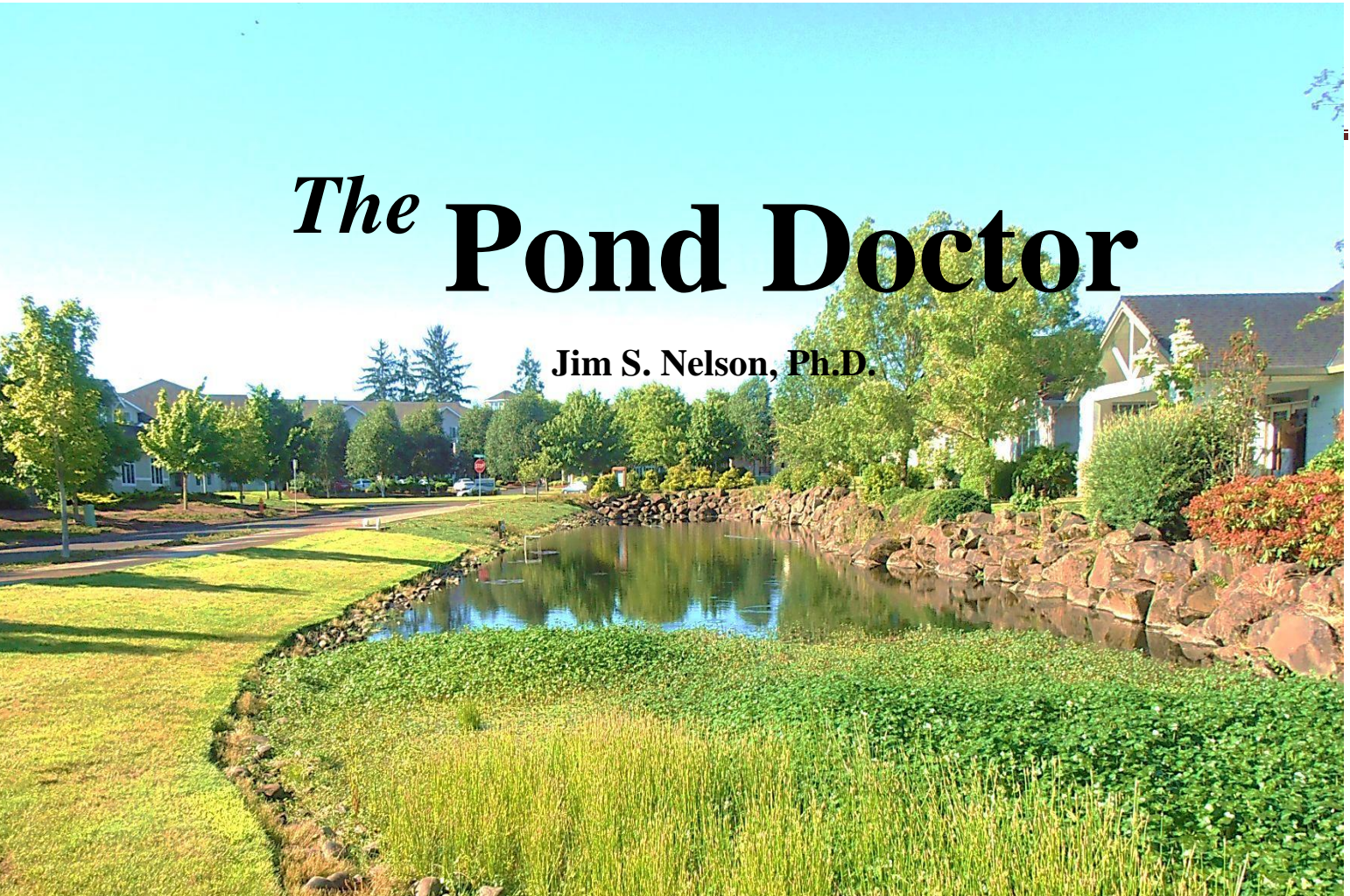


The Pond Doctor

Jim S. Nelson, Ph.D.



Interview and Objectives

Barbara Bowns called on behalf of Stoneybrook Village to examine their water retention pond. I agreed “to perform an onsite assessment and evaluation of the current health, design and structure of the SVOA pond. The assessment should include strengths and/or weaknesses of the current design and ecological health of the pond and include recommendations for changes/improvements to sustain a healthy pond.” I met with Kurt Powell, Community Manager, Willamette Community Management, and Barbara on July 1, 2011. Barbara brought along “The Pond Keepers Guide” that describes how to construct and maintain a pond. The two ponds at Stoneybrook are in very poor shape having some invaders: pennywort and spreading rush; and some sick lilies. Three major problems must be addressed before restoration can proceed:

1. Removal of bark dust surrounding the pond.
2. The large rocks on the west shore need cover.
3. There is no shade on the pond.

The bark dust contains tannins and is killing the invertebrate population. The rocks are heating the pond stimulating the pennywort to grow. And the lack of shade or a canopy does not allow cooling of the pond. The ponds are essentially dead. The spreading rush and pennywort show the ponds to be over fertilized.

Rocks



The entire west shore is covered with rock. This overheats the ponds. Create planters among rocks and put in running drapes (consult landscaper) (e.g. kinnikinnik). You can use many types of plants and the rocks become more interesting as you add various plants. Plants like creeping Jenny should be avoided as it can become invasive. You can plant near the water or above so they grow together. As shown here, a rock wall becomes less toxic to the pond:



It takes around three years to accomplish this where you establish pond ecology and land ecology at the same time. Shade on the rock from across the pond will be equally important.

Throughout this narrative, I will suggest some plants and their function. It is up to a landscaper to choose some plants and their placement. The importance of my narrative is to show you these components are necessary for a healthy pond.

Bark Dust



The bark dust has turned the water a murky brown. Very little is alive in the pond. That is the function of bark dust: it kills weeds and it kills lilies too. I would recommend using wild strawberry as a general ground cover around the pond. This will limit weed growth and provide a lot of forage for birds and insects. Each layer of ecology should support itself and others in the community of nature.

Trees and the Canopy

The entire east side of the ponds should have trees. Use birch in the strip between the sidewalk and the street. Use Maples scattered in the area between the sidewalk and the pond. Use white alder next to the pond. And use willow near the pond and in the pond.

Each of the above issues will be addressed; however, for years, I have used the same steps to effect dramatic changes in pond ecology. They are very straight forward and can be established within a few years. Within three years the whole system starts to mature. The beauty of this method is it is relatively inexpensive and easy to perform:

1. River run rock the entire shoreline for a pond engine. This provides planting beds that directly contact your water.
2. Plant slough sedge and rushes in the rock planting beds. Plant willow and trees (see tree plan).
3. Provide bottom diffused aeration with bacteria and cellulose barley straw substrate.
4. Add deciduous logs and plant wild flowers.
5. Transplant fish. Use disease free fish.

6. Transplant crayfish.
7. Build bird houses.
8. Install tables, dock and chairs for you.

Your comfort should be primary. You need to be at your pond while you are changing it. Be comfortable!

To enhance the property, the surrounding ecology of the property should be addressed. This includes many forage crops and habitat enhancement for native wildlife. For instance, attracting nectar eaters such as butterflies, hummingbirds and insects, enhances the ecology of fish and humans. This is simply planting flowers. Basically, the ponds will have to be pondscaped with the correct plants and ecology. Although a bit long, the following report covers the structures of the pond. Do not hesitate to call or email me if you have any questions. And consider bringing me out again when you get into the process. You will find having ponds and learning how to care for them is a joy and gives you a place to leave the trials and tribulations to calm the mind. Nobody understands why water does this but a few hours near the ponds does this.

Ponds are not just holes in the ground with water in them. Ponds are the source of water for plants and animals. Without placing the right habitat in the pond, you will not have a balanced ecology. This is a process as each part is necessary and the entire ecology has to be considered. This is very complex but made up of very understandable parts. Each is integral into the whole and must work in concert. This report will show you how to achieve good ecology to make vibrant vital ponds that you will enjoy and be a home for fish, plants and fowl. Remember water plants and flowers are the total answer to pond health. Please contact me with any questions you have while you read this and I will promptly answer them.

If you have not done everything, you have not done a thing.

Dr. William "Red" Whittaker when speaking of closed systems where if you leave one thing out, the whole system fails.

Ponds are closed systems...

Findings of ^{The} POND DOCTOR

Stoneybrook Ponds

Stoneybrook Village Pond Information June 2011

The pond was built approximately in 1998 as part of the Stoneybrook Village development project. The pond was designed as a stormwater detention pond with a Pocket Park. The purpose of the detention pond is to filter out sediment and chemicals prior to redistributing the outflow to the stormwater system and Mary's River. Inflow to the pond is from the stormwater drains servicing the development. The main inflow is at the South end of the pond, with additional inflow in the middle East side of the pond.

