



January 13, 2015

To: Members of the SIC Committee
Milton W. Matthews, President

From: John McCoy, Watershed Manager

Through: Dennis Mattey, Director Open Space and Facilities Services
Department

cc: Columbia Association Board of Directors
Daniel D'Amore, Open Space Maintenance Division

Subject: **Lake, Pond and Stream Water Monitoring**

Background

There are three lakes, more than 40 ponds, 60 assorted stormwater management facilities and over 40 miles of streams on Columbia Association (CA) property. The lakes, ponds, and stormwater facilities are all manmade. They were originally built as stormwater treatment facilities and/or amenities, for our community. They also serve as home to a wide variety of wildlife. The watersheds that serve as the water sources for our streams, ponds and lakes are comprised of residential homes, commercial and industrial areas, roadways and parking lots, public facilities, open turf areas and woodlands. Everything that falls, is deposited, applied or placed on the ground within these watersheds, regardless of the source, has the potential to be washed into our streams, ponds and lakes. Some of the material like animal waste, lawn fertilizer, trash and road wash-off can have a negative effect on the quality of our environment. Attached is a report that outlines the activities CA has initiated to monitor water flow and quality of our lakes and streams.

Next Steps

Following this discussion with the SIC, staff plans to post water quality monitoring data on the CA webpage to let the community know the results of the water quality monitoring. Data will also be shared with the County Health Department. In addition, it is important to advise community members about general conditions (heavy rain storms, for instance) that can result in potential high levels of bacteria. Staff plans to post these advisories near the lakes and on CA's website as a regular practice.

New information related to water quality monitoring data will be posted when received. This will be dictated by sampling frequency and data turnaround by the testing labs. Bacteria data can be posted biweekly with a lag of at least a week after samples are taken based on the time required for the data to be processed by the testing lab. The data return time for the algae sampling is approximately four weeks. Flow monitoring by USGS is posted in real time on their website and the URL for that site can be posted at the lakes and on CA's website. Water Quality data from Howard County is received once a year. That data should be posted on CA's website when received from the county.

Please see the attached report for more information on water quality monitoring and test results.

Lake, Pond and Stream Water Monitoring

Background

There are three lakes, more than 40 ponds, 60 assorted stormwater management facilities and over 40 miles of streams on Columbia Association (CA) property. The lakes, ponds, and stormwater facilities are all manmade. They were originally built as stormwater treatment facilities and/or amenities, for our community. They also serve as home for a wide variety of wildlife. The watersheds that serve as the water sources for our streams, ponds and lakes are comprised of residential homes, commercial and industrial areas, roadways and parking lots, public facilities, open turf areas and woodlands. Everything that falls, deposited, is applied or placed on the ground within these watersheds, regardless of the source, has the potential to be washed into our streams, ponds and lakes. Some of the material like animal waste, lawn fertilizer, trash and road wash-off can have a negative effect on the quality of our environment. This memo outlines the activities CA has initiated to monitor water flow and quality of our lakes and streams and makes recommendations for how CA will report the information to the public on a regular basis.

Water Monitoring

To provide staff and the Columbia community with a better picture of the quality of our waters, CA has begun to develop a comprehensive monitoring program to examine and monitor water flow, nutrients, sediment, bacteria and algae in our main lakes. The intent is to provide information on water quality and to make that information available to the public as it is available.

CA is using several different methods for measuring various aspects of water quality. We are also using other organizations' data, where available. Table 1 presents the various types of data being collected, the organization collecting it and whether they are under contract with CA. Following the table, each of these monitoring components is discussed.

