

Pond Construction Practicum:
By Tom Biebighauser and Ian McIntosh

53 participants of the Turtle Stewardship and Management Workshop took part in a pond design and construction practicum. The practicum was led by Tom Biebighauser of the USDA Forest Service, an expert in creating wetlands that look and function naturally.



The team arrived in the field at 9:00 a.m and by dinner time that evening two ephemeral ponds had been constructed on an area of construction fill within table lands adjacent to the Rouge Valley. Ephemeral ponds (vernal pools) provide important habitat for many of Ontario's reptiles and amphibians. These two wetlands were specifically designed to create important breeding habitat for Gray treefrogs that find refuge in the Rouge Valley. Similar wetlands will be constructed at other locations for SAR turtles.

Sampling Soil:

Building a wetland with a groundwater source and a high water table can be easy as you simply dig to expose the available water underneath the soil. However, when constructing wetlands to hold surface run-off and precipitation your method of construction will be determined by the soil-texture at your chosen location.

Generally, clay soils will hold water whereas sandy soil will not. If you discover that you have sandy, permeable soil then you will need to construct your wetland with a liner. If you have clay soils you may construct your wetland without a liner.

You can determine the texture of soil you have with just your bare hands and a spray bottle of water. Take approximately 2 teaspoons of the soil in one hand. Lightly spray the soil with water from your spray bottle. Generally, if you can form the soil into a ribbon between your thumb and forefinger that is 5-centimeters or longer before it breaks then you have clay soils. If your soil sample falls apart when wet and cannot be formed into a ribbon between your thumb and forefinger then you have sandy soils. Most soils will be some combination of sand, silt, and clay. For a helpful flow chart to determine what mixture you have in your soil go to the following USDA link.

http://soils.usda.gov/education/resources/k_12/lessons/texture/

Building a pond with a liner:

Using a synthetic liner is required when constructing a pond in permeable soils. While some recommend lining your wetland with a clay or commercial bentonite, both of these options are ineffective and/or difficult.

If lining the bottom of your wetland with clay you will need to import a considerable amount (generally a minimum of 60-centimeters depth throughout the wetland) for it to hold water and not break-up over time. This means that unless you have a substantial amount of clay nearby, it can become quite costly. To prevent punctures and/or break-up, the clay will need to be applied in 15-centimeter layers and compacted by heavy equipment after each layer application. This can all add up to a great deal of labour, time, and cost.

Many advocate spreading bentonite over the bottom of the wetland to help it contain water. Bentonite is finely ground clay that is packaged and sold in farm supply stores. Bentonite is expensive to buy, and ineffective to use. The thin layer of clay you spread is easily punctured by deer hooves and burrowing crayfish, and will crack and leak if it dries.

List of equipment and cost of materials:

1) Heavy Equipment – Having the proper equipment is essential to constructing your wetland on a set timeline. An excavator, 100 series or larger (90 horse power or greater), with a 42 inch wide bucket or larger, and metal tracks is one of the best machines you can use. This machine has a long reach, which is essential to be able to cover your liner in soil without driving on it. The metal tracks allow the machine to operate in all sorts of weather conditions and can be used to compact the soil. Hire your machine from a contractor with an experienced operator to build the wetland.



A dozer is also an effective tool when building wetlands from clay soil or that will have a groundwater supply, particularly in combination with an excavator. Make sure your dozer is a minimum 100 horse power, metal tracks, with a 6-way blade.

2) Synthetic Liner – Make sure that your liner is **aquatic safe, fish-grade**. This means that your liner will not have been treated with any algaecides, pesticides or fungicides that may harm wildlife in your wetland ecosystem. The best quality liners are EPDM (45 millimeter or thicker) and PVC (30 millimeter or thicker). EPDM is reputed to be better in northern climates and more flexible in cold conditions. Select the square footage of your liner based on the size of your desired pond. Synthetic liners can be purchased from garden nurseries, pool supply, and industrial liner companies.

3) Geo-textile padding – Make sure that your geo-textile material is **aquatic safe, fish-grade**, 8 ounce or thicker. You will need 2 pieces of geo-textile equal to the size you select for your liner (one piece will go underneath your liner and the second piece will go on top). *For example, if your wetland is going to be 2,500 square feet, you will have a 50' x 50' liner and 2 pieces of 50' x 50' geotextile.* Geo-textile often comes in a roll of a

certain width and you may need to cut it to the desired length of your wetland if you haven't specified it be stitched together by the supplier.

4) Spikes and washers – You will need 12” long twist galvanized landscape spikes and washers to hold your liner and geo-textile in place. Both the spikes and washers are available at most hardware stores. You will want to make sure that the washers you select fit over the spikes before you buy them. *For your 2,500 square foot wetland you will want 100 of each.*

5) Hand tools – You will need hand rakes, shovels, one post-hole digger, spray paint, and one construction or surveyor's level. These can be purchased from most hardware stores and garden nurseries at variable cost. The number of tools required will depend on the number of workers involved in the project. Tools can often be borrowed from friends, family, and volunteers.

