Clear Pointe Pond
Water Quality Assessment Report

Lynch Station Va.

Prepared by
Ben Tumolo, Nolan Compton – Environmental Science Students
Thomas D. Shahady, Ph.D.
Lynchburg College
May 31, 2013

Executive Summary

A study was conducted to identify the watershed and associated water quality of Clear Point Pond located in Runaway Bay Development in Lynch Station Virginia. The study was conducted by Lynchburg College to provide educational opportunities for students and a pond management plan for homeowners.

The watershed is 167.2 hectares (412 acres) and primarily forested. Five tributaries were identified flowing into the pond. Most are ephemeral with one primary tributary flowing into the upper end of the pond. During a monitored storm event some of the tributaries had elevated nutrient levels and this was associated with sedimentation. Recommendations for controlling sedimentation into tributaries is provided.

The pond is 0.7 hectares (1.8 acres) and currently exhibits good water quality. It stratifies in warm weather and measured water quality suggests it is healthy. It is believed to not contain any fish and the zooplankton and other wildlife suggest this is true. The dam and shoreline are well maintained. The fountain is believed to be a benefit to water quality. It is very important to maintain the depth of the pond to continue to enjoy good water quality.

Recommendations for management of the pond are given on a household and community level. Most relate to the control of stormwater. It is recommended a fisheries management plan is adopted that reflects the desires of the community. It is also recommended that future development control erosion, sedimentation and nutrient inputs as the pond is a direct reflection of the quality of the development around it.

Objectives of the Plan

The development of this plan is to provide homeowners and interested individuals an assessment of current watershed and water quality conditions of Clear Point Pond located in Runaway Bay subdivision in Lynch Station Virginia. Another objective was to provide environmental education opportunities through Lynchburg College Environmental Science Program. The final objective was to produce a lake management plan to maintain the lakes water quality to ensure aesthetics for home owners, recreation, and future educational opportunities for local students.

Background:

Clear Point Pond is a stormwater pond located in Runaway Bay Development. The pond has good water depth for a stormwater pond, with a maximum depth of 17.1 feet, and an average depth of 5.1 feet. The current storage volume of the pond (measured in 2012) is about 8.9 acre feet or 2,961,595 gallons. There has been heavy sedimentation accumulation in the upper portions of the pond at the point of entry for the largest tributary. In particular, at the mouth of this inlet some sediment formed islands have been noted. Along the northern shoreline of the pond there are also some shallow areas where sediment has accumulated. Along the southern shore and towards the outflow of the pond the water depths are much deeper. Currently the lots around the lake and throughout the watershed of the lake are primarily forested. Some residential development exists but is not concentrated.

Methodology

Four assessments in total were conducted at various dates from February to April of 2013. Two general reconnaissance visits to the pond and portions of the watershed in February. During these visits we walked streams, drove through the subdivision and generated a work plan to study the area. On March 6th, we sampled all of the tributaries flowing into the pond during a one inch storm event. Our rational was to capture sediment and nutrients entering the pond during a high loading event. From this information we could develop an idea of function for the pond and retention vs. outflow. Our final visit to the pond occurred April 16th to assess the water quality of the pond. Chemical and biological water quality was assessed early evening between 6-7pm. At dark, we electroshocked the pond to assess fish populations.

GIS- Maps delineating the watershed were creating using ArcGIS 10.1. Data for these maps were gathered from county and city databases. All watershed measurements were calculated using ArcMap. These measurements include watershed area, and land use.

Stormwater Sampling- Stormwater samples were collected from tributaries acid washed 125ml Nalgene bottles, chilled and transported back to the laboratory for analysis. Analysis for total phosphors was completed within one week using Easy Chem. Auto Analyzer and associated methodology.

Lake Methodology

We established two measuring points to examine water quality. A sampling point was near the dam and away from the fountain. Our rational was to capture the deepest potion of the pond and also look at effects of the fountain. A second point was established near the tributary entry to the pond. Our rational was to look at the pond free from effects of the fountain and at the point of entry from upper tributaries. All water quality measurements were taken using a Hydrolab Datasonde 4 and logged using a Surveyor 4 logging instrument. Zooplankton were captured using a 153um Wisconsin style zooplankton net. Nutrients were sampled using 125 ml Nalgene bottles and analyzed in same manner as stormwater. Chlorophyll *a* was measure using a turner handheld fluorometer.

