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# Golf Course Habitat Restoration Pilot Program: A Project Between the US Golf Association and The Nature Conservancy Final Report



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## Introduction

As golf has become more popular, people have become interested in how golf courses affect land resources and the environment. For the past 25 years, the United States Golf Association (USGA) has supported more than 90 university research projects to evaluate the relationship between golf and the environment. Based on factual, unbiased university research, the results indicate that the turf, trees, and natural areas commonly found on golf courses provide several environmental benefits. Some of these golf course ecosystem benefits include topsoil erosion control, wildlife habitat, stormwater retention, improved air quality, and damaged land restoration.

The USGA recognizes that the ecological impacts of golf courses and the cost associated with course maintenance are limiting factors to the sustainability of the game, particularly in the realm of water management. It is estimated the more than 2 billion gallons of water per day are used across the US for green and fairway irrigation. Additionally, the USGA recognizes that there are areas of golf courses that are rarely used by players, yet are intensely managed to maintain course aesthetics. The USGA has a strong desire to improve the efficiency of water use and reduce overall course management costs, while improving environmental stewardship of course lands. However, successful implementation of these efforts is limited by the golf course decision maker's technical capacity associated with the implementation of more efficient irrigation techniques or appropriate restoration and maintenance of native ecological communities.

The Nature Conservancy has a long history restoring and maintaining native ecological communities, as well as a history of engaging industries, such as agriculture, chemical producers, oil and gas, to develop and implement environmentally responsible business practices. The Conservancy is also highly engaged in water issues around the globe and has developed a wealth of ecological restoration and maintenance expertise through the protection of nearly 119 million acres globally.

The USGA Green Section and The Nature Conservancy are partnering to develop an implementation program that improves course-level capacity relative to the operation and maintenance of sustainable course management systems. This partnership will bolster the course-level experience with design, construction, and management of ecological community restoration and management projects.

The intent of this partnership is to build internal, transferrable capacity within the USGA and member courses to improve the sustainability of course management while maximizing the potential ecological benefits those courses provide.

## The Neversink River

The Nature Conservancy has been working in the Neversink River Watershed for more than 20 years. Our on-the-ground efforts have resulted in the removal of the Cuddabackville Dam and the establishment of the Neversink Preserve comprised of two significant parcels. Currently, we are conducting a berm removal to reconnect the mainstem of the Neversink to its floodplain and between 2015 and 2016 we planted more than 15,000 saplings in an effort to re-establish a functional floodplain forest on abandoned agricultural fields. These efforts have contributed to improved ecological function in the watershed, but social challenges associated with natural flood events are prevalent and generally occur through two pathways. The first pathway is through surface run-off caused by locally intense storms. The second, and less common, pathway is through high water levels in the mainstem of the Delaware River which can effectively stop the discharge of Neversink River flows. When the Neversink Valley experiences a locally heavy precipitation event, and the Delaware River is also at, or approaching, flood stage, major damages to private property and public infrastructure are likely to occur as the floodwater begins to access the constricted floodplain.

### The Lynx at Riverbend

The Lynx at Riverbend, a privately-owned golf course but open to the general public, is situated on a 124 acre parcel (Figure 1) in the last, largely undeveloped, floodplain complex along the Neversink River before it joins the Delaware River. The course contains several natural oxbow pond complexes developed as the Neversink channel shifted its course over thousands of years. The course also receives significant run-off from the Shawangunk Ridge which runs along the southern border of the golf course property. The soils located on the course are quite permeable and allow water to percolate into the groundwater quickly. However, when the groundwater table is high, the Neversink River is generally approaching bank-full flow or flood stage. The natural function of the floodplain is to store water during these kinds of events and then slowly release it as the mainstem falls back within its banks. Receiving both flood water from the Neversink and surface run-off from the Shawangunk Ridge, means The Lynx at Riverbend is highly vulnerable to flooding with “worst case scenario” events occurring three times in the past 15 years. As precipitation events are expected to intensify in the future, significant flooding impacting the course is expected to become more frequent.



Figure 1. Aerial image of the 124 acres parcel that comprises The Lynx at Riverbend in Port Jervis, NY.

