Pigeon Lake Rehabilatation & Protection District

Clintonville, WI.

Scott Koehnke
State of Wisconsin
Department of Natural Resources
Shawano Office
547 Lakeland Road
Shawano, WI. 54166

April 20, 2011

Dear Sir:

This acknowledges receipt of your letter of February 14, 2011 (see attached letter) regarding you receipt of our "DNR permit application to place a recirculator structure on the bed of the Fairway Lake area of Pigeon Lake in the City of Clintonville, Waupaca County". You stated in your letter: "In accordance with state law, this letter is notification that your permit application is incomplete and you must submit additional information."

On page 2, paragraph 1 of your letter you stated "The scientific research regarding the efficacy and limitations of this type of technology to address the concerns of residents around Pigeon Lake and specifically the Fairway Lake area, indicates that your proposal has a high probability of not meeting your desired objectives and expectations (copies of these references are available upon request). It may actually make the problem worse."

On February 25th, 2011 Rick Waite delivered your letter of February 14th 2011 to Dennis Krueger, President of PLRPD, and Dennis copied me. Upon receipt of you letter of February 14, 2011, I discussed it with Dennis Krueger and at his request I sent you a letter dated February 25th, 2011 (see attached) in which we requested copies of these "scientific research references" that were available upon request along with clear indication of those sections and their interpretation that formed the basis of your opinion regarding our proposal.

On February 28th we received your e-mail (see attached) with three attached reference documents and a link to a fourth, Thank You. But, you provided none of the requested interpretation, quotation or direction on the location (within these references) that indicated how they supported the conclusions you had formed. It then became our responsibility to read through the references in search of information that you might have had in mind. As a result we conducted a thorough review of this literature. You may find the results of this review, quite informative.

The first "Scientific Research" reference you provided, **Sedimentological Effects of Aeration-Induced Lake Circulation,"** that of Engstrom & Wright, offered lots of reading. We are attaching pages 201 and pages 212-213, page 201 starts with an *Abstract* of the next 12 pages. The last line of the *Abstract* states "Results from this study do not support claims that aeration-induced circulation will enhance the removal of organic sediments from the lake basins by mineralization or offshore transport."

If this were all the further one might read, the *Abstract* supports your conclusions; however, the first paragraph on the same page (201) refers to another study that is in contradiction of this *Abstract.*

The paragraph states "Lake aeration has been promoted as a means for reducing the net accumulation of organic-rich sediments in the off-shore regions of eutrophic lakes. This reduction is thought to occur because aeration disrupts thermal stratification, brings oxygenated water to the lake bottom, and leads to increased rated of decomposition of seston and bottom sediments (Laing 1979b, Laing 1988). If you then turn to **Discussion and Conclusions** on page 212 and continuing on page 213, read the second paragraph of the second column on page 213, this discusses the study of Laing 1979b. This study (Engstrom & Wright) then claims a direct contradiction of the earlier Laing 1979b study.

The simple truth is both of these studies lead to correct and true conclusions! The facts are, each study is based on analysis of a different area in lake basins and each uses different methods appropriate to that part of the lake. The Engstrom & Wright study involves the bed of the lake itself and relies on core samples taken to collect data from under the lake bed. The Laing 1979b study involves the removal of the "muck" layer and measures results above the bed of the lake. There is no reason given to believe or claim that either study might be wrong.

Our DNR permit application, for the installation of a *Circul-O^2-Rater*™ on Fairway Lake, is not about removal of organic material that might have found its way into a core sample taken from the bed of a lake, either by mineralization or offshore transport as studied by Engstrom & Wright. The installation of a *Circul-O^2-Rater*™ is about providing sufficient oxygen to the lake bottom to enable aerobic bacteria to reduce and clean up the "muck" as studied by Laing 1979b.

The second "Scientific Research" reference you provided (see attached) is "**Aeration of Lakes and Reservoirs** " (pages 44-45) by Welch & Gilbbons. This Paper reflects a general opinion on the effectiveness of circulation "achieved by an unconfined rising plume of air bubbles, causing the water to circulate and oxygenation occurs when the circulating water mass that is under saturated absorbs oxygen thru atmospheric exchange." This Paper also cautions that "if mixing is insufficient, nutrients can actually increase and algae problems can worsen." The Paper further states "To effectively destratify a waterbody and

prevent buoyant cyanobacteria blooms by air injection, the air flow must be at least 9.2m3/km2 per minute. (9.2m3 = 325 cu ft per minute) To supply 325 cu ft/minute requires at least a 100 hp compressor.

The last paragraph on page 45 states "Nevertheless, if applied correctly, aeration/circulation is a useful method for managing Lakes and Reservoirs...." This might be true if all you wish to do is to prevent cyanobacteria blooms by destratifying the water column to the same temperature from top to bottom. But it does not remove the accumulation of organic material, sludge and muck at the bottom of the lake. While this is an interesting paper, it has to do with the use of air bubbles, which is in no way parallel to our methodology of direct circulation of lake water and has nothing to do with our DNR Permit Application seeking to install a Circul-O2-Rater™ on the bed of Fairway Lake.

The third "Scientific Research" reference you provided (see attached) "Freshwater harmful algae blooms (FHAB) suppression with solar powered circulation (SPC)" (pages 215-216) . The *Abstract* on page 215 states "This report evaluates the efficacy of a new technology, solar powered circulation (SPC), designed to create long distance circulation of the epilimnion (>200 m) to suppress FHABS." The *Abstract* further states "SPC units were deployed at densities of approximately 0.15 km2/unit" (that's one unit every 37 acres). In conclusion these Abstract states "SPC provided an effective approach to FHAB control that was ecologically benign and environmentally sustainable."

