Site Name: Kloker Prairie 1-11 Wetland Project

Date: November 4, 2022

Landowner: U.S. Fish and Wildlife Service (Meredosia National Wildlife Refuge)

Designer name: Thomas R. Biebighauser

People assisting: Stephanie Bishir (U.S. Fish and Wildlife Service) and Emily Hodapp (U.S. Fish and Wildlife Service).

Objectives of the project:

1. Provide breeding habitat for the Illinois Chorus Frog
2. Improve habitat for a diversity of native animal and plant species, including the Plains Hognose Snake, Eastern box turtle, and Regal Fritillary Butterfly.
3. Build naturally appearing and functioning wetlands that will not require maintenance.
4. Respond to climate change and the lowering of local groundwater elevations.
5. Increase wildlife viewing and environmental education opportunities on the Meredosia National Wildlife Refuge.

Designed Wetland Data

Wetland Number	GPS (center)	Liner & Geotextile size (feet)	Wetland Area (ft^2)	Wire flag color	Elevation Change (feet)	Planned depth (inches)
1	39.926626 -90.505827	50x50	1,966	pink	0.8	17
2	39.926698 -90.506654	60x60	2,831	orange	0.7	22
3	39.92644 -90.507124	60x60	2,831	pink	0.5	20
4	39.926531 -90.507974	50x50	1,966	orange	0.9	18
5	39.926507 -90.508419	50x50	1,966	pink	0.4	15
6	39.924762 -90.50874	50x50	1,966	pink	1.0	14
7	39.924793 -90.507886	50x50	1,966	orange	0.6	13
8	39.926041 -90.506214	60x60	2,831	orange	1.7	19
9	39.927876 -90.505435	60x60	2,831	pink	1.0	22
10	39.928846 -90.505598	60x60	2,831	orange	0.6	20

11	39.928152 -90.506872	60x60	2,831	orange	0.2	21
			26,816	Total		

Primary plant species present: Indian grass, little bluestem, switch grass, prickly pear cactus

Invasive species present: Locust, red cedar

Hydric plants and/or hydric soil present? None

Groundwater elevation: More than 8-feet below the surface.

Soil texture in layers & length of *thin* ribbons: 0-2-inches = sandy texture topsoil, 2-72-inches = sand. The soil test holes were located in the center of each designed wetland basin.

Evidence of historic drainage (ditches, buried drain lines): The elevation of groundwater in the field may have been lowered by the removal of groundwater.

Construction fill present (buried asphalt, concrete, soil, wood): Not found.

Soil Compaction: Soils may be too compacted for burrowing by the Illinois Chorus Frog, measuring 70-80lbs/inch^2 within 6-inches of the surface. Compaction has likely been caused by years of farming practices involving the use of rubber-tired tractors and trucks.

Size of proposed wetland: Eleven-naturally appearing and functioning wetlands may be built in the restored prairie, a former crop field. The wetlands will fill naturally with precipitation and snowmelt, and be built using aquatic-safe liners that are protected by geotextile, and covered with at least 8-inches of soil. The deepest water will be shaped in the center of each wetland to allow for gradual slopes. The inside slopes of each wetland will be no steeper than 10-percent so that soil does not slip off the liner when human or animals enter the wetland.

How the planned wetlands were marked on the ground: The center of each wetland was marked with a fiberglass stake; perimeters were marked using colored flagging (see Wetland Data Table). The center points were mapped using a smartphone and a Garmin GPS.

Would a stream or drainage enter the planned wetlands? No.

Are head-cuts located upstream or downstream that may threaten the designed wetlands? No.

Construction Timing: The wetlands may be built most any time of year when the ground is not frozen.

Construction Guidelines:

The field is an excellent area to build wetlands that will provide habitat for the Illinois Chorus frog as the species has been found in the area. There are no fish or American bullfrogs present that could limit populations of the Illinois Chorus Frog. The restored prairie is well-suited for building wetlands that will be used by the Illinois Chorus Frog with its large areas of sandy soils, lack of cultivated crops, with no livestock.

This will be a partnership project involving the Illinois DNR, Illinois Natural History Survey, Save The Frogs, Sheltowee Environmental Education Coalition, U.S. Fish and Wildlife Service, and Wetland Restoration and Training LLC. Naturally appearing and functioning wetlands will be built on the location. The wetlands will be built so that it does not require maintenance. No dams, berms, levees, diversions, wells, pumps, or water control structures will be used. The wetlands cannot be damaged by flooding, humans, or by livestock.

