



Pond Build I

First you dig a hole. Well, OK.....there *is* a little more to it than that, but not that much more. The following instructions will guide you through a simple and generic construction project suitable for most backyard ponds. Your pond can be as uncomplicated or as elaborate as you choose when using a flexible Pond Liner. We suggest you read a few of the many excellent books on water gardening and visit Nelson Water Gardens for ideas. We're more than happy to help you design your pond!

Design

Designing the pond is a series of steps. The first step is to dream. Thumbing through books and magazines on gardening will help you envision your ultimate water garden. Next create a portfolio of favorite garden designs and elements. You will discover as you build your portfolio that you tend to choose the same designs and elements over and over again. This will give you a base on which to build the aesthetic portion of your design.

Two helpful rules of thumb in design

1. Gardens come into two very broad categories; formal and natural. If you choose formal, then the garden will fall into straight lines and geometric shapes. A natural garden is comprised of flowing lines and curves. All other elements of the garden should be consistent with a formal or natural layout.
2. Choose a design element whether it be color, form, texture or line and repeat it over and over in the your design. This repetition will give your water garden consistency and establish a theme. For example, creating a white garden—a garden consisting solely of white flowers.

The functional portion of design; where to place the pond, best type of construction material, what type of filter to use, how the site impacts the design are covered in the following construction techniques. Your final design will be a marriage of aesthetics and function, each will influence the other.

Site Selection

1. If at all possible, site your water garden where it can be viewed from inside the home as well as outside.
2. The sunniest site possible is best for a water garden featuring aquatic plants. Sunlight is not as crucial for Koi Ponds.
3. Avoid low areas where rain runoff into the pond brings with it mulch, grass clippings and any chemicals you may have used in your garden. The sudden influx of water into the pond can affect the pH levels in the pond, stressing the fish.
4. Locate all underground water lines and cables before digging.
5. Avoid placing the pond under a roof overhang.
6. Avoid placing the pond under a tree but if this is unavoidable try to site the pond on the south side of the tree.

Constructing a Liner Pond

1. Call city hall, find out what building codes, deed restrictions and easements apply. For example, many city municipalities require fencing around all bodies of water deeper 18".
2. Lay the pond out first with a hose or rope before digging. View from all angles then go into the house and check out the view from inside. A nudge of the toe will change the pond to your specifications!
3. Start Digging! Using a spirit level, line level or transit check all sides, add soil to the low sides and remove from the high areas. Work carefully, the pond must be level!

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4. Add 1 inch of sand to the bottom of the excavation. Remove any protruding tree roots and rocks. In rocky soils line the sides with a cushioning material such as pond underlayment. (Lining sides not necessary in the Houston area.)
5. Lay the liner in place and smooth away any wrinkles. Begin filling the lined pond with water. As the pond fills continue smoothing away wrinkles. Leave as much overlap of liner on the sides as possible. A 1' to 1 ½' overhang is recommended.
6. Place all your stones or rocks around the pond, after they have been arranged to your satisfaction, then mortar the stones into place.
7. Clean all the mortar joints with vinegar using a stiff wire brush.
8. Completely clean out the pond, a Shop Vac is helpful in removing all construction debris from the bottom.
9. Refill with water and dechlorinate, we recommend AquaSafe.
10. Add Water Garden Starter to start up the beneficial biological activity in your pond.
11. Stock pond with plants and a couple of fish and snails. Wait a week before adding more fish, snails, and tadpoles.

Tips

Build the pond for you, what you'll enjoy, reflecting your own unique personality. Having said that; here are a few odd bits that will guide you in the design process.

1. Keep the safety of young children in mind when building a pond. Treat your water garden with the same respect and diligence toward safety as you would a swimming pool.
2. Partially raised ponds tend to look larger, the same size pond will "shrink" when constructed at ground level. Construct ground level ponds slightly larger to compensate for this optical illusion.
3. Building a water garden is like building a deck, once you are finished you'll wish you'd made it bigger!
4. Keep it simple; build the pond with a broad expanse of surface area. Islands, channels, peninsulas and other features look great on paper but rarely translate to the garden, except in ponds of great size. Not only that, these features creates dead water areas. They are also much more difficult for the novice to install.
5. Not one single guest will be able to resist walking right up to the pond edge, make it accessible and stable.
6. Maintenance will be easier if you construct the pond so that filters, pumps and fountains are easily accessible.
7. Decorative tiles look great in a swimming pool, but won't work in the pond. All ponds develop a natural (and desirable) patina of mossy algae which coat the sides and bottom of the pond.

