
Report of the Waterfall Lake Study Group

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This report is divided into six parts, Part 1 being an introduction explaining what the Lake Study Group did, how it did it and what resources it relied upon in doing its work. Part 2 is a brief summary about the Lake, its maintenance and the rights and responsibilities associated with the Lake. Part 3 is a more detailed account of the Waterfall Lake explaining very generally how it works and the rules and regulations associated with it. Part 4 explains in greater detail how a stormwater detention pond works and lays the foundation for Part 5 which discusses particular issues with the Waterfall Lake and the Study Group's findings. Finally Part 6 contains the Study Group's recommendations.

PART 1 – INTRODUCTION

WHAT WE DID AND HOW WE DID IT

The Waterfall Lake Study Group conducted an investigation to determine what, if any remedial or maintenance work is needed now or in the future to insure that the Lake remains functional and continues to be an attractive and enjoyable feature of the Waterfall community. In the course of its investigation the Study Group considered the following:

- The nature, purpose and functioning of the Lake in general;
- The State and County laws, rules and regulations that apply to the Lake;
- The provisions in the Waterfall Declaration of Restrictions and Protective Covenants and the Waterfall POA Bylaws that apply to the Lake;
- The nature and features of the Waterfall Lake;
- The current condition of the Waterfall Lake and any conditions that require attention;
- The advisability of establishing a formalized inspection and maintenance program;
- The advisability of hiring a Lake management company.

As part of its investigation the Study Group did the following:

- Conducted inspections of the lake, the shoreline and all the readily visible elements associated with the lake;
- Documented those inspections with photographs;
- Obtained a copy of the As Built Lake plan on file with Horry County;
- Collected historical information regarding the construction and operation of the Lake to date;
- Researched and collected source materials regarding applicable laws and recommended practices;
- Consulted with experts in stormwater retention pond operation and maintenance including Mr. Ben Powell a Natural Resource Agent from Clemson University Cooperative Extension program who was already familiar with the Lake from two prior visits and Mr. Joseph Yuhasse, Civil Engineering Associate, Horry County Stormwater Department who inspects the Lake for the State and County.

During the course of its work the Study Group learned that in 2009 a prior group, the Water Committee had done much of the same work as the Study Group was now doing. A good part of the information the Study Group was now collecting and reviewing had been collected by the Water Committee but apparently had not been deposited in a central location. Members of the Water Committee were most helpful in providing information to the Study Group. In an effort to insure that all information regarding the Lake is available to future Board of Directors the Study Group has prepared a binder containing;

- A copy of this report
- Reference guides published by Federal, State and County authorities regarding the lake;
- Photographs, maps and the As Built plan relating to the Lake;
- Historical information regarding Lake matters;
- A list of internet sites containing information regarding the lake management;
- A proposed Semi-Annual Inspection Checklist.

SOURCE MATERIALS USED IN THE PREPARATION OF THIS REPORT

The information in this report was collected from personal observations by the Study Group members, consultation with experts and from the sources listed in the Appendix A. The most helpful and authoritative of these sources were the *Neighborhood Stormwater Pond Maintenance Log and Resources*, published in a cooperative effort by the College of Charleston, Clemson Carolina Clear and Clemson University Cooperative Extension Service; , published by the South Carolina DHEC office of Ocean and Coastal Resource Management; , published by Horry County.

EXPERT ADVICE

In reaching our conclusions the Study Group relied heavily upon advice and observations of Mr. Ben Powel, a Natural Resource Agent from Clemson University Cooperative Extension and the Regional Coordinator for the Carolina Clear program and Mr. Joseph Yuhasse, Civil Engineering Associate, Horry County Stormwater Department. The contact information for both of these individuals is contained in the Appendix A.

The Study Group would also like to acknowledge and thank those homeowners who worked previously on Lake Issues and provided information gathered in those efforts.

PART 2 - SUMMARY

A LITTLE BIT ABOUT THE LAKE

The Waterfall Lake is actually a South Carolina mandated storm water retention pond designed and built to control the quantity and quality of storm water runoff in the community and as such its operation and maintenance falls under State and County jurisdiction. Turning the stormwater retention pond into an attractive lake required an initial effort and keeping it an attractive lake requires ongoing attention.

The retention pond consists not just of the Lake itself but also the catch basins, inlet pipes, out flow structure, fountains, waterfall, fish population and surrounding vegetation all of which act in concert to keep the Lake functioning and attractive. When any of these components fail to function properly or breakdown and the breakdown is not addressed the pond can begin to fail. Safeguarding the pond's health is not only a legal responsibility it is also vital to the community because when a storm water retention pond fails it becomes an eye-sore, a source of obnoxious odors and a breeding ground for mosquitoes and other unwanted pests. Once that happens the cost of remediating the pond usually far exceeds the cost of the regular maintenance practices that would have prevented the pond from failing.

The simplest and most effective way to safeguard the pond is to conduct regular inspections and perform maintenance and remedial work when necessary. Coupling good maintenance practices with smart governing policies will insure that the lake remains a well functioning, attractive and value adding feature of the community.

All Waterfall property owners have a role in maintaining the Lake and it begins with understanding how the Lake works and what actions can be taken by each owner to safeguard the Lake. In Part 3 of the report there is a short explanation of how the Lake operates as a storm water retention pond. Those interested in the more technical aspects of the Lake will find Part 4 of this report more informative. For now suffice it to say that homeowners can help maintain the Lake by reducing pollutants entering the lake. They do this by picking up after pets, avoiding oil spills on the roadways and driveways, minimizing the use of fertilizers near and in the lake's perimeter vegetation zone, and insuring that runoff water from their property does not erode the shoreline.

A healthy Lake requires a well balanced ecological system comprised of aquatic plants, shoreline vegetation and sufficiently oxygenated water. The plants and vegetation in and around the perimeter of the Lake are there to prevent erosion of the shoreline, to filter out damaging contaminants and to control the oxygen levels and temperature of the water. Some plants do this well while others actually damage the Lake and so while there is latitude in determining the nature and extent of the shoreline vegetation all such choices must be judged based upon how they impact the Lake's functionality. Shoreline vegetation that is aesthetically pleasing but damaging to Lake's health must be avoided because of the consequences it brings.

The shoreline of the Lake is comprised of different zones each of which has its own unique characteristics making each suited for different types of vegetation.

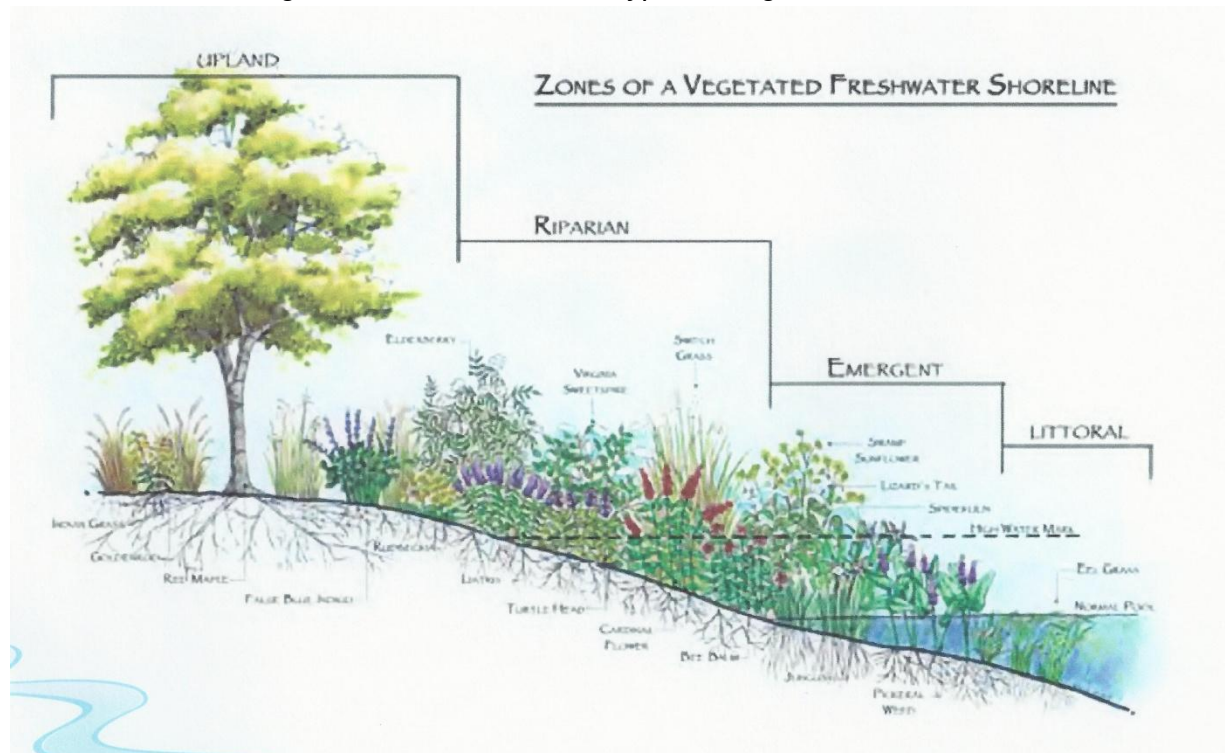


Illustration from *Shorescaping Freshwater Shorelines* – Clemson University Water Resource Program

Clemson University and the South Carolina Department of Health and Environmental Control have both published pamphlets with recommendations for suitable shoreline vegetation in these zones.