The wetlands will be built specifically to provide habitat for the Illinois Chorus Frog. The wetlands will be built in an area that has no fish or ponds that provide breeding habitat for the American bullfrog. The wetlands will be distant from roads. The area is not being used for recreation by off road vehicles which means there is little risk of amphibians being crushed by motor vehicles.

The wetlands will be built so they fill naturally in late winter and early spring, and then dry in the summer. Shallow water areas will be shaped in full-sunlight for egg hatching and larval development. Large woody debris and branches will be placed in and around the wetland for hiding cover. Compacted soils within and surrounding the wetland will be loosened for burrowing using the rough and loosen technique. A diversity of native plants will be seeded and planted within and surrounding the wetland.

The wetlands will be built to provide high quality habitat for waterfowl: The wetlands will be built to contain a diversity of water depths, slopes, and plant species. This will be done by making dips, pits, mounds, pools, ridges, points, and peninsulas in the wetland basins. Compacted soils will be loosened to facilitate invertebrate and plant colonization. The wetlands will be built in a watershed that has no fish or American bullfrogs that eat ducklings and compete for waterfowl for food. A diversity of flowering plants used by pollinators will be sown on the soils removed from building the wetland. These areas may provide waterfowl with nesting habitat.

The wetlands will be built to provide habitat for a diversity of bat species for drinking and foraging. The wetlands will be made so they dry each summer, creating conditions that are not suitable for cattail development. The open water areas will be of great importance to bats for drinking. A diversity of flowering plants used by pollinators will be sown on the soils removed from building the wetlands. The moths attracted to these plants at night will provide food for bats.

Beaver cannot build the wetlands that were designed for this project. The beaver is not able to build these wetlands because their construction involves excavation and land shaping, not the construction of a dam across a stream. The wetlands to be built are not located near flowing water where beaver can build a dam.

Thomas R. Biebighauser will be on site full-time directing the construction of the wetlands. He will provide training to biological personnel and heavy equipment operators in the use of techniques he has developed over the past 43-years for restoring wetlands to provide habitat for rare species of frogs across North America.

Construction Technique

It will be necessary to use one-piece, factory seamed, aquatic-safe liners that are protected with 8oz geotextile and covered with at least 8-inches of soil to build wetlands on this site. Groundwater is not present near the surface so wetland that are supplied with groundwater cannot be built on the location. Soil that is high in clay is not present so it would not be possible to build a wetland basin that would be lined with a thick layer of compacted clay on the location

Aquatic-safe liners are needed to build the designed wetlands. This is because the texture of soils on the sites is too low in clay to be shaped to hold water, and the elevation of groundwater is far below the surface.

Aquatic-safe liners may be used with success to build wetlands that are expected to last for thousands of years. The aquatic-safe liners may be manufactured from 30-mil PVC, 30-mil RPE, or 45-mil EPDM. Here are why aquatic-safe liners are preferred for building certain wetlands that were designed for this project:

Construction Technique	**Reason not chosen**
Groundwater	No groundwater is present within 10-feet of the surface. It is not likely that groundwater is with 20-feet of the surface.
Compacted clay liner	Clay texture soils are not present on the site. Clay texture soils are not available in the area. The cost of trucking clay texture soils, mixing with water, spreading in layers, and compacting would be very high.
Bentonite	Not effective. The author has not seen successful use of this product for building wetlands. Bentonite cannot be compacted. Bentonite is not fish grade or aquatic-safe. Bentonite will stay in solution and kill aquatic-life. Very expensive

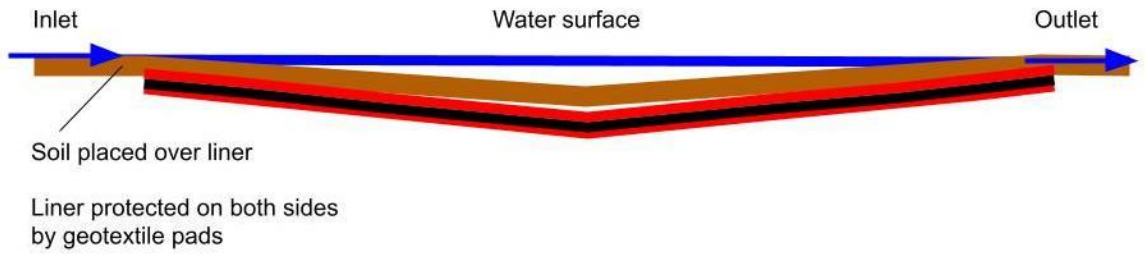
Bentonite liner	Not effective. The author has not seen successful use of this product for building wetlands. Not labeled for building ponds with standing water. One is not able to seam panels so leaks occur where sheets overlap. Not labeled as aquatic-safe. Proven to kill aquatic-life by the author Specialized equipment is needed to load onto a large trailer and to install. Very expensive to purchase.
ESS-13 (Spray Polymer)	Not effective on gravelly, rocky, or sand texture soils Only reduces water loss by seepage from 60-90-percent on soil textures that are not gravelly, rocky, or sandy. Not labeled for use on sites with sand and gravel Not aquatic-safe Specialized heavy equipment is needed to transport and install Can be very expensive.