There are usually two fountain sprays (inoperable at present) and a waterfall feature. The pond is 475 ft. long with an average width of 34 ft, an estimated average depth of 3 ft. with a maximum depth of 5 ft. and an estimated volume of 350,000 gallons. The pond is divided into two sections; the upper (South) section and the lower (North) section.

There is a large raft of *Hydrocotyle ranunculoides* (floating marsh pennywort) forming a dense mat in the lower section of the South pond and a smaller raft and scattered clumps in the North pond. There are a half dozen water lilies (*Nymphaea*) near the East shore of the South pond. Various grasses/sedges are invading from the E. shoreline of the lower pond.

Chemicals used to treat algae and weeds include Sodium Carbonate Peroxidehydrate (Greenclean) as an algaecide, Phosclear (buffered aluminum sulfate) for water clarification and Bacta-Pur (concentrated bacteria).

Plants introduced include *Nymphaea*, *Sagittaria* and *Hydrocotyle*. We have been advised that a pond needs to have 40% minimum of its surface in aquatic plants to use up the nitrates and starve out aquatic weeds and algae.

Submerged weeds have been manually removed by raking approximately once per year for the past several years.

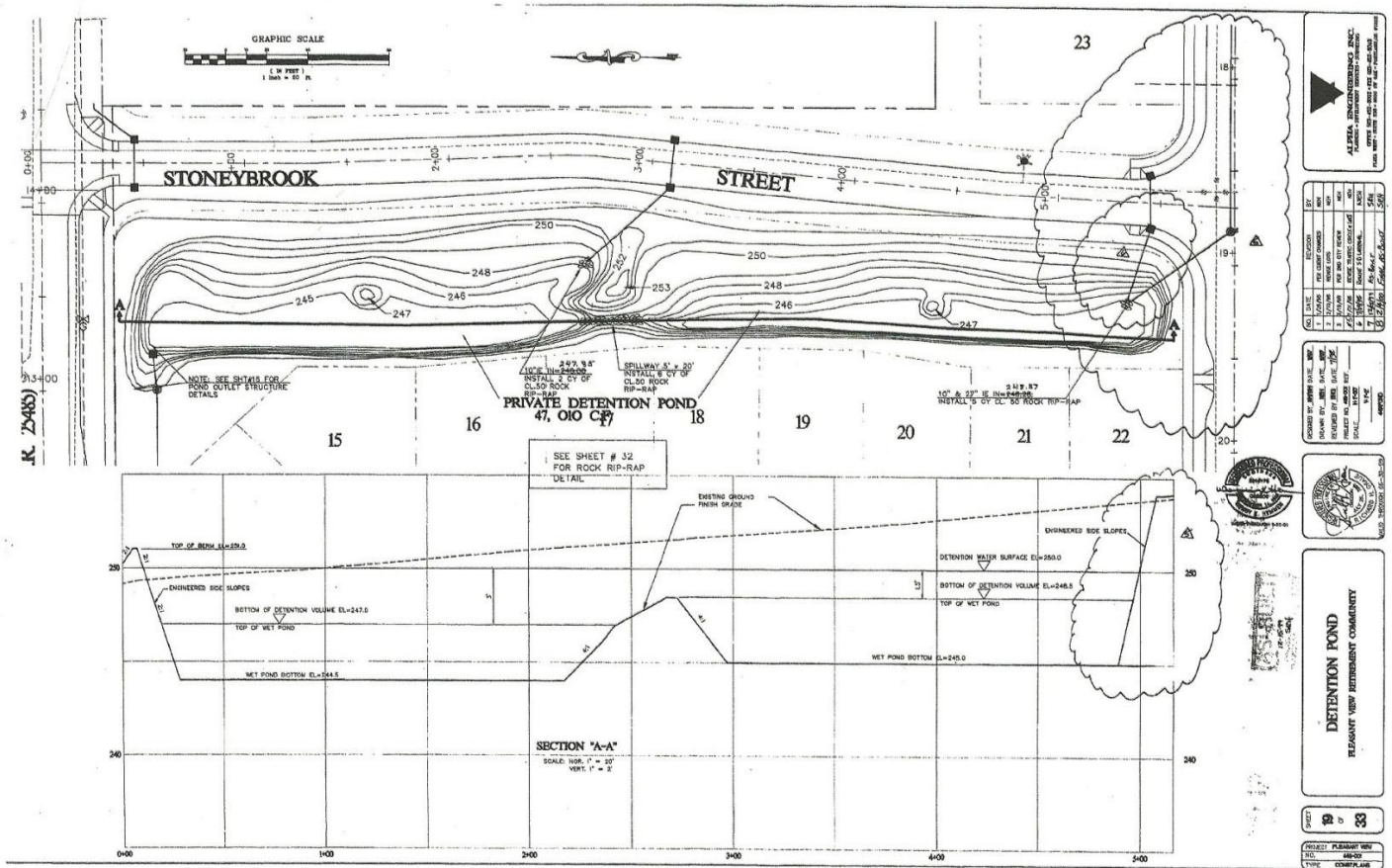
The base of the pond consists of a 6-8" layer of bentonite sitting on a layer of clay.

Sludge and sediment buildup in the bottom of the pond was removed mechanically in 2009 and will need to be repeated approximately every 5-7 years in the future.

There are three pumps servicing the pond; two @ 7.5 hp and one 15 hp pump. Each fountain also has its own pump.

It has also been recommended that we install Koi, Crayfish, Bluegill and Bass as a natural remedy to assist with improving pond water quality.

Stoneybrook Ponds



The ponds were poorly designed. Most of this can be mitigated. The steep wall on the west side and ends will have to have some shelves using some large rock from the bottom.

Much of the information in how to handle the maintenance of the pond is unnecessary. The chemicals mentioned do little in mitigating the problems. Weed control is a matter of taking care of the reason that they are there rather than killing them or removing them. The overgrowth of the invaders, spreading rush and pennywort, require replacement with beneficial plants.

Fountains are expensive and also expensive to maintain and operate. They do little for water management other than blow water into the air blocking some IR. Aeration using bottom diffusers lift the pond gasses out of the pond (See "Respiration" in *The Pond Keepers Guide*).

Stoneybrook Ponds



Topography: The ponds have a drainage system flowing in at the south and at several sumps along the watercourse. The ultimate destination is north of the pond to the Mary's River.

Acre feet estimate: Each pond is about 1/4 acre with a varying depth from 2 to 10 feet or less than one acre feet.

Depth Profile in foot average (Banks Steep or shallow, Deep or Silted): It is reported the ponds range from 2 to 5 feet, or very shallow.

Water Sources (Agricultural) (Forested) Effluent Destination (Creek, River): The ponds are surface filled from residential run-off. The watershed flows to the Marys River.

Temperature: Approximately 60 F. There is no shade on the ponds.

There are two types of energy feeding a pond. One is solar energy affecting the temperature and the other is chemical energy or fertilizer. Both are mitigated using plants.

Fertilization Deactivation necessary? The ponds need nutrients removed from to improve water quality. They need structure using plants. Until this can be accomplished you will need aerators (4 - 1/3 hp pumps) to perform artificial nutrient replacement.

pH: I did not do this as the numbers would be meaningless. Neutral is 7 with lower than 7 being acidic and higher being alkaline. Algae and weeds proliferate sexually in an alkaline environment. You will need to buy an aquarium pH test strip and monitor the pH. This will tell you when to perform certain tasks with the pond. For instance, a raising pH indicates an algal

bloom is about to occur. This usually occurs after a heat die off in the pond. You will need to replace the barley straw and add more bacteria. A low pH indicates bio-degradation and little weed growth, leave the pond alone. A neutral (7.0) pH indicates a well buffered healthy pond. (You can prevent algae blooms using straw fermentation). A lower pH indicates there is some biodegradation occurring which is normal for winter. I would recommend using barley until you get a log fermenting in the pond.

Hardness: High hardness indicates that non-ionic detergents should be used in the herbicides. This is recommended regardless of the hardness. R-11 can be purchased from Wilber Ellis.

Dissolved Oxygen: Three milligrams per liter or parts per million will not sustain much life and 12 is saturated. There can be a dead bottom. Plants are needed to attain balanced oxygen in the pond. See Respiration.

Water Clarity: The water is brown-green. What color is water? Dumb question as water is clear. What color is yours? Installing the correct ecology in the pond will clarify the water.

Conclusion: Use the Pond Engines. Then move towards an overall ecology program for the entire area. A detailed discussion follows.

Plants

Shade There is no shade on the ponds. See the shade discussion to give yourself some ideas on how to manage the water using trees, willows and shrubs.

Riparian Plants: Virtually None. The pond needs riparian plants that remove nutrients and store them; sedges do this.

Animals

Fishes: Clicking on the underlined area at left will show you how to properly manage the fish.

