

AGENDA

2014 May 8

Regular Meeting: 6 pm

Lincoln City, Council Chambers

801 SW Hwy 101, 3rd Floor



Devils Lake Water Improvement District

Post Office Box 974, Lincoln City, Oregon 97367

Phone: (541) 994-5330 Fax: (541) 994-6040

www.DLWID.org

Quick Look:

- Board Appointment
- HABs
- Devils Lake Revival

I. Roll Call

II. Consent Agenda

- Minutes of the Previous Meetings
- Financial Report

III. Special Order of Business

- Board Appointment: Applicants are invited to address the board about their application.

IV. Comments from Citizens Present on Agenda/Non-Agenda Items:

This is an opportunity for members of the audience to bring to the District's attention any item not listed on the agenda for public hearing. Comments are limited to five (5) minutes per citizen, and the Board of Directors may use the light system. Speakers may not yield their times to others, and as a general rule this is not a time for exchange of questions. At the conclusion of this agenda item, a board member may discuss or raise questions regarding an item presented by a citizen. The Chair has the authority to reduce the time allowed for comment in accordance with the number of persons present and signed up to speak.

V. Unfinished Business

(Agenda Support Item A)

- The Devils Lake Plan
 - Septic / Sewer
 - Save our Shoreline
 - Vegetation Management
- Communications Report
- Safety Report
- MidCoast TMDL
- East Devils Lake Road
- Policy Updates
- Harmful Algal Blooms

VI. New Business

(Agenda Support Item B)

- Water Quality Monitoring
- Devils Lake Revival
- Intern

VII. Non-agenda Items

VIII. Additional Comments from Citizens Present on Non-Agenda Items:

This is an opportunity for members of the audience to bring to the District's attention any item not listed on the agenda for board discussion. Comments are limited to five (5) minutes per citizen, and the Board of Directors may use the light system. Speakers may not yield their times to others, and as a general rule this is not a time for exchange of questions. At the conclusion of this agenda item, a board member may discuss or raise questions regarding an item presented by a citizen. The Chair has the authority to reduce the time allowed for comment in accordance with the number of persons present and signed up to speak.

IX. Board Comments & Announcement

X. Adjournment

Meetings of DLWID are handicapped accessible under the ADA.

If special accommodations are needed, please contact the District Office at (541) 994-5330 48 hours prior to the meeting.

**Staff Reports 2014-05-08
Robertson**

Special Order of Business

Board Appointment: The District received 3 applications for the vacancy left by Noel Walker's resignation. Copies of the applications have been forwarded to the Board. Candidates are invited to address the Board at this meeting with an appointment and swearing in anticipated immediately following.

Applicants:

- Tina French
- Jeff Komer
- Kent Norris

Unfinished Business

Agenda Support Item A

- a. **The Devils Lake Plan:** A watershed based plan adopted by the Board in 2011 that seeks to address the root causes of nuisance aquatic vegetation and/or Harmful Algal blooms which are excessive nutrients.

Executive Summary excerpt:* "Devils Lake is a shallow, 680 acre coastal lake that has long suffered from the effects of inputs of excess nutrients. Most prominent of these effects was the domination of the lake by nuisance aquatic plants in the 1980's. Aquatic weed infestations largely choked the lake covering over 60% of the surface. Recreation was greatly impacted, and property values were in decline. In 1984, a local government entity, Devils Lake Water Improvement District (DLWID), was formed with the purpose of improving water quality, improving the environment for fish and wildlife, and generally reestablishing beneficial uses, including safe navigation and public access.

"Current concerns in the watershed are ongoing inputs of nitrogen and phosphorus, increasing sedimentation, erosion, stormwater, annual cyanobacteria blooms, and the threat of the return of nuisance aquatic plants to the lake."

*View the full document online: http://www.dlwid.org/Projects/Devils_Lake_Plan/Devils_Lake_Plan_v2.1.pdf

Projects within the scope of the plan are being worked on simultaneously and are listed on the Agenda and in this staff report as subheadings. Updates to the work on the projects are presented month to month as change happens and are left on the agenda until the project is complete. For a full background and all updates, please refer to previous staff reports and the Projects Page of the District's Website under these headings: <http://www.dlwid.org/Projects.html>

i. Septic / Sewer

- <http://www.dlwid.org/Projects.html#Septics>
- <http://www.dlwid.org/Projects.html#Sewer>

Work continues on improving the sewer infrastructure in the watershed. Budgeting for a sewer master plan upgrade is being proposed by the City for FY 2014-2015.