Keeping the shoreline and the lake free of debris and excess weeds is important to maintaining a healthy Lake. Limiting the amount of debris and contaminants entering the roadway catch basins or flowing into the lake from the surrounding shore not only helps safeguard the lake's eco-system it helps prevent stagnation by keeping the inlet piping and outflow structure clog free as well.

The fountains in the lake are there primarily for aesthetic purposes. The Waterfall Lake has two fountains which should be inspected and serviced at appropriate intervals to insure that they continue to work.

Particular species of fish have been added to the lake to help balance the lake's eco-system by eating unwanted aquatic plants including filamentous algae the "hair like" strands that grow on the surface of the water and on other plants. When the filamentous algae become too dense it grows into unsightly floating clumps and causes stagnation of the water. The fish population needs to be monitored and maintained at sufficient levels to be effective. The State of South Carolina has published recommendations for the types and number of fish that should be stocked in a storm water retention pond.

WHY HAVE INSPECTIONS AND MAINTENANCE?

Regular inspections of the Lake are important to detect early warning signs of potential problems which in most cases can be dealt with and corrected before they become big and expensive problems. Regular maintenance practices protect against the development of preventable problems. A number of authoritative sources have been relied upon in determining, what should be inspected, how often these inspections should be conducted, and what specific maintenance practices should be employed. There are specially trained and licensed contractors that can be hired provide all or some of these services.

WHO'S RESPONSIBLE FOR THE LAKE?

The following is not a formal legal opinion nor is it based upon the advice of a qualified South Carolina lawyer, it is merely a reference to the provisions in the Declaration of Restrictions and Protective Covenants that deal with the lake, its use and its maintenance. The specific provisions mentioned and summarized here are more fully cited in the Part 3 of the report.

The Waterfall Declaration of Restrictions and Protective Covenants creates a twelve (12) foot maintenance easement around the perimeter of the Lake and charges the POA with the responsibility of maintaining the lake. According to the provisions of the Declaration of Restrictions and Protective Covenants the cost of the maintenance is to be paid by the Association through either Base Assessments or Special Assessments. Maintaining the Lake to established standards is also a legal obligation of the community under the Horry County *Stormwater Management and Sediment Control Ordinance* and under the South Carolina *Stormwater Management and Sedimentation Reduction Act*.

Reserves should be established to fund longer range maintenance concerns such as dredging, fountain replacement, some fish restocking and inlet and outflow cleaning. Annual budget line items should be considered for yearly clean up of the vegetation zone, restocking of fish that die each year and the repair of damaged shorelines.

The property boundary lines of all of the lots in the development were established by the plats filed by the developer with the county. The water's edge is not necessarily the boundary line of the Lake front lots and owners should consult their deeds and surveys to determine where their property ends.

PART 3 - AN INTRODUCTION TO WATERFALL LAKE

WHAT IS WATERFALL LAKE AND WHY IS IT THERE?

While it is identified on the sales map as Lake Serenity it is in fact a South Carolina mandated storm water retention pond that serves to control the quantity and quality of the storm water runoff in the Waterfall community. Originally dug by the contractor building Route 31 to provide sand and fill for the highway's roadway bed it ultimately became the community's storm water retention pond. Because it was not originally built as a retention pond it is approximately twice the depth of the typical retention pond and it has a far greater holding capacity than is generally required. It also differs from the typical storm water retention pond in that it narrows significantly in the area of the outflow structure and its banks in this area are steeper than the banks of the typical pond. These steep banks are a matter concern addressed further on in the report. Other than these features the Lake has the same features and operates the same way as all other storm water retention ponds.

The Lake helps prevent flooding and erosion in the community by collecting and retaining storm water runoff. Catch basins located in the community roadways and elsewhere collect the rain water and deliver it into the Lake rather than allowing it to collect in low laying areas of the community. Holding the runoff water in the Lake allows contaminants in the water to settle out before the water is discharged through an outflow pipe at the south end of the Lake and this keeps pollutants from contaminating nearby waterways.

Stormwater retention ponds are not simply holes dug in the ground, they are sophisticated structures designed and built to governing agency standards established for specific reasons. The slope angle of the lake's bank leading to the water's edge is designed to be steep enough to allow water flow yet not so steep as to cause erosion. The slope angle of the area beginning just below the waterline is designed to control aquatic weed growth which is an essential part of the ponds ecological system. Both of these angles must be maintained for the Lake function properly.

A minimum depth must also be maintained for the Lake to function properly and not become a swamp. Sedimentation build up must be monitored and dealt with by dredging the pond in order to maintain the required depth. In that regard we are fortunate that Waterfall Lake is much deeper and larger than the typical pond and dredging is not as big an issue for Waterfall as it is for other communities.

Generally speaking the vegetated buffer zone of plants along the Lake's edge protects the Lake's bank while at the same time making the lake more attractive. The aquatic plants growing in the shallow water are essential to the lake's eco-system and are also helpful in maintaining the Lake's underwater slope, but they can become unsightly and damaging to the lake if not properly controlled. Trees within the buffer zone are not good for the lake because their root systems tend to destabilize the shoreline and the leafs they shed into the Lake rot creating damaging pollutants.

Although Waterfall Lake exists and functions primarily as a storm water retention pond it is also an attractive community feature which adds value our property and provides each of us with an opportunity to commune with nature. However if not properly maintained the Lake can become an eye-sore of over growth, stagnant green water and a source of obnoxious odors all of which is very unpleasant and most certainly reduces property values.

WHO OWNS THE LAKE AND WHO CONTROLS IT?

The Lake itself is common property held by the Waterfall Homeowner's Association, Inc. (POA) which is responsible under the Declaration of Restrictions and Protective Covenants for its maintenance. Lot owners on the Lake own the property near or to the water's edge however the Declaration of Restrictions and Covenants (discussed more fully below) grants the POA a twelve (12) foot maintenance easement around the entire perimeter of the lake.

Because the lake is storm water retention pond it comes under the jurisdiction of the South Carolina Department of Health and Environmental Control (DHEC) under the *Stormwater Management and Sedimentation Reduction Act*, and is subject to inspection by that organization at periodic intervals. It also comes under the jurisdiction of Horry County under the *Stormwater Management and Sediment Control Ordinance*. Under this Ordinance the POA is charged with the duty of maintaining the pond to County standards and failure to do so can result in the County coming onto the property to correct deficiencies at the expense of the homeowners.

PROVISIONS IN THE DECLARATION OF RESTRICTIONS AND PROTECTIVE COVENANTS AND THE BY LAWS DEALING WITH THE LAKE

The Declaration of Restrictions and Protective Covenants defines "Lake" in Section 1.14 to *"mean and refer to the 9.15 acre, more or less, total lake area located on the Property..."* The actual size of the lake as detailed on the Subdivision As Built plan filed with Horry County in November 2000 is 6.71 acres.

In Section 4.5 of the Declaration, the Association (defined previously at Section 1.4 as the Waterfall POA, Inc.) is charged with the duty of maintaining among other things the Lake as well as the *"twelve (12) foot maintenance easement around the perimeter of the Lake."* The Section goes on to state that all the expenses associated with such maintenance *"shall be paid for by the Association through either Base Assessments or Special Assessments imposed in the best interest of the Association in accordance with Article V."*

Section 7.30 of the Declaration states as follows:

Lakeside Area. Surrounding the entire perimeter of the lake there is a 12' maintenance easement. Other than the areas where there are common areas or common access, no other owner or the guest or lessee shall have the right or permission to occupy, access, fish, or perform any other activities on the 12' maintenance easement area around the perimeter of the lake without the individual lot owner's permission. The individual lot owner's property extends into this area to or near the lake edge."