Emergent wetland built using an aquatic-safe liner 21-years ago on the Daniel Boone National Forest in Kentucky

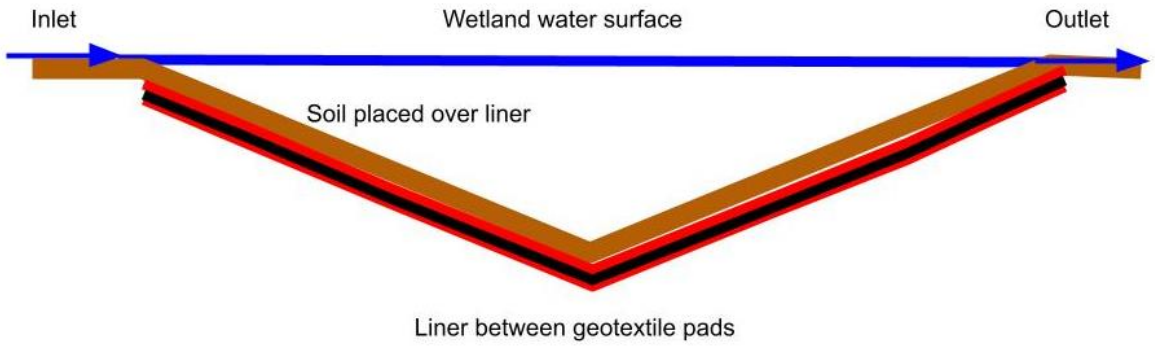
Wet-meadow & vernal pond wetland built using an aquatic-safe liner by Mass Audubon on Cape Cod, Massachusetts.

This emergent wetland was built 25-years ago on the Daniel Boone National Forest in Kentucky using an aquatic-safe liner.