Table 1: Monitoring Program Components

Type of Monitoring	Location	Data Source
Stream Flow Volume	Above Wilde Lake and Lake Elkhorn	CA via contract with the US Geological Survey
In Stream Water Quality Monitoring	Above Wilde Lake	Howard County DPW*
Remote Sensing Water Quality Monitoring	Wilde Lake, Lake Elkhorn and Lake Kittamaquandi	CA via contract with Blue Water Satellite
Bacteria Monitoring	Wilde Lake, Lake Elkhorn and Lake Kittamaquandi	CA via contract with Versar Inc.
In Lake Algae Monitoring	Wilde Lake, Lake Elkhorn and Lake Kittamaquandi	CA via contract with Versar Inc.
Remote Sensing Algae Monitoring	Wilde Lake, Lake Elkhorn and Lake Kittamaquandi	CA via contract with Blue Water Satellite
Sediment Monitoring	Wilde Lake, Lake Elkhorn and Lake Kittamaquandi	CA via contract with Bayland as part of the Large Lake Sediment Management Plan project.

*Howard County DPW monitoring required by State of Maryland Municipal Separate Stormwater Sewer System Permit (MS4 permit)

CA has contracted with the US Geological Survey (USGS) to monitor flow in the creeks that feed Wilde Lake and Lake Elkhorn. The USGS site above Wilde Lake is co-located with Howard County's water quality monitoring site for the County's Municipal Separate Stormwater Sewer System (MS4) permit. These flow monitoring sites provide water quantity data that is tied to CA's Large Lake Sediment Management Plan.¹ Howard County uses the flow data to generate storm event volumes which they report with the water quality data.

The monitoring site above Lake Elkhorn is located on the stream that flows in to Lake Elkhorn, just below where the stream comes under Oakland Mills Road.

Details on Water Quality Monitoring

CA receives the data Howard County collects above Wilde Lake. CA has also contracted with Blue Water Satellite to use remote sensing to monitor phosphorus levels in all three main lakes. Phosphorus is of particular interest since it can result in an overabundance of aquatic plants, both algae and larger plants, in the lakes which in turn can deplete oxygen from the water.

Bacteriological Monitoring. Bacteria are microscopic, single-celled organisms that can be found in virtually any environment. Some bacteria are pathogens and can be harmful to humans when we come in contact with them. Identifying pathogens is expensive and time consuming so in most cases bacterial indicators are used. Bacterial indicators of pollution are common bacterial species found in the intestines of warm-blooded animals, including humans, where many pathogens also originate. Indicator bacteria in a waterway can come from many sources: animal droppings, faulty or leaking sewage systems, stormwater runoff and disturbed sediments.

CA has contracted with Versar Inc. to collect bacteriological data on a bi-weekly basis in the three main lakes through the spring, summer and fall.

Algae Monitoring. Algae are small plants that grow in water. When stimulated by nutrients like nitrogen and phosphorus they can grow rapidly, reaching high enough concentrations to be both unsightly and a potential nuisance. Blue Water Satellite provides remote sensing data on algae concentrations and CA has contracted with Versar to collect algae species concentration data. Both contractors provide data on green and blue green algae. Green algae contribute to the unappealing appearances of the lakes during hot and dry weather. The blue green algae have the potential to be harmful in large enough concentrations.

Sediment Monitoring. Bayland Consultants and Designers, Inc. are monitoring sediment accumulation rates in the three large lakes as part of the Large Lake Sediment Management Plan.

Monitoring Results

The results of the various monitoring reports are summarized below in text and figures.

¹ CA's Large Lake Sediment Management Plan is being developed to prevent the accumulation of large quantities of sediment in Columbia's large lakes through the regular removal of sediment that accumulates in the forebay or upstream area of each lake.

Water Quantity. Water quantity data is presented as volume measured in cubic feet per second, (CFS). Figures 1 and 2 show the volume data at each site for the period of record. Peaks during storm events and low flows during periods of base flow can be seen. In the creek above Wilde Lake, base flow is about 1 CFS and the peak storm flow in May of 2014 was close to 100 CFS. Baseflow in the stream above Lake Elkhorn is around 3 CFS and the peak storm flow on the same date in May was around 250 CFS.

