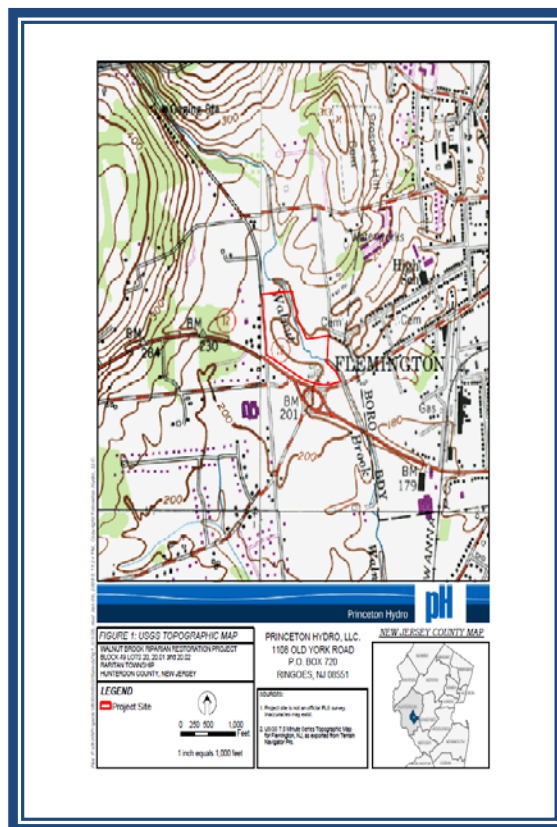


13. Implementation Showcase: Walnut Brook Streambank Stabilization and Riparian Restoration Project

The Walnut Brook watershed is located on the eastern side of the Route 12 and C.R. 523 circle and north of Mine Street (C.R. 523), in Raritan Township, Hunterdon County, New Jersey and is currently identified as Block 49, Lots 2, 2.01 and 2.02 on the Raritan Township Tax Maps. Lot 2 and 2.02 are owned by the Hunterdon Land Trust Alliance and is currently operated as a farm and future plans to operate as an educational facility. Lot 2.01 is owned by Raritan Township and is operating as a public park, Mine Brook Park.

Walnut Brook is designated as Freshwater 2 Trout Maintenance (FW2-TM), headwater stream of the First Neshanic River. The First, Second and Third Neshanic rivers join together to form the main stem of the Neshanic which flows to the South Branch of the Raritan River.

The two streambank reaches that were proposed for stabilization are located along the mainstem of the Walnut Brook. The site is traversed by three watercourses: (1) the mainstem of the Walnut Brook, which generally flows in a north to south direction across the site; (2) an unnamed tributary of the Walnut Brook, which generally flows in a north to east direction before entering the Walnut Brook mainstem on the site; and (3) a small drainage ditch that drains into the unnamed tributary of the Walnut Brook on the site, which runs in a southwesterly direction.



13.1. Project Overview

In early 2007, North Jersey Resource Conservation and Development (RC&D) Council received funding to continue the streambank stabilization work along the Walnut Brook as it flows through Mine Brook Park and the Hunterdon County Land Trust (HLTA) owned Dvoor Farm in Raritan Township, Hunterdon County and to create 2.97 acres of forested wetland. The project was managed by North Jersey RC&D. The streambank stabilization portion of the project was part of this large watershed management grant ‘Developing the Neshanic River Watershed Restoration Plan’ led by New Jersey Institute of Technology and funded by the Office of Policy Implementation and Watershed Restoration (formerly the Division of Watershed Management) of the NJ Department of Environmental Protection (DEP). Additional funding for the streambank stabilization and wetland creation portion of the project was provided by the New Jersey Wetland Mitigation Council. The RC&D received \$126,000 in funds from the NJDEP and \$566,260 in funds from the New Jersey Wetland Mitigation Council to complete the three phases of the riparian restoration project.