Above all take the time to enjoy the process as well as the finished project!

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Pond Build II

Advanced techniques for pond building:

Concrete Collar Technique

One of our favorite methods of pond construction is the concrete collar technique. You can find this technique illustrated on page 47 of the book Water in the Garden by James Allison published by Tetra Press. The benefits of this technique are:

- Ideal for soft soil areas or very deep ponds.
- Leveling is accomplished before rock work is installed, eliminates need to constantly check levels as you are laying rock.
- Prevents you from digging the pond larger than planned.
- Prevents cave-ins along the sides
- Safe firm edges
- Allows you to raise the pond above the existing grade thus preventing runoff from heavy rains from muddying your pond.

Although a concrete collar is not required for pond construction, it is an example of how a little extra effort pays off. The collar gives you a nice firm platform on which to lay in the stonework. Not one visitor to your pond will stand back and admire your pond; right on the edge is where they will be. A concrete collar guarantees a stable footing.

Directions:

Before starting assemble:

Liner, Shovel, rake, level, sand, underlayment (optional) wheel barrow, and a long board to span the length of pond (used to check levels).

1. After determining the final length and width of your pond, first dig a trench around its outside dimensions. The trench should be 8 to 12 inches wide and 4 to 12 inches deep depending on how far north you live. The further north the deeper you should dig the trench. If the pond will be above ground see next page for instructions.
2. Lay in some reinforcing chicken wire or gutter screens (which are pre-cut to the desired width).
3. Pound stakes every 12" or so inside the trench. Level each stake by pounding it to the top of the desired grade of the collar. Check levels with a spirit level, string level or transit level.
4. Mix up concrete, 1 to 2 bags at a time (one 80 lb. bag is good for 2/3 of a cubic foot) and fill the trench to the tops of the pegs.
5. After the concrete is set, check the level again. If not level it's a simple matter to mix up a little concrete and trowel in the low areas.
6. Now the pond can be excavated. Tip: Slope the bottom to a "dimple" in the bottom. This approximately 2'x2' low point allows for easier maintenance when cleaning the pond. All detritus and debris is easily swept to this low point for removal from the pond. As you dig, angle the sides slightly, see illustrations next page.
7. Check the sides and bottom for sharp objects and remove.
8. Shovel and rake 1 to 2 inches of sand in the bottom

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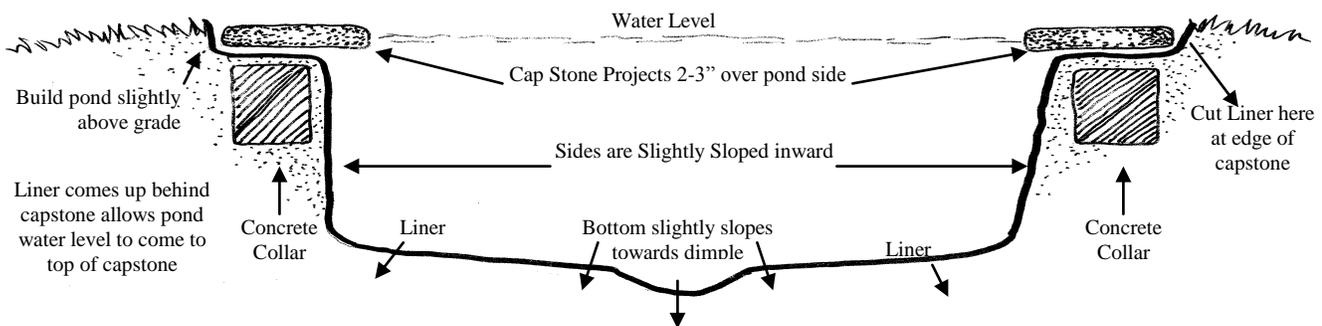
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9. Line sides with liner underlayment material or old carpeting.
10. Lay the liner in the center of the pond and unfold.
11. Line the excavation with the liner. Lightly hold the edges in place with stones or bricks.
12. Fill with water, as the pond fills, the weight of the water will do a good job of smoothing out the wrinkles
13. Lay the rock work around the pond, then mortar into place.
14. Do not cut the excess liner until you are positive there are no low areas or fold where pond water can leak

Tip: fill the pond to one inch depth. Starting at one end lift the edge of the liner up and slowly let it down. As the water rushes to fill the low area the weight of the water helps smooth out many of the wrinkles.

