediate erosion control was beyond the resources and time available within the current internship year. The sites needing work required damming the brook, packing more boulders, working at the scour line, and other tasks. Improvement at one site in particular, the area where the EB merges with the Wissahickon is particularly complicated because the land around this area is owned by three different entities, the Morris Arboretum, Chestnut Hill College, and a private neighbor of the Arboretum.

Because of the uncertainty of when this project would begin, and what areas would be affected (such as worker and machinery access, storage of rocks and/or other construction materials, and overall construction needs), it was decided that large scale installations of new plants at this time would be an inefficient use of resources. Thus, only limited plantings are planned. A small planting (Fig. 3.) will be added around the 1980-056\*B *Taxodium distichum*, (bald cypress), to aid in the protection of the emerging knees from visitors who have been

observed standing on and kicking of the knees.

*Ilex verticillata* (winterberry), *Carex pensylvanica* (sedge), and *Polystichum acrostichoides* (Christmas fern) were chosen to be appropriate for use in this location. *P. acrostichoides* was chosen over the more widely occurring (around the Arboretum) *Matteuccia struthiopteris* (ostrich fern) due to its evergreen habit, low maintenance requirements and ability to tolerate periodic dry spells. It was decided that the planting around the *Taxodium* if successful would provide a miniature example of the planting design that could be used at the low rock area. Also, due to the unknown potential start time of this project, it was decided that a coconut coir log will be staked to the undercut *A. rubrum* to buy time until more permanent erosion control efforts can be implemented in this area. The coconut coir log was selected because it would help save the soil still left at that site, it is biodegradable, it will protect the tree and soil from heavy brook flows, allow plant establishment, and land stabilization, and will add nutrients back to the area. The coconut coir log will be installed in the late spring along with *C. pensylvanica* that will be planted around it.

Smaller sized plants will work best in this planting because digging will be difficult due to the existence of large tree roots in these areas. New plants will be planted as densely as possible, as appropriate for the species, but weeds will continue to emerge until the new plants have established themselves and have filled in the area. As a result, continued weed removal will be necessary to lessen competition for nutrients and space.

The project area is also important because it provides important viewing opportunities that need to be maintained. Any plants selected for planting along the brook, especially in the sunny area in front of the *M. glyptostroboides*, must not have the potential to grow so high that they interfere with the year round view and to not create an unobstructed view into the English Park. With that in mind, it was decided that *Cornus sericea* (red twig dogwood) would be planted in the corners of the wall on the northern side of the EB after the 1980 *T. distichum* and before the *M. glyptostroboides* grove. This was decided because that sunny location, if maintained invasive free, is usually filled by aggressive pollinator plants such as solidago spp. which is an acceptable plant because it dies back in the fall and reveals the wall. The red stems of the *C. sericea* would instead frame the wall and highlight it when the leaves fall and the pollinator plants go dormant. Further down the brook near the stone bridge (Fig. 4.), *I. verticillata* and *Euonymus americana* (strawberry bush) will be planted to provide food for native wildlife and provide an anchoring structure for surrounding soil. Large thickets of *T. radicans* can be an issue due to the irritating skin reaction one gets after interacting with any part of it unprotected. Another issue is that even though it is a native species, clumps of *T. radicans* can decrease biodiversity in that area. As of the end of March, 2017, 45 full industrial trash bags of *T. radicans* have been removed from areas along the bank and continued removal is planned. As with any area in a public garden, it will need to be routinely monitored for weeds/invasives. Native fauna will always disperse these plant species to unwanted areas. As a result, periodic checking and maintenance of both the brook bank and surrounding areas to remove weed/invasive seed banks/sources will be required.

## RECOMMENDATIONS FOR THE FUTURE

Other than the long term need for erosion control in this area, there are additional issues that could not be directly addressed within the time period of this project. Issues identified for future consideration include the control of running bamboo and the potential construction of a new public path. With respect to bamboo control, a popular art piece along the EB is Lorraine Vail's *American Bull*. The *American Bull* was created as an oversized piece to make viewers feel small in the environment, a sensation reinforced by the neighboring presence of the *M. glytostroboides*. However, the *American Bull* is not entirely out in the open because is engulfed by a healthy stand of *Pleioblastus viridistriatus*. Although *P. viridistriatus* fills the space around the *American Bull* wonderfully, this running bamboo species has now spread along the northern side of the EB from halfway through the *M. glytostoboides* collection to near the stone bridge. Usually kept in check around the art piece by mowing so a turf/dirt path exists, its underground runners have jumped over that path and are now seemingly out of control.