Initial restoration work along the Walnut Brook began in fall 2005 in Mine Brook Park. The project funds received for this work totaled \$21,250 in grant fund and cash towards the project which came from The National Fish & Wildlife Foundation (5-Star Restoration Program), NRCS-Wildlife Habitat Incentives Program, and from two Raritan Township committees, additionally over \$30,000 of in-kind services and material were donated to this initial project.

Mine Brook Park is a 15.8 acre property which is heavily utilized as it supports a playground, soccer and baseball fields plus walking trails. The HLTA Dvoor Farm is a 42 acre preserved farm that abuts Mine Brook Park. Continuous stream-flow monitoring data shows that peak flows in the Walnut Brook have greatly increased since much of the housing development occurred in the watershed in the 1960s – 70's. These increased flows have negatively impacted the stream resulting in serious stream bank erosion, excess sediment, and related impacts to native flora and fauna.

The objectives of the project, as stated in the initial Scope of Work, are outlined below:

- To restore the riparian functions and values of the Walnut Brook
- Reconnect 1,000 feet of stream to 2 acres of floodplain for the 2-year storm event and restore an additional 11 acres of floodplain functions and values.
- Establish 8 acres of new riparian buffer plantings along with the enhancement of 3 acres of existing buffer through invasive exotic vegetation removal and replanting of native species.
- To transfer the restoration process and techniques used on the site to other interested parties.
- Transfer technology to 1,000 people through outreach efforts such as workshops, newsletters and presentations.

North Jersey RC&D and the project partners can successfully state that the above outlined objectives were achieved. The original timeline for the scope of work as presented to the New Jersey Wetland Mitigation Council was off by a few years as it took that long to work out the details of permitting and in locating and securing the full financial support required to complete the project. Thanks to the additional funding support obtained through the New Jersey Institute of Technology funded *Developing the Neshanic River Watershed Restoration Plan 319(h)* grant.

The riparian buffer planting started in April 2009. The riparian buffer planting occurred in phases throughout the length of the project through August 2011. One hundred and thirty-five volunteers, from within the community up to corporate groups accounted for almost 600 hours of work at the site. They helped to establish the riparian buffer corridor. The volunteers worked to plant, mulch and place protective caging around the material. Throughout the course of two years the volunteers also assisted with watering the plants as necessary by lack of rainfall during the planting period.

In June 2009, streambank stabilization practices were constructed along Meander #1 and Meander #2 along approximately 1,000 feet of bank preventing additional scour and erosion of the streambanks and thereby reducing the stream's pollutant load. The construction of the entire stream project was completed in less than two weeks by two local excavating contractors. Construction costs were minimized by using day rates for the equipment onsite and material costs were reduced by donations from private companies. During the US Army Corps *Working Workshop*, which was one week of active construction, 40 people contributed about 540 hours of

labor to the installation of the streambank stabilization practices. With the guidance and additional oversight obtained from Linda Peterson, PE USDA-NRCS, Mary Paist-Goldman PE, Princeton Hydro and Dave Derrick, US Army Corps of Engineers Research Hydraulic Engineer, North Jersey RC&D was able to have volunteers, both near and far, construct rock vanes, LPSTP (longitudinal peaked stone toe protection), ERR (engineered rock riffle), LL (locked logs), SSBW (single stone bendway weirs), smooshed riprap, angle slam, and boulder-log revetment.

Once completed the streambank stabilization utilized 980 tons of rock; 4,400 willow and sycamore cuttings; 2.98 acres of area was treated for the removal of multi-flora rose along with a 5 acre riparian buffer containing 2,061 trees and shrubs and a 1.18 acre of native warm season grasses.

The wetland component construction started in September 2009 and concluded in March 2010. It will further improve stream water quality through retention of stormwater and will increase sediment removal functions associated with the establishment of additional vegetative cover and adjacent 6 acres of native riparian buffer. With the streambank stabilization practices in place and the constructed wetland, this project is achieving the reconnection of the floodplain to the brook, in turn helping to reduce downstream flooding.