Figure 1 Gauge Height at USGS Site Above Wilde Lake

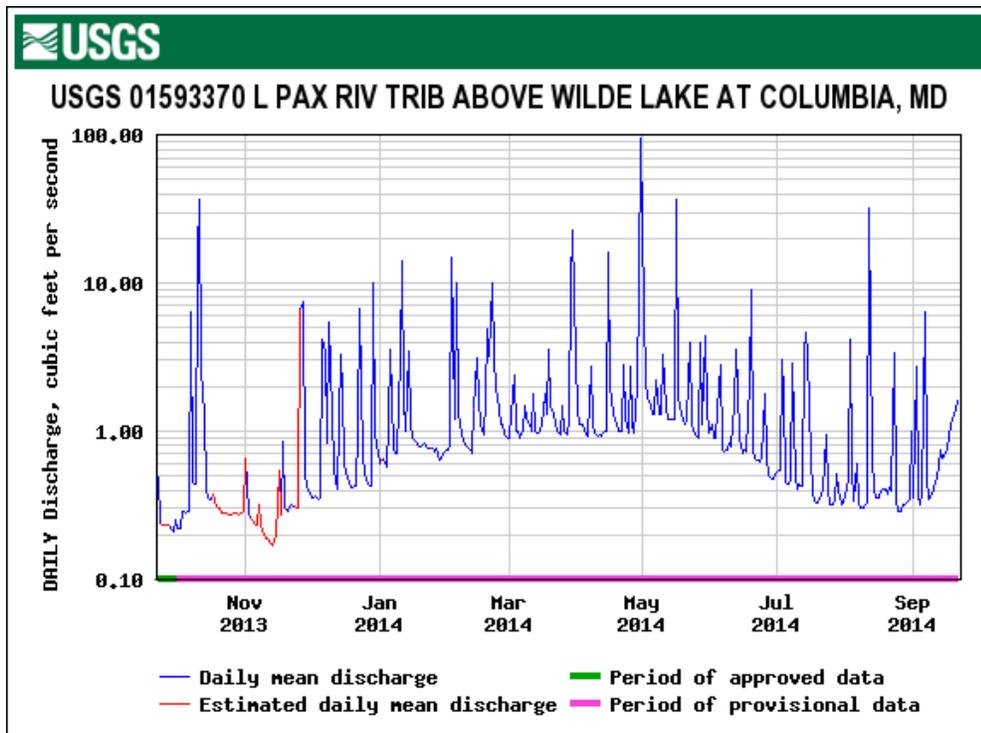
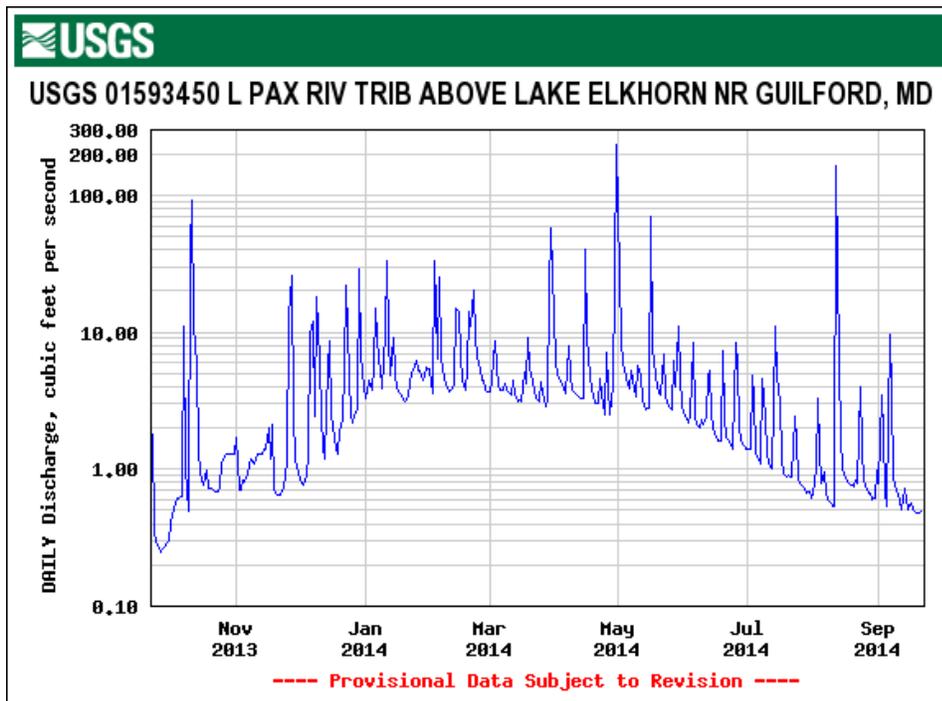


