President: Diane Giangrande pres@atlantakoiclub.org
Vice-President: Marlon Tiller vp@atlantakoiclub.org
Secretary: Kim Munie scribe@atlantakoiclub.org
Treasurer: Angie Jones money@atlantakoiclub.org
Equipment Manager: Neal Phelps stuff@atlantakoiclub.org
Membership Rhonda Eubanks membership@atlantakoiclub.org
Auction Chair Diane Giangrande koishow@atlantakoiclub.org
Koi Show Chairs: Diane Giangrande koishow@atlantakoiclub.org
Chad Bishop
Pond Tour Chairperson: tour@atlantakoiclub.org
Public Relations Chair: Cheryl Jacobs pr@atlantakoiclub.org
AKCA Director: (vacant)
Volunteer Coordinator: (vacant)
Newsletter Editor: Bob Chaffer editor@atlantakoiclub.org
Webmaster: Cynthia Landon wizard@atlantakoiclub.org
Koi Rescue: Chase Tomkosky rescue@atlantakoiclub.org

August, 2022

By the Pond

Hello Members,

Time is indeed flying and August is here already! It was great seeing those of you that were able to attend the 2022 AKC Summer Social last month - the Caribbean themed menu, member -made side dishes/desserts and drinks really made for a great time! I would like to once again thank Ellen Richardsan and Al Wiley for hosting.

For this month's meeting, Kevin McDonough and Rhonda Eubanks have been kind enough to host our meeting at their home, and we're looking to have a very knowledgeable guest speaker to present for us virtually. Details for the meeting are as follows:

When: Saturday, August 13th @ 3 PM
Where: (Address displayed on cover letter to members, to assure privacy)
Further details regarding any parking instructions, etc. will be sent out in a reminder.
Looking forward to seeing you all! Stay cool and keep hydrated!

Next month's meeting:

September 11th, 3 PM - Randy's Perennials and Water Gardens (Hosts), Melanie as speaker (**topic pending**)

Afterwards, we should be in the home stretch for meetings/events for the rest of the year with the show in October and the Moh's hosting the winter social again for us.

Marlon Tiller
Vice President

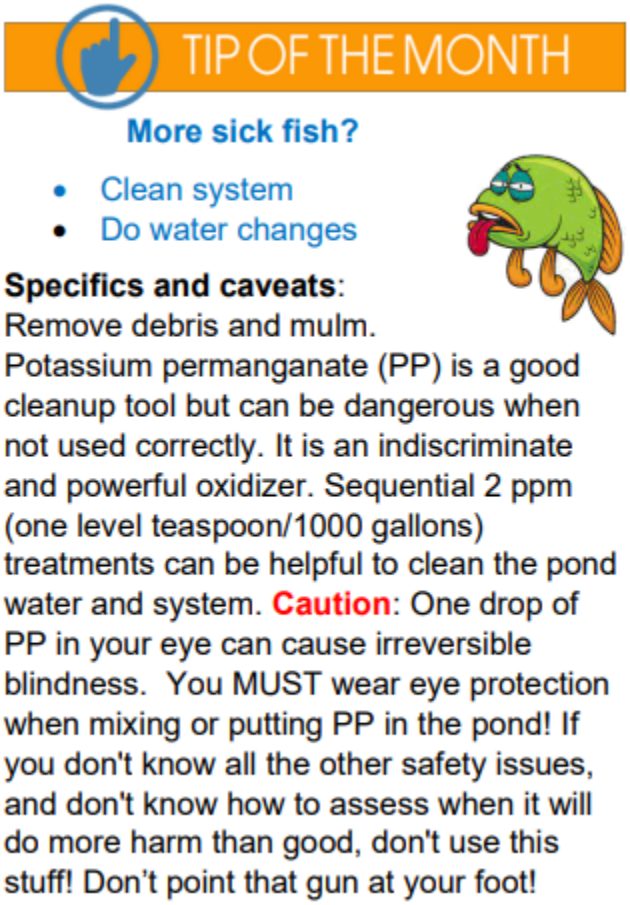
Hi All,

We desperately need someone to head the nominating committee for the upcoming board elections. The Chair will get a few people to serve on the committee and those people will give their suggestions for candidates to fill the positions. The Chair will then rank the candidates based on number of nominations and then reach out to the individuals to see if they will run. The club's Bylaws have a very specific time frame for everything to be completed so we need to get started now. Melanie has done this in the past and will be available to answer any questions the new Chair might have.