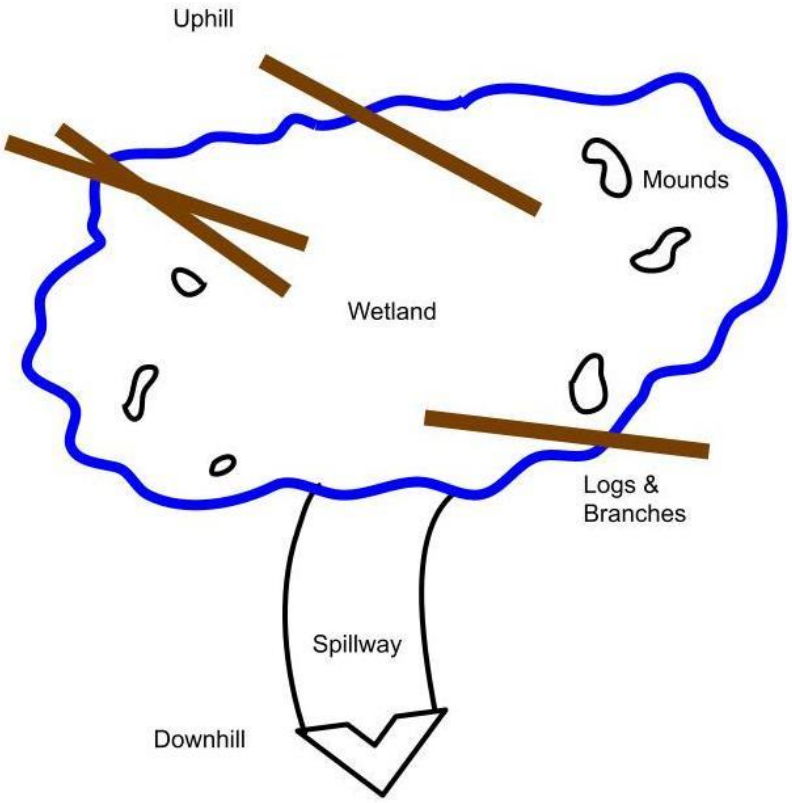
Engineering Drawings



Profile view of wetland to be built

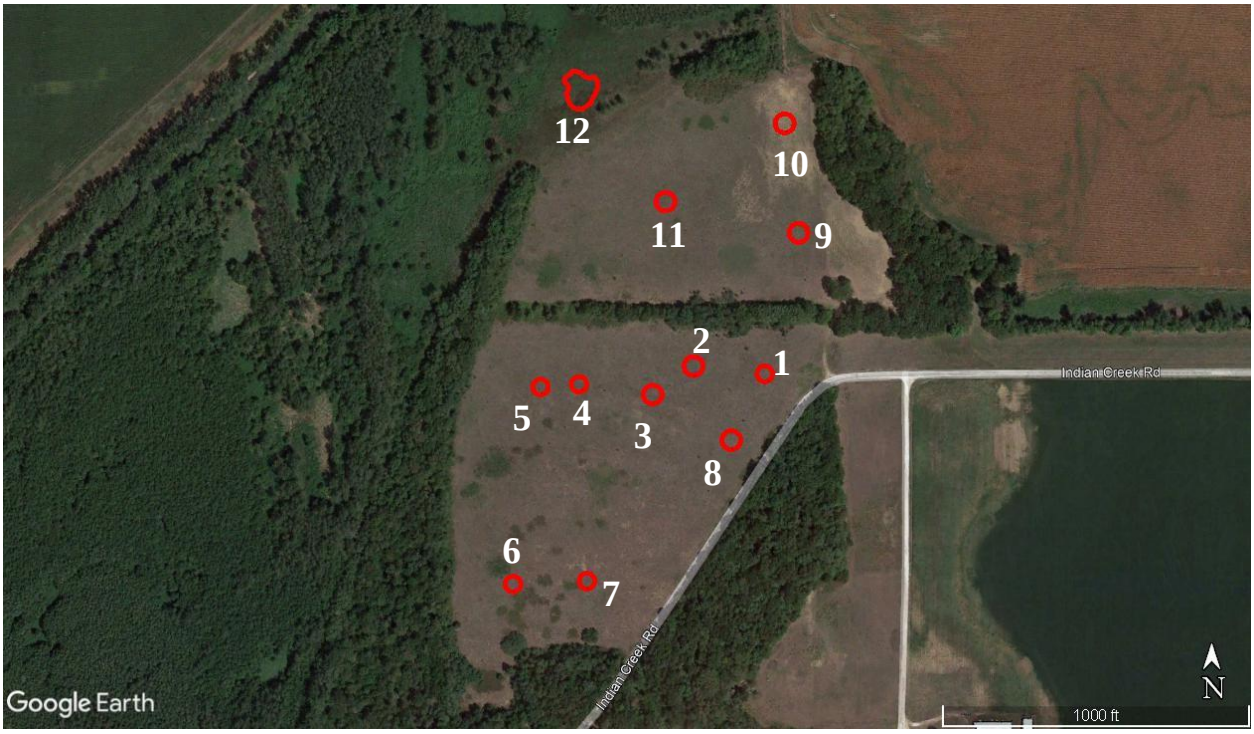


Deeper-water wetland built using an aquatic-safe liner that is protected on both sides using geotextile, and covered with 8-inches of soil. The wetland basin is made to include depressions, mounds, and large woody debris. (Typical profile view, not to scale).



Plan view of wetland to be built

Map showing the area surrounding the Kloker Prairie Wetlands



Location of the Kloker Prairie Designed Wetlands (each wetland would be built with a natural, amoeba shape).

