VERNAL POOL RESTORATION WEBINAR RECORDING ANNOUNCEMENT WITH WEBINAR LINKS AND ADDITIONAL RESOURCES

Subject: Recording now available for "Vernal Pool Wetland Restoration Webinar" presentation

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Greetings!

Thank-you for registering to attend last month's webinar titled "Vernal Pool Wetland Restoration Webinar".

Since the webinar was two hours long, we divided it into a series of shorter videos, with an introduction and four main content recordings. You can click on each video link below, or go to the Vernal Pool Webinar Playlist to have the videos queue up for you.

Vernal Pool Wetland Restoration Webinar Series
**you may need to copy and paste the link into your browser*

- VP Webinar Intro. An Introduction to the Pennsylvania Vernal Pool Restoration Webinar https://youtu.be/IP071wi6nx8
- VP Webinar Part 1. Pennsylvania Vernal Pool Ecology and Wildlife https://youtu.be/qYWbVcs0ric
- VP Webinar Part 2. Wetland Loss in Pennsylvania and Wetland Restoration Planning https://youtu.be/WvDlAlwGBCU
- VP Webinar Part 3. Wetland Restoration Techniques https://youtu.be/7cw2nQVhoOU
- VP Webinar Part 4. Post-restoration, Monitoring, Webinar Q&A, Additional Resources https://youtu.be/_gWrpuiQx8E
- Vernal Pool Restoration Webinar Playlist (all videos grouped together) https://youtube.com/playlist?list=PLDnLZKqb5RNUFoOvjXDx4sqbnbJshLeCT

And please find attached two Microsoft Word documents. The first contains answers to the questions that were posted throughout the webinar, and the second contains additional wetland resources we listed at the end of the webinar.

Vernal pool season is upon us, get out and enjoy!
Betsy Leppo

Betsy Leppo, Invertebrate Zoologist
Pennsylvania Natural Heritage Program
Western Pennsylvania Conservancy

Vernal Pool Wetland Restoration Webinar
February 7, 2023

Vernal Pool Wetland Restoration Webinar: A presentation on vernal wetland restoration techniques that were implemented at three State Parks in Pennsylvania. We discussed identifying sites for restoration, planning stages, permitting, selecting and implementing construction techniques, establishing native plants, and post-construction monitoring. Hosted by the Western Pennsylvania Conservancy, Pennsylvania Natural Heritage Program and the Pennsylvania Bureau of State Parks.

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WEBINAR QUESTIONS & ANSWERS

How/where can we learn more about vernal pools? I'm hoping to monitor some at local preserves but would love to learn more about the cycles and critters that live there first! Are there any good online resources or contacts specific to Pennsylvania?

The Pennsylvania Natural Heritage Program has vernal pool related resources on our vernal pool pages, at https://www.naturalheritage.state.pa.us/VernalPools.aspx. We cover a variety of topics from vernal pool animals to conservation and management of vernal pools with downloadable resources.

The Pennsylvania Amphibian and Reptile Survey is a good resource for species identification and life history information, and along with iNaturalist is a good place to report observations of vernal pool wildlife. This PARS guide is a nice resource for vernal pool species identifications: https://paherpsurvey.org/doc/Pennsylvania-Seasonal-Pond-Species-and-Egg-Identification.pdf

At the end of each section of our vernal pool webinar series, we include slides with additional wetland-related resources that you can explore. These resource slides are also provided as a word document attachment to the follow-up email sent out to all webinar registrants.

What is the minimum requirement time wise in identifying a vernal pool? If it dries up within a couple days or within a month, does it not meet the requirements of a vernal pool?

All vernal pools have seasonally fluctuating water levels, but they vary considerably in when and how long they hold water (hydroperiod). The hydroperiod of a single pool can also shift and change from year to year based on rainfall patterns. In addition to a seasonally fluctuating hydroperiod, another key feature defining a vernal pool is that it is used by certain indicator species as breeding habitat. In Pennsylvania our indicator species are the four mole salamanders (spotted, marbled, Jefferson, and blue-spotted), the Eastern spadefoot, wood frogs, and

several species of fairy shrimp or clam shrimp. The successful breeding of one or more of these species is another key feature of a vernal pool.

Because obligate vernal pool species have an affinity for the vernal pool they were born in, how do you know they use new vernal pools?