Anyone can do this, so don't worry if you haven't done anything like this in the past.

If you are interested in being the Nominating Committee Chair please respond to this email ASAP.

Thanks,
Diane



Anoxic Filtration Why You Should Use It.

By John Seifert,
CKK Inland Empire Water Garden and Koi Society Spokane Washington

I am a fanatical fan of Anoxic Filtration. In my humble opinion it is the next best thing since sliced bread and pre-shredded cheese and better than virtually all other biological filters available. I am a DIY'er. I have 14,000 gallon koi pond with three 100 gallon anoxic filtration tanks, two former shower filters that have been converted to Anoxic Filtration and four 50 gallon Kaldness moving beds that will be converted to Anoxic Filtration by the end of this month. So soon I will have 100% Anoxic Filtration for all my biological filtration. For years, my water quality has generally been good except for algae blooms and nitrates well over 50ppm. Within a couple of weeks of adding the first three 100 gallon tanks, my nitrates had dropped to 10ppm and after about six weeks, nitrates were at 5ppm. Today, I have only a trace of nitrates, just slightly above 0ppm.

Here is what you can expect using an Anoxic Filtration System:

- No detectable Ammonia (NH3, NH4).
- No detectable Nitrite (NO2).
- Very low Nitrate (NO4).
- A reduction in Phosphate (PO4).
- Reduced Pheromones and less spawning.
- Improved skin quality.
- Brighter shiro (white), hi (red) and sumi (black).
- Reduction in shimis.
- No reduction in dissolved Oxygen.

Some personal observations:

I had three Koi with substantial shimis, one nice Kohaku had very little reduction in shimis, another Kohaku that once looked more like a speckled Bekko now has one pin-head sized shimi and an Asagi had a large shimi on its head (for over twenty years) that is no longer visible.

- My Koi, before Anoxic Filtration, use to spawn several times each season. I am only aware of once in the past three years.
- I do have a meager 40 watt UV light but I have very little floating algae and no string algae.
- This year, I added a floating plant ring to my koi pond to provide some shade. The pond is in full sun.

The hyacinths all died, the water lettuce is turning yellow and the Azolla (fairly moss) is not spreading. I attribute this to a lack of Nitrate and Phosphate.

- It takes time, well over a year, to see substantial improvement in skin quality, color intensity and reduction in shimis. Have patience, it will happen.

As with any filtration system, it must be sized correctly for your pond and fish load. A few Anoxic baskets will not do much for your pond or Koi.

A few other reasons to consider Anoxic Filtration:

- Very low cost when compared to other biological filtrations systems.
- An easy DIY project if you so desire.
- You can feed it by gravity, a pump or an airlift.
- Can have a small foot print or, if your landscape allows, a spacious design.
- Very low maintenance depending upon the efficiency of your mechanical filter (pre-filter) and if you do not incorporate plants with the Anoxic Filtration.
- Extremely water efficient, you may only need to flush the system once per year.

K.O.I has an excellent E-book on the basics of Anoxic Filtration, cost is only $5.00. For those that really want to learn all the nitty-gritty details on how this all works, go for the K.O.I 311 Anoxic Filtration course for $50.00; it is well worth the bucks. You can find both at https://koiorganisationinternational.org.

Many thanks and credits to Kevin Novak, PHD, the original developer of the Anoxic Filtration System and to Syd Mitchell who further explained the system for us koi hobbyists.