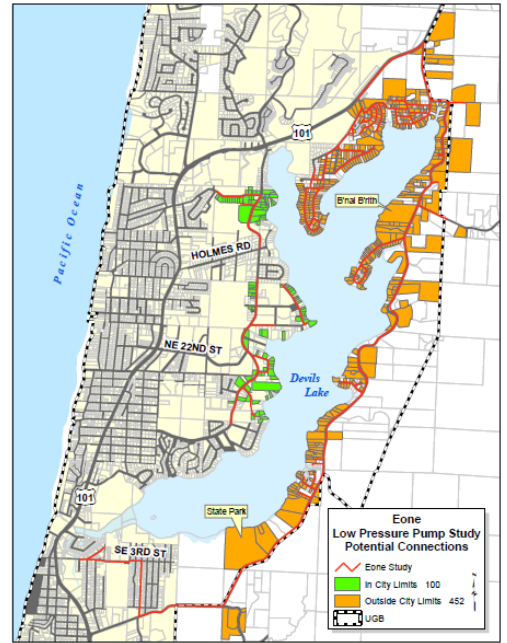
To Do and Pending Items:

- Copy of the draft Urban Growth Management Agreement forged in the 1990's: Lincoln County
- Copy of UGMA with Toledo: Lincoln County
- Full buildable lands inventory: Lincoln County
- Urban Growth Management Agreement: Lincoln City and Lincoln County
- Sewer Master Plan Update: Lincoln City
- Environmental Review of low pressure sewer backbone: City & DLWID

Voyage LID: (Chair Green)

Direct Link to Engineer Report:

http://www.dlwid.org/Projects/Sewer/Voyage_LID.pdf



ii. Save our Shoreline (SOS)

- <http://www.dlwid.org/Projects.html#SOS>

I conducted one site visit this last month which I provided the planting guide and comments. Interested party is pursuing a project with a private landscaper and will seek reimbursement. They understand they need to provide a plan ahead of the project which I can review and approve.



While we no longer have a fulltime staff person administering this program, we continue to provide consultations and certainly have funding available for suitable proposals.

iii. Vegetation Management

- <http://www.dlwid.org/Projects.html#Vegetation>

No Update.

b. Communications Report

- Internet Streaming: Meetings the DLWID are now available for live streaming and/or recorded streaming on the internet. The internet feed can be accessed via the City's website: <http://www.lincolncity.org/> by clicking on Agenda, Packets & Video or from the following link: <http://lincolncityor.iqm2.com/citizens/default.aspx>

- Government Access Channel 4: The District's monthly meetings continue to be broadcast live and throughout the month repeatedly airs. This channel is available for Charter subscribers.
- Social Media: The District uses these social media components to reach the general public periodically.
 - YouTube: <http://www.youtube.com/user/DLWID>
 - Facebook: <https://www.facebook.com/DevilsLake.Oregon>
 - Twitter: https://twitter.com/Devils_Lake
- KBCH am 1400: The District has had a standing interview spot on the THIRD Tuesday of the Month from 7:30 – 8:00 am.
- E-Newsletter: Spring into Action! 2014 edition was released and is available through our website or on the web at: <http://myemail.constantcontact.com/Clearwater-e-Newsletter--Spring-2014.html?soid=1102761961457&aid=CskIPIsdjzk>



Clearwater
An E-Newsletter from
Devils Lake Water Improvement District

Spring 2014

- [Water Quality](#)
- [Squeaky Tanks](#)
- [Limnology 101](#)
- [Why Lakescape?](#)
- [Round Down & Round Out](#)
- [Save our Shoreline](#)
- [Budget & Board](#)
- [Calendar of Events](#)

Spring into Action!

In this issue we wanted to provide the public a few tools you can use to help restore Devils Lake. Many are free, low cost, or will even save you money. In fact be sure to check out the [Devils Lake Revival RFP](#) shown under the *Calendar of Events* where you could even get paid helping others get more educated on lake restoration! So break out those gloves and let's get to work!

- **Concerned about potentially failed Septic Systems?** Call, email, or make public comment at City Council and voice your support for a Mandatory Septic Inspection Program for all watershed properties. Your voice matters, but only if it is heard. Get a direct line to your elected officials through the links below in *Squeaky Tanks*.
- **Want to help destroy Harmful Algal Blooms?** It is easy, and every homeowner around Devils Lake can get started today by planting the shoreline with native vegetation. Not only does the vegetation help keep nutrients out of the lake which support algal growth, but the woody vegetation produces natural algaecides when it decays, combatting a green lake. Read more about this in *Limnology 101*.
- **Free yourself from chemicals!** Living on the shoreline and in the watershed we have a responsibility to the lake. Excess nutrients from fertilizers wash off or percolate through the soils, eventually working their way to the lake. Here they feed Harmful Algal Blooms, turning the lake green.