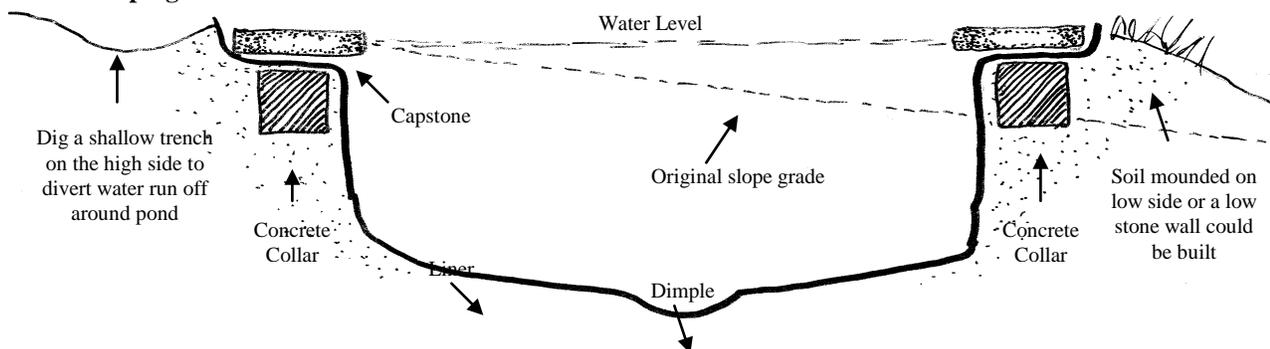
The beauty of the concrete collar technique is that after the collar has set, the pond is level. The fun and artistic part, arranging the stones around the pond can be done without having to check and recheck for level. A concrete collar pond is also safer, providing a firm level footing for foot traffic.

Profile of a Collar Construction



If you are constructing on a sloping site you may need to dig into the high side and build up the low side. To create forms for the low side use masonite cut into appropriate widths. This flexible material is easily bent into the shape you desire. Wooden stakes need to be driven in every 6-12 inches to hold the forms in place. Don't fret about the edges bulging out between the stakes; remember the collar will never be seen.

Profile of a Sloping Site

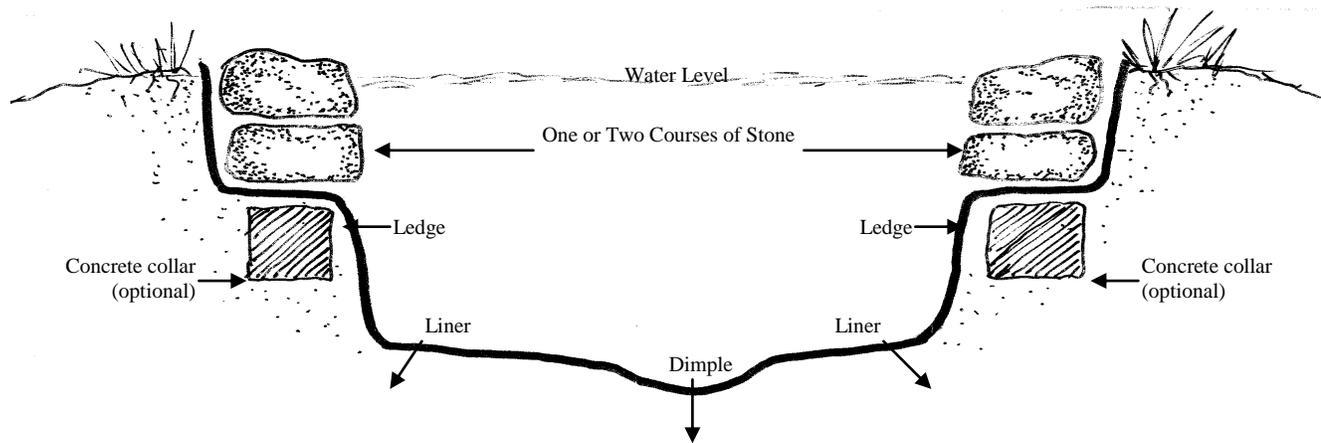


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Alternate ideas:

Here's a method that creates the illusion that the rockwork extends below the surface of the pond to the bottom. Dig the trench 12" deep; only fill it half way with concrete. (Leveling is not an issue with this method.) Excavate the soil in the center. Next comes the liner. You've created a ledge on which to build a stone wall, the liner is pulled up behind the stones and makes the pond watertight.



