RE: WATER QUALITY ANALYSIS AND DAM INSPECTION RESULTS

July 6, 2007

Dear Lakeowners:

Aquatic Environmental Services, Inc. conducted a water quality analysis including fecal coliform, and dam and outlet pipe inspection survey on June 14th, 2007 at 12:30 PM at **Providence** lake. The data collected from this study was analyzed and used to describe the current conditions of the water, uses, and physical structure of the dam and draining pipe. Based on these results, recommendations are made to correct lake issues.

METHODS

Evaluation of the physical structures of the lake (dam, draining pipe, and spillway) was performed by visual inspection and measurement of the different components. We conducted the water quality analysis using oxygen meter equipment (YSI model 55) for dissolved oxygen (DO) and temperature determinations. Hardness and alkalinity were determined by using a portable Hatch® digital titrator. We used a secchi disk and a portable pH meter to determine visibility and pH, respectively.

Fecal coliform was determined by collecting a water sample in the effluent area. Samples were stored in sterilized plastic bottles at 10 ^{o}C and released to a private lab (Environmental Management Services, Inc) for analysis less than 6 hours after collection.

AQUATIC ENVIRONMENTAL SERVICES, INC.
2050 Howell Bridge Rd. Ball Ground, GA 30107 Office: 770-735-3523 Fax: 770-737-5135
Cell Phone: 770-378-6285 Email: info@lakework.com Website: www.lakework.com

I- DAM AND PIPE INSPECTION:

Seepage Observations: Appeared dry on back of dam down to toe of slope.

Spillway Width/Integrity: ~27 feet wide. Concrete spillway without trash rack in good shape (Figure 1).

Dam Vegetation: The dam was in good shape and covered by short grass on the top and back part. However, about 50% of the internal slope was invaded by weeds (emergent grass) and shrubs (hazel alder) (Figure 2).

Outlet Pipe System: Uses spillway as main outlet.

Freeboard Depth: ~7 ft.

Animal Activity: No animal damage to the dam, but beaver signs were observed in the lake.

Evaluation and Recommendations: The physical structure of the dam and lake are in good working condition. However, control the grass growing on the waterline in front of the dam. Although these plants do not cause any physical damage to the dam structure, they can be very invasive and they reduce the aesthetic value of the lake. The shrubs (few hazel alder observed on the dam) must be removed. In the present time they do not damage the dam, but over time they will grow and their roots will cause damage. Feel free to hire a landscape crew to remove the vegetation. We also provide this service but only during the months of December to February.

II- WATER QUALITY EVALUATION:

The results fall within a normal range for a community lake (Table 1). The visibility measured 26 inches, which is above the preferred 18-24 inches for maximum fish production. However, this is the level desired for the aesthetic appeal of a community lake. The alkalinity was low but this is also not a concern unless maximizing fish production. The oxygen and pH levels were adequate and normal for production and aquatic life. There were aquatic weeds (emergent grass) in front of the dam, but not in other parts of the lake. Additional information about these water quality parameters is provided as an annex at the end of this report.

Table 1. Water quality analysis.

Parameter	**Results**	**Desired range**
Water Temperature (^{o}F)	82.0	-
pH	8.3	6.5-9
Dissolved oxygen (mg/L; % saturation)	7.5; 97.2	5-10
Visibility (inches)	26	18-24
Hardness (mg/Las $CaCO_3$)	18	>20
Alkalinity (mg/L as $CaCO_3$)	16	>20

III- FECAL COLIFORM ANALYSIS:

The water sample collected on June 14th, 2007 at 12:30 PM contained **10 colonies/100 ml**. This is below the maximum limit set by EPD and the Georgia Department of Natural Resources Rules and Regulations for Water Quality Control (Chapter 391-3-6, revised May 22, 1997). According with these regulations recreational waters should not exceed 200 colonies/100 mL (Table 2). Therefore, at this time the watershed and lake is safe should humans come in contact with the water.

Fecal coliform is the measurement of the concentration of the bacteria *Escherichia coli*, which is specific to the guts of birds and mammals. They are not dangerous by themselves (pathogenic), but their presence in high number can be an indicator of the existence of potentially harmful microorganisms. Pathogens are relatively scarce in water, making them difficult and time-consuming to monitor directly. Instead, fecal coliform levels are monitored, because of the correlation between fecal coliform counts and the probability of contracting a disease from the water.