I welcome any comments or questions. Please contact me at spokanekoi@comcast.net

Please remember our Sponsors:

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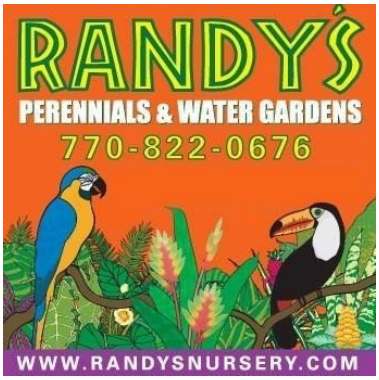

Pond Design Section
Koi Health Advisor Course

by Burt Ballou (last revised 9-22-01) Submitted by Michael Anderson

(Burt was a mentor to many of us old timers starting in the 90s. It is too long for 1 issue of the newsletter; it will be spread out into 4 or more issues. While many of the devices mentioned have been updated or replaced by new technology (RDFs, sieves, static and fluid beds, shower…etc.), the basics are still good and appropriate learning material.)

Introduction

Almost every system is different and thus this information needs to be considered in the context of the system to which it is being applied.

The information in this section will hopefully be useful in planning ponds but it is primarily offered here to help solve problems with existing pond systems and is written from that perspective. When you arrive at a troubled koi pond, your first mission as a KHA will be that of a detective. You must try to determine if the koi health problem is environmental or pathogenic or a combination of both.

This section will give you some tools to assist in determining if the problem is environmental (related to poor or improper pond design). Some environmental issues will be obvious, e.g., 200 koi in a 500 gallon pond or a 55 gallon barrel bioconverter with a 500 gallon per hour submersible pump the only filtration/bioconversion/aeration on a 10,000 gal. koi pond with a moderate stocking rate. These two obvious examples of environmental problems are not what you will normally face.

You may need to ask the owner many questions about the pond, filtration, plumbing, pumps, etc., then investigate, assess, evaluate and then make some decisions whether any part of the pond environment is the culprit, is a contributor or is a non-factor.

In this section we will give you some basic guidelines that will assist you in determining if there are environmental issues affecting the health of the koi. Remember that stressors on the koi from their environment affect their health just as stress on humans has similar consequences. Also keep in mind that the koi owner is under stress because his/her koi are not 'right' when you ask your questions.

Remembering this should help you to present your questions in such a way that they don't add to the stress of the koi owner. The following is a list of necessary questions. Again, please remember you are on a fact finding mission not an inquisition!

1. What is the total volume of the water in the pond, pre-filter, bioconverter, and plumbing, i.e., in the system?
2. How many bioconverters, type, and size?
3. Pumps, their location, flow rates?
4. Plumbing, drains, jets, venturis, skimmers?
5. Depth of pond?
6. Are all pumps running 24 hours a day?
7. Regular maintenance:
   a: how often are the bioconverters cleaned and how are they cleaned?
   b. what is the frequency of other regular maintenance, e.g., pre-filter, leaf traps, UV bulb replacement?
8. Any recent maintenance, remodeling or other changes to the pond or system?
9. Regular water changes, how often and how much?
10. Any water treatments recently?
11. Salt in pond? If so, how much and when?
12. Parasite, bacterial or fungal water treatments in last 30-60 days?

13. Have there been any recent gardening applications of fertilizers, insecticides, etc. done by the pond owner or the neighbors such as sprays on bushes, trees or ground applications?
14. What has the owner observed his/her koi doing that is different and unusual from their normal behavior?

Don't be shocked or amazed by the answers supplied by the pond owner to your questions. Remember this house call is intended to be educational and instructional for the pond owner, not punitive or embarrassing. The answers will run the gamut from, "I don't know." to some very accurate answers. You will have to sift through these answers and quite frequently do your own investigation and calculations to get the correct information.