Join Our Mailing List

Invasive Spotlight: Scotch Broom



- c. **Safety Report** (Robertson) We recently updated our Safety Policy and have incorporated safety components into the Personnel Policy and Procedures. A formal Safety Manual will be developed in the coming months. Safety is no accident!
- d. **MidCoast TMDL** (Robertson)
- <http://www.dlwid.org/Projects.html#TMDL>

Department of Environmental Quality (DEQ) has begun the planning process for developing an Implementation Ready - Total Maximum Daily Load (IR-TMDL) for 303(d) listed waterbodies in the Oregon Mid-Coast Basin. The initiation of this TMDL process has been a long-time in the works and the process itself will be lengthy stretching over the next 18 - 20 months. Devils Lake is listed for Weeds/Algae, Chlorophyll a and pH and Thompson Creek is listed for fecal coliforms, and thus as a local government we have been invited to participate. Notably, temperature listings are also proposed by EPA for the lake and one of its tributaries. Representatives from local, state and federal government, special districts, Tribal Nations, private industry, forestry, agriculture, conservation, NGOs, watershed councils, landowners, and others were also identified.

- Links to the DEQ's website are posted below.
<http://www.deq.state.or.us/WQ/TMDLs/midcoast.htm>
<http://www.deq.state.or.us/WQ/TMDLs/midcoastLSAC.htm>

Stakeholder Meeting: At the last stakeholder meeting updates were provided on the Sediment and Bacteria TWG. No updates on the Temperature TWG as it is still in a legal dispute. View the website for more information.

Bacteria Technical Working Group: No meeting since our place meeting. Next meeting is June 11, 2014.

e. East Devils Lake Road

- <http://www.dlwid.org/Projects.html#EDLR>
No Update.

f. Policy Updates: Postponed until further notice due to HABs.

The District has proposed updates and additions to its Policy Manual for the following items: **(Highlighted require further actions)**

- Policy and Procedures Manual (Adopted 2014-02-13)
- **Personnel Policy/Manual (Draft sent 2013-12-31: reviewed, edited, and tabled)**
- Mandatory Reporter Policy (Adopted: May 2013)
- Safety Policy (included in larger update)
- Financial Manual (Adopted 2014-01-09)
- Records Policy (Adopted 2014-01-09)
- Board Duties and Responsibilities (See Policy and Procedures Manual)
- **MSDS (Postponed until 2014 changes)**
- Employee Training (Policy added to Personnel Policy - **Safety Manual forthcoming separately**)
- Light Duty Return to Work (included in Personnel Policy)
- **Investment Policy (Draft Sent 2013-12-31: Reviewed, edited and tabled)**

Links to these drafts are available on the website:

[http://dlwid.org/Board%20Directors.html#Board Official Actions](http://dlwid.org/Board%20Directors.html#Board%20Official%20Actions)

g. Harmful Algal Blooms: The District presented information about lake management strategies associated with reducing Harmful Algal Blooms, aka blue-green algae aka cyanobacteria at its last meeting, plus held a workshop on a Saturday April 19th on this matter. This was well attended and video and presentation are available on the District's Meetings page. Certified Lake Manager and Hydrologist, Joe Eilers of MaxDepth Aquatics provides this summary of the meeting and offers these recommendations:

1. Continue with a long-term view. Most management actions on lakes deal with short-term issues and responses to vocal individuals and groups. I applaud the DLWID for being an exception to this pattern and urge you to stay the course on long-term planning and execution. There little doubt in my opinion that any long-term solution to Devils Lake should involve a reduction in nutrients loads from the watershed. There is not much quantitative information regarding the sources of nutrients to the lake. KCM conducted a study in 1981, but I can't see where they collected much nutrient and flow data from potential sources.* The goal of reducing watershed sources of nutrients requires attention to a variety of sources and sinks. These include the following:

**This is not a criticism of the study because I don't know what they had for resources or what was the scope of work. In addition, we now have considerably greater access to spatial data and advances in instruments have greatly facilitated data collection.*

a. Forests: timber harvest was probably a major source of sediment and nutrients to Devils Lake earlier in the 20th century, but is likely not a major source of nutrients in the 21st century. There are some isolated areas where unregulated timber harvest could pose problems with regard to sediment and nutrient loading. My experience with DOF is that they are not highly vigilant in monitoring timber harvest practices and are certainly not aggressive in prosecuting any lapses of timber harvest practices. So, if you are aware of timber harvest in the watershed, I suggest you monitor the situation.

b. Agriculture/Livestock: my understanding is that the one dairy in the watershed has discontinued operation. Horse operations remain in the watershed. They can be problematic because they tend to be concentrated in smaller areas. If the geometry of these sites promote rapid drainage into surface networks, efforts should be taken to control the runoff. There are usually funds from NRCS to support these types of actions.

c. Wetlands: there is clearly less wetland coverage in the watershed compared to historical conditions. The extensive wetland at the mouth of Rock Creek is an excellent example of the type of wetlands that performs well in filtering sediment and assimilating nutrients. Additional wetland coverage would be beneficial, particularly if it can be located off the mouth of Thompson Creek and intermittent streams/drainages.