Kloker Wetland 1

Kloker Wetland 2

Kloker Wetland 3

Kloker Wetland 4

Kloker Wetland 5

Kloker Wetland 6

Kloker Wetland 7

Kloker Wetland 8

Kloker Wetland 9

Kloker Wetland 10

Kloker Wetland 11

Kloker Wetland 12

Kloker Wetland 12

Construction Steps and specifications:

1. Obtain permits and approvals prior to construction.
2. Check for buried utilities by going online and submitting a map showing the wetland construction area and locations two-weeks prior to construction.
3. Reserve dates for construction in advance with Tom Biebighauser. He will be onsite full-time supervising the construction of the wetlands and providing training to heavy equipment operators, agency personnel, and volunteers.
4. Hire the services of a contractor and/or agency personnel to provide and operate a one excavator and a large skid-steer with skilled operators to complete the project. The heavy equipment must be equivalent or larger than the following:

   Excavator (for digging, shaping, and loosening compacted soils)
   Cat 335F
   273 HP Net
   77,000 lbs. operating weight
   Large bucket without teeth
   Thumb attachment

   Skid Steer
   Cat 242D3
   74 HP
   2,200 Rated Operating Capacity
   7,138lbs Operating Weight

5. The heavy equipment used for the project will most likely be unloaded from a truck and trailer near the intersection of blacktop and gravel roads. The heavy equipment may then be "walked" to the wetland project area. It is not necessary to unload the heavy equipment near the wetland construction site.
6. Colored plastic flagging was used to mark the perimeter of the wetlands being built. These will be refreshed and replaced as needed prior to construction. GPS shapefiles showing the perimeter of each wetland being built are available from Tom Biebighauser.
7. Different colored plastic flagging will be used to mark any trees, shrubs, and plants to be protected or transplanted, including sedges and rushes that may be present.
8. Colored plastic flagging will be used to mark areas where soil will be spread, spillways constructed, and inlets shaped.
9. Heavy equipment will be used to remove trees and shrubs within the marked wetland area and from the areas where soil removed from digging the wetland will be spread. These trees and shrubs may be saved for later placing in and around the completed wetland.
10. Any nonnative plants that are present will be removed and placed on the surface to dry, or buried.
11. If topsoil is present, it will be removed, piled adjacent to the site, and later spread in the finished wetland.
12. A wetland basin that is deepest in the center with gradual inside slopes will be dug. A laser level will be used to guide the digging of the basin.

13. The wetland will be shaped to contain dips, pits, mounds, pools, ridges, points, and peninsulas.
14. A spillway will be shaped to form an ephemeral stream where water may flow from the wetlands without causing erosion. The spillway will generally measure from 12-20-feet wide, and flow over a slope of 1-percent or less. The spillway may be armored with rock if it is placed on a steeper slope to control erosion.
15. All excavator bucket marks and heavy equipment track marks will be removed during construction.
16. Large woody debris consisting of trees with roots attached, logs, tree limbs, and branches may be placed in and around the wetland to provide birds with perches and waterfowl with loafing sites.
17. Soil removed from building the wetlands will be spread in areas marked by colored plastic ribbons. The soil will generally not be pushed against tree trunks or boulders. Soil will be placed where it will not wash into the wetlands under flood conditions. The spread soil will not be compacted. All heavy equipment track marks will be removed. Compacted soils within and surrounding the new wetland will be loosened to control erosion and to promote plant germination and growth.
18. Colored wire plastic flags will be used to mark the elevation of water in the finished wetland prior to seeding and planting. These will serve as a guide to planting and seeding the higher ground surrounding the restored wetland.
19. Plants that are native to the area will be seeded or planted to restore diversity in and around the restored wetland. Seeds from native wetland plants growing near the worksites may be collected and sown by hand on areas of exposed soil. Other seeds and plants may be purchased. Species of plants sown will favor flowering species used by pollinators. Volunteers may be invited to help with planting and construction.
20. The wetland can be expected to fill naturally with groundwater and precipitation.

Aquatic-Safe Liner Construction Steps

The following steps will be taken to build wetlands using fish-grade/ aquatic-safe liners. These construction steps have been developed by the author following the successful installation of over 400-aquatic-safe, fish-grade liners across North America.

Aquatic-safe liners and 8oz geotextile that are one-piece and factory seamed are available from the following businesses in the United States:

DAKK Liners
14102 Highway 177
Shawnee, OK 74804
405-395-2139
Monica Stroup
www.dakkliners.com
mstroup@dakkmfg.com
Excellent company to work with. High quality materials and service.

Fabseal Industrial Liners, Inc.
42404 Moccasin Trail
Shawnee, OK 74804
(800) 874-0166
http://www.fabseal.com
sales@fabseal.com
Excellent company to work with. High quality materials and service.

Western Environmental Liner
8121 West Harrison Street
Tolleson, AZ 85353
623-414-4432
info@westernliner.com
Excellent company to work with. Low prices, high quality materials and service.

