Come Clean with Campus Lake
By Daniel Nickrent, Professor Emeritus, Plant Biology

1. Come Clean with Campus Lake. Presentation to the SIUC Faculty Senate, Tuesday November 10, 2015, Tuesday December 8, 2015.

2. Dr. Daniel Nickrent. Who am I? Got my B.A. here at SIUC in 1977. Returned to Carbondale in 1990 as an Assistant Professor and retired in 2014 as a Full Professor. So I suspect my history with this institution may go back farther than most people in this room. I want to make sure all you of you understand that the reason I am making this presentation today is because of my long-standing commitment to SIU Carbondale. I love the region and this University that is indeed my home.

3. Campus Natural Areas Stewardship Group. I am here representing not only myself but also the Campus Natural Areas Stewardship Group. This group was initiated in 2013 by Al Parr who felt the strong desire to provide input and hopefully change the direction the SIUC Administration was going with regard to management of natural areas on campus. As you can see, the members have diverse backgrounds but all share the goal of seeing Campus natural areas preserved and properly maintained to maximize multiple uses by the campus community and southern Illinois region.

Charles (Al) Parr (nature photographer, former SIUC employee)
Dan Nickrent (Emeritus Professor, Plant Biology)
George Waring (Emeritus Professor, Zoology)
Jean Sellar (Restoration Ecologist)
Kathleen Fralish (SIU Alumnus, Founder and former President of Center for Comprehensive Services)
Clara McClure (concerned local citizen, environmentalist)
Kevin Horn (graduate student, Zoology)

4. Campus Lake Calendars. You may know of Al Parr from the beautiful calendars he produces that contain photos shot entirely at Campus Lake. I will show some of the incredible biological diversity present right here on Campus Lake if there is time at the end of my presentation.

5. Campus Lake Symbolizes SIUC. Campus Lake is the centerpiece for the SIUC campus and I submit that it is central to our identity, or in advertising lingo - our “brand”. Photos of a beautiful, pristine lake surrounded by the campus are featured in many brochures and on many web pages such as this one about University Housing. Indeed it is this lake, unique among the other Illinois universities, that brings many students to our campus.

6. Campus Lake Important for Many Campus Activities. As shown on this University web page, four out of the top 11 “Things to Do” involve Campus Lake. For our students and all local residents, it aids in the development a healthy lifestyle that includes outdoor recreation and fosters an appreciation for nature thus promoting conservation.
7. Campus Lake Problems Through Time. But Campus Lake has experienced a myriad of environmental problems over its more than 100 year history. Here are just a few of the headlines from DE articles dating back 20 years.

8. 2013 Report to the Illinois EPA. The contamination problems with Campus Lake have apparently become much worse in the past several years causing Lake closure during the summers of 2014 and 2015. This August I obtained a copy of the July 2013 Illinois EPA report, about Campus Lake, authored by three SIUC professors: Dr. Marjorie Brooks, Dr. Frank Wilhelm and Dr. Gregory Whitledge. This report gives extensive detail about results of various tests of the water and land surrounding Campus Lake. This presentation highlights results shown in part C, Water Quality Assessments in 2004 to 2006 and 2010 to 2011.

9. Multiple Stresses Affecting Campus Lake. As shown on this summary graphic from the 2013 EPA report, Campus Lake is experiencing stresses from multiple sources. Today’s presentation will focus particularly on nutrients which include nitrate (NO3), ammonia (NH3) and phosphate (PO4). I will show how increased amounts of these nutrients induce a biological response in Campus Lake, specifically blooms of toxic cyanobacteria.

10. High Nutrient Inputs from Storm Drains. This graphic, taken from the 2013 EPA report, shows the levels of the three abovementioned nutrients in storm drains around Campus Lake in 2010. The green line shows levels of phosphate that is elevated, particularly on the human-developed north side of the Lake.

11. Phosphate Level Increases. Without context, one cannot readily visualize whether the phosphate levels on the previous slide are unusual or not. But comparing levels for two years, 2004 and 2010, one sees that these levels are increased in some cases over 300%.

12. Ground Water Sampling. Dr. Brooks and her crew also measured ground water phosphate levels at several drilling sites. Note that at one site near Lentz Hall on Thompson Point, phosphate levels were greater than 1 mg/liter - a high value. Not shown here is that they also found coliform bacteria such as E. coli in the groundwater samples. As you may know, E. coli is found in the mammalian gut, thus the source was almost certainly from sewage.