Watershed Modeling - We developed a model of stormwater flow into the pond using the rational method to estimate given stream discharge dependent upon land cover. A given land use is represented by a curve number. These curve numbers represent the intensity to which precipitation will run off land directly into the stream or infiltrate into groundwater during a storm event. In our original model we set watershed land use as 90% forested and 10% residential. We believed this to generally represent current conditions. Further simulations of the model simply reduced forest cover and replaced it with residential. In this way we can look at the changes in flow into the pond and associated total phosphorus concentrations. This should give us some idea of the anticipated changes to the pond as development increases.

Summary Of Findings

Watershed

Watershed is primarily wooded. Roads and driveways of a new sub-development are present and property lines exist for future development. We created GIS maps to delineate the watershed (Figure 1) and provide watershed boundaries to better asses effects of development on the pond.

Identification of Inflow Tributaries

Our preliminary reconnaissance work was to identify all of the tributaries that flow into the pond. We could not identify any named tributaries (please help us here if you have information) flowing into the pond. Several are ephemeral. The main Tributary (identified as Tributary #3) is fed by two smaller tributaries (Tributary #1) and (Tributary #2). These smaller tributaries form as headwater ephemeral channels in the upper portion of the watershed and into perennial stream above entrance into the pond. Two ephemeral channels flow into pond only during storm events (identified as Tributary #4 and Tributary#5). Tributary #4 draining the northern area of the pond and Tributary #5 drains the southern portions.