In normal circumstances when attempting to control running bamboo, it is usually removed entirely or has a border installed to prevent further spread. Other techniques for removing running bamboo includes the use of herbicides, and even using an air spade (Missouri Botanical Garden, n.d.). Our running bamboo is a dense groundcover directly along the EB intermixed with ferns and *M. glytostoboides*. Bamboo is unaffected by most herbicides on the market and that if effective may have undesirable consequences for other plant species or the surrounding watershed. The use of "air spading" to unearth new rhizomes would remove most if not all the topsoil in the affected area, making these options not viable for the Arboretum. Therefore, I recommend that the Arboretum start a continuous mowing/weed whacking program to slowly weaken the bamboo rhizomes over several years. Also, in areas where the bamboo is not as dense, rhizomes could be manually removed during a few weeks of the spring growing season. Although this may not be the fastest removal method, it is one that causes the least disturbance and damage to the surrounding area.

With respect to a new public path, there used to be a side path along the EB on the northern bank before the Log Cabin bridge that leads to the 1980-056\*B *Taxodium distichum*. It is unknown when this path ceased being used, but it has since been taken over and colonized by root suckers of *Asimina triloba*, the paw paw, and other woody plants, rendering the path unusable. The ground itself at this old path location has been washed out a few times from storms and has resulted in holes, exposed rocks, and is unstable and unsafe. Evidence of foot traffic near this old path demonstrates that people enjoy walking next to the EB. Thus, re-establishment of this path should be considered. This should not be overly complicated, and could potentially be completed by the engineering firm chosen to work on the EB erosion control. However, because the erosion work will likely require a substantial amount of time, work on the path should be considered for quicker completion. Arboretum staff should be capable of handling removal of the necessary undergrowth. However, stabilizing the ground may be more appropriate for an engineering firm.

## CONCLUSIONS

The overall goals of this project were to evaluate the needs of and preserve the underappreciated area encompassed by an approximately 600 foot section of the EB, protect

plants in the Arboretum's living collection, enhance the project area by adding new plantings, and inform Arboretum staff of issues necessary to support more effective planning, repair, and the prevention of future issues from developing. Bank erosion occurs naturally, but can be accelerated by unwise land use or maintenance decisions by humans. Although hard to imagine after what seems to have been a warm, dry latter half of the year 2016, climate models of the mid-Atlantic region have predicted more extreme precipitation, with wetter winters, and longer dry periods. The warming and precipitation trends for Pennsylvania are predicted to continue and it has been projected that the annual precipitation rate will increase 8% with a 14% increase during winter time (Shortle et al., 2015). With that in mind, Pennsylvania has already been reported to have had higher than normal stream flows and peak flows with more flash storms. All this has resulted in increased potential erosion and stream bed degradation. With the predicted weather reports, we can expect larger erosion rates, greater bank instability, and overall increased stream degradation. This is all the more reason to improve the EB. Ultimately, the stream will adjust, modifying its banks and dimensions as nature and circumstances dictate. However, freely allowing this to occur without consideration of our role and responsibility as a public garden would be inconsistent with our purpose and mission.

### **ACKNOWLEDGEMENTS**

I'd like to thank Kate Deregibus, the English Park Horticulturist and my project supervisor for her time, patience, and guidance. As someone very inexperienced with all of this she always reminded me to wash up after a great ivy harvest. I'd also like to thank Paul Orpello, the Compton Horticulturist, and Lucy Dinsmore, the Azalea Meadow Horticulturalist for being supportive the entire time

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**TABLES AND FIGURES**

Table 1.

<b>Plant Removed</b>	<b>Reasoning</b>
<i>Acer negundo</i> , Box elder	3
<i>Ageratina altissima</i> , Snakeroot	2,3
<i>Ampelopsis brevipedunculata</i> , Porcelain Berry	1
<i>Artemisia vulgaris</i> , Mugwort	1
<i>Celastrus orbiculatus</i> , Bittersweet	1
<i>Fallopia japonica</i> , Japanese knotweed	1
<i>Glechoma hederacea</i> , Ground Ivy	2
<i>Hedera helix</i> , English Ivy	2
<i>Humulus japonicas</i> , Japanese Hops	1,5
<i>Lonicera japonica</i> , Japanese Honeysuckle	1
<i>Prunus spp.</i> , Cherry rootsuckers	4
<i>Rubus phoenicolasius Maxim</i> , Wineberry	1,5
<i>Toxicodendron radicans</i> , Poison Ivy	2,5
<i>Urtica dioica</i> , Stinging Nettle	2,5
<i>Vitis spp</i> , Grape vine	2