Figure 2: Flow in Cubic Feet per Second (CFS) at the USGS Gauge Above Lake Elkhorn

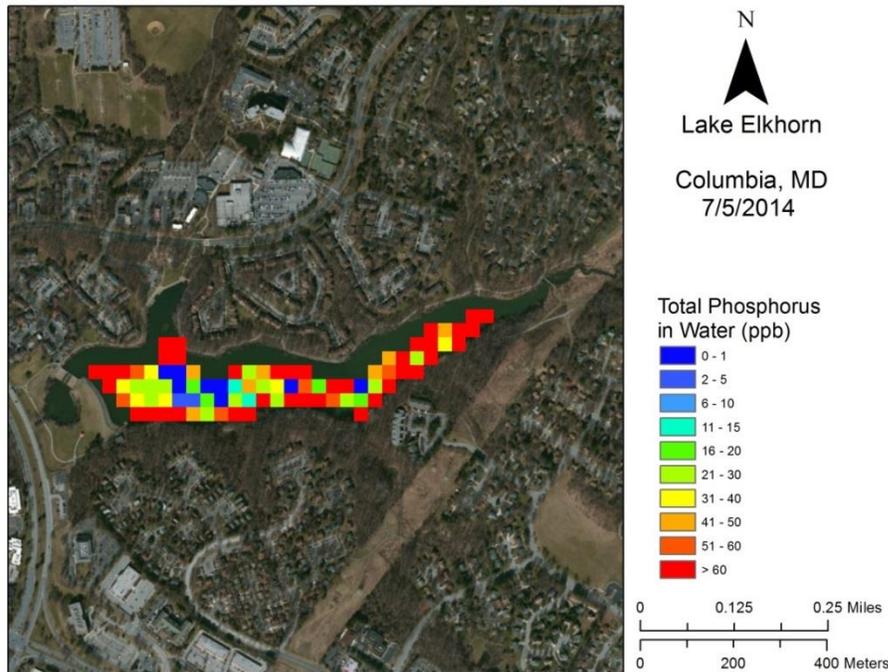


Water Quality

Normal phosphorus concentrations in a stream should be at levels of approximately 0.1 mg/l and nitrogen should be at levels of approximately 2 mg/l.² Water quality data collected by Howard County at the site above Wilde Lake indicates that phosphorus inputs to Wilde Lake are 0.1 mg/l during dry weather, but increase to an average of 0.3 mg/l during storm events and return to low levels after storm events. This means that storm events are washing excessive amounts phosphorus off the landscape and eroding materials containing phosphorus from our streams banks. Nitrogen levels average 2.5 mg/L during both low flow and storm event conditions. This means that nitrogen levels entering the stream systems feeding our lakes are not excessive.