13. Sediment Depths Spring 2011. Over the years, this increased nutrient input has resulted in a massive buildup of biomass, i.e. algae and cyanobacteria. Decomposition rates have not kept pace with this increase such that the shoreline has accumulated large amounts of sediment. The recent data compiled by Marjorie Brooks, and given to Phil Gatton last week, indicates that if the decaying algae and cyanobacteria are not removed, this “savings account” will provide nutrients to allow cyanobacterial blooms for another 18 years.

14. Cyanotoxins. It is not simply the biomass accumulation that is a problem. The presence of large amounts of cyanobacteria are of concern because these bacteria produce
toxins called cyanotoxins. I apologize, but it is now time for a short biology lesson. It is important for everyone to have at least a basic understanding of this to appreciate the dangers involved. The photo taken in September shows the characteristic light blue color on the tree trunks. This is where the Microcystis cells have died, leaving blue pigment. The photomicrograph you see here was taken just a few days ago from a sample I collected at Campus Lake. Shown are two types of cyanobacteria: *Anabaena* and *Microcystis*. Both types of bacteria produce toxins, but of different types. Anatoxin-a, also known as the “Very Fast Death Factor” is a potent neurotoxin. Microcystin is chemically quite different (a cyclic peptide) that is a poison of the liver. Microcystin can also cause severe rashes if it contacts the skin.

15. *Microcystis* in Campus Lake. You may be thinking, “OK, he found these bacteria in a sample, but how abundant are they?” This photo shows a sample of water taken a few days ago from Campus Lake just east of Bailey Hall. The microscopic photo to the right shows that the vast majority of the biomass in this container is *Microcystis*. Just because *Microcystis* is present does not indicate that the toxin microcystin is also present. Elisa-based screening tests (Abraxis) conducted by SIUC CEHS for microcystin showed 12 ppb. EPA recommends issuing warnings when the level rises to 10 ppb.

16. September 9, 2015 Meeting at Campus Lake. During the summer of 2015, as with in 2014, Campus Lake was closed to fishing, boating, etc. The smell of sewage was especially strong and the massive growth of cyanobacteria was alarming. These conditions, as well as the 2013 EPA report, motivated the Campus Natural Areas Stewardship Group to call a meeting with the SIU Administration to address this and related issues surrounding Campus Lake. On Sept. 9 we met with these representatives of the SIUC Administration. A summary of the results of that meeting are shown.

In attendance: Campus Natural Areas Stewardship Group and a former president of the Sierra Club, Kevin Bame (Vice Chancellor for Administration and Finance), Phillip Gatton (Director, Plant and Service Operations), Brad Dillard (Associate Director, Physical Plant Service), David Tippy (Superintendent of Grounds, Physical Plant)

Results from this meeting were as follows:
• None of the Admin. representatives admitted to having seen the 2013 EPA report
• We were told they were awaiting the results of smoke tests of the sewer lines on Thompson Point and would share those with us when available.
• None of the Admin. members could identify the organisms contaminating the Lake
• The opinions, views and recommendations of the CNASG represented only one perspective among many; Admin. attempting to juggle multiple uses
• The existing signs posted around the Lake warning of dangers from toxic algae were adequate and that no restrictions to access points for fishing would be implemented.
• The Admin. had difficulty envisioning ecological restoration of the woodlands around the Lake.

17. Fishing Occurs Despite Warning Signs. During our meeting with the Administration, and on several occasions during my walks around the Lake, I noticed that people were
still fishing in the Lake, despite the signs. When queried, this fellow indicated that he had not seen any signs when he parked his car and walked to the Lake.

18. Signs - September 18, 2015. On September 18 I conducted a survey of the Campus Lake signage. I found that large sections of the Lake had no signs, particularly on the west end where piers exist (asterisks) that are frequently used for fishing. The inadequate number of signs was confirmed by Miriam Link-Mullison of Jackson County Health Department. The wording on the signs was also found to be inaccurate and misleading.

19. Why Say “Bacteria” instead of “Algae”? Bear with me - another short biology lesson! The term “algae” is not very useful in biology. “Blue-green algae” is an old term which refers to the group today called cyanobacteria. These bacteria are prokaryotes, i.e. they lack a nucleus, and they occur in one of the three domains of life. “Algae” are all eukaryotes, i.e. their cells have a nucleus, and they are a diverse group of photosynthetic plants. Most of these algae are relatively harmless and indeed some are even used as food. So my objection to the word “Toxic Algae” on the sign did not arise solely from it being biologically inaccurate, but more from the response the two words evoke. Algae seem normal and harmless - that green stuff we see in ponds every summer. If the wording had been “Toxic Bacteria”, which was more accurate, this evokes a different response - DANGER - STAY AWAY!