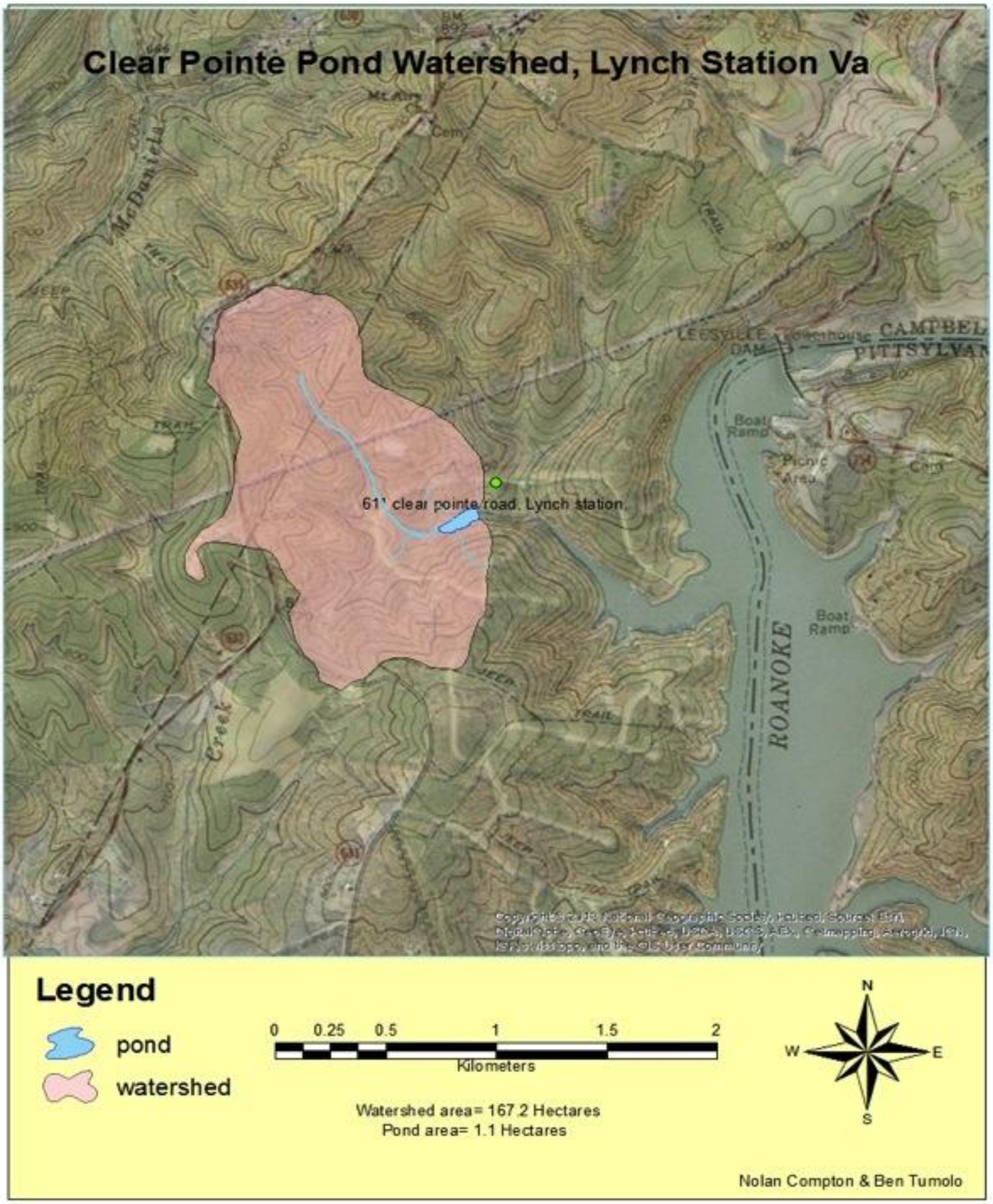

Figure 1: Watershed map of Clear Pointe Pond located in Lynch Station Virginia. The pond is located on a tributary to Leesville Lake. We acknowledge help of Dr. Dave Perault , Professor of Environmental Science for assistance in creating this map.

Tributary Assessment

Tributary #1 is identified as the tributary furthest from the pond as seen entering into the main channel (Tributary #3) from the left as you walk up from the end of the pond. This tributary is very shallow and narrow and appeared ephemeral at the time of sampling. Considerable flow only occurs during storm events. Also, this tributary is part of the drainage system associated with the road system put in with this development. This tributary contained a considerable amount of leaf and stick litter within its channel. This material should flow into the pond during storm events. This tributary runs under the road through a man made concrete pipe before it enters Tributary #3 (Figure 2).

Figure 2: Tributary #1 flowing during one inch storm event. Note considerable turbidity in the water.

Tributary #2 is identified as the tributary flowing to form Tributary #3 from the right as you walk upstream from the pond. Tributary #2 contained water draining from the roadways and driveways and roadside grass (Figure 3). The portion of the watershed draining into Tributary 2 is the most developed area in this watershed.

Figure 3: Water flowing during one inch storm event in Tributary #2. Note the significantly eroded banks entrenching of the stream due to expansion of the stream from prior development. This is an ongoing concern.

Tributary #3 is identified as the main tributary resulting from combination of Tributary #1 and #2. This tributary drains through forested watershed before entering the pond. Tributary #1 contributes a much higher sediment load than Tributary #2 during a storm event (Figure 4). Additionally this creates general turbid conditions throughout Tributary #3 (Figure 5).

Figure 4: Water flowing into Tributary #3 during one inch storm at the confluence of Tributary #1 and #2. Note the contrast in turbidity between Tributary #1 (right portion of the figure) and Tributary #2.

Figure 5: Water flowing through Tributary #3 after one inch storm event near entrance to the pond. Note turbidity levels.

Tributary #4 is ephemeral and had minimal flow during the assessment. The channel was filled with leaf litter and plant material (Figure 6). This channel is predominantly forested however may contribute organic material from leaf litter during storm events. It is very shallow due to limited development in the watershed. These types of channels easily erode from development and can add significant amounts of sediment to a pond.

Figure 6: Heavy leaf litter as the defining characteristic feature of Tributary #4. Channel is ephemeral and note the lack of incision of stream channel due to low flow. Also have low levels of turbidity relative to a disturbed channel.

Tributary #5 is a very small ephemeral stream channel (Figure 7). During the assessment the stream contained very high turbidity and it was noted that stream banks were relatively unstable from erosion. This tributary receives stormwater from impervious surface and culverts creating increased flows and channelization. This channel is exhibiting the characteristics of a ephemeral channel impacted by development.