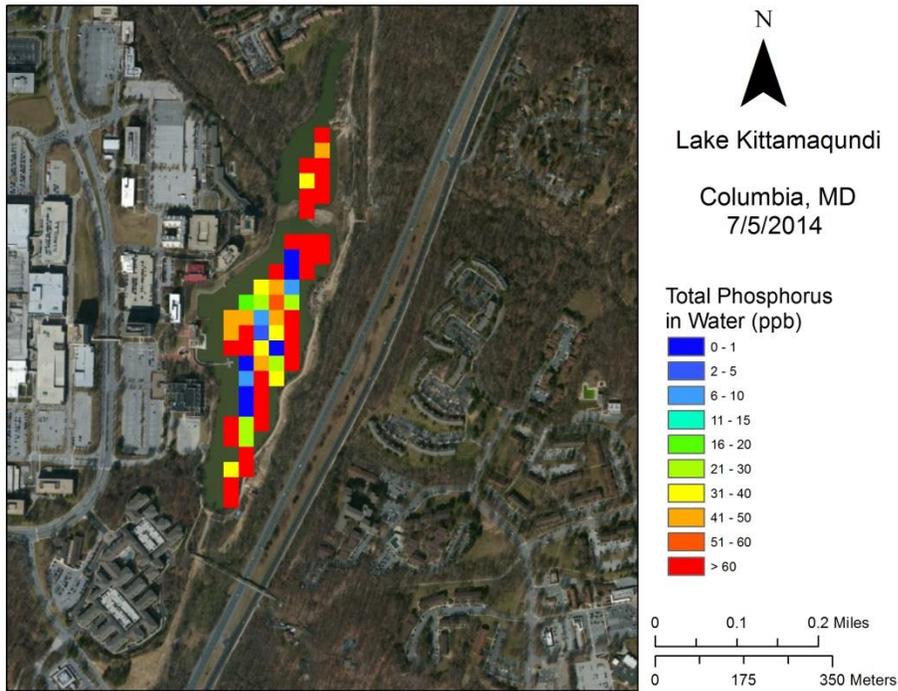
The data collected by Blue Water Satellite indicates that all three of CA’s large lakes had high levels of phosphorus at the time when the images were taken (July 5, 2014). Figures 3 and 4 show the data for Lakes Kittamaquandi and Elkhorn as presented by Blue Water Satellite. The lakes are much more sensitive to nitrogen and phosphorus concentrations than streams because the water stays in one place longer than in a stream, giving plants more time to use the nutrients for growth. A healthy lake should have phosphorus concentrations in the 0.012 to 0.024 mg/L or 12 to 24 parts per billion (ppb) range. Lakes Kittamaquandi and Elkhorn had much higher concentrations based on the Blue Water Satellite imagery interpretation.

**Figure 3: Phosphorus concentration in Lake Elkhorn 7/5/14
(as interpreted from satellite imagery by Blue Water Satellite)**



² Synthesis of Nutrient and Sediment Data for the Watersheds within the Chesapeake Bay Drainage Basin. U.S. Geological Survey. Water Resources Investigations Report 95-4233.

**Figure 4: Phosphorus concentration in Lake Kittamaquandi 7/5/14
(as interpreted from satellite imagery by Blue Water Satellite)**



Bacteria

Bacteriological data collected this year for Wilde Lake and Lake Elkhorn is presented in Figures 5 and 6. The results for Lake Kittamaquandi are very similar. The results indicated that immediately after a rain event, the lakes exceed the State Bacteriological Standard for Infrequent Contact in areas close to where there are inputs like storm drains or streams. The standards are defined as a concentration of the bacterial indicator above which the health risk from waterborne disease is increased. Within several days the bacteria levels return to background or normal levels for the lakes.