20. Signs – October 5, 2015 I communicated my concerns about signage to the Center for Environmental Health and Safety and new signs were printed and posted. The number of signs increased, however, the words “Toxic Algae” were retained. The parenthetical words below (Cyanobacteria - microcystin) confused Microcystis (the organism) with microcystin (the toxin).

21. Misinformation in Newspaper Articles. Several newspaper articles about Campus Lake were printed in the DE and The Southern Illinoisian. These quotes show that misinformation abounds.

a. Reed grasses will clean the water. It is not clear which type of “reed grass” is being referred to here - could be Calamagrostis or Phragmites. The latter (P. australis) is one of the most invasive grasses in the US and southern Illinois. No responsible environmentalist would ever propose planting this on Campus Lake. Also, how would the biomass accumulated by any planted “reed grass” be removed from the Lake ecosystem? Opposition to this idea was strongly expressed by Dr. Marjorie Brooks to Dr. Cheng, but the project went forward anyway.

b. [The algal bloom] occurred naturally because of a long stretch of high temperatures and little rainfall. Yes, high temperatures and stagnant water can coincide with algal blooms. But the presence of massive amounts of cyanobacteria stems from nutrients, particularly phosphates, entering this ecosystem. Campus Lake has experienced high temperature and low rainfall during many summers of its existence, but a massive Microcystis bloom did not occur.

c. Depletes the oxygen level of the water. The “algae” (cyanobacteria) are photosynthetic organisms, thus they produce oxygen [as well as use oxygen during respiration]. What depletes oxygen in an aquatic environment such as this is when the cyanobacterial cells
die and this huge amount of biomass undergoes decomposition. That process removes oxygen, thus the water becomes anaerobic. Those anaerobic conditions can result in the death of animals via inhibition of respiration.
d. The algae will dissipate. We are seeing no evidence that the “algae” (cyanobacteria) dissipate. In fact, the scientific evidence shows an increase in biomass along the shores.
e. The algae ... is [are] naturally occurring. Yes, these “algae” (cyanobacteria) do occur in nature, but their abundance is caused by pollution of the Lake environment from a human source.
f. Cold weather will kill the toxin. Cold weather will kill some of the *Microcystis*, but this does not “kill” (destroy) the toxin. Again, confusion between the organism and toxin it produces.
g. High nutrients and cyanobacterial levels come from E. coli. No! The nutrients come from sewage. The cyanobacteria in the Lake bloom because of the nutrients in the sewage.
h. We are having a hard time proving AND BELIEVING that it [contamination] came from Thompson Point. Look at the data collected by Marjorie Brooks (my slide 11, her Figure 44). There is no question this is coming from Thompson Point, and likely surrounding areas on campus via storm sewers.

22. Utilize Local Expertise! “SIU has the brains of a nationally ranked research university and the heart of a small college” (SIU Brand book, pp. 2.10, 4.7.2). This “branding” phrase was invented by the Chicago based marketing firm Lipman-Hearne: “SIU has the brains of a nationally ranked research university and the heart of a small college” (SIU Brand book, pp. 2.10, 4.7.2). Indeed SIUC has an amazing assemblage of world-class experts who could help address the problems faced by Campus Lake and propose reasonable solutions. But why are they not being consulted? Why when they volunteer their time and expertise are they ignored?

*Specialists at SIUC*
Dr. Marjorie Brooks (Zoology - aquatic biogeochemistry and ecology)
Dr. Michael Lydy (Zoology - aquatic toxicology)
Dr. Matt Whiles (Zoology - freshwater ecology, particularly invertebrates)
Dr. Gregory Whitledge (Zoology - fisheries and aquatic sciences)
Dr. Edward Heist (Zoology – conservation & population genetics of fish)
Dr. Loretta Battaglia (Plant Biology - wetland plant community ecology)
Dr. Sara Baer (Plant Biology - restoration ecology)
Dr. Stephen Ebbs (Plant Biology - ecotoxicology, pollutant biogeochemistry)
Dr. Daniel Nickrent (Plant Biology – flora of Illinois)
As well as the CNASG and many others

The CNASG had been communication with the Admin. for over a year about developing a management plan for Campus Lake (and other areas on campus such as Thompson Woods). Although a productive dialog had begun with Chancellor Paul Sarvela, this stopped following his death. Our group had reviewed numerous natural area mangement plans from other US universities and were interested in preparing one tailored to SIUC.
The current SIUC Administration is apparently not interested in working with CNASG, even when they could obtain such expert advice free of charge.