d. Urban Development: this has been the most profound landuse change in the watershed. Housing and similar development actions promote lake eutrophication through three distinct processes. First is the input of nutrients through septic systems. The soils in the watershed contain a high percentage of sand which promotes good drainage. However, these soils have poor properties for retaining nitrogen and phosphorus. Although few of the septic systems adjacent to the lake fail in the traditional sense (waste percolating to the surface), they likely perform poorly with regard to protecting the lake from seepage of nutrients. Anything that can be done to control wastes from the septic systems will yield long-term benefits for the lake. Conducting dye studies from selected homes can be a powerful message that septic inputs are significant. A passive measurement technique is to measure luminescence .

A second aspect of development that contributes to increased loading of nutrients to the lake is the roadways and storm drains that divert runoff directly to the lake. The infrastructure that accompanies housing development promotes rapid transport of water and effectively moves it to the lake. Any nutrients in the pathway make it to the lake unabated. The third aspect of housing development that contributes to eutrophication is the use of fertilizers applied to lawns and landscaping. Rather than having finely pruned landscape that requires the input of artificial fertilizers, homeowners should be encouraged to allow grasses to grow long, convert to foliage that is native to the area, and eliminate the use of fertilizers. It is likely that most fertilizer applied to yards close to the lake will eventually arrive in the lake.

e. In-Lake Activities: There have been several important changes in Devils Lake that have taken place since the 1981 KCM study. One is the advent of wakeboard boats and their popularity in Devils Lake. Their purpose of these craft is to generate large waves that allow participants to "surf" the wake. One problem is the height of these waves, which can approach 3 ft near the boat. The other problem is that most of the wave action is generated along the length of the lake which means that waves are primarily orthogonal to much of the shoreline. In contrast, the natural, wind-generated waves are typically from north to south or south to north. When multiple boats are operating on the lake, some of the boat-generated waves will cancel one another, but others will coincide causing harmonics that result in waves being greater than the individual waves. The waves generated by speed boats and wakeboard boats likely contribute to shoreline erosion, an additional source of nutrients. A second change in the lake is the use of the dam at the outlet of the D River to maintain a higher than normal lake stage during the recreational period. An elevated lake stage, combined with boating, delivers greater energy higher up the shoreline, which again promotes erosion. Third, the grass carp were introduced to the lake in the 1980s. The fish were successful in eliminating virtually all macrophytes, except some resistant species such as *Nuphar*. Submerged, floating and emergent macrophytes dissipate considerable wave energy, which historically helped to protect the shoreline. A return of macrophytes at some manageable level will assist in reducing shoreline erosion and disturbance of the lake sediment.

2. Consider Conducting Long-term Monitoring. A natural adjunct to long-term planning and execution is long-term monitoring. Monitoring nutrient chemistry, chlorophyll and phytoplankton community composition is essential to documenting how the lake changes in response to natural and anthropogenic factors. Not only are these data needed for documenting conditions and trends, but also for informing the public. I recommend the following:

a. Weather Station: The current closest official weather station is in Otis, which may represent what occurs on the lake. Also, if any hydrodynamic modeling is conducted on the lake, it is best to have an on-site weather station, particularly for wind speed and direction. I recommend an Onset Computer weather station equipped with an anemometer, air temperature, relative humidity, photosynthetic active radiation (PAR), and rain gage (model U30-NRC-SYS-B; S-LIA-M003; S-RGB-M002) (\$2450).

b. Lake Stage: Lake stage can be measured continuously with a pressure transducer (PT). If you use an unvented PT (cheaper and more trouble-free), you will need a second PT operating above the water to allow for corrections in barometric pressure. I recommend an Onset Computer model U20L (\$300 ea.).

c. Streamflow: discharge should be measured at three sites, Rock Creek, Thompson Creek, and the D River. This would require 3 additional PTs. The District has a flow meter which will be necessary for developing rating curves for the three sites.

d. Water Temperature: I recommend collecting water temperature at three sites: Rock Creek, Thompson Creek and in Devils Lake. For the lake site, it would be ideal to hang three thermisters from a buoy at depths of 1m, 3m and 6m.

One type of monitoring design commonly used consists of continuous deployment on a fixed schedule. This is desirable when an intervention or experiment is planned because it allows one to view changes as they happen. However, this approach is relatively expensive and inefficient if anticipated changes are small and not expected over a long period. In this case, an alternative design to consider is a "wheel and axle" design which involves fairly intensive data collection spaced with low-intensity sampling in the intervening period. A long-term monitoring approach such as this might involve an intensive effort once every five years, interspersed with low intensity sampling to tie the intervening five-year cycles together. If changes occur to the lake that suggest it would be beneficial to increase intensity of sampling, design changes can be accommodated within this framework.