Figure 1. Project Area

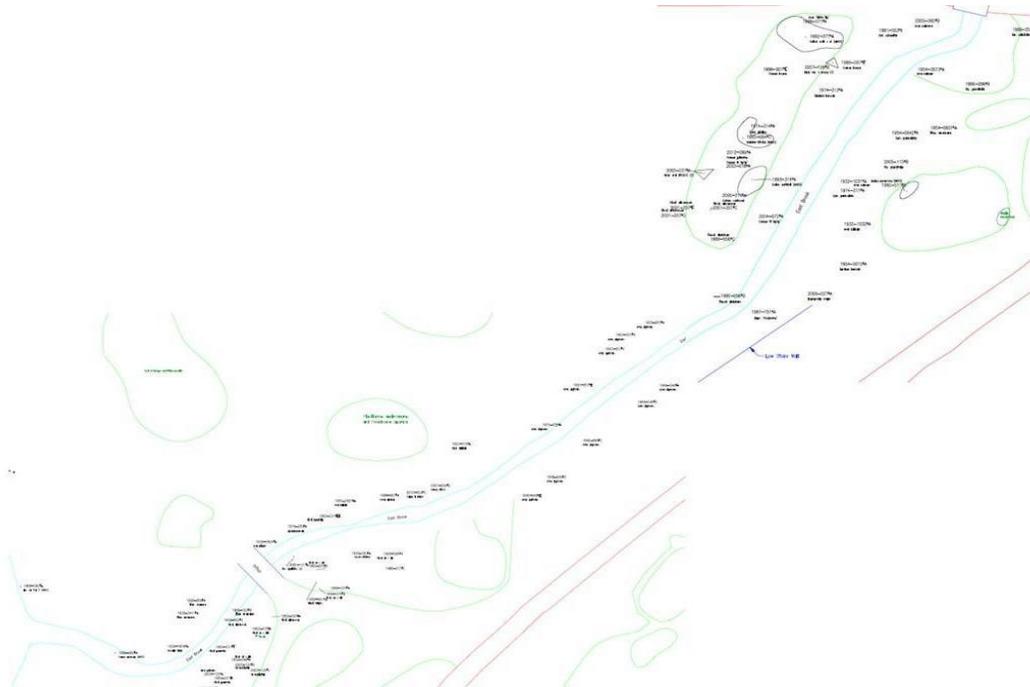


Figure 2. Sites of concern and areas that were worked on