A Natural Edge—The Bog Edge Technique

You can incorporate a filter into the edge of your pond. Full details of this technique are provided in our Bog Filter Construction Handout.

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Stream Construction

Babbling brooks, gurgling streams and sparkling waterfalls, these are the stuff dreams are made of. Our Stream Garden workshop will show you how to achieve your water dreams. A few things to keep in mind; first, contrary to everything you ever learned about pond construction water is NOT level in a stream! Secondly, the water in a stream is constantly moving in a circular motion. The pump moves the water up and gravity moves the water down. When this movement is stopped by turning off the pump, the water stops moving up but still continues to move downward due to the force of gravity. This can have serious consequences unless you plan for this phenomenon ahead of time.

Nelson Water Garden's stream was built using the concrete collar technique. This technique is illustrated in the book; Water Gardens by James Allison. Although this step is not frequently used, we feel it is the best course of action for the following reasons:

- It allows you to set the levels and grades accurately without the possibility of soil settling over time resulting in low lows and possible leaks.
- This technique saves you time and labor later on in the construction process. Once the collar is set the stream bed can be dug out quickly to your exact specifications with out resetting levels. During the finishing stage, less time and labor is spent placing rocks and stones and checking levels.
- The collar provides a firm, stable, safe support for the rockwork around your stream.

Anatomy of a Stream

The Beginning or top---the stream should emerge from the garden in a way that is logical and makes sense. Waterfalls or small pools make great headwaters for a stream; or have the stream emerge mysteriously from under a fence or deck.

The Middle---The middle of the stream is where all the fun is! This is a suitable place for a bridge, stepping stone crossings, large rocks, small waterfalls and riffles.

The End or bottom---this is the most critical part of the stream design. As described above the water in a constructed stream is constantly re-circulating. A large portion of the total volume of the stream is moving downward. When the recirculating pump is turned off, that water continues moving down the stream and stops in the bottom pool of the stream where it can overflow the pool to the point of flooding. Conversely, when the pump is turned back on, the water level of the bottom pool will drop. This problem is easily overcome by the following design solutions:

- Have the stream end in a pond of large enough volume that the level is not greatly affected. There are several formulas for this in the Stream Garden book.
- Create a tiered rock coping of the bottom pool which will disguise fluctuating water levels.
- Construct a Disappearing Stream. A Disappearing stream does not have a pond at the end of the stream. Instead the flow "disappears" into the ground. This effect is created by using Nelson's Disappearing Fountain Reservoirs as a hidden basin. You can find directions on how to build a Disappearing Stream on our website.
- Design several small pools along the stream, which stop and hold the stream water when the pump is turned off. (We also used this solution for the Nelson Stream.)

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Design Considerations

1. The stream should be at least 8" deep. Forget all those pictures of tumbled rocks and pebbled cobbled courses---those types of streams all turn into unsightly filamentous algae beds (you know the hairy green stuff) here in the South.
2. Site the stream in at least 3 hours of direct sun for aquatic plants.
3. Pay attention to your topography. Even yards that appear as flat as a billiard table have a slope to them. It's easier to work with the existing grade than against it.
4. Avoid siting a stream under a tree or roof overhang. Having said that there is a certain charm to a shady brook, so plant the trees after the stream is constructed!
5. The wider the stream the greater the volume of water needed to pump through it. It is easier and less costly to pump water through a narrow stream.