3. Short-Term Restoration Activities: There are few short-term treatments available for a lake such as Devils Lake to treat the symptoms of eutrophication (algae blooms). Chemical treatments to inactivate the phosphorus (alum and phoslock) are expensive and would not be long lasting in this shallow, short-residence time system. Chemical dyes suffer from similar limitations. Other chemical treatments such as herbicides and oxidants (sodium percarbonate and titanium dioxide) only kill the cells present and do not inhibit regrowth of the phytoplankton. Furthermore, application of these chemicals during a bloom will likely release cyanotoxins turning an unpleasant situation into a public health risk. Again, their positive effects are short-lived. Circulation is one method for minimizing (but not eliminating) cyanobacteria through disruption of the habitat. Circulation can be achieved using circulation devices (e.g., SolarBees) or through aeration. Previous attempts to propose SolarBees for Devils Lake were met with strong resistance by members of the community because they were perceived as hazardous to boating-related recreation. Aeration is an alternative means to circulate water and, if configured properly, can move far more water than solar-powered circulators. Aeration has the benefit of not requiring any surface devices and would not pose risk to the current fishery or other wildlife. Aeration may require that the applicant obtain easements from DSL to use the lake bottom (which is owned by the State). Additionally, multiple structures would have to be constructed around the lake to house the compressors and power would need to be brought to these structures. There would be ongoing costs for power consumption and the aeration lines would likely require annual cleaning to remove accumulated organics. Usually this is done by running a strong acid through the lines. Other costs include replacing compressors and distribution equipment. It's unclear if the aeration lines would interfere with fishing. I suggested that before you proceed with a whole-lake application that you consider conducting a pilot study in one of the northern arms of the lake. This would not be a scientifically valid paired study of "with treatment/without treatment" because the arms of the lake differ from one another in multiple respects. However, it would provide management with some indication regarding how the logistics of aeration would work and what types of challenges would have to be addressed to treat the entire lake. Partial lake treatments are problematic because lake restoration techniques are configured based on treating the entire problem. Wind-generated currents are expected to move water into the embayments and likely overload the aeration systems' ability to suppress cyanobacteria. However, there should be some periods where it would be possible to compare

conditions in treated and untreated arms. There have been some applications where aeration has resulted in increasing cyanobacteria populations in lakes. Usually these are associated with treating deeper lakes that have anoxic hypolimnia. In these cases, anoxic water which is rich in nutrients is driven to the surface where it promotes cyanobacteria growth.

Some biologists have pointed to the use of mussel cultivation as a means of improving water quality (Haamer 1996; Lindahl et al. 2005; Stybel et al. 2009). Bivalves have a remarkable capacity to filter water and they have been used in Sweden to achieve positive effects on water quality, usually represented by increased water clarity. Freshwater mussels, which do reside in Devils Lake, would probably have little commercial value because of the potential for the mussels to accumulate cyanotoxins. However, their cultivation and harvest might provide an economical and effective means of reducing total phosphorus, reducing phytoplankton, and increasing water clarity. Use of mussels to improve water quality in Devils Lake might warrant further investigation.

It is important that some macrophyte growth return to Devils Lake. The macrophytes provide multiple benefits including competition with phytoplankton for nutrients, increased habitat complexity, increased stability for shallow sediments, and reduction of shoreline erosion. Although it is believed that the grass carp population is low, it is apparently still sufficient to graze the macrophytes and prevent their recovery. If DLWID is successful in obtaining a permit from ODFW to continue stocking Devils Lake with triploid grass carp the District should proceed cautiously with regard to future stocking rates. Specifically, it is my recommendation that no additional grass carp be stocked in Devils Lake until there is evidence that the macrophyte density is increasing.

Haamer, J. 1996. Improving water quality in a eutrophied fjord system with mussel farming. *Ambio*. 25:356

Lindahl, O., R. Hart, B.Hernroth, S. Kollberg, L.Loo, L. Olrog, A. Rehnstam-Holm, J. Svensson, S. Svensson, and U. Syversen. 2005. Improving marine water quality by mussel farming: a profitable solution for Swedish society. *Ambio* 34:131-138.

Stybel, N., C. Fenske, and G. Schernewski. 2009. Mussel cultivation to improve water quality in the Szczecin Lagoon. *J. Coastal Research*. 5

Notes on Meeting/Presentation for DLWID, April 19, 2014 (numbers refer to slide numbers)

1. Lake Bathymetry. Note that the lake stage at the time of the bathymetric survey was believed to be 8.75 ft MSL. However, I have since learned that the lake staff gage was installed incorrectly and the actual stage at the time of the survey was 8.95 ft. This change is not reflected in the estimates of lake volume, depth or area.