21. Purchase and arrange to have the following supplies available for the project:
    a) Aquatic-safe fish-grade liner and geotextile (a forklift will be needed to unload the pallets or packages containing the liners and geotextile from a large semi-truck and trailer). The aquatic-safe liners and geotextile should be one-piece and factory seamed.
    b) 12-inch long and 3/8-inch diameter landscape spikes (galvanized optional, twisted or smooth sided)
    c) Shovels, one for every two people helping with the project.
    d) Garden or fire rakes, one for each person helping with the project
    e) 5-gallon buckets (4-needed) for carrying rocks
    f) Small sledge hammers for driving spikes, 2.5 to 4lbs size., (3-needed)
    g) Inexpensive utility knives with 18mm retractable snap off blades (8-needed)
    h) Metal cutting snips or multi-tool for cutting wire straps on pallets
    i) Recovery web straps for moving the rolled or folded liner with the excavator, not a chain that can damage the liner.
    j) Large garbage bags for waste
    k) Wheat to sow for erosion control.
    l) Straw to spread for erosion control.

22. Reserve dates for construction and notify all who are involved with the project in advance, including:
    a. Heavy equipment contractor
    b. Tom Biebighauser
    c. People who are transporting the liner and geotextile to the worksite
    d. Volunteers and laborers helping to install the liners and geotextile. At least 8-individuals are needed to install a 40-foot diameter liner, while over 20-people are required to install liners measuring 60-feet in diameter and larger. The

wetland basins may be dug in advance so that laborers and volunteers can install up to 3-liners in one-day.

23. Identify and mark on the ground the route heavy equipment will use to access the worksite. Mark locations where there are overhead wires. Modify fences and gates as needed so the wide heavy equipment may pass. Open locks and provide keys to the heavy equipment contractor.
24. Identify the location where heavy equipment will be unloaded from the semi-truck and trailer. Share a GPS point and photo of this location with the heavy equipment contractor and the business that will be delivering the heavy equipment.
25. Remove any items you have stored near the worksite prior to construction so they are not damaged.
26. Tom will provide the laser, tripod, survey rod, rod and machine mounted laser receivers, rebar stakes, 300-foot-long tape measure, colored plastic flagging, and wire flags needed for construction.
27. Tom will use colored plastic flagging to mark the area where trees and shrubs will be removed for construction. Planned wetland areas that are near each other will be marked using different colored flagging to avoid confusion.
28. Tom will use colored plastic flagging of various colors to mark any trees, shrubs, and plants to be protected or transplanted.
29. Tom will mark areas where excess soil will be spread in advance of construction.
30. Tom will set up a laser level on high ground overlooking the construction site that is far enough away so it is not damaged during construction.
31. The excavator operator will begin construction by removing trees and shrubs from within the marked perimeter. Larger diameter trees are saved for placing in and around the completed wetland to improve wildlife habitat. There is no need to cut and remove trees from the site in advance of construction.
32. Topsoil will be removed from the area where the wetland will be built and saved onsite for later spreading in and around the completed wetland.
33. Tom will drive a 4-foot long, 3/4-inch diameter section of rebar into the ground where the center of the wetland will be built. The rebar will serve as the center stake used for marking the perimeter of the wetland to be built. The end of the 300-foot tape measure is placed over the rebar. The tape measure is stretched out to the maximum radius of the liner being used. Plastic wire flags are pushed into the ground every 3-feet apart to mark the perimeter of the hole being dug for the wetland. Two offset makers are placed approximately 50-feet beyond the marked perimeter that will be used to reset the center rebar stake when it is removed during construction. Three-rebar stakes are placed when using a liner to build a wetland with an oval shape.
34. Elevations will be taken to determine the maximum change in elevation between the upper and lower edge of the marked perimeter. The lowest edge of the marked perimeter is designated by placing a wire flag of a different color. Water will generally flow out of the completed wetland at this lowest edge.
35. The excavator will be used to roughly level and compact the work area in advance of digging the depression for the liner and geotextile if the change in elevation is greater

than 1-foot from upper to lower edge of the marked perimeter. In addition, on sites where dams are located the dam will be leveled prior to digging the depression for the wetland. If leveling of the site is needed the center rebar stake and perimeter flags may be removed and later replaced using the offset markers as a guide.