Figure 5: Lake Elkhorn Bacteria with Flow

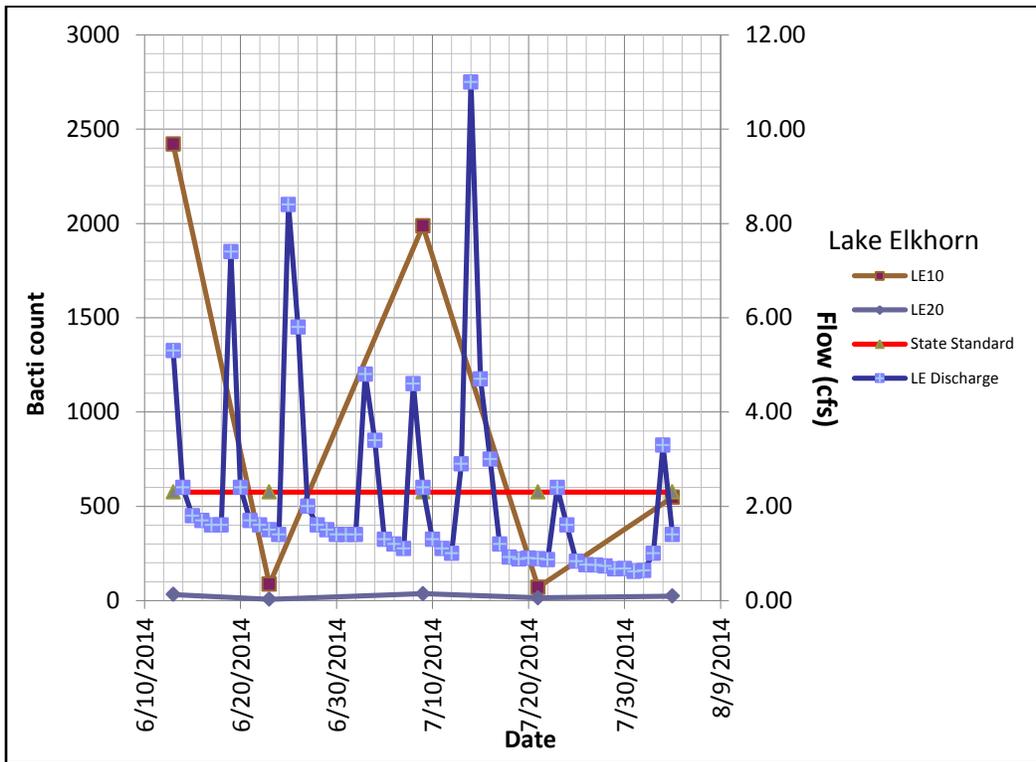
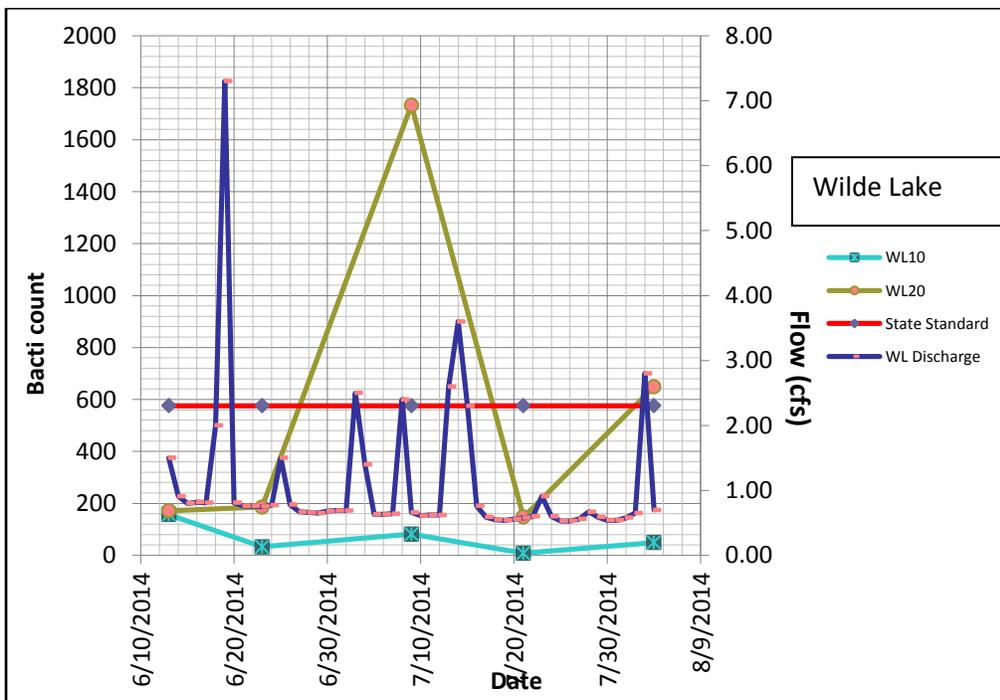