One of the first things to look for is a change that might result in a cause and effect situation, i.e., if the owner has recently made a change to the system, this could be what caused the deleterious effect.

Question one may be any of the aforementioned answers. So you may have to do your own calculations to determine the volume of the pond system. If the pond were a perfect rectangular box with a flat bottom, vertical sides and no slope to the bottom and no rounded corners, etc., the equation for water volume is: length times width times depth (all in feet) times 7.48 equals the total volume in gallons. For circular ponds, the volume in gallons equals the radius times the radius times the depth (again, all in feet) times 3.142 times 7.48. But alas no pond, or very few, happens to fit these criteria. So what do we do, punt? No, you will have to make some assumptions based on measurements you take. For instance in a square or rectangular pond, if the pond bottom goes from 2 feet deep to 4 feet deep at the other end, you would take an 'average' of 3 feet deep. The same must be considered if the walls are sloped and not vertical. If the pond water surface is 10 feet wide and the bottom width is 8 feet, you should use the
'average' of 9 feet wide. The same would apply for the length. Now for irregular shapes, you will have to again use averages. And, for really irregular shapes, you may have to break down the pond into several smaller sections to get the calculations you need. Also and in general, larger volumes of water tend to remain more stable than smaller volumes. In general, the bigger the pond, the more stable it's likely to be.

Question two is mainly to assist you in determining the turnover rate of the pond and later, when you know the plumbing system and pump capacity, you will be in a better position to make recommendations to the owner for any modifications to the pond system to improve the koi's environment. Most all filters have certain limitations whether they are bioconverters, mechanical filters or chemical filters. The section on filtration will discuss in detail their performance criteria both pro and con in detail. This section only addresses them as one part of the pond system and how it relates to the entire environment.

Questions three and four are extremely important and work in conjunction with each other and are the major factors in determining the efficiency and limitations of the pond system. For assessment of the plumbing, please see a quick reference guide to pipe sizing, length of pipe runs and head losses due to friction at the end of this section.
For pump limitations, see Part 11 of this section.

Now back to question three. If it is a small pond, it may have a submersible pump. These pumps normally have flow rates of 200 to 1200 gallons per hour and might be sufficient for a pond of less than 1000 gallons but would be too small for larger ponds. Question 14 could correlate very well with the use of a submersible pump as submersibles are notorious for developing electrical shorts. Depending on the owner's answer to question 14 you may have solved an environmental problem as the koi may be being electrocuted! It may be a minor

electrical short and it is making the koi act skittish and avoiding an area near the pump or some may have crooked backs due to a fairly severe electrical shock.

You need to know the pump's capacity to determine if it is large enough to deliver the proper volume of water to the bioconverters so that a sufficient volume of water is being processed each hour to sufficiently reduce ammonia and nitrite which are stressors to the koi and can lead to their demise. As not all pumps deliver the flow claimed by the manufacturer, you can determine a pump's actual output by measuring the time it takes to fill a container of known volume and then divide the volume by the fill time (Don't forget to pay attention to the units, e.g., gallons per hour, cubic feet per second, or whatever you like.).

Understanding the difference between a low head, high volume pump designed for koi ponds and a high head, lower volume pump designed for swimming pools and spas is helpful. A low head, high volume pump usually delivers between 40 to 90 gallons per minute depending on the motor size (1/8, 1/6, ¼ HP), has certain limitations in that the pressure developed is lower (i.e., 4 to 8 psi.) and cannot lift water as high or push water as far through pipes but generally delivers more water for less energy consumption. Whereas a high head, lower volume pump (swimming pool type) delivers less water but under a higher pressure (i.e., 14 – 30 psi.) and can lift water higher and push it further in a pipe. Additionally a swimming pool pump can use less efficient plumbing. More information on these two basically different pumps is given in Part 11. There normally is an easy way to distinguish the difference – a swimming pool pump has an open faced impeller that must be adjusted to the front surface of the pump housing so you will find adjustment set screws on the shaft connecting the motor to the pump impeller. A low head koi pond pump has a fluted impeller that has no adjustment requirements thus no adjustment set screws on the impeller shaft.