Macroinvertebrates (Crustaceans) (Insects) (Worms) (Brachiopods): Mother Nature's fish food. The pond needs a log or two for over wintering these beneficial bugs. Over 4,000 kinds of invertebrates that infect the log. Pond engines will provide habitat for bottom crustaceans. Consider using one deciduous log in the pond.

Wildlife: Have Nutria, Muskrat, Mink, Ferret or Beaver been detected? The presence of these pond predators should be monitored. (Eliminate them on sight!) You have a large population of typical rodents that should be controlled with a top predator: the barn owl. Boxes should be constructed in your tall buildings. Kurt seem to think this was not possible but it is very possible.

Diagnosis

A diverse population of riparian vegetation needs to be planted. Three levels need to be considered:

- I. Water Plants in the pond creating planting beds to perform natural "Nutrient Replacement" to de-fertilize the pond. The pond can have plants directly in the water.
- II. At pond edge, sedges and rushes. There is ample room around the pond to plant sedge and rush as the base plants and liberal use of ornamentals is recommended. Use a "pond engine" to plant these plants.
- III. Needs to be planted with shrubs willows and trees; liberal planting back 100 feet on the east side.

A regulated fishery/wildlife ecology is necessary for a complete healthy pond ecosystem. Bird (owl) and squirrel houses and feeders should be used to control predators.

Fish habitat structure needs to be installed in the pond. A dead log (s) is beneficial for turtle and frogs as well as fish. A decorative log with limbs helps in many ways such as a roost for birds.

Establishing the correct bottom flora and fauna will clarify the water. This includes the appropriate flora to start a food chain leading to natural forage for fish. Crustaceans are discussed and their rock bottom habitat.

Prognosis

The ponds can be healthy. ^{The} **Pond Doctor** will recommend a series of work projects to achieve pond health. The prescription describes each one and then these aspects will be described. The entire procedure will be instituted this year and proceed for approximately three years. By this time, you will understand how to manage the pond and most probably the pond will start to self-manage where very little work will be required.

How Do We Do This? This is your biggest problem. This has to be a considered approach. Using the step wise methods described and staying in touch with The Pond Doctor will show you the appropriate steps for a rapid completion.
Good luck from the PonDoc.



The Prescription - A Step-by-Step Overview

1. *Plant riparian.*

The pond can be planted with water plants. Once established, artificial methods of nutrient control are not necessary. The plants will clarify the water.

2. *Create regulated fishery.*

Establish a considered controlled fishery in your pond.

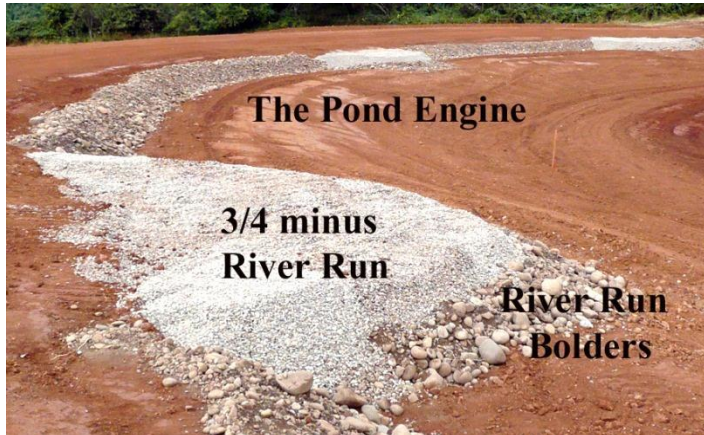
3. *Establish bottom ecology.*

Introducing healthy bottom larvae and crustaceans with bacterial composting microorganisms enhances bottom ecology and water clarity. A dead log will give the pond organic woody substrate for the microorganisms and macroinvertebrates, natural fish food.

4. *People Ecology*

Your comfort should be put foremost as this restoration is for you. This is your vision and requires people comfort.

The Pond Engine

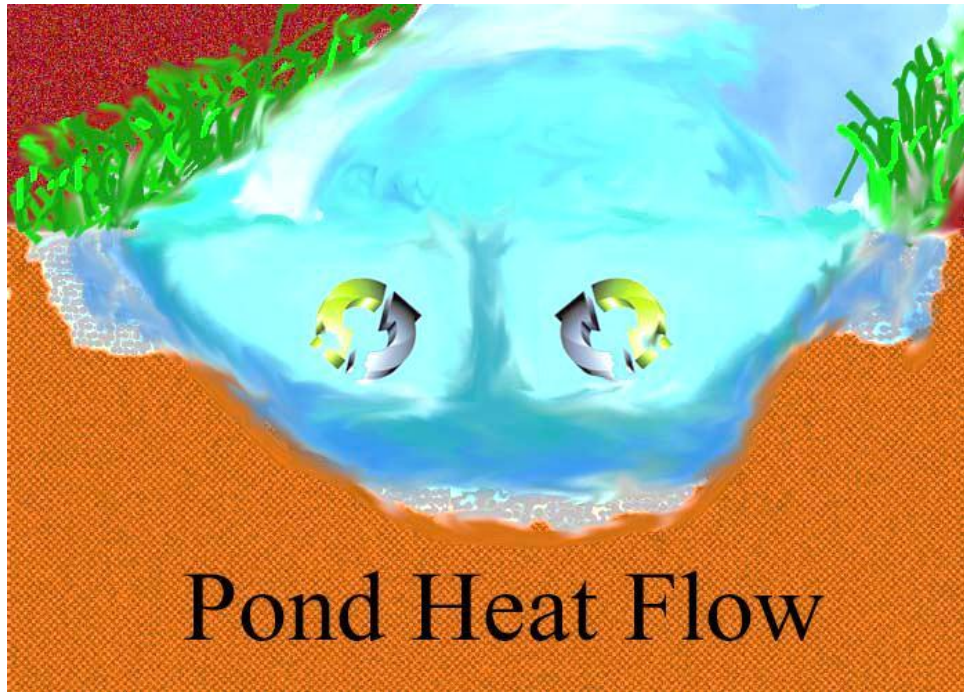


The engine: The plant is the common slough sedge. It is planted in gravel and on the shore. A ledge is placed next to the shore out two to four feet and filled with three quarter minus pea gravel. A four inch layer of three eighth inch minus pea gravel is layered on top (*this is sometimes not necessary unless flow touches the plant). This is planted with sedge and rushes (see below) and topped with sand and clay (the sand and clay are not necessary unless the wave action uproots the plant). The engine should be at least two feet deep:

How a pond engine works: The root ball on a mature sedge plant is around two feet. Water from the pond filters into the root ball and nutrients are removed from the pond. The plants offer habitat for most of the inhabitants of the pond. Approximately 1 BTU of energy is being removed from the pond per square meter of plants. You are water conditioning using natures way.



If you follow the heat, you will see the engine working.



After the engine is planted, the water is cooled (blue) at their roots using transpiration and sunlight; and cold water falls to the bottom of the pond forming a pool of cold water where the interface is called the thermocline. At the surface the sun heats the water causing an upwelling of the water from the bottom and the heavy nutrients on the bottom are cycled back to the shore. Soon the entire water column is cleared of nutrients where no weeds or algae can grow.

Weed and Algae Control

The below photograph shows a beautiful pond planted with a dense sedge barrier with bulrush interspersed. This has eliminated the algae and weeds in the pond and erosion of the stream on the bank. The beautiful native pond plants add dramatically to the landscape. When light strikes water, one-third is reflected from the surface. If you plant plants on the shore, they receive all of the light and out-compete those in the water. For truly weed control is attaining a balance in the pond. Many of the so-called weeds are beneficial if kept in check. Once balance is achieved, the pond will care for itself and weeds and algae will no longer be a problem.



Note on Herbicides: If you use herbicides, you must consider how to use the released nutrients. If you do not, you will get an algae bloom or another weed. You can use artificial nutrient replacement or plant the pond. (see below). I do not recommend using Aquathol as plants in the waterway may be sensitive. Therefore, the herbicide of choice would be Reward (diquat). This is a "cut herbicide" that will kill all of the plants it touches and requires a considered application method. If you decide to use it, contact me (you will need a cocktail of Captain, Reward and R-11). Use it in late February or March at the beginning of the season. I often recommend its use after planting has begun where Reward be used in the second or third years after planting for spot killing. Reward is inactivated on contact with silt or plants and therefore the water is safe. However, this is a chemical. It should be used with consideration such as using during spring high flow.

Further, by planting a canopy, solar energy will not reach the pond. See below.



Weed Control by Nutrient Replacement

Manmade ponds do not have the structure to use nutrients and organics. Until the pond is planted, this is a method to perform this. Nutrient replacement is a method of taking nutrients out of the pond. By removing the organic component in the pond, the water will not support algae or weeds. There are three mandatory components as this is a recipe. If any component is left out, this artificial method will not work.