Individual property boundary lines for all lots in the Waterfall Development were established by the Plats filed by the Declarant in the Records of Horry County. Those property boundary lines do not necessarily correspond to the edge of the Lake and any homeowners who have any questions in that regard should check their deed and survey to determine where their property legally ends.

Article XVII of the Declaration is entitled LAKE REGULATIONS and contains fourteen (14) sections dealing with property owner use of the Lake.

There are no provisions in the By-laws of the Waterfall Home Owner' Association Inc. that apply directly or by reference to the lake.

PART 4 – STORM WATER RETENTION PONDS

UNDERSTANDING HOW A STORMWATER RETENTION POND'S ECO-SYSTEM WORKS

For a storm water retention pond to function properly it must have a balanced and healthy eco-system composed of properly maintained aquatic plants and shoreline vegetation. Aquatic plants and shoreline vegetation are essential to the lake's functioning because they do the following:

- Oxygenate the water
- Treat excess nutrients and pollutants
- Stabilize the shoreline
- Provide temperature control by shading the water
- Provide food and cover for the aquatic animals
- Provide a habitat for beneficial organisms
- Filter debris and pollutants
- Baffle wind and wave energy
- Add a natural and pleasing appearance to the pond

Aquatic plants include algae, submerged plants, floating plants and emergent plants which are rooted in the shallow water at the edge of the lake.

Shoreline vegetation, as the term suggests, are the plants growing in the sloping edges of the lake leading to the water. This area is permanently saturated and subject to submersion, and so landscape plants that grow well in wetlands are best suited as shoreline vegetation.

Stocking the lake with fish is another important element in maintaining the lake's aquatic plants and balancing its eco-system. Triploid Grass Carp which have been specifically bred to be sterile are particularly helpful in controlling most species of submerged plants. They eat large quantizes of weeds for at least eight years after which their ingestion slows. When they die they do not float to the top of the water but rather they sink to the bottom. It is recommended that ponds without heavy weed problems stock Triploid Grass Carp at the rate of 5 to 10 fish per acre in the fall. Tilapias also provide aquatic weed control and they also eat filamentous algae and floating plants such as duck weed and watermeal. Tilapias are tropical fish and do not generally survive the winter temperatures unless the water temperature remains above 55 degrees Fahrenheit and should therefore be restocked annually. South Carolina recommends stocking Tilapia at the rate of 200 to 400 fish per acre of pond surface in mid to late spring once the water temperature is consistently above 60 degrees Fahrenheit.

WHY POND MAINTENANCE IS IMPORTANT TO THE COMMUNITY

Studies have shown that while well maintained storm water retention ponds increase property values poorly maintained ponds have the opposite effect.

Improperly maintained storm water retention ponds can become eye-sores, create obnoxious odors, breed mosquitoes and become a habitat for unwanted wild animals. Stagnant water, algae blooms, floating trash/debris, invasive plants and weeds and fish kills are the most common problems resulting from lack of maintenance.

Structural problems such as erosion of the pond's edges, collapsed or clogged inlet and outlet pipes, over sedimentation and fish kills can all occur if proper maintenance procedures are not carried out on a regular basis.

Remediating a failed pond is generally very expensive and usually always more expensive than the cost of the regular maintenance that could have prevented such failure from occurring

WHAT ARE THE SIGNS THAT A POND HAS A PROBLEM?

How the pond looks is most often indicative of the pond's health and whether or not it is being properly maintained. However when judging the pond's health by its appearance an untrained eye will often fail to notice warning signs apparent to a qualified professional.

The most common indications that the pond is not being properly maintained are:

1. Stagnant polluted water,
2. overgrown vegetation and excessive weeds
3. eroded shorelines,
4. muddy water.
5. surface films, slimes and foams,
6. fish kills,
7. the presence of nuisance wildlife.

Stagnant or Polluted Water

Stagnant water can be caused by a blocked or clogged outflow structure or excessive amounts of filamentous algae. The water fall was added to south end of the lake near the outflow structure to increase water circulation in that area and combat stagnation.

A storm water retention pond is designed to collect and handle runoff water containing contaminants which are likely to include pollutants. However the contamination is compounded if there is fertilizer or animal waste washed in from the shoreline. This places an additional load on the pond that can lead to it becoming polluted. A sign that the pond water may be polluted is an excessive growth of algae which thrives on the nutrients derived from pollutants such as fertilizer and animal waste which contain high levels of fecal bacteria and other pathogens.

Weed Infestation and Overgrown Vegetation

Weed infestation and overgrowth of plants and vegetation along the shoreline are both that threaten the ponds health. These problems must be addressed by periodic inspections and by carrying out proper maintenance practices when needed.

Excessive algae growth results from too many nutrients from fertilizers and animal waste entering the lake. When this happens the lake can become very cloudy and turn green, sometimes as green as pea soup. Excessive algae can also appear as a bright green or red scum floating on the lake's surface or in the case of filamentous algae result in floating mats. Maintaining a balanced level of algae is essential to both the lake's functionality and appearance.

Uncontrolled and excessive growth of vegetation can cause the following problems:

- Impede circulation of the lake's water
- Choke vegetation leading to decay and low oxygen in the water that can result in noxious odors and a fish kill
- Reduction of the lake's pollutant trapping ability.

The Horry County *Guidebook for Maintaining Stormwater Systems*, suggests that maintenance be performed on vegetation when:

- There are areas bare or exposed soil
- Vegetation is buried by sediment
- Vegetation appears unhealthy or has died
- Nuisance and invasive plants are present
- Vegetation is blocking the inlets or outflow structure

Weeds can be controlled by pulling or cutting using special equipment, or by using herbicides many of which can only be applied legally by licensed applicators or by stocking the pond with certain species of fish that eat the weeds.

Shoreline Erosion

Shoreline erosion is a problem that if left unaddressed will worsen and lead to bigger structural problems that will adversely affect the lake's functionality. Erosion can be caused by any or all of the following

- Lake banks that are excessively sloped
- Soils in the banks that have low structural integrity due to the absence of natural rock
- Lack of shoreline vegetation needed to protect the bank
- Wave or wind action
- Nuisance wildlife

Erosion problems can be prevented by addressing the conditions that create the problem before the erosion occurs. Once the erosion occurs it requires remediation but then preventive measures should be taken to insure that there is no reoccurrence of the problem.

Muddy Water

While muddy water is generally an indication of a problem in a storm water retention pond, water that is too clear can be a problem in its self. Muddy water is most often caused by soil erosion along the banks of the pond, heavy inflows with contaminants coming from heavy rains or by the pond bottom being disturbed by wild life. The condition is usually temporary and clears itself.

On the other hand water that is too clear allows too much sunlight to reach the submerged plants and cause an unwanted over growth. In the case of the Waterfall Lake its depth alone is sufficient to protect against this problem.

Surface Slimes, Sheens and Foam

Surface slimes and sheens result from insoluble materials entering the lake. These materials can range from pollen and dust to hydrocarbons and oils. Some oils are come from decaying leaves and algae while other oils, such as motor oil come from the road surface run off. The former type of oil sheen as well as any surface slime created by organic materials like pollen and dust will break up and dissipate on their own. However slimes and sheens caused by motor oil or cooking oil will require special treatment as well as a plan to eliminate further contamination.

Foam in the water can come from two basic sources, first from the release of surfactants from dying algae blooms and second from soap and detergents entering the lake. Typically a foam caused by a soap or detergent will be a brighter white and have larger and more varied bubbles than a foam created by dying algae. Natural foams will turn brown and tend to stay close to their source and dissipate on their own. Soap and detergent foams are best dealt with by controlling their entry into the lake.

Fish Kills

Fish kills in a storm water retention pond are most frequently caused by low oxygen. Toxins in the water can also result in a fish kill but when caused by toxins it is usually only the smaller fish which die.

Oxygen is generated in the water by the sun through the process of photosynthesis and therefore oxygen levels are at their lowest during the early morning hours before sunrise. During this period plankton and other microbes in the water continue to consume the oxygen and this reduces the oxygen supply available to the fish.