The Construction Process

1. Lay out the stream course using a rope or garden hose. Once you are happy with the shape, spray paint the stream edge and remove the rope or hose.
2. At the bottom end of the stream start digging a 6-8" wide and 4" deep trench around the outside border of the stream---this is the concrete collar. The bottom portion of the collar will be seated in the trench. If your site is flat then the beginning of the stream will need to have the collar built up by using forming materials. We use strips of masonite which are flexible yet strong enough to serve as a simple form.
3. Pound stakes every 12" or so inside the collar. Using a carpenter's level pound each stake to the top of the desired grade of the collar. Remember the height of the stakes should gradually decrease from top to bottom. The only exception to this would be where any pools are along the stream course. The collar must be level along these points just like water garden construction.
4. Line the collar with chicken wire or gutter screens for reinforcement.
5. Mix the concrete---1 to 2 bags at a time and fill the collar to the top of the stakes.
6. After the concrete is set, check the grade again. Any low areas can be fixed by troweling a little concrete onto the low area.
7. Now the stream bed can be dug out, remember 8" deep. Pools constructed along the stream need to be the same depth of a regular water garden---12" - 18" deep.
8. Line the stream with 45 mil EPDM liner---this is the best material to use in stream construction---it is tough enough to endure all the rockwork but flexible enough to line the irregular shape of a stream.
9. Lightly hold the edges of the liner down with stones or bricks and fill with water.
10. Now start laying in the rocks but don't mortar into place.
11. Place a hose at the top of the stream to observe the flow---adjustments to the rocks can be made at this point.
12. Once you are satisfied with the flow, lay in the inflow and outflow water lines in the mortar joints at the beginning and end of the stream. Pipe size should match your pump's outlet size. Here at Nelson's our stream is run with two 3,000 gph Little Giant 6E-CIM pumps and 1 1/2" PVC lines.
13. Now everything can be mortared into place.

We strongly urge you to purchase one of the many excellent books on water gardening which have information on stream construction. Here several helpful book selections:

- The Stream Garden by Archie Skinner & David R. Scott
- Waterfalls, Fountains, Pools & Streams by Helen Nash & Eamonn Hughes
- The American Horticulture Society's Complete Guide to Water Gardening by Peter Robinson
- The Complete Pond Builder by Helen Nash

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Gravel Bog Filter Construction

I have always been intrigued by the idea of turning waste into a resource and that is exactly what a bog gravel filter does for you. It turns fish and plant waste into fertilizer (plant food). This plant food is then consumed the plants growing in the filter. The happy byproduct of this process is clear water and low maintenance. If a gravel bog filter had a mission statement this is what it would be:

To create an environment that maximizes organic decomposition and nutrient absorption thus starving the (always present) algae in the pond while looking gorgeous!

Here at Nelson's we are so sold on Bog Gravel Filtration, we will not build a pond without one and for one solid reason; there are virtually NO call backs from unhappy clients. They don't call back because with fewer pieces of equipment needed there is less chance for breakdown, secondly a properly constructed bog gravel filter only requires seasonal maintenance. More enjoyment of the water garden and less work for your client.

The only drawback to a gravel bog filter is there is no fancy filtration system (or as Cla Allgood of Allgood Outdoors calls them "The Big Uglies") to sell to a client, the bog gravel filter is designed and constructed on site. If a client insists on a "big ugly" filtration system, we install one in addition to the gravel bog filter. In my opinion the loss of monies from selling a fancy filtration system are more than made up by the elimination of call backs, the peace of mind from that and a happy customer, not just after the pond is constructed but in the years to come. We have too many fly-by-night contractor in this industry than can build a pond that looks great for a month.

Let's be clear about (pun intended) why ponds turn green. The green water is comprised of billions of tiny one celled plants called algae. Like all plants, algae needs sunlight, carbon dioxide, water and nutrients to grow, eliminate any one of these elements and it will not grow. Bog filters are extremely efficient at removing nutrients from the pond water.

This mission is accomplished by pumping pond water evenly through a gravel bed via a grid of perforated pipework. The gravel provides the surface area for nitrifying bacteria to colonize. The bacteria reduce fish and plant waste into plant food. Growing in the gravel are bog plants that take up the plant food. The water is returned to the pond stripped of all nutrients thereby "starving" the algae which cannot grow.