13.2. Installation

13.2.1. Streambank Stabilization

At the onset of the project, it was determined that a detailed stream survey was necessary. A tooth-pick survey was conducted to establish some of the key characteristics of the stream channel including the Rosgen classification of the stream reaches. Researching the historic photos of the site revealed that the stream channel was straightened sometime prior to 1956, hence the extreme instability in the channel. A detailed topographic survey of the channel and the floodplain was performed. The riffle-pool sequence proved to be a Type C3 meandering stream. The project team had several meetings to discuss the stream stabilization techniques and several additional field meetings were held.



Willows harvested in March, taken out of cold storage days prior to use and allowed to "soak" in nearby pond.

The hydrology for the stream project was established using HydroCAD Software Solutions' Stormwater Modeling System and hydraulic modeling of the stream was completed using the United States Army Corps of Engineers Hydrologic Engineering Center River Analysis System (HEC-RAS). The hydraulic model established in-stream velocities and shear stresses and provided the basis for the rock sizes specified in the stream stabilization measures proposed.



Root growth after being soaked for few days



Meander #1: May 2009

March and kept cool (33-35 degrees) and moist in large, walk-in coolers. In mid-June the plants were taken out of the coolers and allowed to soak for 2-4 days in a nearby pond prior to installation.



Meander #1: Looking Up Stream at completed Grade Control (Engineered Rock Riffle) July 2009



After Construction: Looking Down Stream July 2009

Due to fisheries concerns, construction could not commence until after June 15th. This meant that dormant plant materials needed to be harvested and kept dormant until we could install the bio-engineering practices.

Willow cuttings were harvested in

Construction for the access/haul road was delayed by rain storms that had been hitting the area throughout the entire month of June.

Meander #1's proposed design as constructed in June 2009 included both resistive and re-directive measures to address several problems, including head-cuts and severe bank erosion. The head-cut movement and channel migration from the time of survey to the time of construction was startling. To address the changes, a large grade control structure in the form of an engineered rock riffle was added during construction.

Treatments of Meander #1 included several rock vanes with large keyways and scour pools and longitudinal peaked stone toe protection (LPSTP). The downstream outside bend was stabilized with additional LPSTP and smooshed riprap beneath existing exposed tree roots.

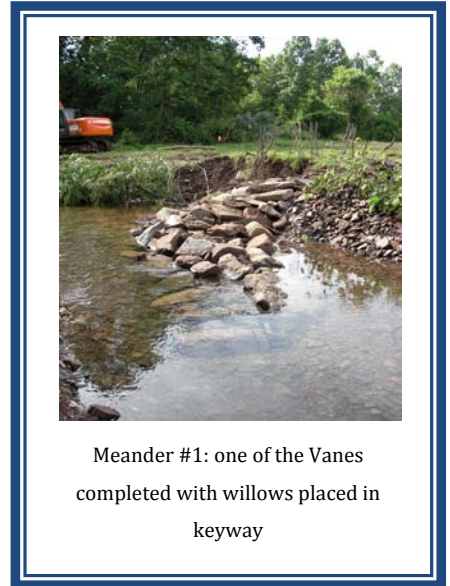
Meander #2 although shorter than Meander #1 presented challenges as well. Most severe in this reach was the headcutting in the stream channel and severe bank erosion at the inside bend at the upstream limits and at the outside bend on the downstream limits. The proposed design included the use of single stone bendway weirs (SSBW) and slit trenches to be planted



Equipment used in June 2009



Meander #1: Triangulating Vane construction June 2009



Meander #1: one of the Vanes completed with willows placed in keyway

with willow cuttings. The weirs were placed with LPSTP between them and a grade control structure immediately downstream of the weirs. The downstream limit had a boulder-log revetment locked log structure.

Unique to Meander #2 is the t-shaped single-stone bendway weirs. Again, adaptive management during the June 2009 construction required innovative use of some of the irregular boulder sizes and shapes available at the time of construction.

All design elements were selected to maximize the use of vegetative techniques wherever possible; however, the velocities and shear stresses anticipated in the channel indicated that some armoring would be required.