Nuisance Wild Life

While some wild life in the Lake is desirable and pleasing the benefits to the Lake are few. Migratory birds such as, geese, ducks or swans trample the shoreline, infect the water with feces that increases algae and weed growth and often bring weeds into the lake either stuck to their feathers or excreted from their digestive tracks. When the population of these migratory birds becomes too large they threaten not only the health of the Lake but of the community's

residents as well. Authorities recommend that two birds per acre, or approximately 18 to 20 birds in the case of the Waterfall Lake, is manageable and will not significantly damage property or water quality.

POA members can help in this regard by not feeding the migratory birds. Studies have proven that the population of migratory birds in a storm water retention pond increases dramatically when the birds' diets are supplemented by human feeding. If the bird population becomes too large even absent of human feeding, then deterrent actions or even trapping may prove necessary. One expert the Study Group consulted found that using a toy remote controlled boat to chase the birds was an effective solution to the problem.

Turtles in the pond do not normally cause damage to the pond but they can be a hazard to human health as they can carry the infectious bacteria salmonella. Under normal conditions a pond will support 5 or less turtles per acre but the number grows when the turtles are fed. As with the migratory birds the best way to control the turtle population in the lake is by not feeding them.

Snakes do not harm the lake; rather they help protect the lake by keeping the frog, duck and insect population in check. The biggest problem caused by snakes is frightening residents. Because snakes do help maintain the pond the authorities recommend that snakes be avoided not removed. Removing shoreline plants to reduce the snake's cover is not recommended as it can result in far greater and costly problems than those caused by the snakes.

Mosquitoes do not normally breed in a healthy storm water retention pond because of the motion of the water, the depth of the pond and the presence of numerous predators. However when a pond fails it can become a breeding ground for mosquitoes. There is however an insect called a Midge which is a small fly that looks very much like a mosquito and it breeds in storm water retention ponds with mass emergences in the late spring and early summer. Midges pose no threat to health or property and have very short lives.

Beavers, muskrats and otters can all cause problems in a storm water retention pond. Beavers with their dam building abilities can cause the most harm and should be trapped and removed from the pond. Muskrats build burrows in the banks of the pond and this can lead to significant shoreline erosion problems and therefore it is recommended that they also be removed from the pond. Otters cause no direct harm to the pond other than they trample down shoreline vegetation because they enter and leave the pond at the same location and they also eat at these locations leaving fish bones. They are a threat to the fish stocked in the pond but other than that they cause no other problems. Because beavers, muskrats and otters are furbearing species they are protected under South Carolina law and can only be trapped and dispatched by licensed individuals.

The presence of frogs in the pond is not a significant hazard to the pond or to the community in general. In fact since frogs are more sensitive to pollution than are humans and fish the presence of frogs indicates the water in the pond is generally of good quality. Some frogs excrete toxins from their skin which are not normally harmful to human health. If a dog picks up

a frog with its mouth it may cause the animal to develop foamy saliva which is generally temporary and not harmful.

PART 5 - THE WATERFALL LAKE

The Study Group conducted a series of inspections of the Lake, the shoreline and the associated structures of the pond and documented these inspections with the photographs attached to this report. Also attached to this report are:

- A copy of the Subdivision Asbuilt Plan prepared on November 9, 2000 Eld of South Carolina, civil engineers, land planners and wetland consultants and filed with Horry County
- A Lake map showing the depth of the Lake at various locations as measured by Study Group members on November 17, 2013 and as measured in 2009 by a prior Study Group.

The Study Group conducted one inspection with a representative of a lake management company, one inspection with Mr. Joseph Yuhasse the Horry County Stormwater Department inspector and held a consultation with Mr. Ben Powell a natural resources agent from Clemson Extension. Mr. Powell had visited Waterfall and inspected the Lake on two prior occurrences and while he did not do so this time he was provided with copies of the photographs taken by the Study Group. All parties consulted expressed the opinion that the Lake was generally in very good condition and that only certain areas needed attention.

WHAT DO WE KNOW ABOUT THE LAKE AND HOW DO WE KNOW IT?

The Subdivision Asbuilt plan containing the details of the Lake and its elements was prepared by Elam Todd d'Amrosi (ETd) of Murrels Inlet on November 9, 2000 and revised in July and again in August of 2003 "per Horry County." The plan describes the Lake as being 6.71 acres with a storage capacity of 1,729,517 cubic feet and an average bottom elevation at $28.0 \pm$ feet from a WSE (water surface elevation) at $40.00 \pm$ feet. The plan also shows the 12 foot maintenance easement around the perimeter of the lake as well as all of the inlet pipes and outflow structure.

Horry County conducts inspections of the Lake for compliance with County and State regulations every five years or so. The last inspection was conducted by Mr. Joseph Yuhasse approximately one year ago and everything was found to be in good order. During his recent visit requested by the Study Group Mr. Yuhasse expressed the opinion that the Lake was in very good condition, with the concerns being those mentioned below.

CHECKING LAKE DEPTH AND CLARITY OF THE WATER

As noted above the depth of the Lake is critical to its functioning as a stormwater retention pond. Retention ponds are normally six to eight feet deep and must be dredged to remove sedimentation when their depth is reduced to half due to sedimentation build up. Dredging is expensive and it is recommended that the POA establish a reserve fund to cover the estimated cost. How soon dredging is required depends upon how quickly the sedimentation builds up to reduce the pond's capacity. According to the Horry County *Guidebook for Maintaining Stormwater Systems*, sediment should be removed when the depth of the sediment

is damaging or killing vegetation or when it is preventing the Lake from draining in the time designated which is usually 48 to 72 hours. *The Citizen's Guide To Stormwater Pond Maintenance*, published by the South Carolina Department of Health and Environmental Control, suggests that ponds be dredged when their holding capacity has been reduced by half due to sediment buildup. They estimate that dredging for the typical pond is needed roughly every ten years. However because the Waterfall Lake is unusually deep dredging is not likely to be an issue for a much longer term so long as proper maintenance practices are maintained. There is no precise way to predict when a pond will need dredging. Mr. Ben Powell when asked when he would expect Waterfall Lake to need dredging said to plan on 30 years and hope for 50. Making periodic depth checks of the Lake is the best way to monitor sedimentation build up and thereby estimated when dredging might be needed.

The Subdivision Asbuilt Plan prepared by ETd, and filed with Horry County in 2000 recorded the WSE (water surface elevation) at $40.00 \pm$ feet and the lake's average bottom elevation at $28 \pm$ feet giving an average depth of $12 \pm$ feet in the year 2000.

The Study group obtained data from depth measurements made in 2009 by a prior Study Group and also conducted its own depth measurement on November 7, 2013. The Study Group used a brick painted white and a line with markings at one foot intervals in taking its measurements. There was a twofold purpose to the exercise, one to determine the depth of the Lake at various locations and two to determine the clarity of the water. It was suggested in one of the guides that the quality of the pond's water can be judged by its clarity, which can be tested by lowering a white object into the water on a measured rope. If the object is visible at a depth of 18 inches the water is considered clear and its quality satisfactory.

The November 17th measurements were taken at 18 locations as shown on the attached Lake Map, Exhibit 1. At all locations the brick was observable at depths between three and four feet. The depths recorded on November 17th were generally consistent with the depths recorded in 2009 with the only possible exception of concern being at the south end of the lake near the outflow structure.

Comparing the depths recorded in 2013 against the original average depth on the Asbuilt Plan it is evident that there has been very little change in depth over 13 years. This being so it confirms Ben Powell's opinion that dredging of the Lake is not likely to be an issue for a very long time.

The simple and basic water clarity testing done by the Study Group suggests that the Lake water quality is satisfactory. This conclusion was confirmed by Mr. Yuhasse, the Horry County Inspector and by the independent contractor both of whom who visited the Lake and observed the condition of the water. However, there has been no laboratory testing of the water to determine possible bacterial content or the presence of other pollutants.

In the Study Group's conversation with Ben Powell he advised that bacteria content was not a matter of concern so long as the lake is not used for swimming. He was also of the opinion that given the size of the lake and its depth bacteria was not likely to be a problem unless there was an over population of water fowl. As for other pollutants Ben did express mild concern over the possible presence of heavy metals but only insofar as it related to eating any fish caught in the

lake. Here again the possibility of contamination is mitigated by the depth of the lake but caution would dictate that homeowners be advised of the possible hazard in eating fish from the lake.