Techniques including mark and recapture, radio telemetry, and genetic analysis have been used to study movements and population genetics of vernal pool amphibians. Research has found that they generally return to the same pool year after year to breed. This tendency to habitually return to their breeding pool is called philopatry. There is a risk and energy cost to animals as they travel to and from their breeding habitats, but that risk and cost is even higher when searching for new habitats. Especially so for vernal pool species because they use a dynamic habitat that changes from year to year. Finding a pool with the right qualities that will give a species good reproductive success can be challenging, especially as suitable breeding pools become more rare or fragmented in a landscape. Philopatry allows vernal pool amphibians to minimize risk and energy costs associated with migration and dispersal and maximize breeding success.

But philopatry is not 100% in all individuals within a species. Having even a very small percentage of the population that colonizes new pools is also advantageous to long term species success. And at the species level, some vernal pool animals have higher rates of philopatry compared to others. Species with high rates of philopatry, like spotted salamanders and wood frogs, tend to prefer stable vernal pools in later successional forests with closed-canopies. Species with lower rates of philopatry, like the Eastern spadefoot and facultative species like gray treefrogs and chorus frogs, tend to favor newer and/or earlier succession pools with more vegetation and open canopies. So those species benefit by having more individuals that will disperse and colonize the early successional pools they prefer.

Juvenile amphibians are not thought to be particularly good at finding new habitats, but because they leave their home pond in a more random fashion than adults, they may accidentally encounter new habitats during their movement through upland habitats in their first year.

The probability of a new pool getting colonized is probably a combination of how many other pools are nearby, and how many obstacles animals may encounter around the pools (roads, ag fields, large rivers, etc.).

Adding or restoring wetlands within a half mile of existing vernal pools increases the chances that they will eventually be colonized by vernal pool amphibians. Or in other words, new wetlands that intersect the dispersal pathways of migrating juveniles or adults are more likely to be discovered. More research on this fascinating aspect of vernal pool amphibian life history is needed, but for a good discussion of amphibian migration and dispersal, see the 2008 paper "Differentiating Migration and Dispersal Processes for Pond-Breeding Amphibians" by Raymond Semlitsch, The Journal of Wildlife Management, 72(1) pp 260-267.

What is the definition of "Species of greatest conservation need"? What entity defines those?

The Pennsylvania State Wildlife Action Plan (SWAP) is a non-regulatory, proactive natural resource management document designed to prevent species imperilment and to recover endangered and threatened species. You can view the current 2015-2025 SWAP online for detailed information on the overall process and for accounts for individual Species of Greatest Conservation Need (SGCN) at https://www.fishandboat.com/Resource/StateWildlifeActionPlan/Pages/default.aspx.

Species status assessments are conducted using standardized protocols by taxonomic committees of the Pennsylvania Biological Survey (http://www.pabiologicalsurvey.org/). Each taxonomic committee is unique but generally has representation from government agencies, academic institutions, conservation organizations, and other species experts. SGCN must meet a series of criteria outlined in the SWAP, and final designations are reviewed and approved by the agency responsible for those species where applicable (e.g., PA Fish and Boat Commission, PA Game Commission, US Fish and Wildlife Service). Species in the current SWAP, along with new species not previously evaluated, are currently under review as part of the process to update the plan by 2025.

Unless guidance has changed, or will change with delisting, I believe USFWS requires 300-ft buffers on vernal pools that contain or even just have potential to contain, the northeast bulrush

In 2019 the Northeastern bulrush (*Scirpus ancistrochaetus*) was recommended for down-listing from Endangered to Threatened under the Endangered Species Act, and it may be removed completely from protection under the Act (delisting). The final ruling for this species has not been finalized by the U.S. Fish and Wildlife Service. Projects that occur within 300 feet of vernal pools that have or likely support populations of this plant are still being evaluated for potential impacts to those wetlands.

This species has a very limited global range and Pennsylvania is the stronghold with a majority of the known populations. Since Pennsylvania has special responsibility for the survival of this species, the Pennsylvania Department of Conservation and Natural Resources will continue to review projects that may impact NE Bulrush wetland habitats directly, or the adjacent upland, even if the species is delisted at the federal level.

Will restoring a wetland help with climate change?!

Yes, wetlands are very important for mitigating the impacts of climate change. When wetlands are adequately protected or restored within a watershed, they act like big sponges during storm events as they capture surface run-off. Wetlands provide flood control / water attenuation, reduce stream flashiness, moderate stream temperatures, and remove pollutants. Wetlands can help mitigate climate change itself by capturing / sequestering and storing carbon.

