The Stench that Shaped History

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As a child in the mid-nineties I often went to a little beach by the name of Olbrich Park situated on the northeast side of Lake Monona with my mom and my baby brother. I would play with the other kids at the beach, making elaborate sandcastles with moats out of sand, rocks, and sticks. One thing I hardly ever did though was swim. It wasn't that I didn't like swimming, but that I was so terrified of the long, slimy strands of "seaweed" that perpetually choked out the swimming area that I almost never went into the water. If I tried opening my eyes underwater, the only thing I could see was a murky green color. Once I grew out of making sandcastles, there was no point in going back to Olbrich. Not only did this beach look unsightly, but it was often accompanied by an awful fishy stench, especially on hot summer afternoons. Every time I pass Lake Monona on my bike or in a car with the windows rolled down, I am reminded of my childhood excursions to the beach.

As a kid I thought I knew exactly why Lake Monona stunk. My teachers showed my class educational videos that told us when people polluted, animals and fish died and rivers and lakes became stinky, scum filled messes. Until I researched this paper, I held the belief based on those educational videos that Lake Monona had undergone extensive eutrophication entirely because of pollution. Eutrophication is the natural process of nutrient accumulation that occurs as a lake ages. As a lake becomes more eutrophic, algae and weeds become more prominent. This normally occurs on the time scale of thousands of years but human actions may speed up the process drastically.[1] I believed that if people would just stop fertilizing their lawns so much, control farm runoff, and pick up their trash, Lake Monona could turn back into its crystal-clear, pristine, wild, and undeveloped state. I now know that this belief was partially wrong. Yes, pollution

has undoubtedly had immense effects on Lake Monona, but there also exists solid evidence that Lake Monona was not a crystal-clear lake before humans began polluting it. [2] Just as my own perception of Lake Monona has changed, so has the general scientific information in regards what is causing the eutrophication of Lake Monona and how to fix it. This change in understanding has in turn affected Madison's efforts to control the lake's odor, algae levels, and plant growth.

In the early years of Madison, the city government did not treat Lake Monona in a sustainable, pragmatic way which caused, from a modern perspective, predictable results. The year 1885 marked the first instance of point source pollution into Lake Monona. Madison had a growing population of 12,000 and to support this population the city government installed a sewer system. This system discharged untreated sewage into Lake Monona near Blair Street because the Common Council decided that building a treatment plant would be too costly[3]. If the city government had known how disgusting releasing raw sewage into Lake Monona would be, they probably would have made the investment in a sewage treatment plant. First hand accounts use descriptions like "pool of filth" and "sickening stench" to sum up the state of Lake Monona at the time.[4] It soon became clear that the city could no longer discharge untreated sewage into the lake because the sight and the aroma were too much to bear.[5]

As a result, in June of 1889 Madison took action and opened its very first wastewater treatment plant. This plant failed within two years due to high operating costs and low performance and for the next twenty years would be replaced by a series of new plants and upgrades[6], but the fact that the city built this plant in order to improve Lake Monona has huge historical significance. The spending of taxpayer money to build a treatment plant by the city government acknowledged that humans had

created a problem with the ecology of Lake Monona and recognized that it is public duty to protect this iconic natural resource for present and future generations. This conservation ideology surrounding Lake Monona and all of the other Madison area lakes would be the driving force behind years of future scientific research, laws, and tax spending.

The first taxpayer funded research on Lake Monona to solve the odor problem was conducted by John W. Alvord of Alvord & Burdick, an environmental engineering consulting firm based in Chicago. During the summer of 1918 Lake Monona hosted "widely prevalent and disgusting smells" and the concerned public blamed the sewage treatment plant, a beet sugar factory and the algae living in the lake as the cause of the odor nuisance.[7] Alvord knew that nitrogen could stimulate algae growth, which decayed and caused the unpleasant aroma, so he meticulously kept track of the nitrogen outputs from the sewage and beet sugar plants. However, this nitrogen content alone could not have caused such massive algae blooms, so Alvord concluded that the cause possibly was "physical conditions and also apparently some stimulating agent or substance other than the recognized organic plant food constituents."[8] This "stimulating agent" of course is the element phosphorus, which is always present in human waste, but Alvord makes not a single mention of this important nutrient in the entire report. Had Alvord done his research in the present day, he would have known that phosphorus is a large contributor to plant and algal growth in lakes and he definitely would have monitored the effluents' phosphorus content before concluding the sewage plants and sugar factory did not aid algae growth.