Figure 7. Tributary #5 during the storm event. Note the high turbidity and channelized stream banks.

Tributary Stormwater Results

The total phosphorus content of the tributaries during the storm event provided insights into phosphorus loading into the pond. Tributaries with noticeable sediment turbidity (Tributaries #1, #3 and #5) contained the greatest concentrations of total phosphorus (Table 1). Two of the tributaries contained high levels of total phosphorus (over 0.1 mg/L). This illustrates the greatest concern for management of the pond. As the area is developed, sediment turbidity loading and flow will increase into the pond. Phosphorus is a limiting nutrient and will control noxious levels of algae growth in the pond as long as it remains limiting. When phosphorus levels increase we expect the pond water quality to deteriorate. It is imperative during development to control both stormwater quantity and quality. Recommendations for the association are included in the recommendation section.

Table 1- Total phosphorus measured during one inch storm event in the ponds tributaries.

Tributary	Total Phosphate mg/L
Tributary #1	0.081
Tributary #2	0.009
Tributary #3	0.206
Tributary #4	0.055
Tributary #5	0.152

Model

A simple model was developed to examine how phosphorus inputs to the lake would be impacted by residential development. For each run of the model residential development was increased until the entire watershed was assumed developed (Table 2). The changes in phosphorus loading to the pond are significant. A 50% build out in the watershed will almost double the loading of phosphorus to the pond. This is a significant finding as this is a likely scenario and a doubling of loading will significantly impact the water quality of the lake. It is imperative that all efforts to maintain buffers from this development are put into place and maintained.

Table 2 – Model results from measured one inch storm using various changes in watershed build out. A value of 0.05 mg/L is used for phosphorus concentration with the one inch storm calculated throughout the watershed.

Percent of Watershed in Residential Development	Total Phosphate Loading Kg/Day (per one inch storm event)
10%	0.07
20%	0.09
50%	0.12
80%	0.18
100%	0.22

Clear Point Pond

From previous studies the pond is estimated to be 1.8 acres. This is a good size for a pond and it is important to maintain as much surface area and volume in the pond to mitigate the impacts from development. Smaller ponds (less than 1 acre) tend to accumulate and express impacts from development as visible algal blooms and poor water quality. This is based on prior experience and understanding that greater volume allows better processing of inflowing material. Inflow to pond is from the identified tributaries. We did not assess the contribution from groundwater. Visual observations suggest it is minimal and has limited impact on water quality. The pond is contained by an earthen dam and at the time of assessment was well maintained with no visible vegetation that could compromise the integrity of the dam. It is important to maintain this condition as large woody vegetation can cause a dam to leak. Outflow is through pipes in the dam. We did not measure outflow water quality conditions.

The pond did show visual evidence of sediment turbidity entering the lake during a storm event at the time of assessment (Figure 8). This occurs in the area of confluence between the lake and Tributary #3.

Figure 8 – Visual conditions of Clear Point Pond during a one inch storm event from March 2013. Note the visible sediment plume entering the lake.

The perimeter of the lake is well maintained and at the time of assessment did not have and vegetation growing directly on the perimeter. By evidence of stumps it appeared alders and other woody vegetation within one meter of the littoral zone were removed. This is a good practice maintain good shoreline and keep excess organic material from entering the pond.

Figure 9 - Littoral zone of the lake including alder and woody vegetation removal.

Other observed characteristics of the pond included some beaver activity (Figure 10). Beavers are important to manage as this species can cause damage to the pond. Specific recommendations are given in management section of this report.

Figure 10: Observed beaver activity along the perimeter of the pond. Note this is recent activity suggesting a current pair of beavers occupies the pond.

Along the upper portion of the pond a stone foundation was detected (Figure 11). It is important to understand any historical significance of this foundation as certain laws and restrictions may apply to any disturbance of this structure as future development of the pond occurs. We would suggest research to document the significance of the structure.

Figure 11: The remains of a stone foundation along the upper perimeter of the pond. Historical significance is unknown.