For instance, if fecal coliform counts are high (over 200 colonies/100 ml of water sample) in the lake, there is a greater chance that pathogenic organisms are also present. A person swimming in such waters has a greater chance of getting sick from swallowing disease-causing organisms, or from pathogens entering the body through cuts in the skin, the nose, mouth, or the ears. Diseases and illness such as typhoid fever, hepatitis, gastroenteritis, dysentery, and ear infections can be contracted in waters with high fecal coliform counts.

Some of the more common sources of fecal coliforms are leaking sewer lines or failed septic systems, animal waste in the watershed or excessive waterfowl use. Traditionally the fecal coliform test serves as an indicator of possible sewage contamination because it persists longer than most other harmful pathogens associated with sewage, and it does not prosper or reproduce outside its host animal.

Fecal coliforms were once thought only to be persistent for 24-48 hrs after leaving their host warm-blooded animal or birds. But, in warm, moist climates, such as here in Georgia, these micro-organisms may bind with the sediments, nutrients and other bacteria of the soil and remain there dormant for several months until say a ground disturbance or rain event transport this contaminated sediments to streams and lakes. For example, if sampled after a rain event, fecal coliforms can reach elevated levels (i.e., 500 to 10,000 colonies/ml). For this reason, erosion and sedimentation activities are also an important factor along with possible sources of pathogens and bacteria to monitor within your respective watershed basin upstream of your lake.

Table2. Fecal coliform (FC) standards for different sources of water.

Water use	**Coliform standards (colonies/100 ml)**
Drinking water	1 TC*
Total body contact (swimming)	200 FC
Partial body contact (boating)	1000 FC
Treated sewage effluent	Not to exceed 200 FC

* Total coliform (TC) includes bacteria from cold-blooded animals and various soil organisms.

IV- CONCLUSIONS

In general water quality is adequate for production of fish. Also the fecal coliforms test indicates that water quality is safe for recreational activities. The physical structure of the dam and lake are in good working condition. Remove or control the undesirable vegetation on the the dam. If you have any question or need more information about issues discussed in this report, please feel free to contact us.

Sincerely,
Aquatic Environmental Services

Jesus Venero, Ph.D
Fisheries Biologist

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Figure 1. Concrete spillway. It looks in good shape and almost free of debris.

Figure 2. Observe emergent grass and short shrubs growing on the internal slope of dam.

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APPENDIX:

Water Quality Parameters Description:

Dissolved Oxygen

Dissolved oxygen (DO) is a measure of the amount of oxygen available to aquatic organisms, and is reported as mg/l or percent saturation. Percent saturation is a representation of how much oxygen is dissolved in the water relative to the amount of oxygen that can be held at a specific temperature. Colder water can hold more oxygen than warm water. Dissolved oxygen fluctuates daily being at its lowest levels in the early morning hours. DO does not pose a problem for most fish until levels fall below 3 mg/l.

pH

The pH measures the concentration of the hydrogen ions present in the water, and is usually thought of as the measurement of acidic or alkaline conditions. A pH of 7 is neutral with lower values being acidic and higher values being alkaline. Most organisms in lakes prosper when the pH is between 6.5 and 9. The pH cycles daily due to complex interactions of alkalinity, hardness, carbon dioxide, and photosynthesis and respiration. The lake is more acidic in the mornings, and will vary according to depth. When pH levels are out of the desired range for long periods, detrimental affects may occur.

Temperature

The temperature affects many other parameters making it critical to determine and report. It is also a major factor in the reproduction strategies of many fish species. When measured as a depth profile it indicates the possibility of year around trout habitat.

Hardness

Hardness is a measure of the quantity of divalent ions in water. Generally in Georgia, calcium and magnesium carbonate account for the majority of the hardness. Hardness levels affect the toxicity of some algaecides, limit phytoplankton formation, and play a role in fish growth. Levels below 15 mg/l should be increased with the addition of 2-3 tons per acre of agricultural lime.

Alkalinity

Alkalinity is defined as the quantity of base present in water. The most common bases include carbonates, bicarbonates, hydroxides, and phosphates. Total alkalinity is closely related to hardness with both reported as mg/l $CaCO_3$. Alkalinity basically determines the buffering capacity of a lake. A good buffering capacity will absorb introductions of acids and bases minimizing pH levels. By maintaining desired pH levels nutrients are available to phytoplankton resulting in a lake with increased carrying capacity.

Visibility

Visibility is measured with the use of a secchi disk. The white/black disc 20-cm in diameter is lowered vertically through the water until it can no longer be seen. Suspended particles reduce this visibility level. Therefore, in the absence of turbidity from silt or mud the secchi disc serves as an international standard to indicate phytoplankton abundance.