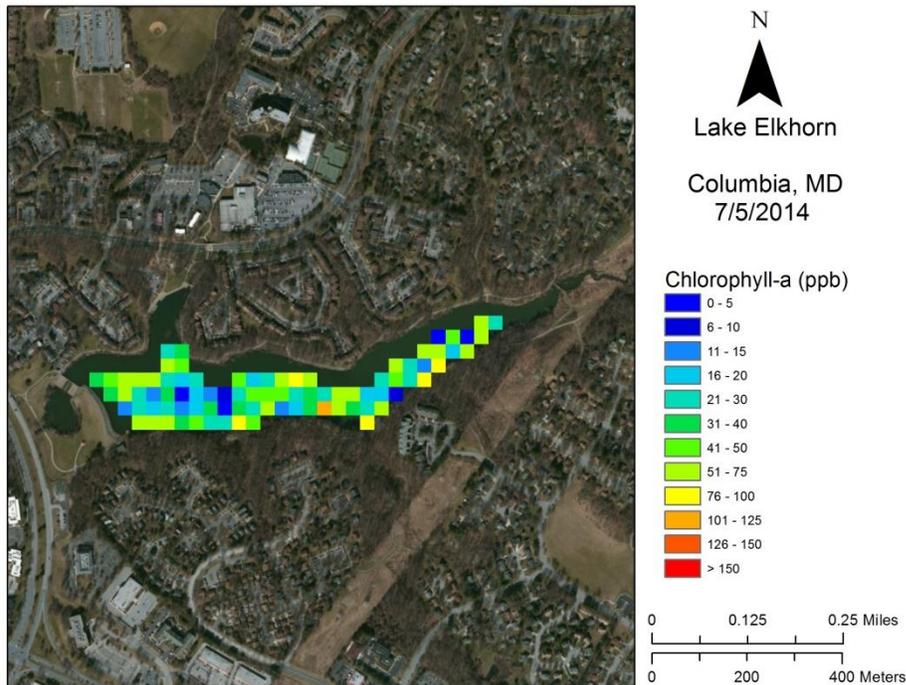
Figure 6: Wilde Lake Bacteria with Flow



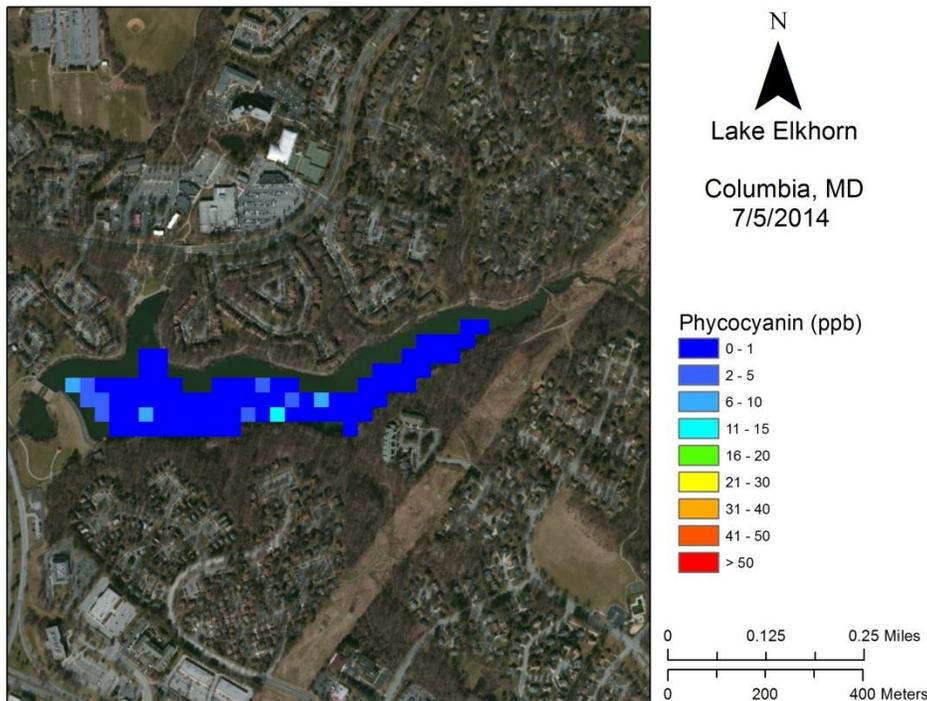
Algae Data

The most recent algae data from Blue Water Satellite for Wilde Lake and Lake Elkhorn is presented in Figures 7 and 8. The results indicate that the lakes have had moderate to high concentrations of green algae and for the most part low levels of blue green algae in early July of this summer.

**Figure 7: Concentration of chlorophyll a in Lake Elkhorn
(as interpreted from satellite imagery by Blue Water Satellite)**



**Figure 8: Concentration of blue green algae in Lake Elkhorn
(as interpreted from satellite imagery by Blue Water Satellite)**



What Do the Results Mean?

The water quality results indicate that runoff during storm events carries excessive amounts of phosphorus and bacteria into our lakes. The phosphorus stimulates algae growth and the growth of other larger plants, causing most of the unsightly conditions in the lakes. The concentrations of algae did not reach levels of concern this summer based on the July 5, 2014 image analysis by Blue Water Satellite.

Bacteria concentrations in the lakes do exceed the State Health Standard for Infrequent Contact after a storm event. Residents should avoid unnecessary contact with water in the lakes for a day or two following a storm event and bathe if they do come in contact with the water in the lakes.

Based on the Maryland Fish Consumption Advisories and state recommendations, fish caught in the lakes should be thoroughly cleaned and cooked before eating. There are also recommendations on the quantity of fish, which applies to our local waters.

What Can be Done?

Columbia's residents and property owners can help reduce water body pollutants, specifically phosphorus and bacteria, in our lakes by not using phosphorus containing fertilizer unless a soil test indicates the need and picking up after their pets both at home and when walking them. They can also install practices like rain gardens that reduce the volume of runoff from their lots. Rain gardens and similar practices will help reduce the stream bank erosion that contributes to the phosphorus in our lakes.