The most recent event occurred in 2011 with Tropical Storm Irene and Tropical Depression Lee. The course was open for play within a day or two of Tropical Storm Irene. However, as the flood pulse from Irene began to raise the Delaware River to flood stage, water began to back up into the Neversink River. Then, when Tropical Storm Lee hit a few days later, the course was inundated with more than 15 feet of water for more than a week. The impacts of these flooding events included deposition of significant sediment loads into the course water features, oxbow ponds, fairways and greens while also distributing seed material of both native and invasive species. The damage to the course was both extensive and persistent.

### The Opportunity

Repair and mitigation funding were made available to the region following the trio of storms which included previously mentioned Irene and Lee and the remarkable Superstorm Sandy. The Lynx at Riverbend was able to secure \$200,000 of this support to not only repair damaged infrastructure (e.g. cart paths, fairways and greens) but was also able to implement proactive measures likely to reduce damage from future storms (e.g. pond dredging and naturalization areas). The Nature Conservancy and the US Golf Association mutually agreed to invest resources into the Lynx at Riverbend as a pilot project to inform feasibility of a more robust collaboration in the future.

The Nature Conservancy’s involvement focused on developing a scientific understanding of how the Neversink River interacts with the floodplain which encompasses the golf course, development of project design, assistance with permitting the project and design implementation. The US Golf Association provided not only the resources to execute a project but also technical assistance relative to the game of golf that were not well understood by Conservancy staff and provided the capability to track course users

during individual rounds. The Lynx at Riverbend was responsible for managing the federal and state resources, consulting on design measures and species lists, and implementation.

### Project Execution

The project team agreed on five necessary components for a successful project. The first component was a hydrologic evaluation and inundation analysis to better understand how, where and when storm and/or flood water interacted with the course. The second was to identify low-use areas of the course that could be naturalized without significant impact to course use or maintenance operations. The third was development of a project design to include a species list comprised of native grasses, plants, shrubs and trees as well as the development of plant distribution scheme. The third phase was applying for and securing the necessary permits. The final phase was implementing the agreed upon design in strict accordance with the terms and requirements of the secured permits.



Figure 2. Moderate Flooding around the 18<sup>th</sup> hole of The Lynx at Riverbend. All areas left of the pine trees and inundated in the photo were naturalized in the Fall, 2017.

### Inundation Analysis Summary

Being that flooding is the most significant management concern for the Lynx at River Bend, a fundamental step in the design process for the full repair, mitigation and naturalization project was to determine how floodwaters access and flow through the floodplain in which the course is embedded. Milone & MacBroom, Inc. (MMI) was contracted to conduct the hydrologic and inundation analysis to provide a better understanding of how the Neversink River and the floodplain interact under various flow conditions and, more specifically, indicate the pathways by which the floodplain becomes inundated (Appendix 1). Due to the topographic nature of the area around the course and the challenges of modeling surface run-off, only floodwaters originating from the mainstem of the Neversink were analyzed and the resulting analysis does not take upland surface run-off into account.

Initial data collection methods included field surveys as well as accessing public, remote sensing data. In this case, we accessed stream gauge information developed and maintained by the US Geologic Survey, soil maps developed and maintained by the USDA Natural Resource Conservation Service, and various GIS data available from the New York State GIS Information Clearinghouse. MMI conducted a series flood frequency analysis using these data resources and was able to effectively develop an inundation model for the golf course over a range of flood magnitudes; in this case 1-year to 20-year return intervals.

This analysis revealed that no reasonable grey or nature-based approaches to stormwater management or flood protection were going to be effective at eliminating future flood-induced impacts. With a 1.25-year flood interval event, a 98.75% chance of occurring in any given year, the course experiences some super-saturation and high water around existing waterbodies and oxbows, but play and operation is easily managed at this magnitude. With a 2-year event, a 98% chance of occurring in any given year, the northern pond complex becomes inundated and the eastern oxbow begins to impact cart paths and fairway fringes. Both of these areas are directly connected to the mainstem of the Neversink by underground piping. During low intensity, high frequency events these stormwater outfalls become inundated and stream water flows back up the pipes to the course while standing water in the ponds is not able to discharge from the pipes. These scenarios cause very minor course flooding conditions.