Construction of the stream project was completed in large part with the aid of volunteers who were led by Linda Peterson PE, USDA-Natural Resources Conservation Service, David Derrick, US Army Corps of Engineers and Mary Paist-Goldman PE, Princeton Hydro LLC. The construction of the entire stream project was completed in less than two weeks by two local excavating contractors. Construction costs were minimized by using day rates for the equipment onsite and material costs were reduced by donations from private companies.

Equipment used to complete the streambank stabilization included: Cat 924 Loader, Case 9020 Excavator, Cat D4 Bulldozer, 621 Loader, Skid Steer, CAT 416 Backhoe, York Rake and probably one of the most important machines was an Excavator with a thumb to properly place the rock for the grade control structures.



In spring 2010 the project team had to conduct adaptive management along Meander #1. In mid-June, an additional grade control structure in the form of an engineered rock riffle was installed above Vane #1. This additional structure was submitted to amend the exiting permit and it was approved by NJDEP Land Use for installation. In April and May, the project team worked with the stream contractor to adjust some of the rocks and boulders that had gotten displaced during the past major storm events. It was anticipated that with the installation of the upstream grade control the velocity of the brook would get dissipated prior to hitting Meander #1's vane structures. At that time slit trenches were constructed to install additional willow material that would aid to capture the woody material that occurs due to the out of bank flows. The willows utilized were harvested in March 2010. In a similar fashion as had been completed in 2009, the willows were harvested while dormant. They were kept moist and in a walk-in cooler at 33-35 degrees. Once needed, they were removed from the walk-in cooler and placed in a near-by pond to soak for a few days prior to use. Unfortunately the 2010



spring and summer did not receive a lot of rainfall and the temperatures were considerably hotter than in 2009. A majority of the willows installed in the slit trenches did not survive.

13.2.2. Riparian Buffer Restoration

This portion of the project focused on the establishment and enhancement of the riparian corridor along a specific length of Walnut Brook and the surrounding land. The project goal was to restore natural stream function and improve overall water quality. This involved planting trees, shrubs and native grasses in areas immediately adjacent to the brook to strengthen its banks, increase shading on the brook, increase wildlife habitat, and help to reduce the volume of runoff over the landscape. Volunteers played a huge role in working to plant the trees and shrubs in the project area.

Approximately eight (8) acres of floodplain were restored by the increased flooding frequency, native planting and invasive exotic plant removal. The entire 8 acres of floodplain may not meet the jurisdictional definition of wetlands (due to soils and hydrology criteria) but



will provide many of the ecological functions discussed previously. Eight acres of riparian buffer were established on farm fields on each side of Walnut Brook to protect the stream from any agricultural runoff or other nonpoint source pollutants such as lawn fertilizers and pesticides, and road runoff. Buffers were planted to native floodplain trees, shrubs, grasses and forbs. A total of 13 acres of riparian restoration represents approximately 30% of the Hunterdon Land Trust Alliance property at the Dvoor Farm. A small portion of the riparian buffer restoration took place at the upstream end of the HLTA property in Mine Brook Park owned by Raritan Township (lot 2.01).

Over the course of three years, North Jersey RC&D lead the riparian buffer restoration process along the Walnut Brook. The RC&D had the contacts, experience and knowledge to secure volunteers, material and professional services which translated into planting 2,061 native trees and shrubs in 2009, 2010 and 2011. To date 135 people have volunteered to assist with planting or caring for the riparian buffer plantings. The volunteers were invaluable in



helping to plant trees and shrubs along both sides of the Walnut Brook. In working with Hunterdon



County Roads, Bridges and Engineering Department, North Jersey RC&D was able to secure mulch that was placed around the newly planted trees and shrubs in an attempt to reduce the amount of competitive vegetation and grasses from growing around the buffer plants. The volunteers put mulch around all the plants and placed protective caging around the newly planted material in an attempt to protect the plant from

wildlife damage.