Bog gravel filtration is not new, Mother Nature has been using this technique for eons, we call it an aquifer, swamp or marsh. NASA has experimented with the technique for waste treatment on space stations. Some Sanitation Facilities use it in waste water treatment. In the pond industry, Dick Schuck presented this idea back in early 1990's. Years ago I met a fish farmer who used this technique and ended up making more money from the plants he grew in the filter than the fish! Nelson Water Gardens has been building bog gravel filters for the past 18 years. Before I get started here is a famous quote:

*"Learn from the mistakes of others,
you can't live long enough to make them all yourself"*
-Eleanor Roosevelt

Over the last 18 years of constructing Bog Gravel Filters, we've made plenty of mistakes and have also refined the process. We've given countless lectures and workshops and have learned from the feedback of audience. In a backward kind of way I'm going to start with the mistakes we made, to remove immediately any pre-conceived notions. In some instances the right way to do it seems wrong. For example, if a little bit of gravel does the job then a lot of gravel should be even better right? Well...not when it comes to depth of the filter bed, build deeper than 12" and the system can fail. Surface is key, the greater the surface area the more filtration! So here are the top 9 mistakes made construction bog gravel filters:

1. Too deep a bed of gravel – this is the most common mistake made, you need no more than 12" of gravel substrate. If you are adding a Gravel Bog to an existing deep pond area; construct a false bottom using grating.
2. The bog is too small: For water gardens 10 – 15% of surface area should be bog, and for koi ponds there should be 25 – 30%.
3. Wrong size gravel – use 3/8" pea gravel. Period. End of story.
4. Not capping the pipes, water follows the path of least resistance and will simply shoot out the ends instead of through the slots.
5. Not enough plants- initially you should plant one plant per square foot.
6. Wrong plants – there are many aggressive species which can clog the pipes and grow out of the filter.

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7. Washing the soil off the roots of the plants before planting in the gravel. Don't do this! There is not enough nutrition in a new bog to sustain new transplants. Just knock the pot off the plant and plant it soil, roots and all directly into the gravel. We promise the soil will not "contaminate" the bog.
8. Not taking the plants out of their pots; this severely limits the plants ability to absorb nutrients and defeats the purpose of the gravel bog filter.
9. Starving the bog; this happens when a pre-filter* is placed on the intake of the pump, this not only stresses the pump but defeats the entire purpose of the bog by starving the plants of the nutrients that are being caught in the pre-filter.

*We are speaking of a true mechanical pre-filter (usually made from foam pads which need frequent cleanings) and not the pump protector or intake screen we recommend using.

Even a gravel bog filter constructed all wrong works to a certain degree. Near our shop, our local county park had a Koi pond that you couldn't even see an inch into the water. When they constructed the filter they used with 3-5" rock instead of 3/8" gravel (Why? I don't know!) and they left the plants in their pots. Despite these drawbacks, the pond did clear to a 12" depth! It has since been redone properly.

A Gravel Bog Filter can be constructed in any number of ways, examples of the most common configurations we have used in constructing water gardens.

1. **Partition:** The filter is within the pond separated by a porous retaining wall.
2. **Raised:** The filter is built next to and higher than the pond; water flows back via a stream or waterfall.
3. **Border:** A ledge 12" deep and as wide as it needs to be is constructed around the perimeter of the pond. At the edge of the ledge a porous wall is built to retain the gravel.
4. **Island:** Created by building a porous retaining wall on all sides in the middle of the pond.