How far the pump is from its intake water source effects its efficiency, a pump pushes water better than it pulls water. A pump located below water level insures it will not lose prime. Prime can be lost by a power outage or an air leak on the intake side of the pump on pumps that are located above the water surface. Normally swimming pool pumps are self priming so this doesn't create a big problem but koi pond pumps are not self priming thus the need to locate them below water level or install one way flapper valve (low loss check valve) to eliminate loss of prime. For a detailed description of prime, see Part 11 of this section.

Question four ties into pumps and their proper selection based on the plumbing restrictions. Pipe size and distances play a major role in whether a pump will be working at its maximum efficiency or at less than optimum. The quick reference chart (Figure 30) at the end of this section will show the limitations on flow rates through gravity flow versus pressure flows in the same size pipes. These flow rates coupled with the pump flow rates will show you when a 4" drain pipe is needed instead of a 3" pipe for gravity flow, yet a 2" pipe that is a pressure pipe (meaning connected to the intake or exhaust of the pump) will deliver a similar volume of water.
The advantages and disadvantages are discussed in detail in Parts 4 and 11 of this section.

How drains are plumbed and sized will tell you if they are adequate to insure that detritus is continually eliminated from the pond bottom. If they are inadequate, mulm can build up (detritus, parasites, anaerobic bacteria, etc.) and can lead to a buildup of hydrogen sulfide (a gas

that is lethal to koi). Jets and venturis create currents that can eliminate stagnant water and low oxygen regions that are both stressors and need to be addressed. Skimmers and their placement are also important. They should be placed downwind relative to the prevailing wind and/or farthest away from the current created by jets or waterfalls so they will work effectively to remove debris from the pond's surface.

Question five is important for a couple of reasons: first, for a given volume, a deeper pond will have less temperature fluctuations, eliminating one more stressor. Second, a deeper pond provides the fish a greater sense of security or safety, another stressor removed.

Question six may seem like a silly question but you might be surprised at the answer. Owners sometimes shut off the pump at night as the waterfall is too noisy, or because they want to reduce the electricity bill! It's also not uncommon to see folks shut their bioconverters down for the winter for the same reasons. This question shouldn't be overlooked.

Question seven could be a clue to whether the bioconverters are functioning properly or not. A recently cleaned bioconverter using tap water and not pond water could have killed most or all of the nitrifying bacteria due to the chlorine or chloramines in tap water. So in effect it is a new bioconverter going through the "start-up" phase of ammonia and nitrite conversion. Filters that have not been cleaned for a long time could be channeling and have lost their efficiency. Parts of the filter could have gone anaerobic and as a result of less efficiency, there could be a buildup of ammonia and/or nitrites so you might have additional stressors created by improper or lack of maintenance. Also, a heavy build up of debris in the filters, is a haven for some parasites like Trichodina.

A quick look at the pond bottom will tell you if there is a detritus or mulm build up. The stressor consequences of such a build up were previously discussed in the discussion of question four. Green water could be the result of the bioconverters not functioning properly or inadequate bioconverter size or too slow a turnover rate or ... haven't replaced the UV bulb in 3 years!
(This needs to be done annually or when you notice the water becoming tinged with yellow-green.)

Question eight could have many answers to the extreme, e.g., "I removed all plants, koi, etc. and pressure washed the entire pond and then put everything back in." They may have forgot to use AmQuel tm or some other water treatment product with the new pond water! Major stressor! Remodeling may be minor or major, e.g., adding a few rocks to the border or building a new waterfall. Some rocks, bricks or other masonry may leach toxins when coming in contact with the pond water.