As designed the buffer installation was completed in phases. The importance to phase the installation of the plantings was multi-faceted. The benefits were that plantings could occur prior to the proposed major construction activities, the plantings could be completed when



Warm Season Grass seed being poured into no-till grass drill: April 2009

volunteer groups were more readily available, the project spread out the risk of losing trees and shrubs to drought or wildlife damage, and areas could be reassessed to make sure that an adequate buffer was planted once the majority of the project was completed. North Jersey RC&D was able to initiate the buffer phase of the project in March 2009. Volunteers planted 660 trees and shrubs along the Walnut Brook prior to the active construction of the streambank stabilization work or the wetland being started. Throughout the spring, summer and fall of 2009 additional plantings occurred with assistance from volunteers. In 2010 another way of plantings occurred

focused on the streambank side of the buffer. Plantings were installed between the completed wetland and the constructed streambank stabilization practices. In 2010, due to drought conditions volunteers were enlisted to help water the trees and shrubs. In early 2011 causalities of the drought-like conditions were noted in the buffer. Some reasons why the causalities occurred were from wildlife damage, even on trees and shrubs that were caged, since there were so many plants a handful of them did not have the proper caging around them to protect from deer browse, buck rub or girdling; poor plant material received from nurseries; and plants that did not get enough watering during the drier/drought conditions. The majority of the plantings survived and are thriving.

A unique quality of the project was the ability for the riparian buffer restoration to occur on both sides of the Walnut Brook. The use of the properties was also diversified prior to the restoration work being completed. The bulk of the riparian buffer plantings as noted above occurred along the brook, referred to as the Shield's Avenue side of the project. This portion of the property has historically been maintained as an open field/meadow. It was mowed every so often to help control the multi-floral rose growth. The project partners felt the Shield's Avenue side of the restoration project would be a great place to establish a native warm season grass area. In April 2009, 1.18 acres of the field was prepared to have warm season grasses planted on it. North Jersey RC&D worked with the USDA-NRCS Wildlife Biologist to establish an area along side of the shrub planting area. The farmer that the Hunterdon Land Trust Alliance works with to mow the field on Shield's Avenue planted the seed with a no-till seeder. Since the warm season grass seed is lighter and fluffier than typical seed a specific no-till seeded was utilized.



Teaching Moment: EvanMadlinger, USDA-NRCS speaking to June 2009 Construction volunteers about establishment of Warm Season Grass planting