6) Annual grass – You will need oats, wheat or annual ryegrass for overseeding your wetland to control erosion. Annual grass seed can be purchased from most seed supply companies, nurseries, and farm supply stores. *For your 2,500 square foot wetland you will need approximately one 50lb. bag of seed.*

7) Straw – You will need straw to use as mulch. This will help to prevent erosion and protect plants as they germinate. Be careful not to use hay, which often contains many weed seeds. *For your 2,500 square foot wetland you will need approximately 15 bales of straw.*

8) Soil – You may need additional soil to cover the synthetic liner and geo-textile pads when building on steep ground or from rocky soil. On steep ground all the soil removed to dig the basin is needed to create a level surface, with no soil remaining to cover the liner. It is important to cover the liner with soil to protect from puncture by deer and bear, to create habitat for wildlife, and provide a substrate for plant growth. You can use the soil available at your construction location to cover the liner if the location is relatively flat, and if it is relatively free of sharp rock. If you need to purchase soil determine your quantity based on desired depth of soil in your wetland (may depend on type of wetland you are constructing e.g. Overwintering pond for turtles vs. vernal pool). It is easiest to order large amounts in increments of 25 cubic yards as 25 cubic yards of soil fits in one tri-axle truck load. Most soil supply companies have an online soil calculator to help with your order. 1 cubic yard at 1” deep covers roughly 324 square feet. *For an 8inch cover in your 2,500 square foot wetland you will need approximately 60 cubic yards.*

9) Native seed-mix and/or container plants - You will need an assortment of native seed and potted plants to reduce erosion, establish wildlife habitat, and limit the potential for invasive species colonization. Make sure that you plant your wetland with only native species of plants. Many garden nurseries and seed supply companies offer native wetland plants and seed mixes. Depending on your location and the natural seed bank available

you will want to purchase a variety of emergent, submergent and partially submerged plant species including sedges, grasses, flowering herbaceous plants, shrubs and trees.

Summary of costs:

The following is a summary of the real monetary expenses of the project to help you with planning your wetland construction project.

- 1) Excavator: \$130/hour x 10 hour minimum + \$600 (\$300 one-way) float charge for delivery) = **\$1,900**
- 2) Synthetic Liner: A 50 x 50 (2500 square feet) liner cost **\$1,700** (an average price is around \$1 per square foot)
- 3) Geotextile Pads: (one under, one on top) 5000 square feet cost **\$1,600**
- 4) Spikes and Washers: 100 spikes and washers cost approximately **\$100**
- 5) Hand tools: Borrowed
- 6) Annual grass: 1 50lb. bag of wheat cost approximately **\$50**
- 7) Straw: 15 bales @ approximately \$5/bale = **\$75**
- 8) Soil: 50 cubic yards @ approximately \$10/yard = **\$500**
- 9) Native seed mix and/or container plants: Variable cost. Native grass/sedge seed @ approximately \$50/125 grams + 50 - 4 inch container plants @ \$2.50, + 15 shrubs @ \$20 each = **\$475**

Total construction cost = \$6,400 *

* Note that this cost does not represent person hours and/or labour involved in site survey and construction. The total cost does also not include the cost of hand tools, which can be considerable.

Steps to building a wetland with a synthetic liner:

- 1) Chose a site that appears level. If it's flat enough to pitch a tent on your desired plot of ground, you can build a wetland on it.
- 2) Flag the area with your desired size and shape. For example: for a 50 x 50 (2500 square feet) wetland chose your centre point first. Then flag numerous locations in a circle around, and 25 feet (radius) from the center flag.
- 3) Use a construction or surveyor's level and survey rod to determine the low and high points around the perimeter of the flagged circle. Regardless of how flat your wetland location appears, all will have a high and low point. Remember that the higher the number you see on your measuring stick the lower the point is on the ground. And always remember to not move your construction level as you are creating reference points. You will need to start from the beginning if you move your level. You will want to use the low point measurement as a reference for the depth of your wetland (e.g. add the desired depth for your finished wetland plus the thickness of soil covering to this number).



- 4) Ask your excavator operator to dig the area to your desired depth, being careful to place the excavated soil to keep the surrounding area flat and natural looking. A large berm around your wetland does not appear natural and can make working around the wetland much more difficult.
- 5) When the excavator operator has finished digging, use the construction level and measuring stick to check the depth of the wetland against your desired depth (remember you set this when you added the desired depth to the recorded low point). Ask the excavator operator to make adjustments as necessary.

- 6) Remove any sharp objects, rocks, or branches, and rake the excavated area to remove large clumps and debris and smooth the soil.
- 7) Lay the first layer of geotextile padding. Avoid walking directly on top of the padding. The more people you have to assist the easier it will be to manipulate the material.



- 8) Lay your synthetic liner over the geotextile padding. Avoid walking on top of the liner. The more people you have to assist the easier it will be to manipulate the material.



- 9) Lay the next layer of geotextile padding over the pond liner. Avoid walking on top of the material. The more people you have to assist the easier it will be to manipulate the material.



- 10) Use the construction level, measuring stick, and spray paint to mark where the top edge of the liner should be trimmed and anchored, which is equal to the lowest reading taken along the marked perimeter. Put your washers over your 12” spikes and drive the spikes at the marked locations through all three layers of material to hold the material in place.



- 11) When all of the material has been thoroughly secured with spikes you can cut the edges of the material to within 1 or 2 inches of the top outside perimeter of the spikes and remove the excess material. This will help surface run-off enter your wetland more easily and will require less soil when covering your wetland in the next stage.
- 12) When your material is secured and trimmed you can begin to cover the liner with your desired depth of soil. An experienced excavator operator can do this delicately to avoid stress and shifting of your material or the liner. Remember the depth of your soil should be predetermined based on the type of wetland and target species you are designing for. Do not allow heavy equipment on the liner or it will leak.
- 13) Once the wetland has been covered in soil you can begin to manually rake the soil to an even distribution.
- 14) Cover the sides and surrounding area of your wetland in straw and overseed with an annual grass to limit erosion.



- 15) Place large woody debris such as fallen branches and logs in your wetland to create habitat for various species, including basking habitat for turtles and perching habitat for dragonflies.
- 16) Plant the surrounding area with native wetland species.
- 17) Monitor your wetland for development and enjoy the habitat you've created. Submit the details of your project to Wetland Guardians at <http://www.torontozoo.com/adoptapond/WetlandGuardiansRegistry.asp>