The 5-year flood event, with a 95% chance of occurring in any given year and a stage of only 9.5 feet at a nearby USGS Stream Gauging Station, is when significant impacts being to occur and the course

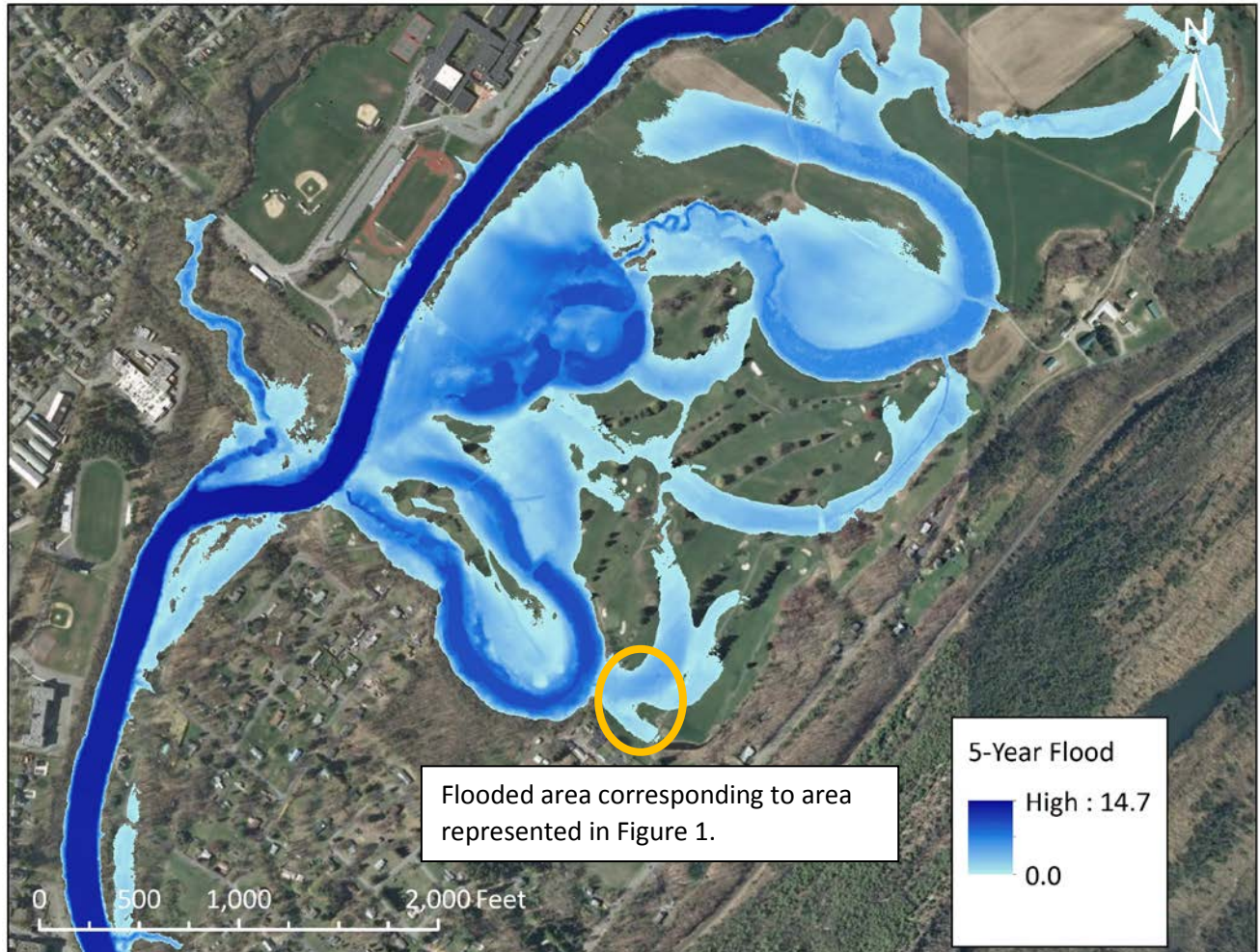


Figure 3. Inundation Modeling results for 5-year flood event (95% chance of occurring in any given year) for the Lynx at Riverbend. The area within the yellow circle is depicted in the Figure 1 photograph. The darkest blues represent the deepest water depths (14.7 feet) while lighter blues indicate shallower inundation depths.

becomes unplayable and unsafe (Figure 2.). During an event of this magnitude, all of the existing waterbodies become inundated and begin accessing the floodplain and cover approximately 50% of the course. A 10-year flood event, with a 90% chance of occurring in any given year, practically impacts the entire course. The highest elevations likely become super-saturated while the lowest elevations may be inundated by nearly 12 feet of standing water or more.