Water Quality Assessment

The pond water quality was assessed during our April sampling to provide a current understanding of the pond (Figure 12). Surveys of water chemistry and biology are provided to quantify current condition of the pond.

Figure 12 – Students conducting water quality sampling on Clear Point Pond near the dam.

Our assessment demonstrated the pond does stratify (Figure 13). This is typical for a pond of this size and depth. The pond does have excellent depth at the dam and all effort should be taken to maintain this good depth. Relatively high chlorophyll *a* concentrations (Table 3) suggest the pond is experiencing some eutrophication and this is a concern. But Secchi depth is good and demonstrates the pond still has excellent water clarity. Oxygen and pH were at consistent measures from surface through depth. This is likely a result of the fountain and early spring conditions. Continued operation of the fountain is suggested.

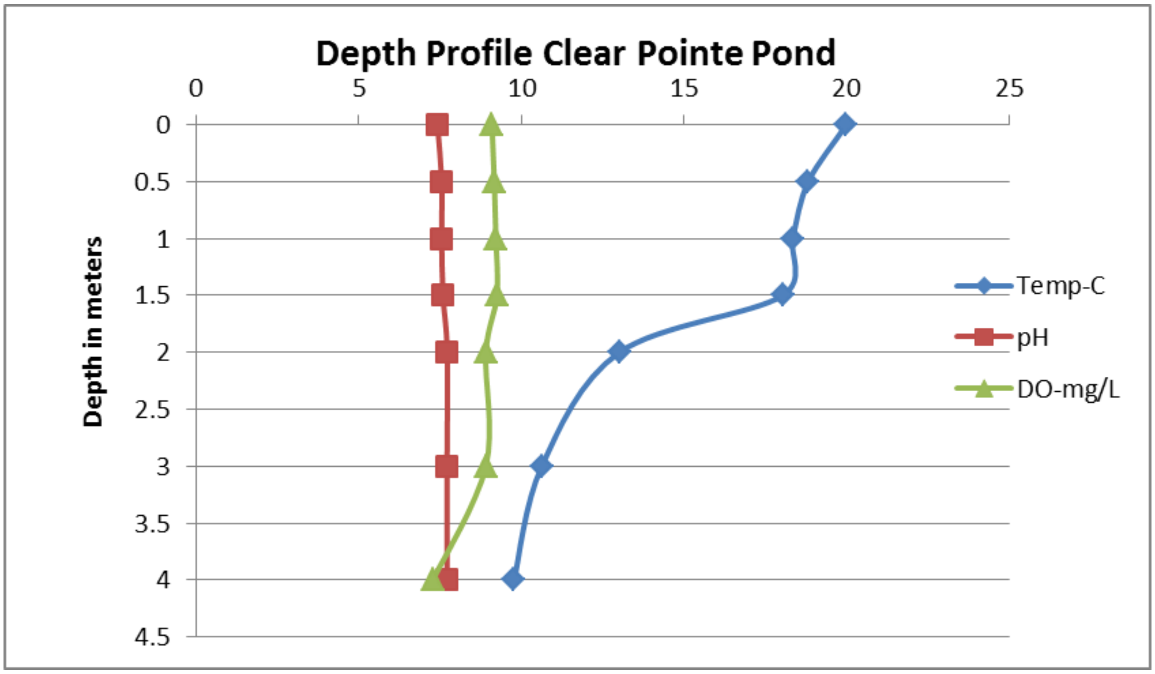

Figure 13: Lake profile developed using the hydrolab on April 16th 2013 at the site near the dam. Note the stratification of the pond (temperature) but relative even distribution of pH and oxygen with depth.

Measures of conductivity, pH and temperature all fall within good levels for the pond. Measures in the upper portion of the lake did not show any measurable difference from the dam (Table 4). Temperatures were cooler and because it is shallow the pond was not stratified at this sampling point. All measures are within good ranges for the pond.

Table 3: Hydrolab measurements from sample site 1 near dam.