13.3. Water Quality Benefits

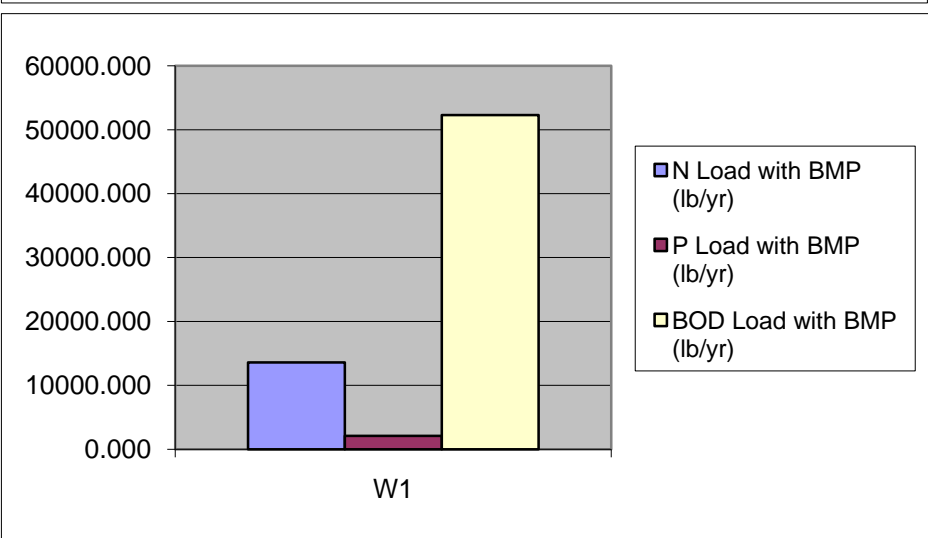
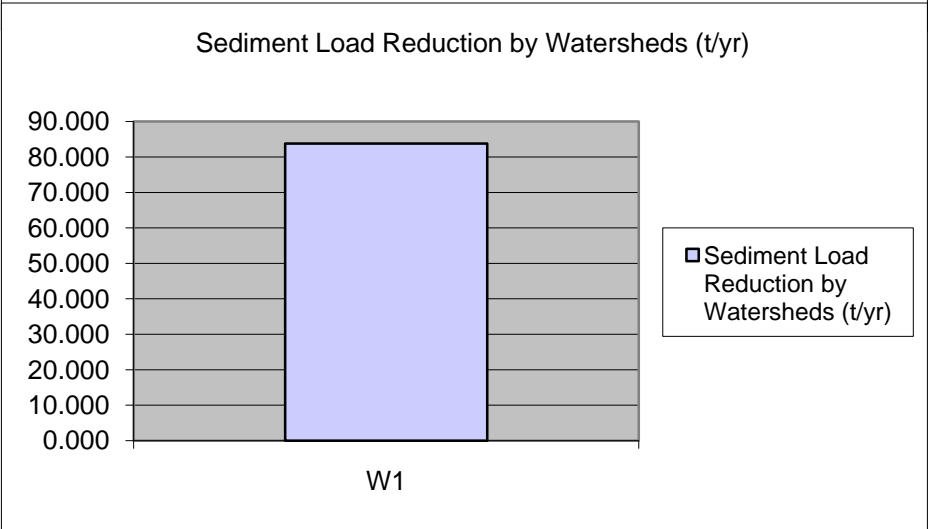
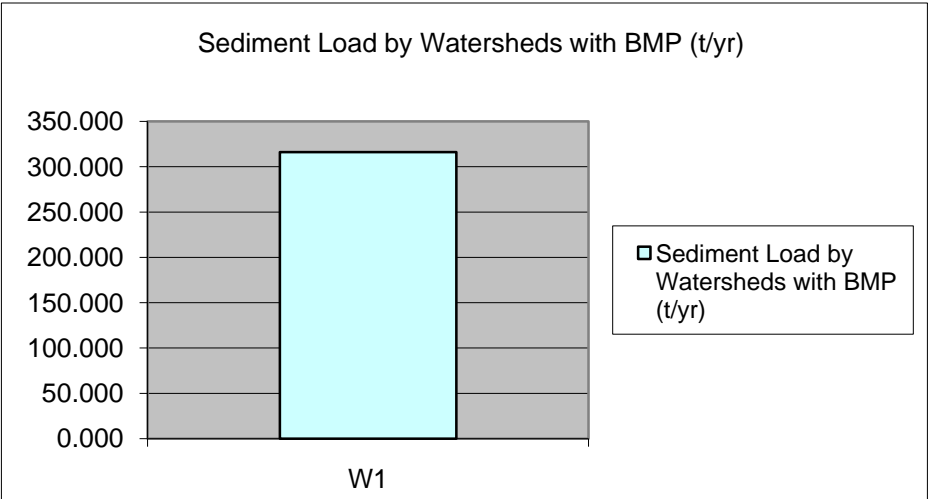
The **Spreadsheet Tool for Estimating Pollutant Load (STEPL)** employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs). STEPL provides a user-friendly Visual Basic (VB) interface to create a customized spreadsheet-based model in Microsoft (MS) Excel. It computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices.

Total load by subwatershed(s)				
Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)
	lb/year	lb/year	lb/year	t/year
W1	13740.9	2152.3	52610.2	399.9
Total	13740.9	2152.3	52610.2	399.9

Total load by subwatershed(s)				
Watershed	N Reduction	P Reduction	BOD Reduction	Sediment Reduction
	lb/year	lb/year	lb/year	t/year
W1	154.2	59.4	308.3	83.8
Total	154.2	59.4	308.3	83.8

Total load by subwatershed(s)								
Watershed	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sediment Reduction
	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	13586.7	2092.9	52301.9	316.1	1.1	2.8	0.6	21.0
Total	13586.7	2092.9	52301.9	316.1	1.1	2.8	0.6	21.0

Total load by land uses (with BMP)				
Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	13578.63	2089.82	52285.62	311.72
Streambank	8.11	3.12	16.23	4.41
Total	13586.74	2092.94	52301.85	316.13



13.4. Recognitions and Awards

After many years of planning, permitting and construction, the Walnut Brook Riparian Restoration project has been fortunate enough to receive six major awards and accolades.