Because of the high impact of relatively common flow conditions, the project team quickly concluded that very little could be done from a floodwater or stormwater management perspective that would meaningfully enhance protection of the course and its associated infrastructure. The best management strategy was to better prepare the course to receive floodwaters and improve the ability, and rate, of the course to recover from those impacts. The attention of the project team began to immediately focus on nature-based solutions that reduce the acreage under active management as a way to both reduce recovery time and cost, but also improve maintenance efficiency and habitat conditions on the course.

### Identification of Possible Naturalization Areas

In order to identify where actively managed areas with low intensity use by golfers existed, we deployed Global Positioning System (GPS) technology provided by the Green Section of the US Golf Association. The GPS Transmitters were deployed over two-month period during the 2015 Season and tracked 90 rounds of play. This user tracking exercise resulted in the identification of 16 areas suitable for naturalization throughout the course and comprised of more than 35 acres (Appendix 1); more than 25% of the entire course property. It wasn't feasible to tackle all 35 acres with the allocated budget, so, in collaboration with course management, we prioritized four areas to be completed with US Golf Association resources, totaling approximately 3.75 acres, based on their likelihood to become inundated, improve course management efficiencies, improve water quality and improve the overall course experience.

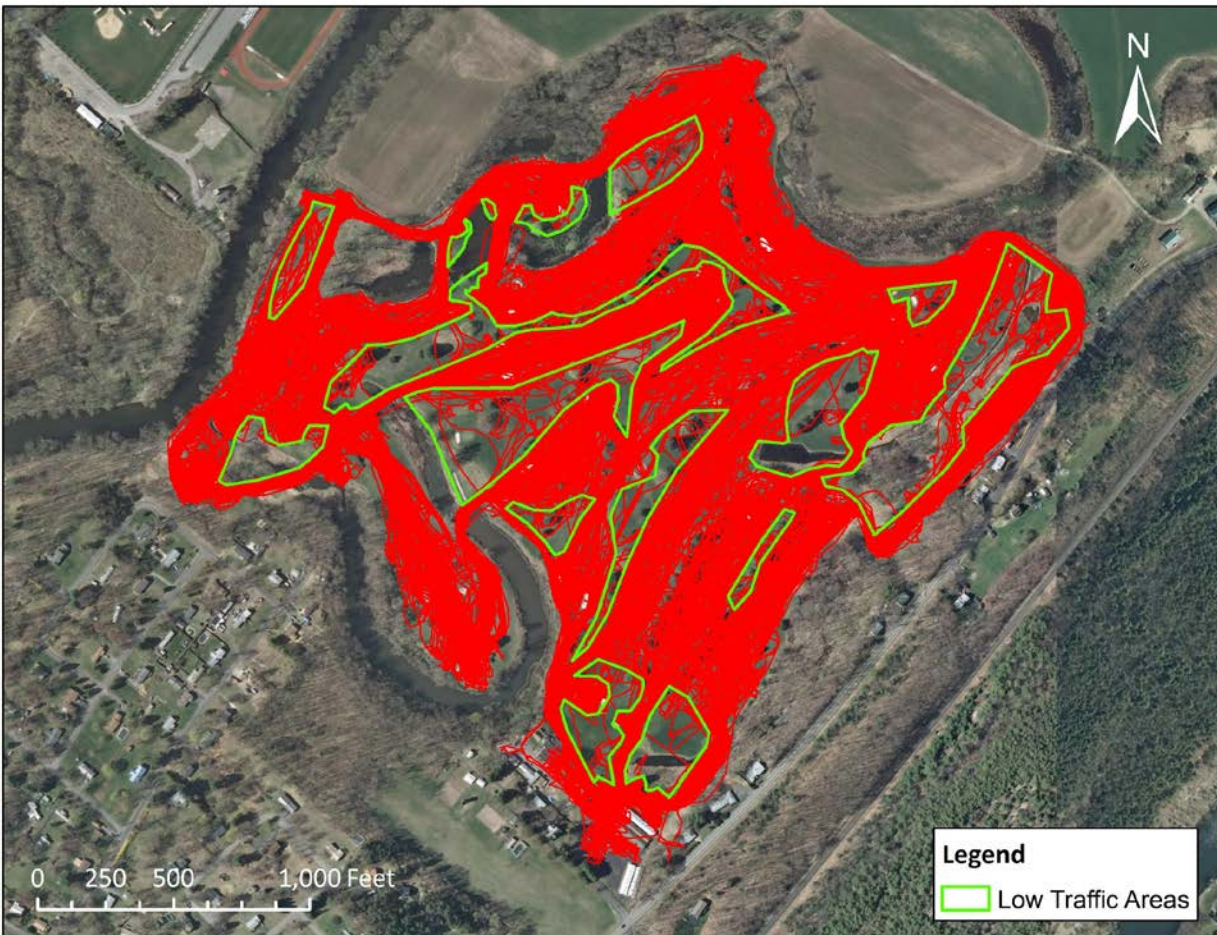


Figure 4. Areas in red represent the 90 tracks used by golfers that were fitted with Global Positioning Systems tracking devices provided by USGA Green Section. Areas inside of the areas with green borders were identified as possible naturalization areas. In total these 16 plots represent 35 acres and more than 25% of the course property.

### Naturalization Design and Course Modifications

Due to familiarity with the naturalization project through the inundation analysis and their extensive restoration experience in floodplain and wetland areas, MMI was contracted to develop a preliminary design for the previously mentioned four priority areas. MMI was able to provide a recommended planting scheme and species list which included grasses, sedges, reeds, shrubs, and trees (Appendix 2). Through a generous review period, the project team members were able to refine the proposed planting scheme