SOME ISSUES WITH SHORELINE VEGETATION AND LAKE BANK STABILIZATION

In discussing shoreline vegetation and other shoreline issues we are dealing primarily with the riparian and emergent zones shown in the illustration on page 5 of this report. These two zones comprise the bank of the lake and maintaining them properly is critical to the Lake's overall health and functionality. Maintaining the upland zone at the top of the bank is important but not as critical as maintaining the other zones.

Because shoreline vegetation and the integrity of the lake's bank are critical the Study Group devoted much of the discussions with Ben Powell and Joseph Yuhasse to this topic.

To begin with there is no consistency in the nature of the shoreline vegetation around at the Lake's perimeter. It ranges from turf grass running to the water's edge to dense growth of bushes and trees which exists predominantly at lots without homes. Photographs 1,2 and 3 illustrate the conditions.



PHOTOGRAPH 1



PHOTOGRAPH 2



PHOTOGRAPH 3

The *Neighborhood Stormwater Pond Maintenance Log and Resources*, states that turf grass is not a good shoreline plant because while it will survive at the water's edge its roots will not penetrate deep enough into the saturated soil to provide bank stabilization and eventually the bank will slump. This opinion was echoed by Ben Powell during the consultation session he held with the Study Group.

There is evidence of shoreline slumping happening at locations on the Lake where the turf grass has been extended to the water's edge. An example is shown in photograph 4. In addition having turf grass to the water's edge lessens the natural filtration provided by shoreline vegetation and increases the amount of runoff which can contain fertilizer, pesticides, sedimentation and pet waste.



PHOTOGRAPH 4

In 2009 after one of his visits Ben Powell suggested that “robust shoreline vegetation is the best management strategy for stabilizing eroding shorelines.” In the Study Groups most recent consultation with him he suggested that only aquatic native vegetation be allowed in the 3 to 5 feet of shoreline beginning at the water's edge. The Study Group inquired of Ben Powell what he would recommend for a shoreline buffer plant that would give a trim clean look and he recommended soft rush (*Juncus effuses*) an extremely hardy perennial that retains its green color through most of the year and most importantly is effective in maintaining shoreline stability. Soft Rush is shown in Photographs 5 and 6.



PHOTOGRAPH 5



PHOTOGRAPH 6

Even a small buffer zone of two to three feet of low trimmed approved shoreline vegetation on the bank can help avoid erosion problems while giving almost same clean trim appearance of grass to the water's edge as shown in photographs 7 and 8.



PHOTOGRAPH 7



PHOTOGRAPH 8

There are locations where, according to all parties consulted, the shoreline vegetation should be trimmed to thin it out and to remove undesirable plant growth. Woody vegetation should be removed as the leaves they shed decompose in the pond releasing pollutants, especially nutrients which can lead to algae problems. For this reason the South Carolina DHEC, *Storm Water Management BMP Handbook*, recommends harvesting dead vegetation annually. Ben Powell made the same recommendations suggesting that woody vegetation such as trees on the banks of the pond be removed using the “hack and squirt” method where the trees are cut low and the remaining stump is painted with a herbicide to kill the root. Photograph 9 illustrates a location where an overgrowth and undesirable vegetation exist in the Lake’s buffer zone.



PHOTOGRAPH 9

Another area of concern that was discussed with Ben Powell was the growth of weeds around the outflow structure. The condition is illustrated in Photograph 10.



PHOTOGRAPH 10

This build up of vegetation at the outflow pipe structure can result in the accumulation of debris which would impede the flow of water into the outlet pipe and should therefore be removed. Ben Powell suggests that the area in a 15 (fifteen) foot radius of the outflow pipe be kept free of vegetation. Joseph Yuhasse made the same recommendation after observing these conditions in the area around the outflow.

As mentioned earlier the lake is unique as a storm water retention pond in that it narrows significantly in the area of the outlet pipe and that the banks in that location are unusually steep for a storm water retention pond. It is the steepness of the banks that is of particular concern. The Clemson Extension website cautions that:

“The slope of the bank is the single most important factor that determines rate of erosion. Steep banks with slopes greater than 3 to 1 (3 feet of run for every foot in height) are almost certain to erode and undercut over time if they are not stabilized.”

The slope of the bank at the southern end of the Lake is so steep that it may be causing significant problems requiring immediate attention. Photograph 11 shows the area in question and Photograph 12 shows clear evidence of erosion. This is an area of the Lake that concerned Ben Powell the most because of the steepness of the bank.



PHOTOGRAPH 11



PHOTOGRAPH 12

Photographs 13 and 14 show the condition of the bank and the erosion that has taken place and will continue to take place if the situation is not addressed. Mr. Powell and Mr. Yuhasse agree that this situation should receive attention as soon as possible. A failure of the bank in this narrow area of the pond it could easily compromise the pond's outflow capability and that would require immediate and expensive remediation.



PHOTOGRAPH 13

Photograph 13 shows how the bank has fallen away and begun to undercut the upper section of the bank. Photograph 14 also shows that the bank contains a great deal of construction debris and foreign materials.



PHOTOGRAPH 14

The Photographs also illustrates how the shoreline vegetation is now growing in the water and how the leaves from the woody vegetation are dropping into the pond. Ben Powell recommends that this area of shoreline erosion be addressed with a hardscape solution installed by a competent contractor. Hardscape solutions range from the simple placement of rocks of sufficient size along to the bank to the installation of a bulk head. Mr. Yuhasse, the Horry

County inspector expressed similar concern with the bank and also recommended that it be addressed with a hardscape solution.

Photograph 15 illustrates a rock hardscape used by Horry County to stabilize a bank of the drainage ditch along Nail Bender Road.



PHOTOGRAPH 15

This erosion may be creating an additional problem in that the depth of the lake in this area may be decreasing more rapidly than in the remainder of the lake. The depth measurements taken by the Lake Study Group show that there was a decrease of 2 feet from 9 feet to 7 feet in the area at the mouth of the narrow section leading to the outflow structure. In the immediate area of the outflow structure the depth was measured as 4 feet but there were no prior recorded depth measurements against which to judge if there has been a similar decrease in depth at this location.

The As Built plan of the Lake filed with Horry County shows two inflow pipes entering the Lake at end of the narrow section in the area of the waterfall. If the these pipes were installed at the elevations indicated on the As Built plan and if the depth of the Lake at that location is 4 feet than the mouth of those pipes may be entirely or partially below the lake bed and therefore at least partially blocked. If this is the case it could account for the water collection problems in the Amenity Center parking lot and surrounding area. Ben Powell advised the Study Group that these issues are best addressed by a qualified civil engineer who can assess the problem and design a solution.

The integrity of the Lake's bank can also be undermined by concentrated surface water runoff from drainage pipes emptying directly onto the bank or near the top of the bank. Many of the homes on the Lake have drains through their privacy walls that empty on the upland section of the Lake or on the bank of the Lake. If the flow from those pipes is not dispersed it can cause gullies that eventually undermine the shoreline and can lead to failure of the pond. Ben Powell advised that problem can be addressed by dispersing the water flow at the point it leaves the

pipe. This can be done simply by adding a pop-up emitter at the end of the pipe or by building a dissipater consisting of geo-fabric staked under the pipe and covered with rocks. Another alternative, although not the most favored, is to extend the drainage pipe directly into the Lake. While this will prevent a concentrated flow of runoff from damaging the bank it has a drawback in that it allows runoff to reach the lake without it having been filtered by the shoreline vegetation. On balance Ben Powell believes that given the size of the Lake and its oversize capacity draining directly into the Lake is the lesser of two evils and makes sense. Mr. Yuhasse expressed the same opinion.

The Study Group lacks sufficient knowledge and ability to categorize all of the vegetation presently growing in the Lake's buffer zone or to determine which types of vegetation should be removed or how much the vegetation should be trimmed.

STRUCTURAL ELEMENTS OF THE POND AND LONG RANGE PLANNING

The catch basins, the inflow pipes and the outflow structure will at some point in time require maintenance and attention. Ben Powell could not give the Study Group an accurate time table for when structural repairs are likely to be needed but suggested that 15 to 25 years was a reasonable time period to expect. He did recommend that reserves be set aside for structural repairs of the Lake.



The catch basins have sumps below their outflow pipes which collect sedimentation and debris. Keeping the catch basins free of litter and debris helps to keep the inflow pipes clear and fully functional and they should be checked periodically and cleaned as needed. Homeowners can help by reporting any blocked catch basins and any ponding of water on the paved areas of the community. Regular street cleaning can also help reduce the amount of debris reaching the catch basins, inflow pipes and ultimately the lake. The photograph

to the left shows how debris builds up in the curb drain and can eventually wash into the catch basins.