Directions

1. Follow the usual directions for building a liner pond, but be sure to leave room for the bog. Size the bog based on the surface area of the pond. If you will have just a water garden with plants and a few goldfish, the bog should be equivalent to 10-15% of the surface area. If you want to keep a lot of fish or a koi pond then size the bog to be 25-30% of the surface area.
2. If you want a raised bog (80% of the bogs we build are raised) build the retaining walls for the bog area out of a combination of full sized cinder blocks (8x8x16" and 4" cinder blocks (4x8x16")) mortared together, making a 12" deep pit for the filter. Be sure to allow for the spillway(s) (a nice piece of flagstone works well) for the water to spill over and return to the pond, and a space on the side or the back side of the bog for the piping to go over the wall and down into the bog. Use a grinder and bevel the top inside edges of the cinder blocks or cover the edges with underlayment to soften the edges. Then line the bog with 45 mil EPDM pond liner allowing it to overlap the top of the walls.
3. Install the pump on the opposite side of the pond from where the bog filter is located. This is to facilitate good circulation of water throughout the pond. Select a pump that will turn the volume of the pond over every 1-2 hours. (You can go with a higher flow rate if you wish.) Run the flexible tubing¹ along the bottom of the pond, then up, and out of the pond, then along and over the bog wall, connecting with the PVC piping via a hose barb fitting threaded into a female PVC adaptor.
4. Next cut slots into the distribution pipe. The outlet of the pump determines the size of the pipes. Always bump up the pipes for efficient use of the pump. For example use 1" pipe on pumps with 3/4" outlet. Minimum pipe size is 1" diameter for small bogs, though 1 1/2-2" piping is recommended for most other bogs to avoid the possibility of clogging. The pipe is cut with slots a third of the way into the PVC pipe approximately 1" apart.
5. Attach a vertical capped stand pipe to the distribution pipe under the gravel². Cut this pipe (now referred to as the "clean out pipe") to discreetly rise just above the gravel bed. Spray paint the cap black or brown and it will "disappear" from view.
6. Next lay the distribution pipe on top of the pond liner in the area partitioned off for the bog filter. Be sure to point the slots up into the gravel bed. Gravel bogs that are 2-3 feet in width can be fed by a single line of pipe. Wider areas require additional lines spaced 2'-3' apart. This layout is similar to setting up a septic drain field.
7. Be sure that each distribution line in larger bogs has its own clean out pipe³. (see mistake #4).
8. Once you are satisfied with your piping layout and location of the clean out pipe(s), glue all parts together. Turn on the pump and see if water is evenly distributed.
9. Mortar Rocks, flagstones, bricks, or whatever you wish on the outside and top of the bog filter retaining walls to give it a finished look.

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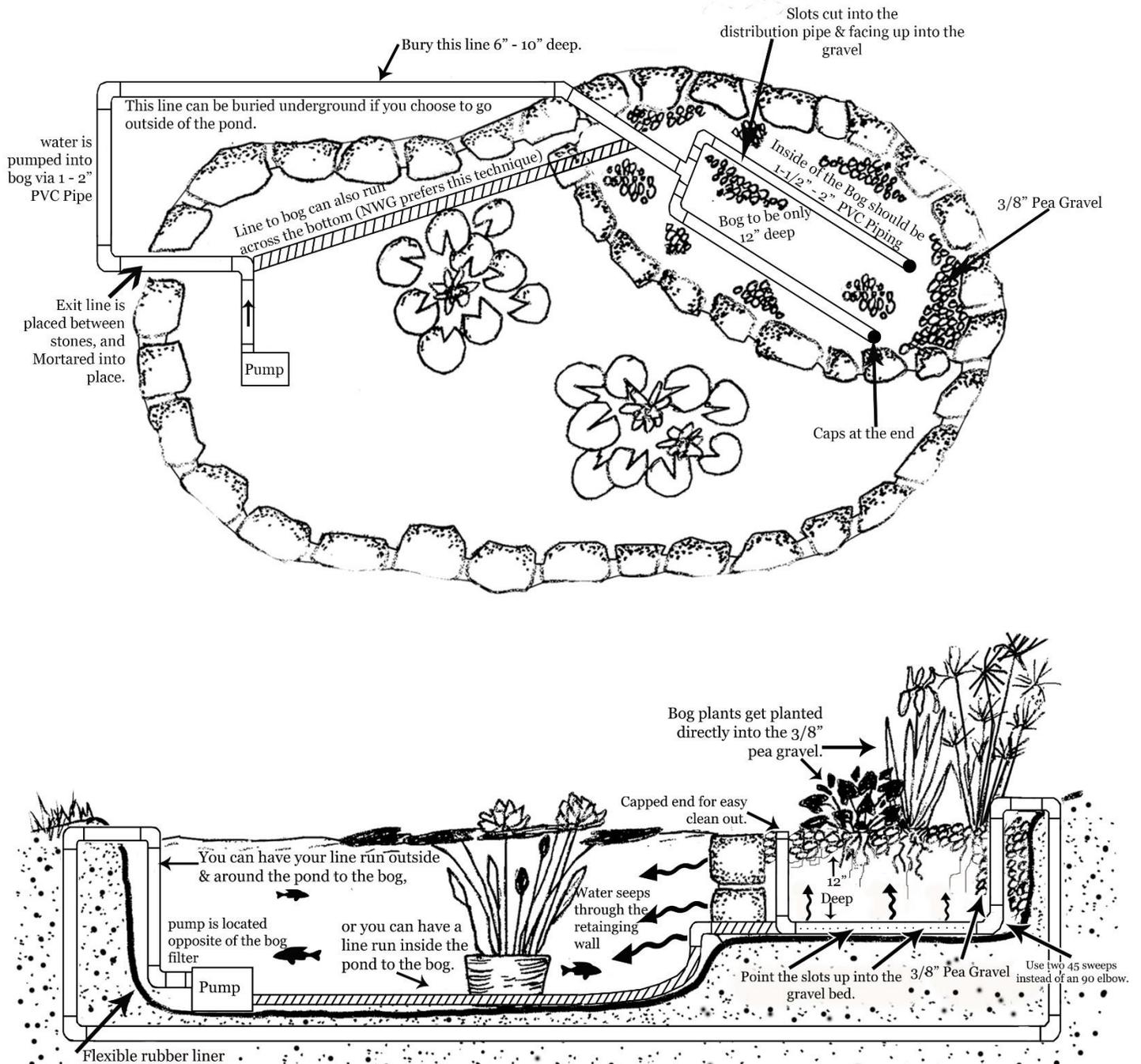
- Shovel 3/8" pea gravel into the Bog Filter area but only fill halfway (the rest of the gravel will be added during the planting). Most gravel is not very clean, wash it as best you can before adding to the filter but be aware it will muddy up the pond, do not to worry, it will clear up. After all, that's what the filter is designed to do! The construction process is finished, now it's time to plant your bog.