Here are two websites for more information:

1) Carbon sequestration in wetlands from the Minnesota Board of Water and Soil Resources: https://bwsr.state.mn.us/carbon-sequestration-wetlands, and
2) Climate benefits of wetlands and soils from the Natural Resources Defense Council: https://www.nrdc.org/experts/melanie-sturm/stewardship-wetlands-and-soils-has-climate-benefits

If I don't have a historical context, how can I determine if my wetland area is healthy?

One way to gain historical context is by comparing public-sourced old aerial photos and land use data with current data. Context can be gained by current field surveys by looking for signs of altered natural hydrology through ditching, buried drainage structures, damming, filling or excavation. Evaluate the land use and vegetation within the core and supporting upland habitat zones. Estimate how much of that area is forested or vegetated with other natural habitats (shrublands, lightly managed / naturalized fields and meadows, etc.), versus other land uses that don't support the life history needs of vernal pool amphibians (active agriculture, golf courses, higher density developments, etc.). Also look for significant barriers to amphibian movement like highways and large rivers.

The Pennsylvania Natural Heritage Program (PNHP) has a conservation ranking form we use to evaluate the health of vernal pools and clusters by documenting the species using the pool and evaluating landscape condition around the pool. If you'd like a copy of that form, please contact the PNHP at spcoordinator(at)paconserve.org.

This video explains how to look for evidence of past activities that drained or otherwise altered wetlands on the landscape, and is full of fascinating photos: A History of Wetland Drainage – How they Pulled the Plug by Tom Biebighauser (a BCWF Wetlands Education Program, Oct. 2022): A History of Wetland Drainage - How They Pulled the Plug, presentation by Tom Biebighauser.

When you mention other wetlands you do include man made ponds? Can we apply what you suggest to vernal ponds to our man-made ponds?

Yes, you can apply some of the same construction techniques to create or repair a permanent pond. But permanent ponds won't attract or support populations of vernal pool specialists as well as vernal pool wetlands do. Many generalist wildlife species will visit and benefit from vernal pools, but vernal pool specialists can't use permanent ponds equally well.

Given how many vernal pools have been loss to drainage, fill, or conversion to permanent pond habitats, we emphasize the need for restoration projects that create wetlands with a seasonal / fluctuating hydroperiod and a dry phase or significant dry down in late summer. And here is a link to an interesting paper we came across that explores the values of and opportunities for converting farm ponds back into some more natural type of wetland: https://kwo.ks.gov/docs/default-source/project-pages/2014-epa-wetland-grant-final-report.pdf?sfvrsn=7ae38714_0

Do you know of any wetland restoration projects that have converted a moist soil unit (MSU) originally created for waterfowl into a vernal pool? I have dozens of MSUs on the refuge I work on, some of which are easily taken over by beaver, and am hoping converting some of these sites could help relieve this problem while also creating breeding habitat for amphibians.

For some context, here is a link to a description of moist soil management from Ducks Unlimited: https://www.ducks.org/conservation/waterfowl-habitat/a-primer-on-moist-soil-management.

We (WPC/DCNR) haven't done any restoration projects involving this type of constructed wetland. MSU wetlands appear to be built with infrastructure that requires a long-term investment of time and resources to properly maintain. There is potential to remove the infrastructure and convert these into more naturally functioning wetlands using some of the techniques we discussed in the webinar.

We recommend Tom Biebighauser's 2011 publication "Wetland Restoration and Construction - A Technical Guide" for restoration techniques used to create a variety of wetland types including vernal pools, forest and shrub wetlands, fens and peatlands, emergent wetlands, and wet meadows.

When determining the value of restoration at a certain site, do you give extra weight to the site if there is a scarcity of other vernal pools within 15+ miles?

Proximity to other vernal pools is an important consideration for vernal pool restorations. If you have evidence of vernal pool indicators breeding in low quality and/or non-vernal pool habitats within a half mile of the potential restoration site, then it would be beneficial to create more viable breeding habitats for them to

discover and use that would support the local populations. If you have no evidence of vernal pool indicators nearby, we recommend doing targeted surveys for them and/or look online at data sources like iNaturalist. If you still don't find vernal pool indicators nearby, then the wetland will likely not get colonized by them, though it could still function as a valuable wetland for facultative amphibian and invertebrate species.