and original species list. This step was necessary because New York State has instituted an invasive species management law which provides a list of prohibited and regulated invasive plant species whose sale, and subsequent planting, is either banned or regulated within the state (Appendix 3). This statute required some changes to the proposed species list while project team was also able to incorporate some preferred species. Due to the topography of the course, each priority area had some combination of perennially wet, seasonally wet, riparian/floodplain, and/or upland habitat types which is reflected in the species list (Appendix 2).

Appropriate species and seed mixtures were selected for the appropriate moisture and anticipated inundation conditions and positioned to accentuate species diversity while not interfering with play. This was accomplished using 24" spacing between plugs and shrubs with shorter species around the perimeter and taller species being more concentrated toward the interior of each area. Additionally, course management agreed to adjust out-of-bounds markers and lines to ensure the naturalized areas are not impacted by cart or foot traffic following project completion. Shifting boundaries was not insignificant, but did not result in changes to hole par ratings. Tee boxes were also shifted on at least two holes, which was done largely to improve pace-of-play and used materials excavated from the naturalized areas and pond dredging.

### Permitting

Upon completion and acceptance of the naturalization design, initial permit applications were compiled by The Nature Conservancy. Due to the location of golf course in a federally regulated floodway and floodplain and both state and federal funds being used to significantly augment USGA resources, an extensive permitting process was required. Federal and state disaster assistance funds were being used for extensive but separate activities (e.g. fairway reseeding, replacement of greens, cart path repair and additional naturalization) on the same parcel requiring that the entire project be permitted at the same time. This determination, as well as identification of lead agency, delayed the TNC/USGA portion of the project almost an entire year. Because both state and federal funds were being used for the project, a project application first needed to go through both the National Environmental Policy Act (NEPA) and the New York State Environmental Quality Review Act (SEQR) process which identifies all the potential concerns and resulting necessary permits from the various regulatory agencies required to move forward with implementation and construction. Several federal, state and local permits were identified including:

1. Nationwide Permit #27: Section 404 Clean Water Act
2. Water Quality Permit: Section 401 Clean Water Act
3. NYS Uniform Procedures: Water Quality Certification
  - a. State Pollution Discharge Elimination System Stormwater – Construction
  - b. NYS Erosion and Sediment Control Plan
4. Local Floodplain Management Permit