INGREDIENT #1

Cellulose substrate: Barley straw is recommended. Small bundles in chicken wire of barley straw (or tubes) in the pond will act as a cellulose substrate. A dead deciduous log placed in the pond, once infected, will work but it takes a couple of years to become infected. Therefore, barley straw can be used to start.

Place the barley straw in mesh onion bags and place near the shore.

Barley can be purchased for \$20 per bale.

Kathy Bridges

Santiam Valley Ranch

6516 Hunsaker Road, SE

P. O. Box 613

Turner, Oregon 97392

503-743-2931

KathyBridges@aol.com

INGREDIENT #2

Bacterial Fermentation: LAK PAK POND BACTERIA SYSTEM comes in water soluble packets containing 100% non-toxic, non-pathogenic, non-corrosive dried bacteria. Six packets are initially placed around the pond. Then at approximately one month intervals one or two packets are used. One season: 24-8 oz packs \$375. This is all dependent on the clarity of the water. **Order from Pond Doctor**

INGREDIENT #3 (You will need 2 units with extra diffusers)

Aeration: A 1/3 -hp rotary vein compressor drives the system. The pump is designed so no oil passes into the air line. The system includes the pump and diffusers at \$880. Additional diffusers \$100. Some hardware to install the pump will be required.



Air Diffuser: This is a sintered glass tube with a hole drilled in it. Sintered glass is made by blowing finely divided air into molten glass as it hardens. When air is pumped into the center of the glass tube, it becomes finely divided. One end is sealed and the other has a plastic male pipe fitting.

The diffuser is actually an assembly of four diffusers strategically arranged to allow the best air/water interface oxygen transfer. The diffuser includes a check valve, self-ballasting manifold and a substrate barrier keeps the diffusers away from the bottom improving the clarity of the water.



HOW THE TECHNIQUE WORKS

Plants grow in and around ponds because there are enough nutrients for them to survive. The idea of this technique is to remove these nutrients. It is called "nutrient replacement." It works like this:

First ingredient: The bacteria eat the sugars in the leaf cellulose ferments to humic acid. This lowers the pH of the pond. Algae and weeds raise the pH when they release sex products.

Stoneybrook Ponds

Weeds and algae use sex to multiply. Sex is the fusion of two cells forming a gamete. Basic pHs solubilize membranes (why soap is slick) and therefore the low pH from the fermentation blocks sex and the algae and weeds are not allowed to proliferate. This is why it is very important when temperature spikes occur to monitor pH. But this does not solve the problem as the nutrients are still trapped in the water.

Second ingredient: The bacteria in the Lak Pak are specifically selected to eat the nutrients in the pond and degrade them to gasses: acetic acid, hydrogen sulfide, ammonia, carbon dioxide and methane. Carbon dioxide and ammonia are fantastic fertilizers and will stimulate further weed and algae growth. The heavy pond gasses need to be released from the pond.

Third ingredient: The **aeration is key** to this whole recipe. Carbon dioxide and ammonia are heavier than water and accumulate in the bottom of the pond. By creating a bubble curtain from the bottom, the gasses are lifted and the surface tension is broken and this fertilizer blows away on the wind. This is called "Nutrient Replacement." You take the fertilizer and change it into a gas and then blow it out of the pond.



Specific Recommendations

The rest of this report shows how to set-up an ideal pond situation. I will report on all of them. Each component is relatively easy to install. Remember, ecology is a combination of systems that operate in concert. So you must consider all aspects not just one or two. Planting is just the beginning of maintaining a pond. You must consider the entire pond environs. Your primary problem is to construct all of these components in a concerted effort. You can obtain the appropriate plants and animals to do this.

1. **Riparian Plant Ecology**
2. **Pond Respiration and Aeration**
3. **Wildlife and Fish Ecology**
4. **Bottom Ecology**

You cannot just dig holes in the ground and not put back the natural plant or the habitat for animals. Nothing happens. If you put the natural flora back, then the fauna will move in. Everything comes to balance.

Specific Recommendations

You can immediately start locating plants as we will start with the plants. Wildlife and fish ecology will be discussed including bird habitat improvement. Then the whole key: Bottom Ecology will be described in detail. This report will conclude in showing you how much each aspect is going to cost and outline some work projects for you to accomplish bringing the pond to health.

Riparian Plants

Plants do many things for your pond. They are responsible, in-part, for the respiration of the pond. This keeps the animals alive in the pond. Plants consume fertilizers before they enter your pond; and thus weeds and algae won't grow in the pond. The plants also offer habitat for fish, wildlife and birds.

The **Pond Doctor** recommends three levels of planting. Our prescription is for water plants and bog flowers in the pond (Level I), grasses and rushes (marginal, Level II), and shrubs and trees (canopy, Level III). Most man-made ponds do not have these plants. Decades if not centuries are required to establish plant ecology. With just a little instruction, your pond can be planted in a few years.

Native perennials are the best to use for your pond because they thrive and once established will care for your pond continuously. Although most ponds have some of these plants already, they usually have only 5 or 6 species. The key to pond health is to create a diverse ecology. You may need as many as 50 species. The fall, winter and spring is the best time to establish these perennial plants. *The* **Pond Doctor** can help you select these plants and how to place them.

Ornamental perennials that are non-native can also be used. Like native plants, they also help the pond and offer a great variety of color.

As always, price is the major problem in stocking a pond with the proper plants. Because as many as 3,000 plants are necessary for a quarter acre pond, I recommend native plants as they are inexpensive. Many of these plants are readily available on the pond's property or on nearby properties. I identify these plants and show pond owners how to transplant them or take cuttings. I also recommend field plant identification books so you can touch your own environment. The natives are hardy and beautiful. However, to add color to the pond, I recommend the use of ornamentals. Some of the ornamentals are large leafy plants that consume a lot of fertilizer and are excellent to add to the pond.

I must warn you that many of the pond plants are invasive. You must select the correct plants to start the process. After a base planting is made, some of the invasive plants can be used. Examples of invaders are cattail, yellow water iris, and pond lily. As you can see a considered approach is necessary.

Ecology is a mixture of plants and animals. Because plants provide the food for the animals, we will start here. However, you must not look at an ecology as any one thing, the concept is still an orchestra. Plants are an integral part of the pond as well as are the animals to the minutest creatures in the pond.



Gunnera: You have the perfect slope for this plant.

Below are listed over 4,000 water plants both Oregon natives and non-native ornamentals. Please carefully examine these plants to see if you have some of them. There are pictures of most of the Oregon water plant natives:

[Oregon Perennial](#)

[Water Plants](#)

[Flower Ornamentals](#)

<http://members.peak.org/~jnelson/plants.htm>

<http://members.peak.org/~jnelson/Ornamentals.htm>

Without moving plants around the pond and waterway, decades if not centuries are necessary for the pond to attain a balanced ecology. This is why your pond has not achieved this ecology. The native plants growing in your environment are the best to use for your pond. However, to increase the diversity that increases the health of the pond ecology, you are going to either buy or search for some of these plants. You start by moving and cutting the plants you already have and inventorying what you have in your immediate environment. Do not degrade an environment to get transplants.

The approach to planting: Most man-made ponds do not have plant structure and require an economical approach to establish this ecology. You can collect many of the plants and take cuttings to stock the pond and waterway. However, to obtain some of the beautiful flowers, you will need to buy them. Likewise to obtain the biomass necessary to control the weeds and algae in the pond, you may have to buy some native plants. As the native plants are inexpensive, I recommend their use. Although perennial ornamental flowers are a little expensive they are very desirable. Your pond planting will ultimately beautify the entire property. You can buy these plants from ^{The} **Pond Doctor**.

Herbaceous Riparian Water Perennials: Level I.

Water plants need to be selected to be placed in the pond to reduce nutrients. You need these plants in order to have habitat for fish and to condition the water. Water plants remove nutrients from the water so algae and weeds will not grow.

Plants that should be considered are wapato

(arrowhead or duck potato)*, water plantain*,

pickle weed, water lettuce, hyacinth, elephant ear,

yellow, white and blue iris*, pickerel, water

marigolds*, dwarf lilies, white callas*, blue bells and lots of marsh grass sedges* and cattails,

both regular size and miniature. You also can have water hawthorn and water mint. Of course in the deeper areas you can have your lilies.

* use these

Healthy hardy native Western Oregon stocks are the best to use because once established they will continue to protect your pond and meld into your natural ecology. You must be careful. I have included warnings on certain plants that can become invasive. See Pond Keepers Guide.

Sedges and Rushes: Level II.





Slough Sedge



The next level of planting is at the pond edge. At water's edge and about three to four feet up the bank should have sedges, nature's barrier between the terrestrial and the aquatic environment (erosion control). These plants offer the best buffer between the water and the bank. They should be the dominant plants in the ecology growing very dense and low. There are quite a few to choose: Dense Sedge, Dewey's Sedge, Wooly Sedge, Lyngby's Sedge, Slough Sedge, and Sawbeak Sedge. They each attract different birds that diversify the ecology.