On page 216, paragraph 5. Conclusions, this study states "Densities of chlorophytes and diatoms increased as those of cyanobacteria decreased." The conclusion further states "Although the mechanism(s) through which SPC suppressed FHABs remains unknown, the evidence indicated that the magnitude of suppression increased over time. SPC provided an effective approach to FHAB suppression that was ecologically benign and environmentally sustainable."

In our DNR permit application we state we intend to circulate Fairway Lake in its entirety not just the epilimnion. This will not only prevent algae blooms, as reported in the previous research paper, but also provides oxygen to the aerobic bacteria in the Hypolimnion as well as the Benthal portion of the lake to enable aerobic bacteria to thrive and digest decaying organic matter left in the bottom.

The final "Scientific Research" reference you provided was a link to (see attached) "Use of Upflow Water Circulators for Managing Eurasian Watermilfoil in Lake Cochituate (eastern Massachusetts)." This report is dated May 2009.

On the last page of this (23 page) report, first paragraph, *3.6 Implications,* at about the middle of the paragraph is the statement "That after two years of circulation use there was no measurable change in milfoil extent or abundance within the study areas around the lake." That was not surprising. This study

designed to fail. The previous study (Scientific Research reference #3) concluded that SPC did a commendable job on FHABs in circulating the epilimnion. With that in mind this report states on page 11 "that two solar bee units were installed in October 2006 and removed 1st of October 2008." On page 10 this report shows that one Solar Bee Unit was placed on South Pond (18' deep with a surface area of 247 acres) and one Solar Bee Unit was placed on Middle Pond (27'deep with a surface area of 95 acres) that's a far stretch from circulation of the epilimnion in a 37 acre area.

This study confirms what we already know, that Solar Bee Units are not capable of circulating at a depth greater than the epilimnion, and can not even accomplish that type of circulation in such large surface acres.

In our DNR permit application, we included a study conducted at Pointe-Calumet Lake, Quebec, Canada. This study was successful in reducing Eurasian Milfoil. We have attached an update provided by the author, Dany Boudries. On page 3 this lake ecologist states that following the 1997 installation of circulation on Pointe-Calumet Lake, there have been more that thirty (30) lakes in Canada introduced to this technique. On page 17 He states that ten years later water transparency readings are now at more than 4.5 m (14'9"+) and six (6) more native species of Macrophyte have colonized the lake. Eurasian Milfoil is still present but in very low density and never emerging at the surface.

After spending considerable time reading and analyzing the "Scientific Research" references provided by you, we are very confident that when we are granted a permit to install a Circul-O2-Rater™ on Fairway Lake we will be able to start reducing the tremendous amount of organic waste "muck" that has accumulated in the years since Fairway Lake became part of the Pigeon Lake Impoundment. And we are confident that reducing the amount of nutrients available, will also address the Eurasian Milfoil problem.

Regarding your Letter of February 14, 2011, and questions 1-6 that you asked;

#1--- Find attached a detailed Bathymetric map of the current conditions in Fair Way Lake.

#2--- Find attached a sediment analysis per your instructions.

#3--- Find a review by John Reis, PE of the Circul-O^2-Rater™, regarding the potential for the Unit to re-suspend bed materials based on shear stress associated with the manufacturer's designed pumping and circulation rates.

#4--- Please see the DNR copy of, the Pigeon Lake Districts commissioned **"Aquatic plant survey and Lake Management Plan"**, by Tetra Tech, Inc—Wausau Wis. 54401.---Project No. 1156340172 April 2007---Pages 7-16 plus tables as noted.

#5--- Please see the above noted survey, pages 4—7 plus tables as noted.

#6--- Please read our permit application which address's our intentions for improvement of water quality, control of macrophytes etc.

Regarding the opportunity to explain how the project will avoid impacts to public rights including water navigation & recreation, fish & wildlife populations, natural scenic beauty and water quality, these were completely addressed in our original permit application.

There is one further reference we would like to identify that truly supports our DNR permit application. In 1974 the WDNR in cooperation with the University of Wisconsin and sponsored by the Upper Great Lakes Regional Commission published a *"Survey of lake rehabilitation techniques and experiences"* (1974) p.19. This was: an inland lake renewal and management demonstration project report. (see link). Page 19 summarizes what they said about lake aeration.

> Fast (1971a) and Mercier (1955) reported that aeration increased the rate of oxidation and decomposition of bottom sediments and organic matter in the water column, but circulation and suspension of sediments and decomposing plant cells also increases the oxygen demand (Fast 1971a). Aeration should promote the sorption of phosphorus by the hydrous oxides of iron and manganese (e.g. Lee 1970c; Mortimer 1941; Wildung and Schmidt 1973), but Fast (1971a) found that the increased sediment temperatures associated with destratification accelerated nutrient release. Wirth et al. (in prep.) found that hypolimnetic aeration led to substantial reductions in the concentration of phosphorus in bottom waters.

The conclusion, by Fast & Mercier, was "that the rate of oxidation and decomposition of bottom sediments and organic waste increases the oxygen demand." **Please note**, ***the specific requirements of any Circul-O2-Rater™ installation is to meet that oxygen demand of the lake and sustain it until the job of the natural aerobic bacteria in the lake, "decomposing the organic waste" is accomplished!***

Dunst, Russell C.; Born, Stephen M.; Uttormark, Paul D. /

***Survey of lake rehabilitation techniques and experiences* (1974) p.19**

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