Several project components were restricted or eliminated to avoid further permit requirements, delays and costs. For example, to mitigate impacts to nesting and migratory Bald Eagles, construction activity was only allowed to occur between April 1 and November 30 to avoid impacts to this recovering species. The project team had also considered expansion of existing water features but these concepts were withdrawn due to the high likelihood of finding native artifacts and the stringent federal and state permit requirements related to historical preservation. Ultimately, the permitting process did cost more than

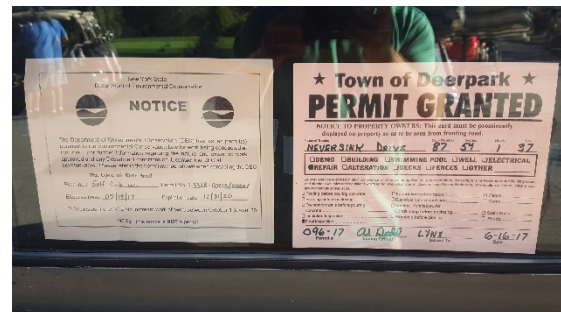


Figure 5. Required NYS Department of Environmental Conservation and Town of Deerpark Floodplain permits displayed in clubhouse windows as required.

anticipated and did somewhat alter our original planning but the reconciled activities were all ultimately permitted and the project allowed to proceed (Appendix 4).

### Project Construction

Preparations to begin the implementation process were instituted in late spring/early summer 2017 with plans for intense on-the-ground activities beginning in Fall 2017. The process began by staking of naturalization areas and realigning out-of-bounds markers and boundaries to get course users accustomed to the new layout of affected holes. These new out-of-bounds areas were then removed from active management and allowed to grow to gain a sense of how future course management activities and costs might be eliminated.

### Site Preparation

In early September 2017, during the regions typical drought period, the course superintendent, a certified and licensed herbicide applicator, applied glyphosate to all the areas identified for naturalization. The herbicide areas were rested for roughly three weeks to ensure all existing turf and other plant material had been neutralized. We broke ground on the naturalization areas on September 25, 2017. The glyphosate treated turf was pulled up using a “Harley Rake” attachment on a wheeled mini-excavator (Figure 7). This not only pulled up the turf but also loosened the ¼” of remaining soil (Figure 6). The resulting turf material was then incorporated into new tee boxes or otherwise incorporated on-site.



Figure 6. Resulting planting area conditions following removal of turf by “Harley Rake.”



Figure 7. All equipment used in the turf removal and disposal process. Light brown areas have been treated with glyphosate, but not yet “Harley Raked.” Mini-excavator and “Harley Rake” used to remove turf (upper left corner). Dump truck and front-end loader used to transport removed turf to final destination.



### Plant Material and Planting

Plant material was delivered to the course on September 27, 2017. An inventory of delivered material was taken and condition of the plants were checked. The majority of plugs and plants were delivered in very good condition, but not all. A reconciliation was made with supplier to our satisfaction and replacement plants were delivered within three days. Seeding began immediately using both native seed mix for the appropriate moisture conditions and oats as an erosion and sediment control measure. All seeded areas were then drug using a steel mesh mat to ensure good soil to seed to contact conducive to seed germination.



Figure 8. Plug, shrub and Tree staging area following delivery on September 27, 2017.

Planting of plugs occurred over two periods, September 28 – October 3 and November 2 - November 6. A third-party contractor and a volunteer group from the Albany Pine Bush assisted in planting more than 12,000 plugs along with 117 shrubs and trees on nearly 4 acres.

Although soils were dry during the initial planting period, we received moderate precipitation shortly after which allowed for initial germination to be observed on October 10, 2017. The Erosion and Sediment Control inspections identified good germination rates across all sites with some small areas benefiting from additional seeding. In these small areas, a supplemental mix of winter rye and oats were seeded. Germination continued to be observed through mid-November as weather conditions were very favorable.



Figure 9. Contractor planting plugs in naturalization area in front of 18<sup>th</sup> Hole using an approximately 24-inch layout scheme.