Mr. Yuhasse recommends that the catch basins be inspected and cleaned every 3 to 5 years. At the bottom of each catch basin there is a sump designed to collect sediment and debris and it is this sump needs to be cleaned.

As for the two fountains, Ben Powell reminded the Study Group that they are decorative only and other than "looking pretty" they do nothing for the Lake. They do use electricity to operate and they require scheduled maintenance so they are a cost factor to consider in budgeting for the Lake.

Ben Powell was of the opinion that given the size and depth of the Lake no aerators or other mechanical devices were needed at this time to maintain the Lake's health and functionality.

FISH IN THE LAKE

Stocking the Lake with fish is done for two purposes. The first and most important purpose is weed control and the second less important purpose is to provide for recreational fishing. Based upon the limited documentation available and the evidence of what has been caught by homeowners fishing in the Lake the Study Group concluded that the Lake was stocked with a number of species of fish including Triploid Grass Carps, Tilapias, Cat fish and Largemouth Bass.

The Grass Carps and the Tilapias were added to the Lake for the specific purpose of controlling weeds. As was noted above the Grass Carp help control weeds on the bottom of the Lake by eating most species of submerged plants. Ben Powell recommends restocking Grass Carp every three to five years at the rate of 5 per acre for maintenance purposes.

The Tilapias eat algae and floating plants but because they are tropical fish they die during the winter. The last purchase record the Study Group has shows that 100, three to six inch Tilapias were added to the pond in June of 2010. The fish were purchased from Stanley Vending in Surfside Beach. Ben Powell recommends restocking Tilapias yearly in late April or early May at the rate of 50 mature fish per acre if there is no apparent algae problem and at the rate of 100 mature fish if there is an algae problem.

A report to the Waterfall POA on the Pond Status dated June 4, 2012 states that between 2007 and 2012, twenty to thirty five Grass Carp were introduced into the Lake with the last added in 2009. The report also states that Grass Carp live from 5-8 years. The Study Group also obtained a copy of an invoice from Stanley Vending of Surfside Beach, for 100 Tilapias added to the pond in June 2010.

Based upon the lack of algae and underwater vegetation along the shoreline Mr. Yuhasse was of the opinion that there is a sufficient Grass Carp population to control the algae even if the Tilapias have died off. According to both Ben Powell and Mr. Yuhasse the fish population is considered adequate so long as the algae growth covers less than 25% of the pond. However for aesthetic purposes far less algae growth is desirable.

When stocking fish for recreational purposes Ben Powell recommends Largemouth Bass being stocked at the rate of 50 per acre and Blue Gill Bream being stocked at 500 per acre. For additional information on recreational fish maintenance the South Carolina Department of Natural Resources, Wildlife and Freshwater Fisheries Division has published a paper, *Managing Ponds for Recreational Fishing* which can be accessed on the web site www.dnr.sc.gov.

Given the possibility, minimal though it might be, that there are heavy metal contaminants in the Lake that could affect the edibility of the fish a caution should be considered.

ABOUT MAINTENANCE OF THE 12 FOOT EASEMENT

During its work the Study Group has discovered an issue regarding who has the obligation to maintain the 12 foot easement and who has the right to determine how it is maintained. The Study Group offers no legal or for that matter any definitive opinion on the issue but merely

presents the facts along with the provisions in the Declaration of Restrictions and Protective Covenants that seem pertinent.

The Declaration of Restrictions and Protective Covenants provides at Section 4.5

The Association shall at all times maintain in good repair, and shall repair or replace as often as necessary, the paving, drainage structures, street lighting fixtures, landscaping, the Lake, and amenities (except utilities) situated on the Common Areas and within any maintenance easements including the subdivision perimeter berms and landscaping and the twelve (12) foot maintenance easement around the perimeter of the Lake. The Board of Directors acting on a majority vote shall order all work to be done and shall pay for all expenses including all electricity consumed in the Common Areas and all other common expenses. All work pursuant to this Section 4.5 and all expenses hereunder shall be paid for by the Association through either Base Assessments or Special Assessments imposed in the best interest of the Association in accordance with Article V. Excluded herefrom shall be paving and maintenance of individual lot driveways which shall be maintained by each Owner. Nothing herein shall be construed as preventing the Association from delegating or transferring its maintenance obligations to a governmental authority under such terms and conditions as the Board of Directors may deem is in the best interest of the Association.

The Study Group learned that at a time when there were many less property owners those property owners agreed to assume responsibility for the maintenance of their property to the water's edge leaving the manner in which it was maintained to the discretion of the owner. This was done to save the POA money and lessen the maintenance burden. This arrangement however contravenes the provision of the Declaration of Restrictions and Protective Covenants quoted above because it relieves the Association of the obligation created under the quoted section.

Section 14.2 of the Declaration of Restrictions and Protective Covenants provides in part:

This declaration may be amended during the first thirty (30) year period by an instrument signed by the Voting Members representing not less than sixty-seven percent (67%) of the Lot Owners, and by the Declarant, so long as the Declarant still owns any Lots, or as provided elsewhere in this Declaration. Any Amendment must be properly recorded.

For informational purposes the Clemson Extension web site addresses the question of easements with the following statement:

There is an easement around my pond. Does that affect what I can do to the shoreline?
Many communities have established easements around ponds. Most commonly the easement extends up the bank 10 to 15 feet from the normal water line. In some cases this easement is merely for maintenance, and what goes on in the easement is determined by the HOA's bylaws. In other instances, the pond is owned/maintained by a municipality rather than an HOA, so it is important for homeowners to know the rules about activities in the easement and who has authority over those activities. Activities such as planting plants or building bulkheads may be

restricted by the terms of the easement, and homeowners may be liable for damages and repairs for illicit activities in the easement. Nevertheless, the terms of easements can be changed if the community feels the need to do so. For HOAs, this may mean amending the bylaws.

It is not within the mission of the Study Group to determine the legal status any prior arrangements. The Study Group in making its recommendations relies upon the provisions of the Declaration of Restrictions and Protective Covenants available to it which does not contain an Amendment reflecting a change to Section 4.5. No search was made to determine if an Amendment to the Declaration of Covenants and Restrictive Easements reflecting this change was recorded as this is also beyond the scope of the work of the Study Group.

PART 6 - RECOMMENDATIONS

IMMEDIATE ACTION

Issue: It is the opinion of all experts consulted by the Study Group that the south west bank of the Lake in the area of the outlet pipe structure is eroding significantly must be remediated.



If left unaddressed the bank could collapse and could block the outlet pipe causing the Lake to malfunction as a stormwater retention pond. There is a further question whether the erosion thus far has raised the level of the pond bottom in that area possibly blocking or partially blocking the two inlet pipes that feed into the Lake at that area.

Remediation of the erosion problem requires the installation of a hardscape to protect the bank from further erosion. There are various hardscape alternatives available including the installation of, rip-rap (rocks), gabions (rock filled wire baskets), geo-web matrix (thick open cell plastic grids) or a block head. The simplest solution, the installation of rip-rap requires some technical expertise to decide on the size, geometry and placement of the rock to insure adequate support of the bank. The problem may be exacerbated by the amount of debris in the bank soil.

Recommendation: Given the seriousness of the situation and because there are a number of possible remedial schemes available the Study Group recommends the POA retain the services of a civil engineer. The task would be to first assess the bank erosion problem and to check the depth of the pond bottom at the location of the two inlet pipes in that area, and then to provide alternative solutions with cost estimates. While a qualified contractor might also be able to assess the problem and offer a solution, the solution the contractor offers might not necessarily be the best nor the least expensive..

Ben Powell of Clemson Extension suggested the following engineering firm would be capable of providing the services:

Thomas & Hutton Engineering
1350 Farrow Pkwy, Myrtle Beach, SC 29577
(843) 839-3545
www.thomasandhutton.com

Issue: There is a significant amount of weed and vegetation overgrowth along the shoreline particularly at lots where houses have yet to be built. There is also excessive vegetation growth in the area of the outlet pipe structure that must be cleared to prevent possible problems of blockage.

Recommendation: Knowing which of the plants are weeds that should be removed and which are desirable plants that should remain requires specialized knowledge. How much to thin the vegetation and how much to remove entirely is also requires such knowledge and therefore the Study Group recommends hiring a qualified pond maintenance contractor to do this work.