23. Questionable Decisions. On Oct. 3, 2014 university Administrators closed Campus Lake. On April 25, 2015 the 42nd annual cardboard boat regatta took place on Campus Lake. As usual, many of the participants ended up in the water. On June 19, 2015 university Administrators closed Campus Lake because of “algal” blooms. I have many questions about what happened. Was Campus Lake officially opened some time in the spring? Was this decision based on empirical evidence, in other words, tests that showed the absence of Microcystis? But just seven weeks after the regatta, Campus Lake was closed again owing to toxic cyanobacteria. Were the bacteria absent at the time of the regatta and somehow became so abundant in seven weeks that the Lake had to be closed?

24. Testing for broken sewer lines. Compromised sewer lines were detected December 2010 to April 2011 on Thompson Point and reported in the EPA report by Brooks et al. (2013). Smoke tests conducted prior to September 2015 were positive (pers. comm. Ami Ruffing, Center for Environmental Health & Safety. Phil Gatton, Dir. PSO, was quoted in the Daily Egyptian Oct. 1, 2015 as saying “[The pipes] should last 30 years. Now we’re at 60 years, so it’s probably getting to the point where [the pipes are] reaching an age where [they’re] going to have some maintenance issues”. Camera tests by RJN Group took place November 2-6, 2015. “… the nearly 60 year old pipes were in surprisingly good condition” (DE Dec. 7, 2015). “A section of storm sewer pipe was found broken near Lentz Hall, and Gatton said it has the potential to effect the sewer pipes around it” (DE Dec. 7, 2015)

25. Ground Boring Confirms Presence of E. coli in Soil. As reported in the DE 7 Dec. 2015, the ground boring tests of four samples showed E. coli in the soil. This confirms the tests conducted years before by Marjorie Brooks.

26. Sewer System on Thompson Point. This schematic shows their approximate positions of the lines with nodes representing manhole access points. When outside sewer lines are compromised (blocked, broken, leaking), sewer water may leak into the surrounding environment. But according to plumbers at Baker & Sons, this sewer water seldom moves very far from the line. The other outcome from compromised sewer lines is that sewer water can backup into a building, often on the lower floors.

27. Sewage Backup in Basements of Thompson Point Dormitories? This is the issue that has not received adequate discussion. Although the night shift plumber James C. Willis nor the Lentz Hall foreman Joyce Davis would not speak with me about this issue, other SIUC employees such as custodian Brian W. Bolte and former Director of Residence Life Steven Kirk, informed me that flooding has, in the past, been a constant problem with all the dorms on Thompson Point. Brian and others have been involved in cleaning up the raw sewage on many occassions, especially when the ground outside is saturated following rains. How this raw sewage is dealt with is the issue here. It appears the sewage was not pumped into containers for proper disposal. It was either pumped into storm
sewer lines (that go to Campus Lake) or into hoses that were run out of the building, across the lawn, and directly into Campus Lake. One can argue over whether this has happened or not, but the important point today is to make sure it does not happen again. Proper disposal methods should be employed if it should occur.

28. Explosive manholes. Moreover, the sewage backup problem has on some occasions been so severe as to blow the covers off of sewage manholes located near Bowyer and Steagall Halls. Notice that there has been work around these exact manholes and more recently flagging has been placed on the ground between these two locations. The conditions of the manholes, as related in the December 7, 2015 DE article, is in some cases poor. To leakage between sanitary sewer and storm sewer systems is acknowledged as a potential source of the Campus Lake contamination.

29. Campus Lake Remediation Steps.
1. Stop sewage entry into the Lake. Provide alternate sewage disposal methods should dormitories flood.
2. Pump water from Lake to reduce level by at least 1 meter
3. Manually remove and properly dispose of cyanobacterial and algal biomass along entire Lake perimeter (avoid PCB contaminated area)
4. Allow Lake to refill from normal rainfall events
5. Restore riparian vegetation
6. Monitor fish populations and conduct proper management strategies to restore a balanced biological community
6. Involve faculty experts and the CNASG in developing a management plan that includes Campus Lake and other green spaces.

30-51. Some photos of Campus Lake, all taken by Al Parr. While viewing these, ask yourself the question “do we want to keep Campus Lake on the SIUC campus?” If so, are we prepared to take the steps necessary to maintain it as a beautiful and pedagogically valuable environment?