Depth (M)	Temp (C)	Specific Conductivity (us/cm)	D.O mg/L	pH	CHLA ug/L	Secchi depth(M)
Surface	20.00	85	9.1	7.4	37.8	1.42
0.5	18.83	85	9.17	7.5		
1	18.35	86	9.22	7.5		
1.5	18.04	84	9.25	7.5		
2	13.01	87	8.91	7.7		
3	10.63	87	8.91	7.7		
4	9.78	88	7.28	7.7		

Table 4: Hydrolab measurements from upper lake. Units are same as in Table 3.

Depth(m)	Temp(C)	SpC	DO	pH
Surface	18.91	85	9.25	7.66
0.5	18.41	85	9.19	7.70
1	18.29	85	9.34	7.74
1.2	Bottom	Bottom	Bottom	Bottom

Total phosphorus measurements in the lake were low (Table 5). This is a good result and suggests a significant portion of phosphorus entering the pond may exit as well during rain events. An alternative explanation is the accumulation of phosphorus into pond sediments. Phosphorus has an affinity for sediment and will often sorb to sediment as it settles to the bottom. This phosphorus is trapped in these sediments as long as certain conditions exist. Good oxygen concentrations to the bottom of the pond as we observed keeps phosphorus locked to the sediment. As long as these conditions remain the phosphorus is not released and worsens water quality. The second mechanism is mixing. This is why depth is so important. As the pond stratifies mixing is confined to the upper layer. Wind does not mix the pond with the sediment. If the pond becomes shallow then mixing will suspend phosphorus. Even worse, increasing phosphorus loading depletes oxygen in these lower levels of the water column and increases phosphorus concentrations in the pond. Stormwater carrying both sediment (reducing the depth of the pond) and nutrients (declining water quality) is very important to control.

Table 5: Total phosphorus measurements collected in the pond at the various sampling points.

Collection method and location	Total Phosphorus mg/L
Dam Surface	0.034
Dam 3 Meters	0.025
Upper Lake Surface	0.03

Zooplankton

Zooplankton are microscopic organisms that occur in lakes and ponds. They eat algae and in turn are eaten by fish. They provide an important link between fish populations in a pond and the concentrations of algae. Keeping these populations in balance is important in maintaining the health of the pond.

In our measures most of the zooplankton found in the lake were the water flea (*Daphnia*). Concentrations were 13.2 organisms per liter. The other zooplankton found were copepods (3.3 organisms per liter) and *Bosmina* (1 per liter). In water quality assessments it is important to note the presence or absence of *Daphnia*. This organism is a very desired prey item for fish while at the same time is capable of filtering water at a rate to prevent excessive growth of algae. Good populations of *Daphnia* maintain good water quality. These populations are very good at this time and efforts should continue to maintain these populations.

Fish Assessment

Populations of fish are important to water quality in the pond as they regulate zooplankton and they contribute to the processing of organic matter, nutrients and energy. We sampled the pond for fish and were unable to capture any fish for analysis. Additionally, several dusky salamanders were noted in the pond. This suggests the pond does not contain any fish. We provide recommendations for stocking and maintaining fish populations in the pond.

Management Recommendations

Management needs to occur on two levels. The first concerns individual households. All inputs to the pond should be minimized and many homeowners can do simple measures to minimize the input from their property. The second is on a community level. The homeowners association carries out these measures and relate directly to management and maintenance of the pond.

Household Level

Rain Barrels – These are an effective way of collecting water during rain events and preventing it from directly running onto pavement and eventually into the pond. This water can be used for gardens and washing cars. By the use of rain barrels you can help prevent excess water running into the pond and decrease the transportation of sediment and other debris. By having rain barrels you may also decrease the chances of flooding your yard and basement during larger storm events.

Fertilizers **–** When using fertilizers use minimal amounts. Also, only fertilize lawns in the fall. Spring fertilization often results in direct runoff into the pond. By using less fertilizer and only fertilizing in the fall your lawn will look better and you will help reduce potential algae growth in the lake. Use lawn fertilizer without phosphorus. Much of the phosphorus (phosphate) runs off the lawn and contributes to algae blooms and other undesirable aquatic plants. Check the second number on the fertilizer bag to make sure it is 0, e.g. 15-0-10.