Question nine may evoke the answer, "What water change?" which will be a clue to the water quality and another potential stressor. A recent large water change 30% - 75% with no water treatment added could be another stressor. The answer, whatever it is, will be a very good indicator as to the knowledge and care given to the koi by their owner. Again remember this is to be educational and instructive not punitive or embarrassing for the owner.

Question 10 refers to not just AmQuel tm or salt but also any water treatment for parasites, bacteria, etc. It means anything that is added to the pond water.

Question 11 is important because when there is salt in the water, there may be adverse reactions that could be toxic or deadly to the koi when another treatment is added to the pond. If the owner has added salt but not changed any of the water since, it will be easy to calculate the percentage of salt content. But the safest way is to use a salt meter or salinity test and learn the salt content exactly.
Certain water treatments may be contraindicated when salt is present in the pond water as previously mentioned so knowing content is very important before determining a treatment protocol. The use of formalin has long been suspected of having an adverse effect when salt is present. Some people routinely use formalin with salt present and report no problems. Some report otherwise. Caution is indicated.

Not to beat a dead horse, **question 12** is a repeat of questions 10 and 11 but is important, although redundant, and could also be a clue to the effectiveness of the bioconverters as well as explain some unusual behavior of the koi.

Question 13 is a continuation of your detective work and may entail some observations of the pond itself to determine if ground water (with contaminants) could have gotten into the system. You will need to look around the edges of the pond to determine if there are any areas low enough to allow ground water to enter the pond. Almost any gardening treatment could be toxic to koi or at the least, a serious stressor.

Question 14 answers will go a long way in providing you clues if the owner has been observant and can describe their unusual behavior as well as their normal behavior. Now that you have all the questions answered it is now time for some observations of the pond system. There are several things you should look for, as they are common problems in many ponds.

Roof overhangs, if it has rained recently affect the pH and alkalinity but also bring in contaminants, all stressors. This must be connected with rain gutters to divert the roof runoff.
Aeration can be extremely important as the fish are lethargic with low oxygen levels and the bioconverters will not perform efficiently either. A long cascading waterfall creates much more oxygen than a high, single drop waterfall. Venturis create a good air mix with the pond water as well as adding currents. A skimmer actually improves the oxygen to the bioconverters because surface water is higher in oxygen content than deeper or bottom water entering the bottom drains. Jets assist in creating currents but also in moving surface water, thus increasing the oxygen content. Many ponds would benefit from just adding some air stones either in the pond (adds currents too) or in the pre-filters or bioconverter.
Trees and other flora that are close enough to the pond will add to the detritus and mulm 'load' on the pond system. Additionally, tree roots can break ponds, even concrete ponds.
Is the lip of edge of the pond elevated at least 4 to 6 inches above the ground? Does the ground slope down and away from the pond or is the ground sloped toward the pond? Ground water entering the pond is a very detrimental thing.
The shape of the pond can be a detriment to a quality environment for our koi. If the pond shape has too many nooks and crannies, there will be poor water circulation and 'dead' water, or