2. High or Low Lake Stage? The purpose of this slide was to present several of the Pros and Cons of keeping a lake stage at an artificially high or a more natural (normal) lower summer recreation stage. Although I tried to couch the discussion that followed in terms of what was best for the lake, the discussion quickly moved to what was best for boaters. Specifically, I prefaced my comments with assumptions on goals. For example, if one's goal was long-term protection of the lake then one would favor a lake stage regime that was relatively close to

natural cycles -- high stage in the wet months with lower stage in the drier months. This had the advantage of allowing the septic drain fields to dry out to some degree and at least reduce the degree of inundation of the septic fields. It also has the advantage of allowing for a natural wet/dry cycle to encourage colonization of native shoreline vegetation. Lastly, a more normal lake fluctuation regime would reduce the constant pounding from wave action at one portion of the lake stage. Keeping the summer lake stage at or near 9.5 ft MSL, in the long-term, will promote erosion at a fairly narrow zone of the shoreline. In addition, the average stage height during the wet period is also near 9.5 ft (Tetra Tech 2011). Thus, a managed regime of 9.5 ft, in the long term, would be expected to focus erosion at this portion of the shoreline instead of distributing it throughout a typical annual range of about 8.0 ft to 10.0 ft. When asked about whether I could distinguish between the erosional effects that might occur at a lake stage of 9.5 versus a stage of 9.0, I answered "No". I should have clarified my response, which in this case would have been that I could not distinguish the effects between these two lake elevations *in the short term*. In the long term, the effects of keeping the lake stage elevated at 9.5 ft should become evident.

3. Lake Depth vs Lake Length. I skipped this slide at Paul's recommendation.

4. Lake Staff "gage". Illustration of current operating range for lake stage.

5. Hypsographic Curve for Devils Lake. This figure showed that about 17.5% of the lake volume was contained in the upper 1.5 ft (8.0 - 9.5 ft). So by letting the lake drop to a lower stage, the volume decreases and the residence time also decreases. Decreasing residence time is one tool that lake managers use to reduce the impact of cyanobacterial blooms.

6. Monthly Precipitation (Otis). Nearly eight feet of precipitation annually for the area. Normally this is more than enough to suppress cyanobacteria because it results in a short hydraulic residence time (fast flushing rates).

7. General Water Balance. Assuming all inputs are well mixed throughout the lake, the average hydraulic residence time is about 2 months which means the lake is "flushed" 6 times per year.

8. Water balance from KCM study. However, 50% of the inflow is derived from discharge from Rock Creek. A question came up about how the lake "stores cold water". I responded that the lake temperature quickly equilibrates to ambient conditions. Solar radiation and wind keep this shallow lake well mixed (polymictic). Consequently, any small introduction of colder water will be rapidly mixed and assimilated in the water column. Without a hypolimnion, there is no capacity to "store" colder water.

9. Watershed Boundary. The total watershed boundary, which includes Rock Creek, is compared with what is probably a more "effective" watershed boundary, which excludes Rock Creek. The reason for not considering flow from Rock Creek as a major component to Devils Lake is because of the location of the outlet of Rock Creek, which is also near the outlet to the D River. As a consequence, it is likely that flows from Rock Creek, especially in the absence of a southerly wind, will move towards the D River. Therefore, the hydraulic residence time of Devils Lake is likely considerably greater than 2 months. This helps to explain why the lake is more susceptible to cyanobacteria blooms than would otherwise have been the case.

10. Weeds or Algae? This slide provides some of the positive and negative features associated with a lake dominated by macrophytes versus phytoplankton. The slide indicates there are

advantages and disadvantages to each state. The natural state for Devils Lake is to be macrophyte-dominated.

11. Total Phosphorus 1991-1997. TP concentrations average about 25 µg/L in Devils Lake, which is moderately high. Therefore, plenty of phosphorus for algae.

12. Total Phosphorus 2001-2006. Similar results as earlier data.

13. Nitrate Concentrations 2001-2006. Devils Lake has extremely high concentrations of nitrate (average of 412 µg/L). Most lakes have concentrations of nitrate near the detection limit (typically around 10 µg/L). [May want to check these data]. High concentrations of nitrate allow for some cyanobacteria taxa such as *Microcystis* (which cannot fix atmospheric nitrogen) to become abundant. High concentrations of nitrate usually favor diatoms and chlorophytes to experience a competitive advantage over cyanobacteria such as *Anabaena* and *Gloeotrichia*. The high concentrations of nitrate mean that the nitrogen:phosphorus ratio is well over 16. We don't know how far above 16 this ratio is because we have no data for total nitrogen. A N:P ratio greater than 7.2 (by weight) often indicates phosphorus limitation.

14. Chlorophyll Concentrations 2001-2006. Chlorophyll concentrations during this period included a number of observations well above the DEQ criterion for eutrophic lakes of 10 µg/L.