Condition of the core and supporting upland habitat zones around a potential restoration site are also very important to vernal pool amphibians since the adults spend much of the year in the uplands. See the 2004 paper "Critical Thresholds Associated with Habitat Loss for Two Vernal Pool-Breeding Amphibians" by Homan, Windmiller and Reed, in Ecological Applications 14(5), pp 1547-1553 for more information.

Is the vernal pool liner used in the Bell Acre project biodegradable? How long does the liner last? Do most wetlands here in PA have a natural geology like a duripan?

The liners are not biodegradable. They are made of aquatic-safe synthetic plastic or rubber materials (PVC, RPE or EPDM). In exposed conditions the liner by itself can last 30 years. But when covered with at least 6 inches of soil and sandwiched between two layers of geotextile fabric they should last hundreds of years. For more information on using aquatic-safe liners, see this page on the Wetland Restoration and Training Website: https://wetlandrestorationandtraining.com/liners/.

A significant number of Pennsylvania wetlands do form over a clay layer or lens (a duripan or fragipan). Others form over bedrock or in floodplains with thick organic soils over gravel, and connect with a high water table.

In the pool conversion was there any concern with an increase in pH from the concrete left there?

We put in a significant amount of densely packed clay over the broken-up concrete which created an impermeable layer between the concrete and the wetland above.

Would be interested to know of any successes in adding infrastructure that enhances use in environmental education--e.g. small boardwalks, stepping stones, or fallen logs for kids to have better access. How can we best do this without negatively impacting a vernal pool?

Wooden walkways, observation decks, and educational signage are great additions to a wetland restoration project to support future outreach events. Wooden walkways and decks help people keep their feet dry while getting a closer view of the wetland. They focus foot traffic onto stable surfaces and protect the fragile soils and vegetation in and around the pool. During construction when have heavy equipment is on-site is a good time to place large rocks and logs at several accessible points around the pool to give additional vantage points for observation.

For outreach events, you can limit disturbance to a pool by keeping group sizes small, and having just one or two trained group leaders with clean gear enter the pool to collect some organisms into buckets or white trays for viewing on shore.

Where should one look for funding for these types of projects?

In the wetland restoration planning section of the webinar we discuss development of project goals. The goals for a vernal pool restoration will include the obvious ones like increasing breeding habitat for vernal pool specialist species. But they can go a lot farther than that and include things like: Convert artificial ponds back into more naturally appearing wetlands; Remove old infrastructure and hazards from public spaces; Control

erosion and flooding; Improve water quality and replenish groundwater; Increase habitat for pollinators with native plantings around restoration sites; Control pest insect populations or invasive plant species; Provide exciting places for park visitors to explore and view wildlife; Increase opportunities for outdoor education; Strengthen partnerships between resource agencies and volunteers.

Thinking broadly about what a project can bring to a site or region will enable you to attract the interest of a variety of funders. Be aware that many local and state government funding sources will require some level of public access to the site. Funding and priorities for different programs (e.g. NRCS) varies from year to year, so having a preliminary wetland restoration plan with clear goals will give you a starting point for conversations with potential funders.

Check out our list of agencies and other resources at the end of each webinar session for more information. These resource slides are also provided as a word document attachment to the webinar follow-up email sent out to all registrants. We welcome hearing from folks who have had success with funding and partnerships for wetland restoration projects, so that we can continue to build this list of resources (please send notes to spcoordinator(at)paconserve.org).

Who do I first approach to start a project in my forest? (NRCS, DEP, County Conservation District, DCNR, PSU Extension, etc.). I have what I believe will be a great project, but from this presentation, I obviously cannot just go into the woods and do it!

Your local conservation district is probably the best place to start and they can help steer you towards other resources. The other agencies on your list are all good contacts and it is a good idea to reach out to all of them. It is hard to predict what opportunities are available at any given moment because funding and priorities change from year to year. So if you approached an agency or group in the past but it has been over a year since you last talked with them or looked at their websites for grant priorities, it is worth looking / reaching out again.

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Additional attachment: "Resource Slides"
A word document with introductory slides on the webinar, information on the PNHP vernal pool website and conservation and management guide, wetland books by Tom Biebighauser, Kings Gap Environmental Education Center vernal pool restoration technique posters (available for pdf download from the PNHP vernal pool website), vernal pool monitoring project information, and additional wetland resources, and acknowledgements.