You should consider Single sided sedge where you want to walk as it is soft and a sharp leaf (Slough Sedge) on the rest of the pond to discourage people and animals from degrading the bank. These plants provide a barrier from invaders such as canary reed grass and water primrose preventing nutrients from entering the pond.



Bulrush Level II.

Likewise, there are many rushes and bulrushes to select from. Bulrushes can grow as high as 12 feet in a tight clump. This provides some height to the pondscape. Besides offering a show, the rushes are great water conditioners providing fish habitat and detoxify the water by removing heavy metals and pesticides. You need at least five species of rushes. Each throws seed at differing times of the year attracting many birds.

Planting Suggestions

Level I and Level II deal directly with water plants. Because the pond is man-made, it is often wise to start bank planting at Level II first as you can control the use of plants there. Then start adding plants to Level I. As each can be a concerted effort, I would recommend using some of the non-invasive ornamental water plants to begin such as Canna and Lobelia. You can also use many of the ornamental plants shown in the website.

Because this is a concerted effort the tree canopy should be considered from the beginning. Level III.

Costs: Begin by using an inexpensive sedge and native perennials and add some ornamentals.

Base Plant Level II Recommendation: The following should be planted first and then other plants can be added:

10,000 [Carex obnupa Slough Sedge](#) br

Common evergreen sedge. Firm dark green blades. Rhizomatous. 18 - 36" tall. Prefers wet sites, sun or shade. This sedge has a good chance of establishing itself and should be planted in clumps and lineally. Where there is a lot of erosion, they should be planted densely in pea gravel.

Can be grown from seed in green house. Allow 4 years to mature.

100 [Scirpus acutus Hardstem Bulrush](#) rz

Rhizomatus, Round stems (hard). 3 - 8' tall. Marshes, muddy shores. Good for wastewater filtration. This rush should be planted in the shade where a seep is entering the pond.

Best to buy. Often 10 years to mature.

The rushes should be interspersed among the sedges.

WARNING!!! There are many plant predators. They are the common herbivores such as deer, raccoon, geese, and beaver. Therefore, you will need wire screening to protect your water plants, trees and shrubs. In a single evening, your whole pond planting can be decimated.

Trees and Shrubs Provide Shade and Habitat Level III.



Click here for Recommended Trees <http://members.peak.org/~jnelson/Trees.htm>
You need to see this link!

Your pond needs a canopy of trees and shrubs. Beginning with the willows and shrubs at pond edge and reaching back 50 to 100 feet from the pond results in a gradual increase in the size of the trees. Some trees can be planted directly on the bank. (In drier areas, all trees must be on the bank). Emphasis should be placed on the South side of the pond to protect the pond from solar heating. This shade will inhibit weed and alga growth in the pond. Consider putting the pond in 60 to 80% shade. The Pond Doctor believes storied planting of trees and shrubs is the best method of obtaining the correct shading. For example, plant more cottonwoods, broad leaf maple and poplar. The cottonwoods will offer shade in the first few years followed by poplar and then maple. The under story should be planted with shrubs such as willow and rhododendron. Careful selection will make it so the view to the pond will not be blocked. You should consider the following for Level III riparian tree planting:

Stoneybrook Ponds

		Special Characteristics
Blossom Color		Attracts Birds
Foliage Color	Native to North America	Attracts Other Wildlife
Fall Foliage Color	Hardiness	Fragrance
Blossom Times	Needs for Light Exposure	Attractive Foliage
Plant Form	Water Requirements	Edible Fruit
Height	Soil Type	Attractive Blossoms
Spread		

Trees and shrubs can be ordered from *The Pond Doctor*. Inquire as to a package and because I know about what is needed, I can help you. **NOTE: Do not place tall trees near buildings. Trees such as poplar and aspen often fall on buildings.**

Trees, Willows, Shrubs and Ground Covers

Landscape the Bank

Level III.



Willows and shrubs should be placed around the pond and in the waterway to further de-fertilize the pond. Shrubs are great to remove nutrients from the pond limiting weed growth. The waterway draining into the pond should have a dense shrub population. Any area that has exposed soil should be considered for ground covers, willow and shrub plantings. I would encourage you to find interesting contrasting willow colors (kinikinik). There are both high-growing varieties and low-growing shrub varieties. The choice here is important because the willows you pick will be the backdrop in your pondscape. I would highly recommend the red-stemmed Pacific Red Willow (*Salix lasiandra*). A stand of them looks dramatic when placed against a green background.

Other natives to use are sword fern, Douglas spirea, black twinberry, Nootka rose, vine maple, choke cherry and elderberry. You should select plants from your own microenvironment because they will be successful in your area. You can use low growing

varieties of hedge plants that will not block the view to the ponds and will beautify the pond *i.e.* rhododendrons and azaleas with dwarf fruit trees would work. The shrubs around the pond offer further habitat and feed for wildlife.

The Willow

Before we move on, I would like to extol the virtues of the WILLOW!

The willow is the easiest of the water plants to culture and perhaps the most beneficial in wetland restorations. You can change your entire landscape in a matter of a few years. They grow fast and have fantastically complex root structures that stabilize soil to prevent erosion. You can geo-form with them (change your topography). This is the most powerful plant in your environment and it is growing all around you. Use it!!!

Our purpose is how to remove nutrients from the pond so a balance of ecology can occur bringing weeds under control. It makes sense to use willows as they are the fastest growing and have the greatest complex wood structure removing the most energy from your system. To increase diversity and resilience in your ecology, you should consider other plants...

Water Flowers

The water plant flowers are the most beautiful in the world and add a lot to the ecology of the pond. They attract butterflies, hummingbirds and bees that pollinate many plants throughout your property. Perennial flowers such as mallow, wapato, calla lily and veronica last season after season. The flowers also have water-conditioning abilities. There are many varieties with brilliant, vibrant colors. Bringing nectar to the pond feeds an entire animal class of honey eaters. This sweetens your pond both esthetically and in a real sense. We will help you select some. It won't hurt to tart the place up a little...

<http://members.peak.org/~jnelson/Ornamentals.htm>

Water Garden & Wetlands Plants

Acorus - Sweet Flag **Nice**
Aeschynomene - Botswana Wonder
Caltha - Marsh Marigold **Great!** First to bloom in the spring
Canna - Marsh Flower **Nice** .
Ceratophyllum - Hornwort
Colocasia - Black Taro (Elephants Ear)
Cyperus - Umbrella Palm, a very nice pond plant
Eichhornia - Pickerel Rush
Elodea - Anacharis
Equisetum - Horsetail
Houttuynia
Hydrocleys - Water Poppy
Hygrophila
Iris **Be careful!** Avoid Yellow!!!
Limnocharis - Velvet Leaf
Lobelia - Cardinal Flower **Great!**
Ludwigia - Primrose Willow; Mosaic Plant
Lysimachia - Money Wort
Menyanthes - Bogbean
Myosotis - Water Forget-Me-Not **Nice**
Myriophyllum - Parrot's Feather **Do not Use!**
N. crenata - Water Snowflake
Neptunia
Nymphaea - Water Lily **Be Careful!**
Orontium - Golden Club
Sagittaria - Arrowhead **Good**
Salvinia
Saururus - Lizard's Tail
Scripus
Typha - Cattail
Xanthosoma - Taro
Zantedeschia - Calla Lily **Great!**

You are in Zone 6 to 7. Take a look at the catalogue and we can get some of these to you. Even though the flowers may seem exotic, they meld into the pondscape very well and add a lot to the looks of your pond. The following package is just a guide to show you about how many to plant. Many of my customers have severe weather and buy them only for the summer season (they die in the winter) and purchase a few every year just to have the flowers.

Base Flower Package: After getting a base planting, you can dress the pond using [beautiful flowers](#). You should add a few every year. You said you liked color. Here is an example package:

Louisiana Game Cock Iris (Slightly invasive but not as bad as the yellow) and I love the color.



Stoneybrook Ponds

Canna. Big fleshy plant that is wonderful for removing nutrients. Large bouquets should be considered. Consider it as a bodacious show but a necessary one.



Stoneybrook Ponds

Canna Thalia A great rush like large leaf plant. And it has a beautiful small delicate flower.



Calla Lily Always a Northwest Oregon favorite. A great show well into the summer. Should be placed on a steep bank so it will not invade the pond.



Umbrella Palm A wonderfully successful plant that stays in a single large clump near the pond.



Rain Lily A beautiful accent plant for any wet spots on your property.



Stoneybrook Ponds

Japanese Sweet Flag Large rush that offers a color accent to the pond.



Water Hibiscus Always the pride of any garden and easily cultured around ponds.



Stoneybrook Ponds

Queen Victoria Lobelia A wonderfully showy pond plant. Always a nice addition. Groups of 5 - 10 plants offer a riot of color with purple stems and bright red flowers.



Marsh Marigold A wonderful spring flower with nice foliage.