13.4.1. 2010 NJ Section American Water Resources Association: Excellence in Water Resources Protection and Planning



The New Jersey Section American Water Resources Association presented the first annual “Excellence in Water Resources Protection and Planning Awards” on October 1st 2010. The award recipients selected exemplified outstanding projects which are designed to protect and enhance water resources management. The three categories of awards recognized included Storm water management projects, Stream restoration projects, Exceptional water resources management and planning initiatives. The Walnut Brook

Riparian Restoration project was given the award for the “stream restoration project”. The project was selected because it meets the following criteria:

- Planning and design using a creative new or innovative approach to water resources management and planning
- Innovative site design demonstrating a unique approach in the physical characteristics, representing high standards in site planning and engineering
- Demonstrated cooperation between local officials, applicants, and public thus promoting sound planning and engineering. Significant consideration will be given to nominations that demonstrate public / private partnerships.
- Projects that embody the essence and mission of the NJ section American Water Resources Association.



13.4.2. 2010 NJ Governor’s Environmental Excellence Award: Healthy Ecosystems

This awards program was established in 2000 by the New Jersey Department of Environmental Protection to recognize outstanding environmental performance, programs and projects in the state. Since its inception, over 100 businesses, individuals, municipalities and institutions have received recognition.

Healthy Ecosystems Category: this award is presented to a nominee demonstrating a commitment to and experience in programs or techniques that have resulted in the restoration, protection and enhancement of the State’s ecological resources: including wetlands, estuaries, coastal areas; and



NJDEP Commissioner Bob Martin, Grace Messinger, Linda Peterson (NRCS), Margaret Waldock (Hunterdon Land Trust), Mark Gallagher (Princeton Hydro), Governor (former) James Florio

non-game and endangered species.

13.4.3. 2010 Hunterdon County Planning and Design Award: Hermia Lechner Award

Each year Hunterdon County Planning Board and staff recognize outstanding planning accomplishments in Hunterdon County and the people responsible for them. The Hermia Lechner Award is given to an individual or organization for exceptional planning efforts that promote the conservation of natural resources; may include ordinances, environmental programs, open space plans or other projects that protect the natural environment. The Walnut Brook Riparian Restoration Project secured this award in the winter of 2010.

13.4.4. 2011 Sustainable Raritan Awards: Remediation and Redevelopment Award

The Walnut Brook Riparian Restoration Project received an award at the June 16, 2011 Sustainable Rivers Conference for the outstanding streambank restoration work completed.

13.4.5. 2011 Bowman's Hill Wildflower Preserve Land Ethics Award: Nomination of Excellence

The North Jersey RC&D nominated the Walnut Brook Riparian Restoration Project for this award because they felt it was in line with the goal of the award, which honors and recognizes individuals, organizations, government agencies, community groups and business professionals who have made significant contributions to the promotion of native plants and have exhibited a strong land ethic while promoting sustainable designs that protect the environment. Ultimately the project was given the award; in addition, the review committee felt that the project deserved to be recognized as a 'Nomination of Excellence'. The full nomination was shared on the Bowman's Hill Wildlife Preserve website.

13.4.6. 2011 Soil and Water Conservation Society Firman E Bear Chapter Environmental Excellence Award

Each year, the Firman E. Bear Chapter awards an individual contractor, construction company, designer or organization that displays excellence in an ecological restoration project, unique soil and water conservation stabilization project, or innovative habitat development or enhancement project. The presentation of the award to the Walnut Brook Riparian Restoration Project will occur at the SWCS annual meeting at the end of November 2011.