stagnant areas. Some of these problems can be eliminated by adding jets or air stones in the dead areas. Sharp inside corners between walls and/or bottoms will create 'dead' areas and peninsulas can also cut off currents.
Bottom drain placement can create a self-cleaning bottom or a nightmare of high maintenance.
See Part 4 of this section regarding proper placement of bottom drains.
Sloping walls versus vertical walls - Sloping walls allow for easier access of predators, and build up of detritus. Sloping walls are also like a launching ramp for koi to guide them in jumping out of the pond!
No pre-filter or sump means that all the detritus from the pond is going directly into the pump, which acts like a blender to grind it all up and deliver this milkshake to the bioconverters. This, in turn, means the bioconverters must work harder, clog quicker and need more frequent cleaning.
Rocks and other sharp objects in the pond or overhanging the pond water are an accident waiting to happen.
Pump placement will affect the efficiency of the pump. It should be as close to the pond or pre-filter as possible. The distance and height the bioconverters are from the pump also affects its efficiency. The type of bioconverter, open or pressurized, is another efficiency factor. The size of the plumbing and the length of the pipes affect the pump's efficiency as well. See Parts 4, 10 and 11 for more details.
Shade and a 'safe zone' are important as koi can get sunburned in a shallow pond with no shade and clear water. Additionally, predators (i.e., herons, egret, fish hawks, etc.) will be attracted while they fly overhead if they can see the pond. The 'safe zone' is preferably a deep area of the pond that the koi can go to get away from danger, perceived or real. Without this zone, stress! **Foam** around the waterfall or skimmers means dissolved organic carbons, or DOCs for short, are likely present. This would indicate an inadequate functioning or a malfunctioning of the bioconverter, inadequate filtration, too heavy a fish load, or a combination of any or all of these.
Electrical circuits can be a 'can of worms' with extension cords all over the place, no watertight electrical receptacles and most important ...no GFCI (ground fault circuit interrupter). A GFCI is made to sense electrical currents in a circuit and to trip the circuit breaker within milliseconds of any abnormality beyond a preset threshold. This is an important necessity any time electricity is around water and can save koi, other pets and humans! It virtually eliminates electrocutions!

Additionally, all electrical work should be protected from the elements.
1. Location
The location of a pond can be either a plus or a minus. Things that can have a negative impact on water quality, which is the bane of koi hobbyists, are many times overlooked when determining the location of a pond.

Shade & sun - A pond in full sun will require greater filtration to maintain clear water. Hair or string algae and pea soup water are both unsightly and can have some deleterious effects on the pond system's function by leading to water quality problems. If you can't see your koi (less enjoyment), you can't determine their health. A pond and the koi needs some shade, either manmade or natural (trees, water plants, etc.)
.
Trees - Although they create shade, they drop leaves that if not removed regularly will affect water quality adversely. Their roots can damage a pond, even cement, thus creating leaks.

Overhangs from buildings can dump rainwater that is normally acidic into ponds with the added problem of also dumping anything else that has settled on the roof before the rained. All of this leads to dramatic water quality changes and is bad for koi. A 20 to 30 percent water change after rain will help to dilute this sudden deterioration in water quality but a long-term solution must be done to alleviate this problem. It may be as simple as putting up rain gutters and redirecting the roof's rainwater runoff.

A pond located in a valley or gully, or even just up against a house or fence can be extremely dangerous to the koi. If ground water runoff (from rains or just sprinklers) can get trapped next to the pond as the water increases it may raise high enough to over flow into the pond, taking any garden treatments (insecticides, fertilizers, etc.) into the pond and creating many times not only a water quality deterioration but a poisoning of the pond water! This may not be as easy to fix as the rain-gutters. It may entail creating a higher 'lip' to the pond and/or installing drains to eliminate the flow of ground water into the pond.

Part 2. Pond Shapes

The shape of a pond perimeter, the walls and the floor all can be a positive or a negative. Waterfall placement can also enhance water circulation.

Bottom contours and shapes are many times overlooked or at best given minimal consideration.

Ideally anything that sinks to the bottom of the pond will be picked up in the bottom drains and transported to our pre-filter (hopefully we have one). A bottom drain will be working continuously so if they are placed properly in a properly sloped bottom, the pond will be self-cleaning and eliminate the need to vacuum the pond. A rule of thumb is that a bottom drain will pick up detritus from a 4 to 6 foot radius if there is a slope of at least one inch per lineal foot towards the drain. A 2 inch or 3 inch per foot slope is even better as it will remove the detritus even quicker. Where the walls join the floor, a 12" to 18" radius curve will help detritus move toward the bottom drains.

The layout for the bottom drains will be discussed in detail in Part 3.