Columbia Association is working to reduce the impact of phosphorus and bacteria to the lakes by limiting its use of fertilizers that contain phosphorus to areas where new turf is being established and areas where turf and landscape plantings are being renovated around facilities and at the golf courses. CA also provides some dog waste bags trash cans for proper disposal near the lakes. The implementation of the Watershed Management Plan includes stormwater projects that will reduce the volume of water in our streams during storms and reduce the stream bank erosion that contributes to the phosphorus levels in our lakes. CA also, with a grant from the Keith Campbell Foundation, offers free soil test analysis to residents to help reduce the use of phosphorus on lawns.

Water quality monitoring data will be posted on the CA webpage to let the community know the results of the water quality monitoring. Data will also be shared with the County Health Department. In addition, it is important to advise community members about general conditions (heavy rain storms, for instance) that can result in potential high levels of bacteria. These advisories will be posted near the lakes and on CA's website as a normal practice. The frequency of posting of new information related to water quality monitoring data will be posted when received. This will be dictated by sampling frequency and data turn around by the labs. Bacteria data will be posted biweekly with a lag of at least a week after samples are taken. The data return time for the algae sampling is approximately four weeks. Flow monitoring by USGS is posted in real time on their website and the URL for that site will be posted at the lakes and on CA's website. Water Quality data from Howard County is received once a year. That data will be posted on CA's website when received from the county.