Blue Sedge A dusty blue sedge that accent Arctic Blue Willow and looks great against green sedges.



Camus Deep blue flower blooming in the spring. Collect seeds from yours and spread them.



Veronica will bloom in the summer and loves damp banks. It liberally reseeds and grows from its roots.



Hardy Water Lilies Should be considered after the restoration is well underway. The reason is lilies require a little study. I love the larger varieties and can help you select a few.



As always, **your preferences are the final decision.** By adding these plants, you will have approximately 25 species of plants in the pond. As many as 50 may be necessary but this is a

Stoneybrook Ponds

great start. The greater the diversity of species, the healthier and more resilient the pond becomes.

Positioning of Plants

In and Near the Pond: The first story, Level I.

Water Lily	Danger	Marsh Cinquefoil	Swamp Rose
Iris		Bog Rosemary	Royal Fern
Marsh Bellflower		Marsh Fern	Swamp Sumac
Spearwort		Arrowhead	Skullcap
Marsh St. John's Wort	Danger	Willow	Monkeyflower
Rushes		Marsh Marigold	Daylily
Cattails	Invasive	Cinnamon Fern	Vine Maple

Next to the Pond: The Next Story, Level II.

Maple	Rhododendron	Service Berry
Elderberry	Currant	Spruce
Pacific Crabapple	Dogwood	Willow
Cedar	Indian Plum	Douglas Fir
Lilac	Honey Suckle Bush	Oregon Grape

Taller Trees: The Top Story, Level III.

Broad Leaf Maple	Poplar	Cottonwood
Black Cottonwood	Alder	Oak
Ash	Red Maple	Apple
Cherry	Red-Osier Dogwood	Birch

This concludes our discussion of plants. I should emphasize one more time that plants are the total answer to a healthy pond. If you need help selecting pond plants, please contact me. I will help. This should be an ongoing project for your entire property. With a little continuous

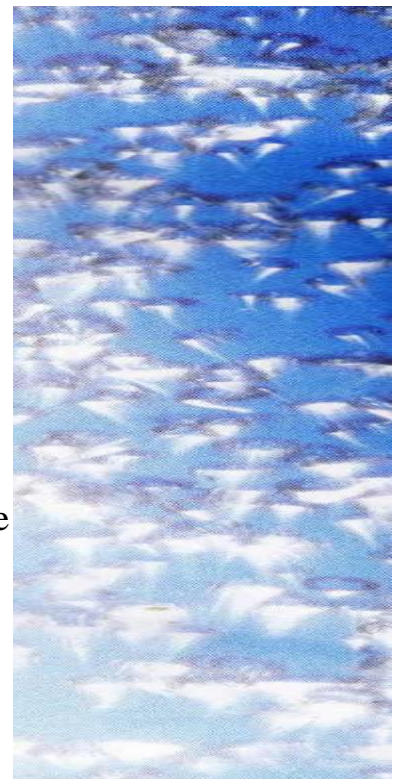
work, the plants will offer all sorts of forage for wildlife and dramatically improve the health of your property.

Aeration for Pond Respiration

Ponds without the proper structure have trouble respiring. Yes, a pond breathes. You must deal with the gasses in the pond. When organic materials and fertilizer decompose and animals breathe, they produce gasses. These gasses are heavier than water and must be removed from the pond. Two of the gasses, carbon dioxide and ammonia are great fertilizers and stimulate algae and weed growth. Plants will remove the gasses. But often these plants will be undesirable weeds. Mother Nature will supply the weeds free; OR you can take care of the gasses until you get the right plants planted in the pond. You can pump air to the bottom of the pond and lift the gas out and it will blow away on the wind. This is called artificial nutrient replacement. Many people think that fountains or artificial waterfalls do the same thing. They won't because the gasses accumulate at the deepest point in the pond where the fountains and waterfall only deal with the surface. There is a little more to this than I can cover here because bacteria and their habitat are necessary to complete the respiration cycle. Often these bacteria are added to the pond to start the process.

Advantages of Aerating Water

- a. Improves and increases fish environment.
- b. Increases fish food organisms.
- c. Reduces or eliminates stagnant bottom water.
- d. Helps prevent both winterkill and summerkill conditions.
- e. Eliminates odor problems.
- f. May reduce nuisance weeds and algae.
- g. Improves water quality.
- h. May reduce the need for chemical treatments.
- i. Reduces hydrogen sulfide, ammonia, methane and carbon dioxide gases.
- j. Reduces harmful bacteria and many fish and wild fowl diseases.
- k. Increases beneficial aerobic bacteria, which decreases organic sediment accumulation by extending the food chain.



Pond Respiration related fish kills: "Summer Kill" happens when all of the oxygen is removed from the pond when the partial pressure of the pond gasses exceed saturation and "turn-over" to the surface: methane bubbles. When all of the gasses pop to the surface Boyles Law of Partial

Pressures says "the partial pressures of all gasses in the pond must equilibrate" and thus oxygen is scrubbed from the pond. "Winter Kill" happens when all oxygen producing organisms freeze in cold water and deplete the oxygen in the pond.

Fountains or Diffused Air

Surface Aeration Fountains

Benefits

1. Attractive sights and sounds.
2. Ripples water surface.
3. Mixes water in upper 4' - 8' to improve water quality in the upper zone.

Disadvantages

1. Water hazard - due to electrical dangers.
2. Short motor life.
3. Inefficient in energy consumption, can cost up to \$90.00/month to run; only moves 600 to 2400 GPH/horsepower
4. Does not aerate lower pond below 8' where most problems occur.
5. Poor choice for large or deep ponds.

Bottom Aeration Diffused Air Systems

Benefits

1. Safe, no electricity in the water.
2. Most energy efficient and effective.
3. Mixes water in entire pond.
4. Moves large volumes of water 50,000-800,000 GPH/horsepower
5. Allows toxic gases to escape pond more readily.
6. Reduces some nutrients used by algae.
7. Oxygenates entire pond, allows aerobic bacteria to quickly decompose bottom muck.
8. Improves overall pond health and allows a natural balance to return.

Disadvantages

1. May increase rooted plants due to reduced water clarity.
2. Will not eliminate all algae.
3. Surface water may be cooler in the summer (in many cases a benefit).

Diffuser Aeration

Boyles Law of gasses in a miscible liquid states that they must be a constant; and therefore, if you pump air (nitrogen and oxygen) to the bottom of the pond, the pond gasses (fertilizers: carbon dioxide, ammonia, hydrogen sulfide (stinks) and methane) will be released from the pond.

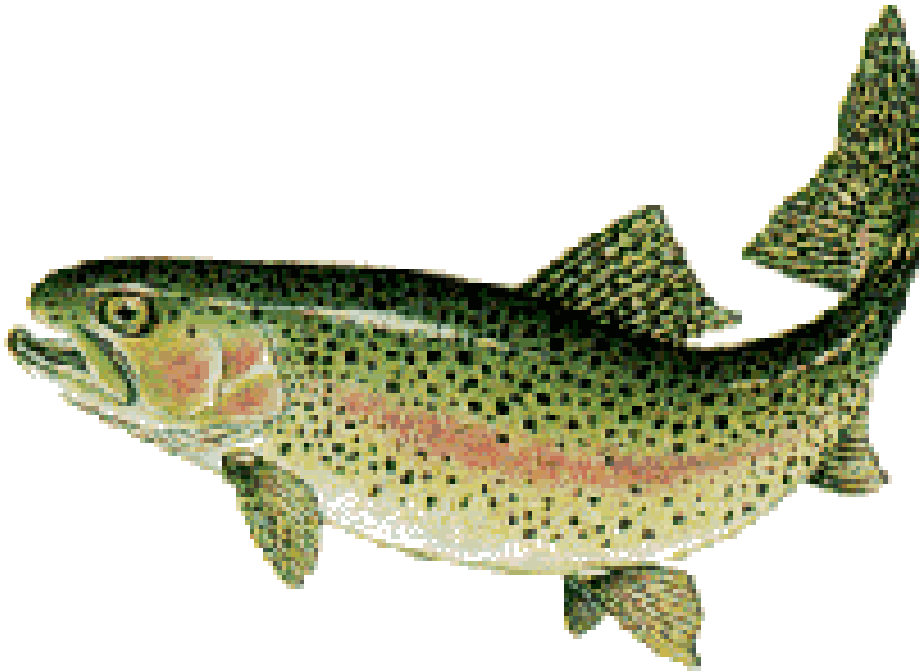
Air Diffuser: This is a sintered glass tube with a hole drilled in it. Sintered glass is made by blowing finely divided air into molten glass as it hardens. When air is pumped into the center of the glass tube, it becomes equally finely divided as the air that formed the tube. One end is sealed and the other has a plastic male pipe fitting or clamp fitting.

Diffuser Assembly: The diffuser is actually a group of four diffusers strategically arranged to allow the best air/water interface oxygen transfer. The diffuser includes a check valve, self-ballasting manifold and a substrate barrier keeps the diffusers away from the bottom improving the clarity of the water.