36. The excavator is used to dig the depression for the liner and geotextile that is deepest in the center with gradual slopes. The final inside slopes of the wetland must be no steeper than 20-percent. This is needed to prevent soil from slipping off the liner and geotextile after the wetland fills with water.
37. The elevation reading at the low edge of the marked perimeter is used to guide the digging of the depression, installing the liner and geotextile, trimming the liner and covering the liner and geotextile with soil.
38. The rebar is temporarily removed so the excavator may dig a hole in the center of the depression that is equal to the planned maximum depth of water in the wetland plus the thickness of gravel and soil to be placed over the liner and geotextile.
39. The rebar stake is driven in the ground in the bottom of the hole exactly in the center of the wetland being built. The elevation of the ground at the base of the stake is equal to (elevation at low edge of marked perimeter) + (maximum depth of water in center of finished wetland) + (thickness of gravel & soil to be placed over the liner and geotextile).
40. The end of the tape measure is placed over the rebar stake to anchor one end of the tape measure. The tape measure is extended to the distance equal to the radius of the liner being placed in the depression.
41. Tom works with the excavator operator to dig the depression for the liner and geotextile, monitoring elevations and distances using the laser and tape measure. This process ensures that the largest size wetland is built using the liner and geotextile in the least amount of time and with a minimum of waste.
42. The soil removed from digging the depression is placed in piles along the edge of the depression, yet within the reach of the excavator. Approximately one-half of the soil will later be spread over the installed liner and geotextile. The soil not needed will be spread out from the lower edge of the finished wetland to appear natural. No dams, dikes, or berms will be built to impound water.
43. Volunteers and laborer will hand pick and remove rocks, branches, roots, glass, and any sharp objects from the depression once it is dug. The soil in the depression is smoothened by hand using rakes and shovels. Elevations are checked along the perimeter of the depression to identify any high or low spots. High or low spots along the perimeter are adjusted using shovels, rakes, and the excavator.
44. A pickup truck is used to transport the liner and geotextile to the worksite. A forklift is used to load the liner and geotextile into the pickup truck. A metal cutting snips or multi tool are used to cut the straps anchoring the liner and geotextile to the pallets.
45. A group of eight or more strong individuals unload each sheet of liner and geotextile one at a time, or the excavator is used to carefully lift the materials from the pickup and place them along the edge of the depression using recovery web straps.
46. A final check of elevations is made using the laser before placing the liner and geotextile in the depression. Rebar stakes are removed from the depression. The wire flags placed around the perimeter are left in place.

47. One layer of geotextile is placed in the depression by hand. The flags marking the perimeter are used to guide the placement of the geotextile and liner in the depression. The geotextile should reach the base of the wire flags along the center of each edge, and overtop the wire flags in the corners.
48. The liner is placed in the depression on top of the geotextile layer.
49. Another layer of geotextile is placed over the liner, forming a sandwich where geotextile is protecting both the top and bottom of the liner.
50. The laser is used to center the liner and geotextile in the depression. Low or high places along the edge of the marked perimeter are adjusted by hand using rakes and shovels before anchoring.
51. The wire flags are removed from under the geotextile and liner before anchoring with landscape spikes.
52. A lumber crayon is used to mark where landscape spikes will be driven into all three layers to anchor the liner and geotextile, preventing these materials from moving when the excavator covers them with soil. The 12-inch landscape spikes are placed approximately 18-inches apart along the top edge of the liner and geotextile being installed. The laser and rod are used to guide where each landscape spike is placed.
53. A landscape spike is driven through both layers of geotextile and the liner at each mark made with the lumber crayon. Small sledge hammers are used to drive the landscape spikes into the ground. The landscape spikes are moved to one side or the other if rocks are encountered below the surface.
54. The liner and geotextile material outside of the heads of the driven landscape spikes is removed and discarded. Excess materials are trimmed to within one-inch of the head of each landscape spike. Inexpensive plastic utility knives with adjustable 18mm breakoff blades are used to trim the excess liner and geotextile.
55. Wire flags are now placed approximately 3-feet apart along the outside edge of the trimmed liner and geotextile to provide a visual clue to the excavator operator while covering the liner and geotextile with soil. These flags are removed after the liner and geotextile have been covered with soil.
56. The excavator places a layer of gravel over the liner and geotextile that is approximately 4-inches thick where there is a possibility that cows, horses, donkeys, or elk may enter the wetland. Neither the excavator or any other piece of heavy equipment is allowed to travel over the liner and geotextile, or the upper edge of the liner and geotextile at any time. Under no circumstances should heavy equipment or rubber-tired vehicles be allowed to travel over any part of the liner and geotextile.
57. The excavator loosely covers the liner and geotextile with a layer of soil approximately 10-inches thick, that when compacted is 6-inches thick. The soil is placed loosely over the liner and geotextile, and is not compacted using the bucket on the excavator. An individual using a shovel with its blade marked at 6-inches regularly checks the thickness of soil being placed over the liner and geotextile as the excavator is moving around the wetland. Soil may be added to thin places by hand raking. Or, the excavator operator is asked to return to add buckets of soil as needed.
58. The excavator operator shapes points, peninsulas, and bays around the perimeter of the wetland while covering the liner and geotextile with soil. Shallow dips, pits, mounds,