Funding acknowledgement
Many of the wetland restoration projects described in this series and this webinar were funded in part by the Pennsylvania Department of Conservation and Natural Resources, Bureau of Recreation & Conservation, Community Conservation Partnerships Program, Environmental Stewardship Fund.

More Questions? Please contact Betsy Leppo, Pennsylvania Natural Heritage Program, bleppo@paconserve.org

Vernal Pool Restoration Webinar
February 7, 2023

Vernal Pool Wetland Restoration Webinar: A presentation on vernal wetland restoration techniques that were implemented at three State Parks in Pennsylvania. We discussed identifying sites for restoration, planning stages, permitting, selecting and implementing construction techniques, establishing native plants, and post-construction monitoring. Hosted by the Western Pennsylvania Conservancy, Pennsylvania Natural Heritage Program and the Pennsylvania Bureau of State Parks.

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RESOURCE SLIDES (compiled from the webinar)

Our topic for this webinar series is vernal pool wetland ecology, restoration and monitoring.

We will discuss:

- the value of vernal pools in supporting healthy forest ecosystems and their importance to wildlife
- the need for restoration to help reverse the historic loss of wetlands and to restore these beneficial features on the landscape
- steps to implement a successful vernal pool wetland restoration project

Webinar Presenters

- Betsy Leppo, Invertebrate Zoologist, Pennsylvania Natural Heritage Program

- JoAnn Albert, Operations Manager, Pennsylvania Natural Heritage Program

- Jack Hill, Natural Resource Specialist, Department of Conservation and Natural Resources, Bureau of State Parks, Resource Management

PNHP

Western Pennsylvania Conservancy

DCNR pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

PA Natural Heritage Program

Gathers and provides information on the location and status of important plants, animals, natural communities and geologic features to inform environmental and conservation decisions

www.naturalheritage.state.pa.us

Western Pennsylvania Conservancy

Protects and restores exceptional places to provide our region with clean waters and healthy forests, wildlife and natural areas for the benefit of present and future generations

- Non-profit Established in 1932
  - 1st PA land trust
- Protected >250,000 acres
- Programs:
  - Land Conservation & Stewardship
  - Conservation Science
  - PA Natural Heritage Program
  - Watershed Conservation
  - Community Gardens & Greenspace
  - Fallingwater

waterlandlife.org

DCNR
Mission Statement

"We **conserve** and **sustain** Pennsylvania's natural resources for **current and future generations' use and enjoyment**."

www.dcnr.pa.gov

pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

PA State Parks
Mission Statement

"The primary purpose of state parks is to provide opportunities for enjoying **healthful outdoor recreation** and to serve as **outdoor classrooms** for environmental education.

In meeting these purposes, the **conservation** of the natural, scenic, aesthetic, and historical values of the parks should be given first consideration.

Stewardship responsibilities should be carried out in a way that protects the natural outdoor experience for the **enjoyment of current and future generations**."

www.dcnr.pa.gov

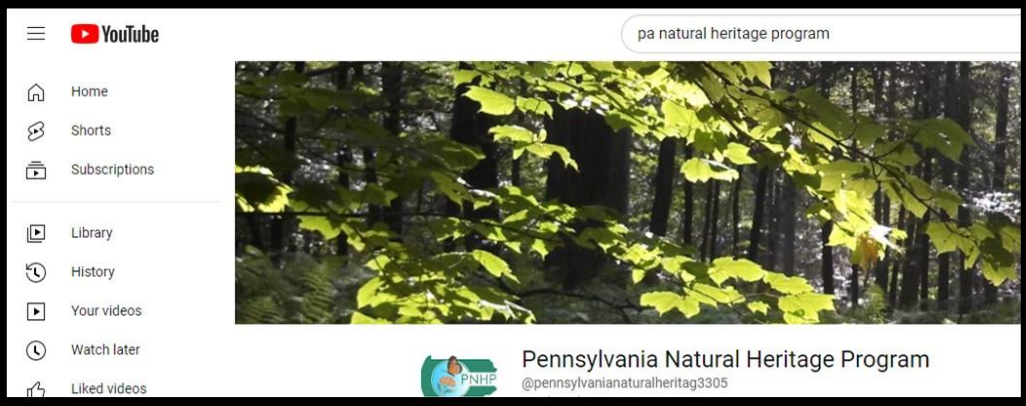
pennsylvania
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

This webinar was first given February 7, 2023. We divided the recording into 4 videos for this series:

- Part 1: Vernal pool ecology & wildlife
- Part 2: Wetland loss & wetland restoration planning
- Part 3: Wetland restoration techniques & case studies
- Part 4: Post-restoration work & monitoring, Q&A, resources

Visit the PNHP YouTube Channel at: https://www.youtube.com/@pennsylvanianaturalheritag3305/videos

Vernal Pool Webinar Series

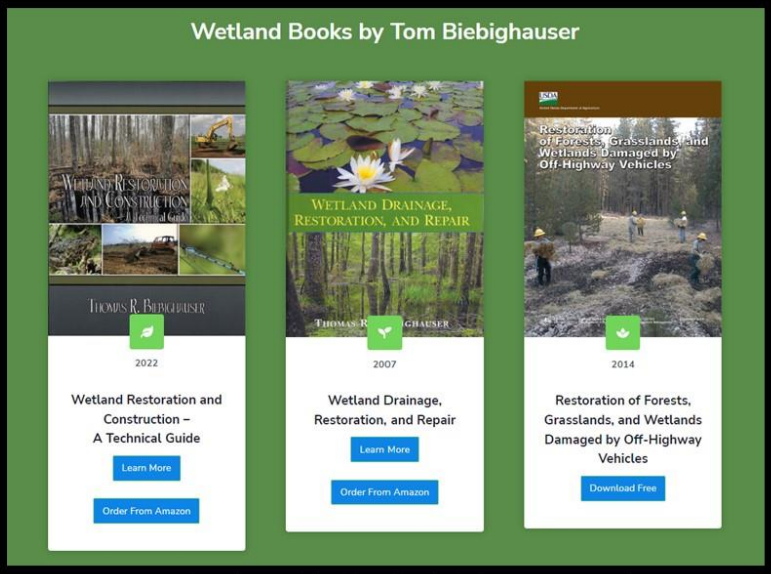


Visit the Pennsylvania Natural Heritage Program YouTube Channel at: https://www.youtube.com/@pennsylvanianaturalheritag3305/videos

Vernal Pool Conservation and Management Guide

Download it from our **Vernal Pools of PA** website under the 'Resources Tab' at

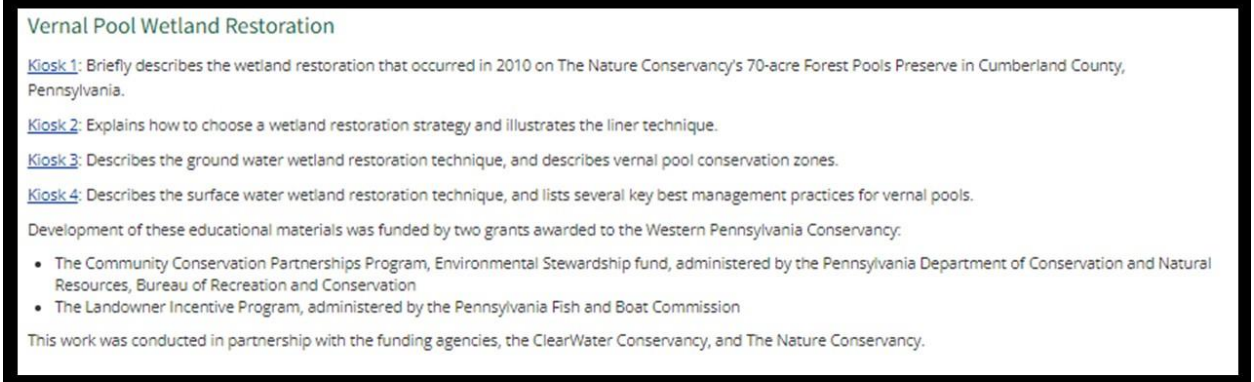
https://www.naturalheritage.state.pa.us/vernalpools.aspx



Great books with detailed information about wetland restoration.

King's Gap Environmental Education Center

PDFs describing three restoration techniques



Vernal Pool Wetland Restoration

Kiosk 1: Briefly describes the wetland restoration that occurred in 2010 on The Nature Conservancy's 70-acre Forest Pools Preserve in Cumberland County, Pennsylvania.

Kiosk 2: Explains how to choose a wetland restoration strategy and illustrates the liner technique.

Kiosk 3: Describes the ground water wetland restoration technique, and describes vernal pool conservation zones.