15 -19. Alternative Stable States. I skipped these slides based on Paul's recommendation.

20. Balancing the Ball. Indicated how the DLWID is attempting to conduct a delicate balancing act by trying to increase the macrophyte coverage from its current level of 1.3% to somewhere in the 10-20% coverage range. This would have been nearly impossible to achieve earlier, but now with the availability of inexpensive means to measure macrophyte coverage, it is possible to have an interactive program of macrophyte coverage mapping combined with low rates of grass carp stocking.

21. How to Reduce Algae (Cyanobacteria)? This was an abbreviated list of some possible means of reducing cyanobacteria in Devils Lake in the short term and over the long term. The most feasible means of reducing cyanobacteria in the short term include, let the grass carp die out, operate the lake at a low stage to increase flushing rate, and providing circulation with aeration. Long term approaches for reducing cyanobacteria in Devils Lake is to implement sewerage the lakeshore, increase wetlands, especially in the vicinity of storm drains, and reduce use of fertilizers in the watershed.

22. A Word About Mud & Phosphorus. Three approaches for dealing with the phosphorus load in the sediments: (1) inactivate it with alum, (2) remove it by dredging, and (3) let it "bleed out". Alum is expensive (~\$2M+) and not likely to be long term in Devils Lake. Dredging is very expensive and provides uncertain results. For phosphorus to naturally dissipate requires that the inflow of phosphorus from the watershed decline to the point where the equilibrium favors loss of P from the sediments.

23. Why I Like (Love) Data. Data needed for an informed management response. It would be very helpful to construct a nutrient budget and apply a hydrodynamic model to the lake to simulate alternatives for its management.

24. Example of Configuring Devils Lake for modeling.

25. Example of modeling output for Odell Lake.

26. Various satellite images of Devils Lake.

STAFF RECOMMENDATIONS:

Firstly, based on the information to date, it would be my recommendation that the District embark on a intensive Monitoring and Modeling project which can then be used to better inform decision making on any Harmful Algal Bloom strategies. This would include a robust sampling protocol outlined by MaxDepth Aquatics above, plus the addition of computer modeling.

Secondly, having ruled out a number of short-term approaches, I believe the District should move forward on investigating those mid to longer term controls that still have merit or may have yet to be explored thoroughly. These include primarily Aeration & Circulation. We were presented with one vendor's approach at the workshop, plus have received information from a second vendor, but additional independent research needs to be done. The District can attain information regarding implementation of such strategies (e.g. costs, methods, permitting, easements, energy consumption, insurance, power hook ups, etc) as well as develop a scope of work that might be developed into an RFP in the future. The results of modeling however will be an important consideration prior to deciding on one tactic or another.

Thirdly, proceed with the implementation of the Devils Lake Plan, focusing on sewerage the lake in the next four years as the primary target for the District. We have heard that many people have said or been told "*sewer will be here in five years...*" I would like to see the District, the City and the public commit to having that become a reality and since we have made a lot of progress on this in the last nine months, I think that if it ever is to get done then we need to strike while the iron is hot and move forward collectively towards this elusive goal.

Fourthly, draft and pass an ordinance either through the City, the County, or the District which will restrict the use of fertilizers in the watershed and require vegetated buffers along the lake and waterways feeding the lake.

Fifth, continue the work on the Save our Shorelines program by providing additional funding for projects and advertising. Raise the reimbursement or funding limit from \$750 to \$1,500 per parcel, and consider 100% funding of the projects or similar incentive over the existing 75% contribution the District makes.

Sixth, maintain the use of the water right at the District's existing policy from June 15 to Oct 15 until the modeling efforts are completed at which time the District should make permanent a decision about its use or return the lake to its natural hydrology to increase the flushing of the lake.

New Business

- a) **Water Quality Monitoring:** The District made an early start to its water quality monitoring this year. The full recreational monitoring however starts at the end of May in time for the Memorial Day Weekend. Look for updates through the website, at kiosks around the watershed, and through our listserv which people can sign up from at www.DLWID.org.