Septic Systems **–** This is a very important management issue particularly in communities around a lake. Often homeowners are told routine pumping of a septic tank is unnecessary. This is not true. Excess buildup of solids in the tank causes these solids to enter the drain field and reduce the treatment efficiency of the field. If allowed to occur over extended periods of time these solids will make the drain field inoperative resulting in direct sewage effluent entering the streams and eventually the lake. It is estimated that up to 50% of septic systems in the United States have some degree of failure.

Make sure to pump and inspect tanks every 3-5 years. Septic systems are designed according to the number of bedrooms your home contains. If all of your bedrooms are occupied then the pump frequency should be 3 years. For lesser occupancy every 5 years is sufficient. This will reduce the risk of costly devastating repairs along with chances of leaching into the pond and water source.

Lawn Care**-** Prevent lawn clippings and leaves from entering the lake. A good way to properly dispose of grass clippings and leaves is composting. Or, use a mulching lawn mower and leave the clippings on the lawn. The clippings add nitrogen and reduce the need for fertilizer. By taking care of yard clippings and leaves you will enhance the aesthetics of the pond.

Rain Gardens **–** Consider the construction of a rain garden to mitigate the runoff from your house or driveway. These are relatively easy to construct and can be accented with plants or flowers. Use native plants if possible. Layers of sand and stone allow water to seep into the ground instead of directly into the pond. These rain gardens effectively remediate stormwater while maintaining the look and feel you want for your yard.

<u>Community Level</u>

Watershed – the homeowners association needs to be diligent during construction activities to enforce Virginia Erosion And Sediment Control Measures. There are 19 minimum standards every construction project should adhere to and these must be followed strictly to protect the pond. Often, residential construction is overlooked by regulators who have minimal staff and must use all available resources to regulate large commercial projects in a county. Additionally, the physical location of Run Away Bay Subdivision is not easily accessed by regulators for enforcement. During construction silt fence is only a minimal defense against erosion and sedimentation and often this fencing is not properly maintained. Knowledgeable residents communicating with contractors is essential to minimize erosion. Dr. Shahady can provide additional information and information session on Virginia Erosion Control Law if interested.

Erosion Control Guidelines:

1. Establish vegetation on any erodible soils as soon as possible after disturbance. Law requires cover within 7 days.
2. Maintain vegetated buffer strips between soil disturbance and tributaries. Never allow removal of vegetation next to any tributary. A 100 foot buffer is desirable.
3. Use sediment basins, check dams and nutrients traps. Use only super silt fence to protect exposed soil – single layer silt fence is often ineffective in protecting waterways from clay silt. Where the tributaries enter the pond some system of sediment control should be put into place. A very simple and cost effective way to control sediment is the use of straw bails in the stream. The straw bails can be installed and staked across the stream creating small sedimentation basins. These bails must be maintained as they will rot over time and sediment will need removal. These structures require annual maintenance and straw bails should be inspected every three months.

   A second more permanent structure is construction of check dams. Use rip-rap to build a series of check dams as the streams enter the pond. These structures will not rot over time but are more expensive to install. A system to remove sediment must also be developed. Again, an annual maintenance is suggested.

Finally, construction of sediment basin is the best protection for the pond. This basin must be constructed with maintenance considerations – the collection of sediment must be removed to be effective. Use of a backhoe and dump truck is the most cost effective way to remove sediment as it is readily available in our area. We would suggest the construction of a maintenance road and sedimentation basin beyond the confluence of tributaries 1 and 2 (Figure 4). A suitable site can be selected based on accessibility and construction possibilities.

The best option is to create a wetland in the area where tributary 3 enters the pond. Wetlands will control and metabolize a portion of the sediment and nutrients entering the pond and enhance water quality. Wetlands also enhance aquatic life in the pond. By mapping the potential area for the wetland creation and providing proper hydrology a wetland can be planted and managed. Plant selection is very important as cattails and water lilies should be avoided in this wetland as they can move into the pond creating problems. We have been successful in creating wetlands in this area and can further guidance for wetland creation.

4. Time soil disturbance activities to avoid wet or rainy seasons.
5. Stabilize all waterways to withstand the expected velocity of flow from a two-year storm without erosion. This will avoid costly stream restoration in the future.