Kiosk 4: Describes the surface water wetland restoration technique, and lists several key best management practices for vernal pools.

Development of these educational materials was funded by two grants awarded to the Western Pennsylvania Conservancy:

- The Community Conservation Partnerships Program, Environmental Stewardship fund, administered by the Pennsylvania Department of Conservation and Natural Resources, Bureau of Recreation and Conservation
- The Landowner Incentive Program, administered by the Pennsylvania Fish and Boat Commission

This work was conducted in partnership with the funding agencies, the ClearWater Conservancy, and The Nature Conservancy.

https://www.naturalheritage.state.pa.us/VernalPool_Resources.aspx

Master Watershed Steward upcoming monitoring projects at Gifford Pinchot State Park:

- Install USGS staff gauges to allow accurate water level measurement
- Enroll vernal pools in "Crowd Hydrology", sponsored by University of Buffalo and the USGS to allow visitors (and stewards) to text water level reads. The resulting water level readings can then be tracked over time online. This will require the installation of signage instructing how to read the staff gauge and report the findings. More information at: http://www.crowdhydrology.com/
- Enroll in Photo Chronolog, another crowed sourcing tool that establishes a photo point for smartphones to consistently take a photo with consistent views. The photo is emailed and immediately becomes part of a time laps photo of the same view. The sender receives an email back with a link to view the time laps log. More information at: https://www.fs.fed.us/eng/webinars/chronolog/chronolog.html and https://www.chronolog.io/about-us
- Install passive acoustic monitoring devices that record the sounds of animals for research and conservation. "Environmental" sound is a powerful data source for investigating ecosystem health. The AudioMoth is an "acoustic logger" that can record sounds across a wide frequency spectrum. Using a software program the audio log can then be "filtered" to identify key mating calls of various amphibians. Additional information at: https://www.openacousticdevices.info/audiomoth

ADDITIONAL WETLAND RESOURCES

- State and Federal Agencies
- Local agencies, NGOs, cooperative extension
- Websites & Programs
- Publications
- Videos
- Vernal pool wildlife identification and reporting
- Prevent Spread of Amphibian Diseases
- **What did we miss? Send your favorite wetland resources to spcoordinator@paconserve.org**

State & Federal Agencies

Department of Conservation & Natural Resources Service Foresters
https://www.dcnr.pa.gov/Conservation/ForestsAndTrees/ManagingYourWoods/Pages/default.aspx

Department of Environmental Protection, Bureau of Conservation and Restoration: https://www.dep.pa.gov/About/Regional/Pages/default.aspx

Department of Agriculture, Pennsylvania Invasive Species Council
https://www.agriculture.pa.gov/Plants_Land_Water/PlantIndustry/GISC/Pages/default.aspx

USDA Natural Resources Conservation Service, Service Center Locator:
https://offices.sc.egov.usda.gov/locator/app

Game Commission Private Landowner Assistance Program (PLAP)
https://www.pgc.pa.gov/InformationResources/GetInvolved/LandownerPrograms/Pages/PrivateLandownerAssistanceProgram.aspx

Local agencies, NGOs, cooperative extension

County Conservation Districts: Contact information listed by county at: *https://pacd.org/?page_id=59*

Penn State University (PSU)

- Cooperative Extension: Contact information listed by county at: *https://extension.psu.edu/county-offices*
- Master Watershed Steward Program https://extension.psu.edu/programs/watershed-stewards

Penn State James Finley Center for Private Forests
https://ecosystems.psu.edu/research/centers/private-forests

Land Trusts - Find a local conservancy at the PA Land Trust Association website: *https://weconservepa.org/*

Watershed Organizations and Resources: *https://pawatersheds.org/*

Websites & Programs

- Amphibian Research and Monitoring Initiative
  http://armi.usgs.gov/
- New Jersey Vernal Pools
  http://www.state.nj.us/dep/fgw/ensp/vernalpool.htm
- Rhode Island Vernal Pools
  http://www.dem.ri.gov/programs/water/wetlands/vernal-pools.php
- The Vernal Pool Association
  http://www.vernalpool.org/
- Upper Susquehanna Coalition
  https://www.uppersusquehanna.org/usc/usc-teams/wetland-team/usc-vernal-pool-program/
- Vernal Pools of Pennsylvania – PA Natural Heritage Program
  http://www.naturalheritage.state.pa.us/VernalPools.aspx