The Pump: A 1/3-hp rotary vein compressor drives the system. The pump is designed so no oil passes into the air line. The system includes the pump, the appropriate fittings and the diffusers at \$880.

Aquatic Animal / Wildlife Ecology



Immediately everyone thinks about fish. Fish are a portion of the animal ecology of ponds. They are absolutely required. A log must be put in the pond to supply substrate for invertebrates and cellulose consuming bacteria. Several thousand species of invertebrates will infect the log. Cellulose consuming bacteria form the base of the food chain in the pond for the invertebrates that supply natural fish food.

The carbon cycle in a micro-environment regulates how healthy a system is. A log is a large energy source and carbon source. The vital energy of a tree is stored in its wood. This can be released into a pond. The decomposed log leads to plant growth, habitat for several thousand species and substrate for the pond bacteria. This leads to fish food, bird food, and your food if you so desire to eat your own fish.

Our prescription so far is to encourage the pond to support animal life by adding plant structure. Methods to reduce the fertilizer and silt need to be considered because this soil carries the largest number of fish disease microorganisms. Your fishery should be monitored and balanced. Your pond requires habitat structure using the plants and dead tree wood substrate. Predator control methods need to be reviewed. For example, establishing bird houses for songbirds to distress the Great Blue Heron and Osprey. (Keep bird feeders near house).

Ponds provide the key ingredient in wildlife ecology: they offer water. Providing forage and housing completes the ecology. By adding wild rice and millets to the riparian ecology

Stoneybrook Ponds

provides forage for many animals. By attracting birds and wildlife to the pond, you complete the ecology of the pond, making for a healthier ecology for all including yourself. The idea is to diversify the various populations of fish, wildlife, plants and bottom ecology. With a little study, you can establish habitat beneficial to property management practices such as owl boxes for rodent control. A single owl pair acts as top predator covering as much as 10 square miles. Your entire environment improves.

The following warm water fish hatchery can supply your needs. Gambusia, the mosquito fish, is a very tough small fish that completely eliminates mosquitoes in the pond. Buying a few will populate the entire pond.

Kathy Bridges Santiam Valley Ranch
6516 Hunsaker Road, SE
P. O. Box 613
Turner, Oregon 97392
503-743-2931
KathyBridges@aol.com

Brian's Trout Ranch (Gary)
26259 SE Brian Trout Road
Sandy, OR 97005
503-668-4733
'susangarybrian@aol.com'

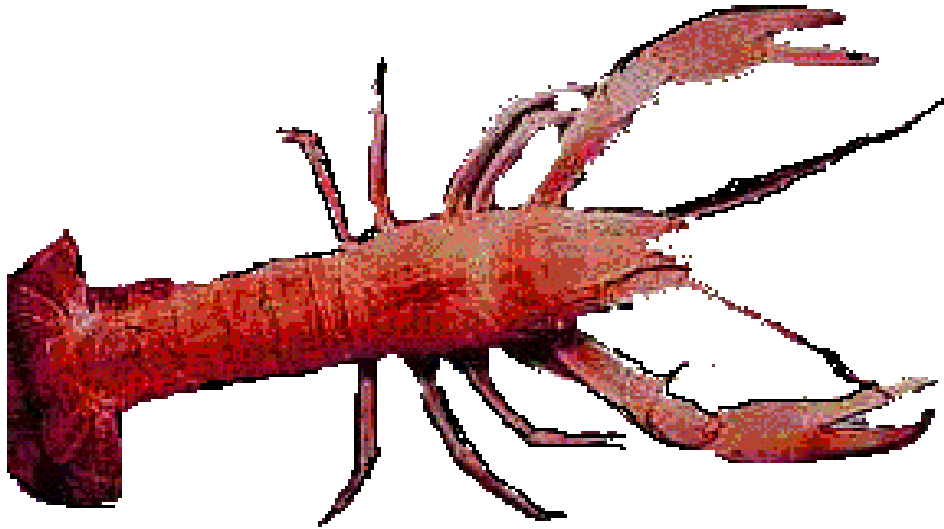
Bottom Ecology Clarifies Water



Often when ponds are built there is a clay silt bottom. Mother Nature provides rock piles. You can do this too by simply dumping in some river run rock. Don't use mined stone as it has many minerals that can poison the pond. River run rock has been washed for centuries and has lost most of its soluble mineral. The bottom should have a deep spot for cold water to accumulate. The bottom should not be smooth.

At this point let us discuss for a moment what a pond should look like. Virtually every artificial pond I have looked at has straight shorelines whereas natural ponds have highly irregular shores. To have a natural landscape you need to have a natural undulating shoreline with shallow areas for planting and shallow sloped banks. Natural slopes are gentle being no greater than 1:3. If you dig steep slopes, they will simply slough into the bottom of the pond.

Bottom Structure and Crustaceans



Rock Pile: Built ponds do not have bottom structure. This is simply a pile of rocks or gravel in the bottom. The best is river run boulders, gravel and sand.

Cellulose Substrate & Turtle: Deciduous logs are used as a nutrient substrate for many invertebrates. (Conifers do not lend themselves to invertebrates). If placed away from the bank and partially submerged, they also offer habitat for the Western Pond Turtle. (She needs a nearby gravel pile in the sun for egg laying). The cellulose adds a complex carbohydrate that replaces the need for barley straw as a substrate for the pond bacteria. Once a log is "infected" with the pond bacteria, it may be no longer necessary to add the bacteria to the pond. They will over-winter in the log and populate the pond by themselves in the spring. This will provide habitat for many of the invertebrates that provide key links in the food chain of the pond. You will need dead wood to accomplish this or a large maple trees (cotton wood, alder, ash or others). Conifers are not recommended due to the high levels of tannins in their woody structure.



This is my thirty year old turtle. She has eaten the "grubs" in this log for ten years. It is perfect turtle food and furniture.

Crustaceans: The American Crayfish (*Procambarus clarkii*) is readily available in most rivers and streams in Oregon. They can be trapped or children love to catch them.

When bacteria are used in concert with aeration, the bottom ecology improves. The regulation of your pond environment includes improving the health of the bottom of your pond. The benthic or bottom environment is where the natural forage for your aquatic animals lives. This includes what are called the macroinvertebrates or the large invertebrates that include nymphs, insect larvae, and crustaceans. Just by scooping up a handful of bottom muck and seeing how much life is there will tell you if you have a healthy pond bottom: the more the better.

Conditions that kill the bottom are silting and eutrophication (anoxia: dead algae in the pond).

If these conditions are not stopped, the pond will fill in. Both can be aided by seeding the bottom of the pond with microorganisms. The bacteria feed on decomposing organic matter. They pose no health hazards to humans, fish, pets, plants, waterfowl or any other wildlife. This is a combination of naturally occurring bacteria that will eat the organic material and actually "compost" the bottom to be a more fertile habitat for the macroinvertebrates. What you are doing is extending the food chain to the smallest inhabitants of the pond that will feed your fish. Constructed ponds usually do not have this flora and need them to complete the food chain in the pond. Habitat for them includes dead trees. Because fish love the macroinvertebrates, a dead tree in the pond provides ecology for the invertebrates and thus for the fish. The **POND BACTERIA SYSTEM** comes in water soluble packets containing 100% non-toxic, non-pathogenic, non-corrosive dried bacteria. 24 half pound packets are \$375.

Top Predator



I will conclude by talking about the top predator. Ponds need top predators. Yes, there is more than one. In the bottom, you should have the common crayfish. The large fish are also top predators and will eat the invertebrates and crayfish. If a log is supplied, the western pond turtle will inhabit the pond. She needs an egg laying area. You can not buy turtles, you offer habitat and they select you. She is the queen of the pond. This sets up tension where no one animal can overpopulate or gain control.

We are not finished. Birds are an integral portion of the pond. Great Blue Heron and Osprey often visit ponds and take fish. To control them, you need song birds and the queen of the sky in Oregon, the barn owl. I show how to structure habitat for them.