Estate Management Services is a company that services many of the stormwater ponds not only in this area but in six other states as well and has a very good reputation.

ESTATES MANAGEMENT SERVICES
305 Indigo Drive
Brunswick, Georgia
Allen Smith, Regional Manager (local presence)
888-30-PONDS
Cell: 843-241-1488

SHORT TERM ATTENTION

Issue: There should be formalized Inspection and maintenance practices and one question is whether this should be done by the POA or should a service company be hired to do this.

Recommendation: Based upon the observations of the Study Group and as confirmed by both Ben Powell of Clemson Extension and Joe Yuhasse of Horry County the Lake is in very good condition except for the one bank which requires attention. The overall size and depth of the Lake make it less subject to problems and generally easier to manage.

The Study Group concluded that hiring a maintenance contractor to perform inspections and regular maintenance is not necessary at this point. However regular inspections are needed and the Study Group recommends that the POA adopt a semi-annual inspection and maintenance policy for future Lake Maintenance. The Study Group has prepared a proposed Lake Semi-annual Inspection Checklist that is based upon a checklist recommended in the Neighborhood Stormwater Pond Maintenance Log and Resources.

The Study Group also recommends that the POA adopt a five year inspection plan for the catch basins and other structural elements of the pond. These types of inspections may require an

expertise beyond that of any property owners and therefore it may be necessary to retain a qualified company to perform this work.

LONG TERM ATTENTION

Issue: The fish in the Lake are part of the Lake's ecological system and must be there in adequate numbers to control weeds and algae.

Recommendation: At this time it appears from all indications that the fish population is adequate. However at some point it will be necessary to add to the fish to the Lake. One indicator that the fish population needs to be increased is the buildup of excessive amounts of algae in the Lake. This item is covered in the proposed inspection checklist. Although the experts advise that algae covering up to 25% of the Lake will not affect the pond's functioning the Study Group recommends that algae coverage should be limited to 5% of the ponds surface for aesthetic reasons. The POA should consider a reserve for fish restocking. Suggestions on the types and number of fish to stock and when to add them are contained in the report binder along with a list of companies that provide stocking services. The Study Group also recommends that the Board encourage anyone who fishes in the Lake follow a "catch and keep" policy even if the fish are not eaten but instead discarded or buried. This helps to prevent over population of the fish.

Issue: The catch basins all have sumps into which sediment and debris will collect and they should be checked and cleaned on a scheduled basis.

Recommendation: Mr. Yuhasse of Horry County recommends that this type of maintenance be performed every four to five years. The Study Group recommends that the POA establish a reserve for this work.

Issue: All stormwater retention ponds require dredging at some point or they become swamps.

Recommendation: Based on the size and depth of the Lake dredging is not likely to be needed for anywhere up to 40 years but when it is required it will be an expensive process. Depth measurements should be taken every two years to monitor the situation for an advance warning of when it may be necessary to dredge.

POLICY MATTERS and SYSTEMIC SUGGESTIONS

Issue: Much of the work done by the Study Group and much of the information it collected was previously done and collected by a prior committee but unfortunately not all of that information was available to either the Board or the Study Group. Members of the prior committee were helpful in providing information which the Study Group has placed in the accompanying binder.

Recommendation: Information on the Lake needs to be centralized and made more readily available to this and to future POA Boards. The Study Group has gathered together into a single

binder a copy of its report, as well as all of the relevant materials upon which it relied in doing its work and all historical documents it collected in its study. The Study Group recommends that this binder be kept with POA records and available to all future POA Boards, and that a duplicate copy of the binder be kept for the Lake Liaison person mentioned below.

Dealing with Lake issues and maintenance is an ongoing process requiring special knowledge and there should be at least one individual upon whom the POA can rely in dealing with these matters. The Study Group recommends that the POA create a position called Lake Liaison whose responsibility would include conducting the recommended semi-annual inspections, dealing with County inspectors and providing the POA with guidance on all Lake issues. The Study Group recommends Mario Badaglicca for the position based upon his historical and technical knowledge of Lake related matters and his willingness to be of help. Mario also has an excellent working relationship with Ben Powell and Joe Yuhasse.

Issue: The type and nature of the shoreline vegetation especially within five feet from the water's edge is a critical factor in the Lake's health and stability. Presently there is no consistency in that vegetation and in some places the lack of vegetation is causing erosion that should be addressed. The erosion mentioned here is much less severe than the erosion of the south western bank in the area of the outlet structure but still should be addressed before it becomes a larger problem.

Recommendation: The Waterfall Declaration of Restrictions and Protective Covenants creates a 12 (twelve) foot maintenance easement around the shoreline perimeter of the Lake and charges the POA with the responsibility to maintain that area at the expense of the POA. The Study Group has found that the shoreline vegetation varies considerably from turf grass to the water's edge to high growing plants and everything in between. It is possible to achieve many different looks around the Lake and still maintain a proper shoreline vegetation belt. The Study Group suggests that the POA in conjunction with the ARB develop a standardized set of vegetation plans and allow homeowners to choose the plan that creates the look they like.

There may be property owners who believe that they can do whatever they want all the way to the water's edge. The Study Group does not believe this to be correct but can only point out the applicable provisions in the Declaration of Restrictions and Protective Covenants without offering a definitive legal opinion.

If the POA develops a set of standards for the vegetation along the shoreline the Study Group believes it can expect four different situations to emerge as a result. Situation one, lots whose shoreline vegetation must be changed because the existing vegetation does not meet the standards and whose owners agree to have it done. Situation two, lots where the existing vegetation meets the standards but whose owners want to change the look of their vegetation. Situation three, lots where the vegetation meets the standards and whose owners have no preference or want their existing compliant vegetation to remain as is. Situation four lots whose believe they have the right to do as they please and contest the standards. Since the cost of remediation or changes falls upon the POA we leave it to the Board to decide how they will approach this issue.

Issue: A number of homeowners have constructed drains which collect water in their back yards and direct it to the lake. These drains range in size from one to four inches in diameter and discharge at varying locations on the Lake bank. All such drains that discharge onto the Lake bank can cause erosion problems and should be controlled. Some of these drains terminate outside of the 12 foot maintenance easement but are still problematic.

Recommendation: Ben Powell of Clemson Extension suggests using pop up emitters on the end of the drain pipe or building a dissipater of geo-fabric and stones at the discharge area. The idea is to slow the velocity of the water to keep it from removing bank material and carrying it into the Lake. In some cases it might be best to extent the drains directly into the lake and while this does mean that storm water entering the Lake this way would not be filtered by the shoreline vegetation it is more desirable than having erosion of the bank. Joe Yuhasse the Horry County stormwater inspector recommends that the drains along the troublesome south west bank near the outflow structure be carried directly into the Lake.

The POA in conjunction with the ARB should develop a policy for drainage that discharges onto or near the bank of the Lake. If there are presently any drains discharging within the 12 foot maintenance easement it may be the responsibility of the POA to deal with them.

Issue: The Lake is not tested regularly for water quality or contamination but fishing is specifically allowed and swimming is not prohibited so there are potential health issues involved.

Recommendations: The Study Group performed a simple and basic test to determine water clarity, an indicator of healthy water conditions, and based upon that test concluded that the water quality is satisfactory. Joe Yuhasse reached the same conclusion when he examined the Lake as ded the representative from Estate Management Services. Ben Powell also believed, based upon the information and photographs provided to him that the water quality was acceptable. However the Study Group has done no testing to determine if there are any bacteria or any contaminants such as heavy metals in the Lake that could impact the health of anyone swimming in the Lake or eating fish caught in the Lake. Ben Powell suggested that given the Lake's large size and depth the likelihood of there being heavy metals present in sufficient quantities to pose a health hazard to anyone eating fish caught in the Lake is very small. As for the bacteria and swimming he offered no opinion because the Study Group is not aware of anyone swimming in the Lake. The Study Group recommends that the POA enact a rule prohibiting swimming in the lake or publish a caution advising all owners that swimming in the lake is discouraged because it could be a health hazard since no bacterial testing of the water is performed. A similar caution should be published regarding fishing and eating fish caught in the Lake. While the health hazard is small issuing a caution as opposed to a prohibition or warning is advisable.