## Lessons Learned

As previously identified, the permitting process was extensive and cumbersome, due in large part to the Federal Disaster Recovery and Mitigation funds that were being matched by US Golf Association resources. This process caused a delay of more than a year and required unanticipated erosion and sediment control inspection costs. Although combining the efforts did cause administrative delays, the final product was far more than would have been accomplished with solely US Golf Associated resources. The federal and state resources allowed the project team to double the number of trees planted, naturalize an additional 3-4 acres, dredge three ponds to hold more surface run-off, relocate two new tee boxes, repair cart paths, and top-dress and reseed several fairways and greens.

In preparing the sites to be naturalized, we opted to try a new technique to The Nature Conservancy. The contractor recommended the use of a “Harley Rake” attachment for a mini-excavator. This was expected to save a tremendous amount of time and effort in turf removal. However, the maintenance crew failed to mow the areas, which had been allowed to grow, uncontrolled, for nearly 3 months, before glyphosate application. This produced a significant amount of turf material that needed to be managed. Although the “Harley Rake” worked extremely well, the areas should have been mowed first with a brush hog and then again with a mower prior to glyphosate treatment to reduce the amount of material requiring disposal management. We were able to develop a “beneficial use” plan for this material, as well as the pond dredge material, by incorporating both into new tee boxes.

Initial expectations were that naturalizing several acres of the Lynx at Riverbend would save both money and resources associated with day-to-day course management and, perhaps, improve profit margins. However, preliminary evidence indicates the management resource savings are likely not realized. Rather the same amount of management resources are still needed, but they are likely redistributed to other management activities. This does yield improved management efficiencies and results, but reducing management input costs through naturalization is not likely to improve profitability margins. Further, sufficient time has not elapsed to determine how this effort will influence the number of rounds played per year, nor has there been a flooding event to indicate a reduction in damage recovery time or cost.

## Budget

The total cost of the naturalization project was overbudget by \$14,554.28. These additional costs were largely associated with the extensive permitting process and the need to hire a planting crew, which was unexpected and largely a product of necessary project management changes associated with permit requirements, resulting design changes and a much more condensed implementation schedule. Reimbursement for the unbudgeted costs will not be requested. Total costs on a per acre scale were approximately \$28,000 per naturalized acre, which beg the question of where can efficiencies be found and what is a feasible price point to increase use of naturalization practices on more acres and on more courses.

Category	Budgeted	Actual	Pending	Difference
Salary	\$10,000.00	\$8,360.65		\$1,639.35
Fringe	\$4,200.00	\$3,684.10		\$515.90
Travel	\$1,500.00	\$118.78		\$1,381.22
Equipment (<\$5,000)	\$500.00	\$2,720.59		\$(2,220.59)
Contractual	\$70,007.00	\$81,820.68	\$2,107.23	\$(13,920.91)
Communications		\$203.65		\$(203.65)
Total Direct Expenses	\$86,207.00	\$96,908.45	\$2,107.23	\$(12,808.68)
In-direct Cost Reimbursement	\$13,793.12	\$15,505.00	\$33.72	\$(1,745.60)
<b>Total Expenses</b>	<b>\$100,000.12</b>	<b>\$112,413.45</b>	<b>\$2,140.95</b>	<b>\$(14,554.28)</b>

## Conclusion

This pilot project between the US Golf Association and The Nature Conservancy on the Lynx at Riverbend, was a valuable learning experience. Many of our watershed management efforts around the world are influenced by golf courses of various types and sizes. The Conservancy has purchased courses no longer in operation and implemented extensive restoration of the parcel (Pennsylvania Chapter), but we do not have a history of engaging active facilities to improve resilience, habitat, water quality or water usage. This relatively small endeavor greatly expanded our knowledge and capacity to engage active golf facilities in a new and constructive way by highlighting the limitations course managers have to modify existing facilities due management constraints and patron expectations. The effort also provided a more accurate representation of what is necessary and feasible to successfully undertake a full-course naturalization effort. The final benefit of this initiative is that the local community supporting the work of the Conservancy may be growing and their perspectives of our efforts may also be shifting in a very meaningful way.

The Conservancy is grateful for the opportunity to partner with the US Golf Association and we look forward to discussing additional opportunities for partnership and collaboration, as warranted.



Figure 10. Initial germination of oats on October 10,2017 in front of the 18<sup>th</sup> green (foreground) and on a steep slope in front of the clubhouse (background). Plant plug material is interspersed, but difficult to identify.