6. Proactively work with site engineers on design of environmentally sensitive home sites.
7. During rain events monitor performance of erosion and sediment control devices.
8. Daily inspect and continually maintain all erosion control areas.

Pond Development – it is important that homeowners that build around the pond understand how their activities influence water quality. It is not known the level of influence the homeowner association can bring onto the development but education is critical. Here are some guidelines.

1. Maintain a 100-foot buffer between development and the pond. It is desirable to keep this buffer forested but if a view of the pond is desired minimize tree removal.
2. Plan the lot to keep septic system as far away from the pond as possible. This limits the possibilities for contamination.
3. Limit lawn care activities and try to landscape with native vegetation
4. Work with landscape during construction to minimize erosion and disturbance.

Education **-** We recommend forming a pond education subcommittee and creating a partnership with Lynchburg College Environmental Science Program. We recommend additional pond assessments in the future again and if desirable allowing Lynchburg College Students to perform the assessment. These assessments give students marketable skills and hands on learning outside of College classroom. This will also allow for a long-term collection of data, the ability to track any concerns with the pond and continued education of homeowners and students. Contact Dr. Shahady if this is an interest.

Fisheries – We recommend stocking the pond. A warm water fishery is suggested as it will maintain the pond throughout the year. Largemouth bass are the most common fish introduced into a pond in Virginia. We suggest a rate of 100 as fingerlings. Coupled with sunfish they provide a good balanced fishery for recreational and pond management purposes. We suggest stocking red ear sunfish (shell crackers) 300 as fingerlings and blue gill sunfish at 300 as fingerlings. Sunfish stocking should be done in early fall with largemouth bass stocking the next summer. We would not recommend catfish as water clarity is an objective for the pond. It is recommended fish are stocked from a hatchery to provide a balanced population that can be managed. When fish from another lake are randomly put into the pond it is difficult to manage.

After fish populations establish it is important to properly fish the pond. This requires some observations of what is caught and then removal of certain species of fish to maintain balance. This should be included into a fisheries management plan. Often, an annual fishing tournament or picnic can be organized to perform this assessment. This will get families together to go fishing along with the community together in management of the pond. We also recommend having an annual clean the lake day were members of the community can volunteer to pick up litter and maintain erosion control implementations.

Vegetation Control – Any excessive growth of vegetation on dam or shoreline should continue to be removed and prevented. Once roots are established, they destroy the integrity of the dam and create leaks and other structural problems. Currently the pond is in good condition and this should be maintained. We did not observe any excessive aquatic weed growth in the pond. This should be closely monitored every year.

Fountain Operation – we recommend continued operation of the fountain. Currently it is providing positive water quality and aesthetic benefits to the pond. Fountains can become problematic when ponds are shallow as they mix sediment into the water and exacerbate eutrophic conditions. If electrical use is a concern and aesthetics not needed, fountain use can be minimized over the winter months.

Beaver Management – Beavers (and muskrats if they appear) are destructive to a pond. Beavers occupy or build a pond as mating pairs. The beavers have a litter and care for the young until full grown. Once a beaver is grown it is forced from the pond and must find a new pond to inhabitant or die. Because of this life cycle characteristic beavers constantly try to colonize a pond. Their activities include removal of vegetation around the pond, building of lodge, manipulation of water levels (to acquire new vegetation) and building of dams upstream. We recommend removing beavers from the pond. You can hire a wildlife removal expert or remove the beavers yourself. They are nocturnal so it is often easier to trap them than shoot a beaver. A permit is required. It is important to remove the female as only removing the male simply makes room for a new male to inhabit the pond.

Links to Useful Information

Rain Gardens

http://www.lowimpactdevelopment.org/raingarden_design/links.htm

Nature Conservancy Good Neighbor Handbook

http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/maryland_dc/placesweprotect/goodneighborhndbk-web.pdf

Fish Hatcheries and Fish Management in ponds

http://www.dgif.virginia.gov/fishing/pondmanagement/

Virginia Sediment and Erosion Control Law

http://www.dcr.virginia.gov/stormwater_management/e_and_s.shtml

Virginia DEQ Wetlands Information

http://www.deq.virginia.gov/Programs/Water/WetlandsStreams/Wetlands.aspx