1 Using tubing within the pond means less leakage, easier repairs, and less likely to be damaged.

2 Use two 45° sweeps instead of 90° elbows to facilitate better water flow.

3 The under gravel pipes can be cleaned out by simply removing the cap from the stand pipe; water pressure from the pump will help dislodge any debris that has collected in the pipes. A reverse flow can be achieved by turning off the pump and putting a pressure washer down the stand pipe.

Fig 1. Layout of Partition Bog Filter



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Gravel Bogs can be designed in many different ways to suit your waterscaping style. Here at Nelson's you can see numerous styles;

Formal Raised Bog

Semi-Formal Raised Bog

Island Bog, Perimeter Bog

Head of Stream Bog

For very small ponds - Pottery Bog or Spillway Bog

Planting the Bog Filter

1. Select your bog plants and arrange them in the bog area that is half filled with gravel. Be sure you stay away from the plants in the middle list. It's best to plant the tall plants towards the back of the filter, and lower growing plants in front. Create interest by contrasting plants with different foliage colors or textures.
2. After you have arranged the plants to your satisfaction knock the pots off the plants and place the plant with the root ball intact with soil. **Do not remove the soil**—there is not enough nutrition in a brand new bog to sustain the plants. (Trust us the soil will not wash into your pond.)
3. After the plants have been placed, gently shovel in the remaining gravel. Your goal is to place the plants at the appropriate level so that when the rest of the gravel is added the gravel level will be above the water level. In other words, no standing water in the gravel filter area.
4. Turn on your pump and your bog filter is now off and
5. running with years of clear water enjoyment to come.

Suggested Plants

Arrowhead

Assorted Taros

Blue Carex

Blue Rush

Bog Lily

Canna

Chinese Water Chestnut

Corkscrew Rush

Creeping Jenny

Dwarf Horsetail

Dwarf Papyrus

Dwarf Sweetflag

Japanese Iris

Lizards Tail

Louisiana Iris

Melon Sword

Red Stemmed Sagittaria

Ribbon Grass

Ruby Creeper

Ruby Eye Arrowhead

Sensitive Plant

Siberian Iris

Spider Lily

Star Grass

Variegated Spider Lily

Variegated Water Celery

Plants that are invasive in a bog

All Cattails

Aquatic Mint

Chameleon Plant

Chocolate Mint

Gold Rush Reed

Horsetail

Mediterranean Reed

Parrot's Feather

Pennywort

Red Stemmed Thalia

Umbrella Palm

Yellow Iris

Non-Bog Plants that have worked for us

Leopard Plant

Butterfly Gingers

Day Lilies

Caladiums

Hibiscus

Calla Lily

Joe Pye Weed

Hosta's

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