HABS
Harmful Algal Bloom
Surveillance

Blue-Green Algae*

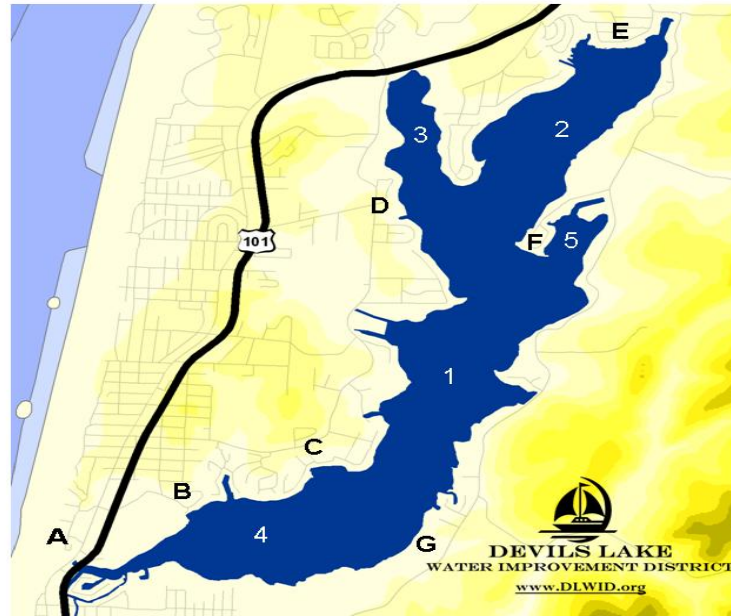
and/or their toxins
may be present particularly in
the summer months.

**Watch for
Scummy Water!**

**Keep Children and
Pets clear, if present.**

*Scientifically known as
Cyanobacteria

Friday, April 18, 2014



MAP ID	Station	Microcystin	Observations - Cell Counts
A	D River	No Data	No Visible Presence
B	Campground	No Data	No Visible Presence
C	Regatta Grounds	<1.00	No Visible Presence
D	Holmes Road Park	<1.00	No Visible Presence
E	Neotsu, K Street	<1.00	No Visible Presence
F	Sand Point	<1.00	No Visible Presence
G	East D.L. State Park	<1.00	No Visible Presence
1	Mid Lake	< 0.16	<u>115 cells/ml</u>
2	NE Arm	<1.00	No Visible Presence
3	NW Arm	<1.00	No Visible Presence
4	Southern End	<1.00	No Visible Presence
5	East Thumb	<1.00	No Visible Presence

Recreational Water Quality Standards			
<p>Highest Risk Water contact not advised. Toxin(s) exceed limit, scum, or high cell counts.</p> <p>Moderate Risk Caution advised. Toxins or blue-green algae known to be present. Water quality may change quickly.</p> <p>Lowest Risk Blue-Green Algae and toxin(s) not present in significant numbers at time of sampling.</p>	Parameter	Description and limit	Regulatory Agency
	Anatoxin-a	A neurotoxin - Less than 20 ppb	Oregon Health Authority
	Cylindrospermopsin	A liver toxin - Less than 6 ppb	Oregon Health Authority
	Microcystin	A liver toxin - Less than 10 ppb	Oregon Health Authority
	Saxitoxin	A neurotoxin - Less than 100 ppb	Oregon Health Authority
	Cells / ml	Must be fewer than 40,000 cells of <i>Microcystis</i> or <i>Planktothrix</i>	Oregon Health Authority
	Cells / ml	Must be fewer than 100,000 cells of all potentially toxic species	Oregon Health Authority
Scum Formation	Must not have toxic species in scum	Oregon Health Authority	

Toxin monitoring from Monday's (April 12) sampling of the mid lake found **no detectable levels** of any of the four most common algal toxins associated with Harmful Algal Blooms.

In addition the Devils Lake Water Improvement District's Microcystin monitoring also found **no detectable levels** in any of the shoreline samples (Thursday, 2014-04-17). These samples sites include Regatta Grounds, Holmes Road, Neotsu, Sand Point and East Devils Lake State Park.

Total Blue green algae = 115 cells/ml (Alert thresholds are 40,000 and 100,000 depending on species). The number of blue-green algae were determined from a Friday sample and are shown here in total. The alert level is 100,000 for Anabaena and its cousins, so we are nearly 1000 times less than that now.

Water clarity has rebounded too. Clarity around the lake is all the way to the bottom in all but the deepest sections. Watch these short videos of Regatta Grounds and the mid lake to see first hand the lake's recovery.

Regatta Grounds Video: http://www.youtube.com/watch?v=zuPE-pvThlo&feature=share&list=UUMDLRPmvSk4_jIqz4yYuJ3Q&index=3

Secchi Disk Video: http://www.youtube.com/watch?v=oISn7he5DIM&list=UUMDLRPmvSk4_jIqz4yYuJ3Q

- b) **Devils Lake Revival:** Revived? An offer was received by the Bay Area Merchants Association, with help from Legacy Real Estate, Chinook Winds Casino Resort, and OCCC, to put on the 2014 Devils Lake Revival event on the date already scheduled.

They are willing to do this at only the cost of advertising the District invested last year for the event. The ad and poster design would be handled by their volunteer team.

“We share the District's belief that increasing awareness of, and participation in, lake activities will help spur Lincoln City's ongoing economic recovery and look forward to the challenge ahead.”

Board Decision: Revive the Revival?

- c) **Intern:** We have made an offer to Ava Laszlo for the summer internship and she has accepted. We look forward to her join DLWID in mid June following her graduation from OSU.