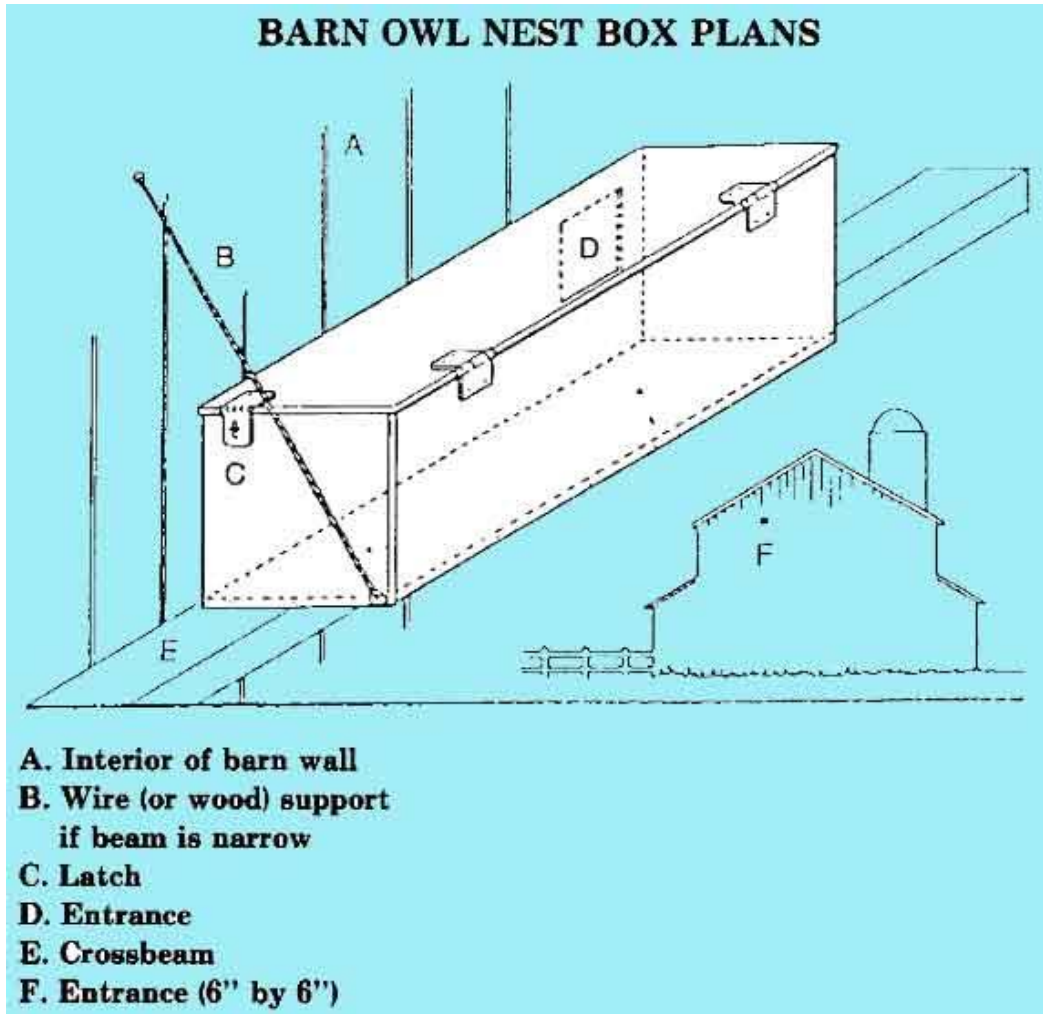
You are the TOP top predator, because with all that I have told you, you can be the master of your pond. You will be your pond keeper.

One of the best predators to have around a property is the barn owl. You do this by installing owl boxes and perches. You will not notice their presence. You should construct perches so the owls can easily patrol various areas such as the near large fields.

I am enclosing plans for construction of the box. It should be placed high in a building either on your property or on a neighbor's property. A single owl will patrol 10 square miles meaning from her box, she will fly three miles in any direction to obtain her living.

Materials and general dimensions can vary somewhat depending upon materials available. Using 1/2" plywood: bottom, 12" x 40"; two ends, 12" x 16"; back, 16" x 41"; top, 12 1/2" x 41". (For 1/4" plywood, back length should be 41 1/2" and top 12 3/4" x 41 1/2".) The barn wall acts as the front of the box. The top is hinged but kept securely latched. A 6-inch square hole in the barn (cut 6 inches above the floor of the box) provides access directly into the box from outside. Ideally, the entranceway is positioned high on the barn wall such as 20-25

feet above the ground. Mount the box against the interior barn wall and nail it securely in place. Use wire or additional boards to help support the box if the cross beam, on which it rests, is narrow. The same box design can be constructed with a front and hung (with heavy rope or metal brackets) from the climbing-well inside the top of a covered (inactive) Silo.



"If you build it, they will come."

Prescription

Getting the Work Done

This is perhaps the most important portion of this Prescription. Getting started is the most difficult in a restoration. You now have all of the theory but now have to put it into action. You need to start planting. This should be done on a continuous basis a few at a time. It will take a few years for these plants to establish themselves and until that occurs you can use aeration and bacteria nutrient replacement.

I would recommend buying plants every year for the pond. I will help you select them. Until this pond is completed, you should budget some money for it every year. That sum will be up to you but it is wise to do this as managing this water will be of great benefit to the pond.

The POND DOCTOR Prescription

Specialists in Aquatic Ecosystems

The Pond Doctor prescription now needs to be implemented.

1. [Riparian plants.](#)
2. [Create regulated fishery.](#)
3. [Establish bottom ecology.](#)

The following is a list of things that have to be done immediately or within the next year. As this is going to be a slow walk at best, getting started on all of these aspects is the only way to get it done.

Getting the Work Done: A Summary

The total cost of each of these materials will be around \$16,000. The total cost of each of these materials will be around \$16,000.

Artificial Nutrient Replacement

Purpose: To [maintain respiration](#) in the pond while new plants are being established and the restoration is completed.

Barley Straw Go see Kathy Bridges and get a bale of straw at \$20

4 - Aerator aerator, hose and extra diffusers \$880 ea

6 - Lake-Pak Composting Bacteria \$375 ea

To [install the Aerator click here](#)

Approximately **\$5,000**

Planting



Trees:

Maple	25	Use 7 year-old trees ~\$20 each	\$500
White Alder	30	~\$20 ea	\$600
Birch	20	~\$20 ea	\$400
Willows (Sitka, Hooker, Dwarf Artic Blue)	40	\$10	\$400
			\$2,000

Shrubs

Holodiscus discolor * oceanspray
Lonicera ciliosa * trumpet honeysuckle
Lonicera hispidula * hairy honeysuckle
Lonicera involucrata * black twinberry

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Oemleria cerasiformis * Indian plum
Philadelphus lewisii W * mock orange
Physocarpus capitatus * Pacific ninebark
Ribes cereum * wax currant
Ribes divaricatum * straggly gooseberry
Ribes sanguineum * red flowering currant
Rosa nutkana * Nootka rose
Rosa pisocarpa * clustered wild rose
Rubus spectabilis * salmonberry
Salix geyeriana * Geyer's willow
Salix sitchensis * Sitka willow
Sambucus racemosa * red elderberry
Spiraea douglasii * hardhack spirea
Symphoricarpos albus * common snowberry

Each Plant sells for around \$10

You will need at least 100 – 300 or **\$3,000**

Water Plants

One inch minus river run gravel to plant the following in a "Pond Engine."

100 yards **\$2,000**

Carex obnupa Slough Sedge .

10,000 sedge two year-old starts @\$0.40 ea **\$4,000**

Assorted Rushes **\$500**

Ornamentals **\$2,000**

It is nice to keep a small nursery for native plants to place around the property. Take cuttings and place in a sand bed and then row them out on a small piece of land. Then when you need them, set them out. I would go get as many slough sedge and plant them in your sand bed separated. Then construct the pond engine and transplant them. This will reduce this cost tremendously.

Please contact me if you need planting materials as I will be able to find most anything you wish.

Rock Substrate

Stoneybrook Ponds

About 10 cubic yards of 1" and smaller river run rock will add enough bottom substrate to the pond to provide habitat for the invertebrates. This is bottom substrate and pond engine material.

Dead Log Wood Substrate

Some 3 to 6 inch logs with some limbs will work. Select something that has some visual appeal. Place it away from the bank but anchored to the shore.

Crustaceans

Put 50 crayfish in a 5 gallon plastic pail with running water and keep them about a week to determine if they have disease. Then place them in the pond.

Bird Houses and Owl Box

Owl boxes are easy to make and install. They do wonderful rodent control on a property and once established, generation after generation of owls will continue to inhabit the box.



I didn't mention frogs as they are already around and readily populate a pond. Their songs are not as loud when hunted. Mud puppies or salamanders often indicate a dead pond. Call the Pond Doctor!

Final Thoughts



Dear Stoneybrook Residents,

I hope this report has cleared up many of the mysteries you may have had concerning the needs of your pond. If you follow the prescription outlined in this report, you will have a healthy and visually attractive pond. If you use the ideas in this report, the entire ecology will become healthy.

The **Pond Doctor** services are straight-forward and hands-on. All consultations over the phone and on the internet are free. I charge per additional visits plus expenses. I would recommend that you have me out during the project.

It was certainly a pleasure to meet you, Barbara and Kurt. You serve a wonderful property. I am here to help you. Please give me a call or drop me an email and stay in touch. I will help as much as possible.

541-258-3010 or email jnelson@peak.org

Sincerely,

A handwritten signature in black ink that reads "Jim Nelson". The signature is written in a cursive, flowing style.

The **POND DOCTOR**