ridges, and tip-ups are shaped in the soil placed over the liner and geotextile to provide habitat for a diversity of plants and animals. It may be necessary for the excavator to travel around the liner and geotextile two or three times to complete this step.

59. A wide spillway is shaped on a gradual slope. The spillway is armored with rock if needed to prevent erosion.
60. The excavator is used to place logs and trees with roots attached in and around the completed wetland to provide habitat for wildlife and to prevent motor vehicles from damaging the wetland. All chainsaw cuts are hidden from view so the wetland appears natural.
61. All excavator bucket marks and heavy equipment track marks are removed during construction.
62. No heavy equipment or vehicles should drive on or near the liner after they are covered with soil. Vehicles can lower the top edge of the liner, causing the wetland to hold less water.
63. Woody debris may be placed in and around the wetland.
64. Snags should not be placed over the liner and geotextile; however, they may be placed on higher ground near the wetland to provide Bald Eagles, hawks, and owls with perches and bats with roosting sites.
65. Compacted soils surrounding the new wetland are loosened to control erosion and to promote plant germination and growth. Soils are loosened using the bucket on the excavator, being careful not to hit the liner and geotextile. No heavy equipment or rubber-tired vehicles is allowed to travel in or around the completed wetland to avoid compacting soils.
66. Colored wire plastic flags may be used to mark the elevation of water in the finished wetland prior to seeding and planting. These can serve as a guide to planting and seeding the higher ground surrounding the restored wetland.
67. Wheat may be sown around each wetland for erosion control. Wheat straw can be spread by hand to mulch slopes and areas where water will flow across the surface.
68. Plants that are native to the area may be seeded or planted to restore diversity in and around the wetland. Seeds from native wetland plants growing near the worksite may be collected and sown by hand on areas of exposed soil. Other seeds and plants may be purchased. Species of plants sown will favor flowering species used by pollinators. *Cattails must not be seeded or planted, or they will take over.*
69. Trimmed pieces of liner and geotextile are disposed of in an approved landfill. Wire flags are collected and reused.

The attached document *Wetland and Stream Restoration Techniques Summary* by Thomas R. Biebighauser describes the techniques that will be used to build this project. The book *Wetland Restoration and Construction-A Technical Guide* by Thomas R. Biebighauser describes how similar projects have been completed across North America

Summary

Naturally appearing and functioning wetlands may be established to provide habitat for the Illinois Chorus Frog, waterfowl, and a diversity of native plant and animal species. The wetlands would provide a reliable source of water for wildlife, improving habitat for frogs, toads, and waterfowl. Opportunities for observing wildlife would be greatly improved by the project. The wetlands would be built to require no maintenance, filling naturally with precipitation and groundwater.

About the Designer

Tom Biebighauser has restored over 2,800 wetlands and streams across Canada, in 26-States, New Zealand, Puerto Rico, and Taiwan since 1979. Tom designs and builds over 100-wetlands and streams each year. He has developed highly effective techniques for building naturally appearing and functioning wetlands in arid regions for endangered amphibians. Having built over 1,400-dams, he has since decommissioned over 300-dams. He retired in 2013 after working 34-years for the US Forest Service as a Wildlife Biologist, where he initiated wetland and stream restoration programs across the United States. Tom has served as an instructor for the British Columbia Wildlife Federation Wetlands Institute for 17-years, restoring over 250-wetlands and streams across Alberta and British Columbia since 2003. He instructs a Graduate-level class on Wetland Design for Engineers at the University of Louisville Speed School of Engineering, along with classes for the British Columbia Institute Technology. Tom has developed highly effective and low-cost techniques for building wetlands and streams for rare species across North America. The habitats he builds require little, if any maintenance, and do not involve the use of diversions, dams, dikes, pipes, or pumps. Tom has written 4-books about wetland restoration, and has received 44-awards for his outstanding contributions.

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