Publications

- Michigan Amphibian and Reptile Best Management Practices: https://miherpatlas.org/michigan-amphibian-reptile-best-management-practices/
- Mid-Atlantic Region Seasonal Pools by the U.S. Environmental Protection Agency https://pubs.er.usgs.gov/publication/5200294
- Science and Conservation of Vernal Pools in Northeastern North America: Ecology and Conservation of Seasonal Wetlands in Northeastern North America. 2007. Calhoun, Aram J. K. and Philip G. deMaynadier.
- Tom Biebighauser's wetland restoration books: Find them on the Wetland Restoration and Training website at: https://wetlandrestorationandtraining.com/
- Vernal Pools: Documenting life in temporary ponds: e-book by Steven David Johnson and the N. Am. Nature Photography Association: http://www.nanpa.org/learning/publications/handbooks/
- Vernal Pools: Natural History and Conservation. 2004. Elizabeth Colburn

Videos

- A History of Wetland Drainage – How they Pulled the Plug by Tom Biebighauser (a BCWF Wetlands Education Program, Oct. 2022): https://www.youtube.com/watch?v=-FGuBk-XaJk&t=30s
- Clam shrimp: Microlife of Vernal Pools, Sacramento Splash: https://www.youtube.com/watch?v=FZCsLb93tyk
- Discover New: Vernal Pools Spring to Life:
  - Filmed in PA with PNHP biologists: https://www.youtube.com/watch?v=fzI_yaY_j-Q_
- Fairy shrimp: Underwater and close-up footage of fairy shrimp from a Pennsylvania Pool
  - Filmed in PA by Chris Egnoto: https://www.youtube.com/watch?v=Mr89ZBKNRJc (start at 1:57)
- Michigan Nature Presents: Ephemeral: https://www.youtube.com/watch?v=vdJDe3bA7j8
- Ohio's Vernal Pools: Fairy Shrimp: https://www.youtube.com/watch?v=GVj4zWqB1is
- Vernal Pool Chronicles: https://www.youtube.com/@VernalPoolChronicles/videos

Vernal pool, plant, and wildlife identification and reporting

- A Field Guide to the Animals of Vernal Pools. 2009. Kenney, Leo P. and Matthew Burne. https://www.vernalpool.org/field-guide
- Amphibians and reptiles of Pennsylvania – PA Fish and Boat Commission: https://www.fishandboat.com/Resource/AmphibiansandReptiles/Pages/default.aspx
- iNaturalist: https://www.inaturalist.org/
- Pennsylvania Amphibian and Reptile Survey: https://paherpsurvey.org/
- Pennsylvania iMap Invasives: https://paimapinvasives.org
- Pennsylvania Natural Heritage Program
  - Report rare species and vernal pool locations to spcoordinator(at)paconserve.org

Resources on amphibian diseases and preventing their spread

- Amphibian Ark for information on Chytrid Fungus and Chytridiomycosis http://www.amphibianark.org/the-crisis/chytrid-fungus/
- Partners in Amphibian and Reptile Conservation
  - Fact sheet on Ranavirus: https://parcplace.org/wp-content/uploads/2022/06/WFP-Fact-Sheet%E2%80%93Ranavirus_3.pdf
  - Video on Ranavirus: https://parcplace.org/resources/herpetofaunal-disease-resources/
  - Factsheet on Bd Chytridiomycosis: https://parcplace.org/wp-content/uploads/2022/06/WFP-Fact-Sheet%E2%80%93Bd-Chytridiomycosis_3.pdf
- Northeast Partners in Amphibian and Reptile Conservation fact sheet on disinfection protocols: http://www.northeastparc.org/products/pdfs/NEPARC_Pub_2014-02_Disinfection_Protocol.pdf

Acknowledgements

Thank-you to our Project Partners:

York County Master Watershed Stewards, Gifford Pinchot State Park, Friends of Gifford Pinchot State Park, Ohiopyle State Park, Kings Gap Environmental Education Center, Wetland Restoration and Training LLC, Beran Environmental, Upper Susquehanna Coalition, Amphibian Reptile Conservation, Fern Hollow Nature Center, Bell Acres Borough, The Nature Conservancy, Bureau of State Parks Resource Management and Field Services

Special thanks:

These wetland restoration projects and webinar were funded in part by the Pennsylvania Department of Conservation and Natural Resources, Bureau of Recreation and Conservation, Environmental Stewardship Fund.

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