Where waterfalls, jets, venturis, water returns, skimmers and streams are located will greatly affect the water circulation in a pond. In essence, you are trying to create a 'toilet bowl effect' in your pond with no 'dead water' areas. If waterfalls and jets are placed in opposing directions they destroy this 'toilet bowl effect.' All sources of water movement should be in harmony to enhance this effect. Ideally the waterfall or stream should be facing downwind and the skimmer should be at the most downwind position to the prevailing winds to assist in removal of surface detritus (leaves, etc.). None of these are absolute necessities but should be considered as they all help to create a minimal maintenance koi pond that doesn't have to overcome many impediments to good water quality and happy koi.

The lip of the pond was briefly mentioned in Part 1 for good reason. It should ideally be a minimum of 6" above grade and can be accomplished by use of rocks (if mortared between them to preclude ground water from entering the pond) or a raised cement lip, or the liner lip raised on a 6 " berm. Whatever building material used for the pond should ideally allow for this 6" elevation to avoid groundwater entering the pond.

Part 3. Plumbing

Plumbing connects all the necessities of a properly running pond. The plumbing moves the water and detritus to the pre-filter, to the pump, to the bioconverters, the jets, venturis, skimmers, ultraviolet sterilizers, foam fractionator, etc. And as previously discussed, plumbing can make the pond a nightmare of maintenance with poor water quality or an almost completely self cleaning koi pond with minimal maintenance and few, if any, water quality problems.

Starting at the bottom, drains should usually be either 3" or 4" piping if gravity fed to a pre-filter and on some rare occasions 6" drainpipes may be necessary. About the only time 2" bottom drains could be used effectively would be on very small ponds of less than 500 gallons, when used in multiples where there is one drain for each 500 gallons of water being drained or when the bottom drains are plumbed directly to the pump intake. To determine approximate pipe size based on needed flow rates in gravity fed pipes or drainpipes plumbed to the pump intake, see the quick-reference plumbing chart Figure 30 at the end of this Section. It will help in determining flow rate friction losses due to length of piping, what impact elbows and other changes of direction fittings have on flow rates, etc. Please note for example, that two 2" pipes will not produce a flow equivalent to a 4" pipe. Two 2" pipes will produce a flow of about ½ of what a 4" pipe will under similar conditions.

As previously stated, a bottom drain will draw detritus and water from a 4' to 6' radius as long as the floor has a t least a 1" slope per lineal foot down toward the drain. The bottom drain functions best if it has a domed cover over it that is close enough to the bottom to not allow curious koi to get into the bottom drains. A bottom drain cover can be made using an inverted trash can lid, filling it with concrete and placing 3 pieces of PVC anchored in the concrete as legs.

From the quick reference chart at the end of this section, you can see that gravity fed pipes require a much larger diameter than a pressurized pipe to deliver the same amount of water. The need for proper pump sizing to achieve adequate turnover rates will be discussed in more detail in Parts 8, 10 and 11.

When we talk of gravity fed pipes versus pressure pipes what we are referring to is that a gravity fed pipe is moving water only by gravity as the result of a difference in static head pressures (the height difference in the water's surface between two vessels). Remember 'water seeks its own level.' Thus when you have two containers of water with a pipe joining them together at the bottoms, when you remove water from one bucket, water from the other bucket will flow thru this pipe connection until the water level in each bucket is the same.

A pressure pipe is when the water is either being pushed or pulled thru the pipe by a pump. Different pumps with different capabilities will drive different amounts of water through a given length of pipe and/or raise it to different heights. Friction loss reduces the flow rate of water thru a pipe. The longer the pipe, the more friction loss and the less water delivered. The higher the water needs to be lifted, less water delivered.

Venturis and jets normally require the water to be delivered via a pressure pipe. A venturi generally requires a higher pressure than a jet as a venturi generally has a smaller restriction in it so that a reduced pressure area is formed by the fast moving water, thus drawing air into the stream and mixing it with the water. Usually a 1" dia. pipe works well for jets and venturis as it produces less pressure drop thus delivering more pressure (and more flow) than smaller piping.

(To be continued on next month's issue)