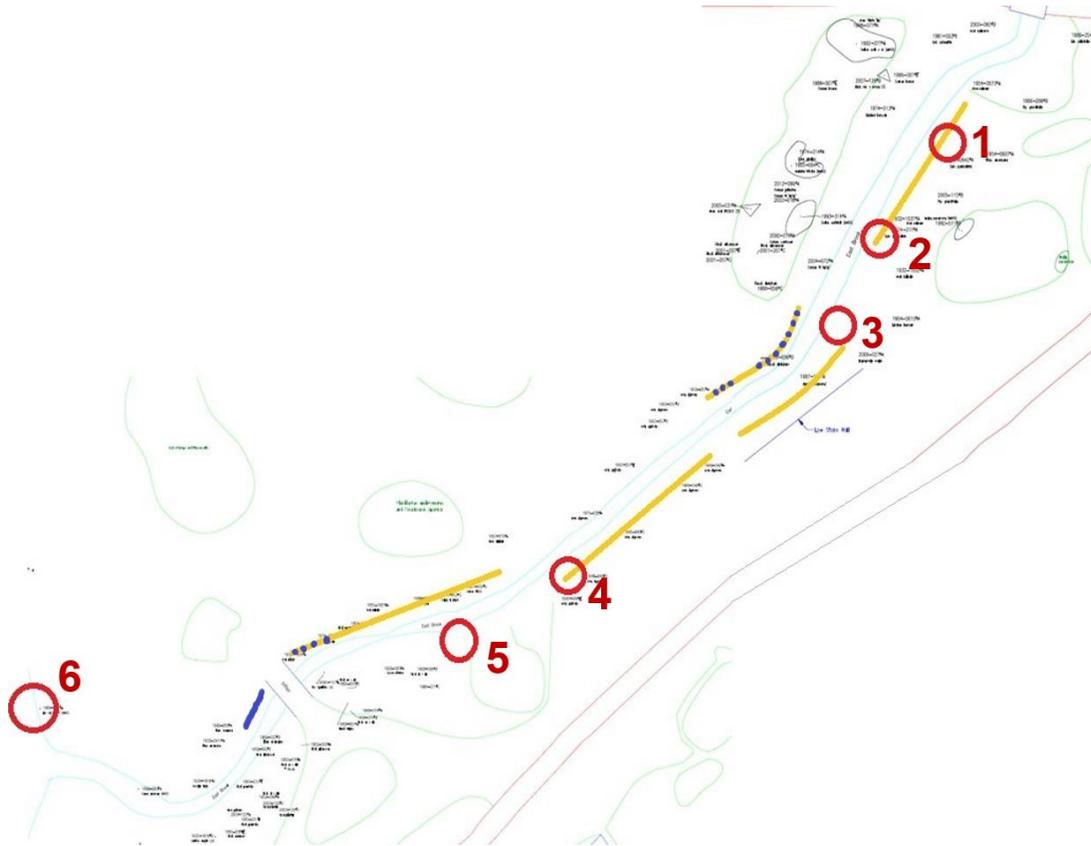


Figure 3. First Planting Area

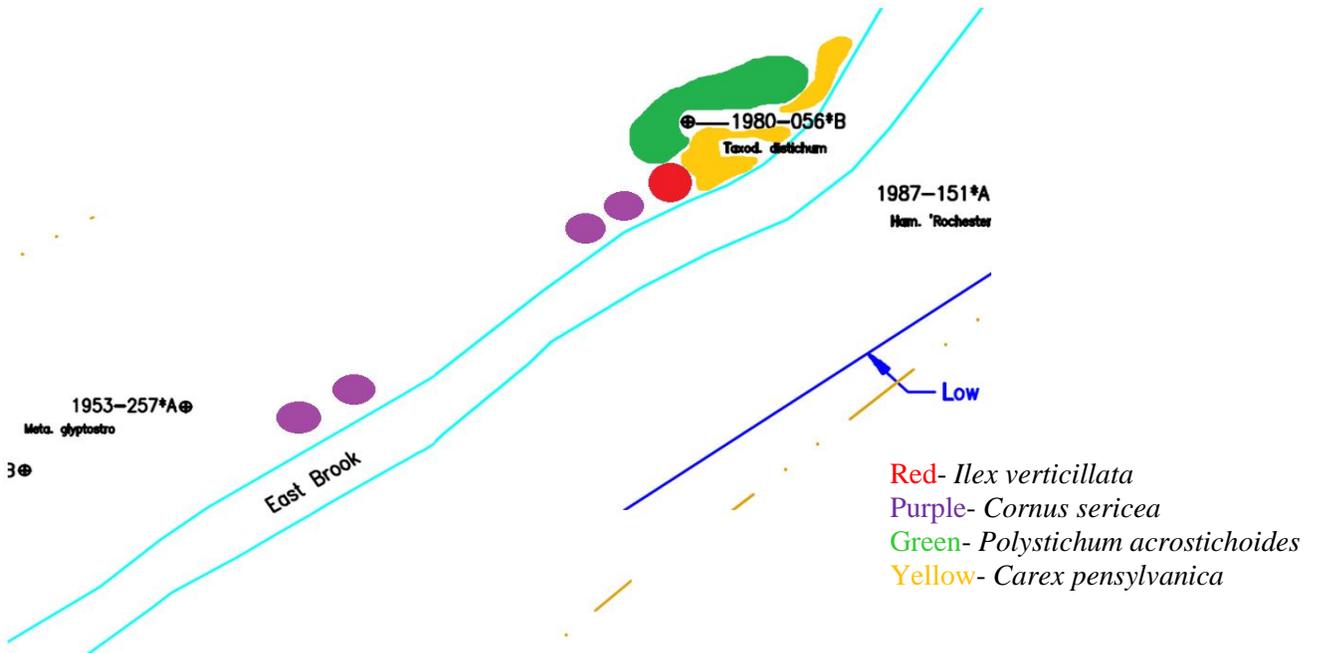


Figure 4. Second Planting Area