APPENDIX A

SOURCE MATERIALS

The following publications and other materials were used as reference materials in the preparation of this report. Copies of these publications and documents are provided in the binder accompanying this report and in electronic format on the accompanying disc.

1. **Neighborhood Stormwater Pond Maintenance Log and Resources**, Compiled by Sarah Rollins from the original content provided by Ben Powell, Clemson University Cooperative Extension Services.
2. **A Citizen's Guide to Stormwater Pond Maintenance in South Carolina**, published by the South Carolina Department of Health and Environmental Control, Office of Ocean and Coastal Resource Management.
3. **South Carolina DHEC Storm Water Management BMP Handbook**, pages 120-121, Wet detention ponds, August 2005.
4. **Maintaining Stormwater Systems, A Guidebook for Private Owners and Operators in Horry County**, a Horry County publication, revised October 2011.
5. **Storm Water Technology Fact Sheet – Wet Detention Ponds**, published by the United States Environmental Protection Agency, September 1999.
6. **Backyard Buffers for the South Carolina Lowcountry**, Publisher and date unknown, article provided by Ben Powell.
7. **Stormwater Wet Pond and Wetland Management Guidebook**, published by the United States Environmental Protection Agency, February 2009.
8. **Report of Ben Powell, Clemson Extension**, undated, provided to prior Study Group, together with attachments on aquatic weed control.
9. **Shoreline Plants for Stormwater Ponds**, Clemson Extension.
10. **A List of South Carolina Commercial Aquaculturists (4/20/2010)**
11. **A copy of the Invoice from Stanley Vending for the Tilapia in June 2010**
12. **Report of the Water Committee dated August 5, 2009**
13. **Report from Ted Morris dated June 4, 2012 regarding Pond Status**
14. **Lake Depth Measurement Map – 2009 and 2013**
15. **As Built Lake Plans on file with Horry County –Sheet 1 and 2**

INFORMATIVE WEB SITES

South Carolina Department of Health and Environmental Control, Storm water,
<http://www.scdhec.gov/environment/water/swater/>

Horry County Storm Water Management
<http://stormwater.horrycounty.org/Home.aspx>

Clemson Cooperative Extension – Managing Storm Ponds

http://www.clemson.edu/extension/natural_resources/water/stormwater_ponds/

Residential Ponds – Service and Management – A power point presentation by Ben Powell

<http://www.rdytogo.com/cai/assets/ben-powell-ponds-powerpoint.pdf>

PERSONS TO CONTACT

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Exhibit A Depth Measurement Map

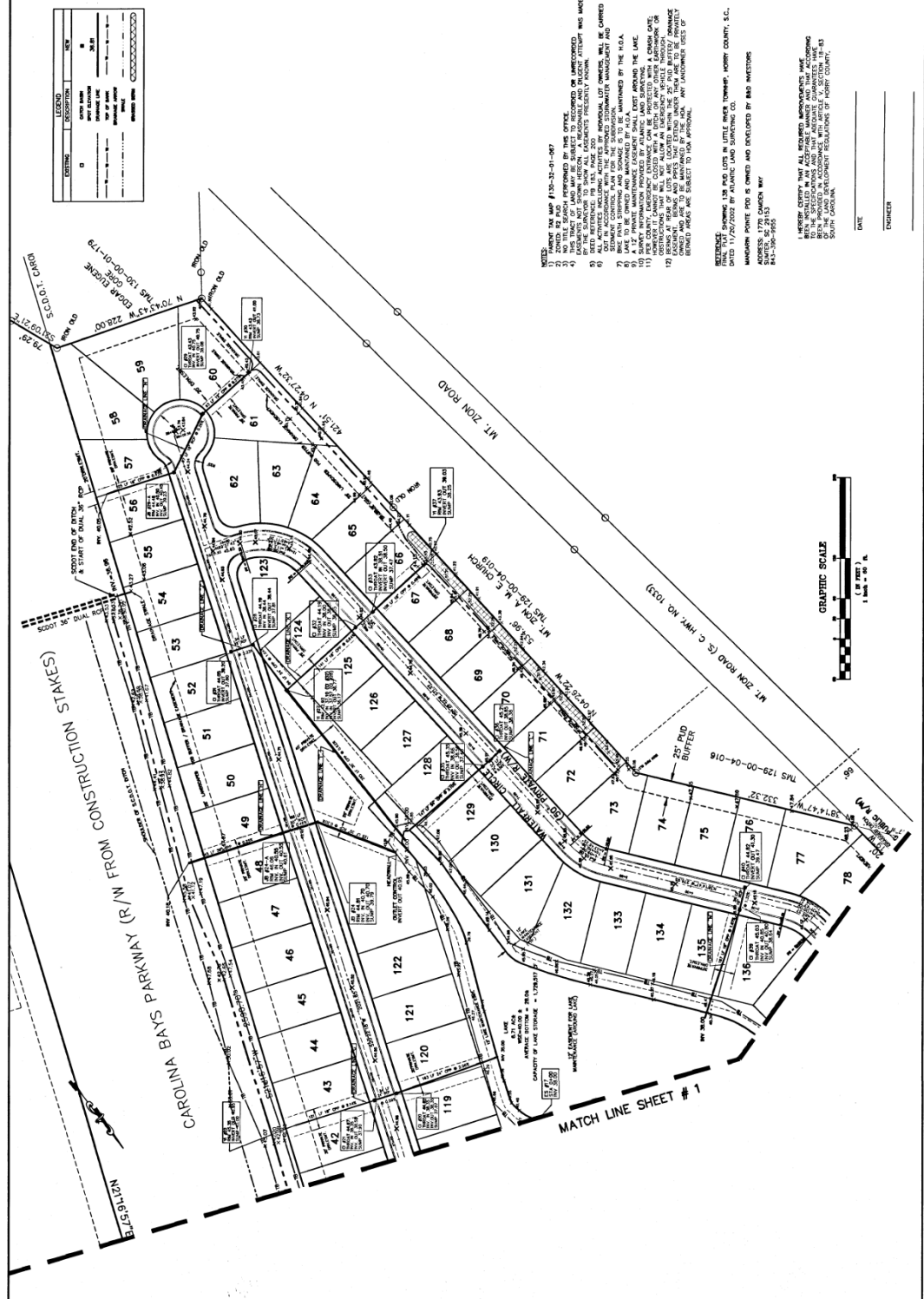


Exhibit C As Built Plan Sheet 2

INSPECTOR _____ DATE _____

INSPECTOR

DATE _____

Standing or stagnant water? YES ☐ NO ☐

If yes mark location(s) with an SW on the Lake Map

Debris/trash in the Lake or on the shore? YES ☐ NO ☐

If yes mark location (s) with T on the Lake Map

Slimes, foams or mud visible? YES ☐ NO ☐

If yes mark locations on the Lake Map

S for slime - F for foam - M for mud

Water turbid, lacks clarity?

If yes mark locations on the Lake Map with CL

Are there shoreline violations?	YES	☐	NO	☐
If yes mark locations on the Lake Map with V				
Excessive amount of algae?	YES	☐	NO	☐
If yes mark locations on the Lake Map with EA				
Under water vegetation unhealthy?	YES	☐	NO	☐
If yes mark locations on the Lake Map with UWV				
Shoreline vegetation need thinning?	YES	☐	NO	☐
If yes mark locations on the Lake Map with TVG				
Trees or bushes falling into the water?	YES	☐	NO	☐
If yes mark locations on the Lake Map with FVW				
Excessive weeds or unwanted vegetation?	YES	☐	NO	☐
If yes mark locations on the Lake Map with EXW				
Areas that need to be re-vegetated?	YES	☐	NO	☐
If yes mark locations on the Lake Map with RVG				

Obstructions at the inlets and outlet?	YES		NO	
If yes mark locations on the Lake Map with OBS				
Shoreline showing signs of erosion?				
Evidence of animal burrows?	YES		NO	
Low spots in the banks?	YES		NO	
Bank has washed into the water?	YES		NO	
Channels or scouring in the bank?	YES		NO	
Areas of bare soil along bank?	YES		NO	
Undercutting of the bank?	YES		NO	
If yes mark locations on the Lake Map with SER				
Is there damage caused by wildlife?	YES		NO	
If yes mark locations on the Lake Map with WLD				
Waterfall working & free of debris and weeds?	YES		NO	
Fountains working properly - spray and lights?	YES		NO	

[illegible]

COMMENTS



ACTION TAKEN NOTES

LAKE INSPECTION FORM 2013