Was the phosphorus from the treatment plant and sugar factory the culprit that caused the infamous stench in 1918? It is still difficult to say for several reasons. Alvord

makes a very clear point in his study that a UW-Madison professor did, in fact, study the correlation between algae blooms and offensive odors three years before the sewer system was even built.[9] This could lead to the conclusion that Lake Monona is naturally a eutrophic lake, a reasonable hypothesis. In addition, Alvord argues that the amount of sewage discharge into Lake Monona had steadily increased, while the odor of the lake and occurrence of algal blooms had varied greatly since the city installed the sewer system (see attached graph, taken from the report). All in all, the Alvord & Burdick report could not offer a complete cure to the algae problem, but the city did follow its band-aid suggestion of continuing to treat the lake with copper sulfate to lower the amount of the algae and hence improve the smell.[10]

More than twenty years later, despite a state funded extensive two year study from 1943 to 1944, copper sulfate treatment, and even mechanical weed harvesting, Lake Monona still smelled of decaying algae. Copper sulfate and weed harvesting proved to be only relatively inexpensive short term solutions; they could not have any lasting effect on the nutrient loadings of Lake Monona.[11,12] This enduring dilemma turned into courtroom controversy in 1943 when the Southern Wisconsin Anti-Pollution Federation (SWAPF), a citizen formed organization, took the Madison Metropolitan Sewerage District Commission (MMSD) to court over the enforcement of a state anti-pollution law. SWAPF believed that the sewage effluent that MMSD discharged into Lake Monona directly caused algal growth while MMSD did not believe diverting sewage around Lake Monona would have any effect on the amount of algae in the lake. Bizarrely, the court ruled in favor of MMSD not because the judge sided with one scientific opinion or another, but based on a provision in the anti-pollution law that did not make the law

effective until one year after World War II ended.[13] This scenario represents a classic case of how politics, imperfect science, and lobbyists clash over environmental issues.

It would take until 1958 for MMSD to comply with the state law and divert all sewage around Lake Monona to the Nine Springs treatment plant. Almost immediately the phosphorus and nitrogen loading of the lake did decrease dramatically[14], however exactly 50 years later, Lake Monona is still a very eutrophic lake; therefore, routing sewage around Lake Monona may have improved the situation, but did not completely cure the problem.

The 1970s brought about a completely new approach to solving the Lake Monona problem because no longer could the blame be placed on sewage effluent. A 1975 report by the Dane County Advisory Council for Lake Quality Improvement set out to address nutrient contributions from non-point sources using technologies unavailable in 1920 such as aerial photographs and more precise sampling equipment. The report identifies the primary inputs of phosphorus to the Lake Mendota and Lake Monona watershed as urban runoff (leaves, grass clippings, construction) and rural runoff (farmed land, manure).[15]

The council thought of many creative ideas for the county and city governments to combat runoff including street sweeping, mechanical weed cutting, and wetland protection. Unlike previous government sponsored reports though, this report had a strong emphasis on what the citizens of Dane County could do to curb runoff. Many of the recommendations of the report would require the action of individuals, such as rainwater downspout dispersion, lawn waste disposal, and cutting back on lawn fertilizers. In addition, a communication subcommittee devoted itself to coming up with

ways to raise awareness to the public about lakes and watershed issues through the media.[16]

The revolutionary idea that citizens could help to "save the environment" changed the way that people thought about conservation, as my generation grew up knowing to always turn off the lights, recycle, and remember to turn off the water when brushing our teeth. This new attitude of environmentalism was a direct result of the public recognizing that industry could not be the sole cause of pollution and that collective individual actions also impact the environment significantly.

Just as lakes always change, so too does scientific understanding. What do educational videos, sewage treatment plants, copper sulfate, legislation, and T.V. news specials all have in common? Someone at one point in time believed that all of these things could help to "fix" the Lake Monona problem. Yet, the stench of Lake Monona has plagued Madison for over 120 years. It is humbling to know that humans have eradicated deadly diseases, travelled to the moon, and even cloned animals, but that the city of Madison has not yet had its way with Lake Monona. Despite the complexity of the challenge, I believe that the idealism behind trying to protect Lake Monona from human pollution will continue as long as Madison exists for the simple reason that politicians, scientists, taxpayers, and little kids alike all wish for Lake Monona to appear as stunningly beautiful up close as it is from a distance.

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[1] (Davis and Masten 2009, 210)
[2] (Flannery 1949, 8-9)
[3] (Proceedings of the Common Council, Madison June 8th, 1894)
[4] (Wisconsin State Journal 1892)
[5] (Corscot 1893)
[6] (Mollenhoff 2003, 215)
[7] (Alvord & Burdick 1920, 2)
[8] (Alvord & Burdick 1920, 49)
[9] (Alvord & Burdick 1920, 53)
[10] (Flannery 1949, 26)
[11] (Morton 2006)
[12] (Lathrop 2007, 351)
[13] (Flannery 1949, 141)
[14] (Lathrop 2007, 350)
[15] (Dane County Lake Quality Advisory Council 1975, 5)
[16] (Dane County Lake Quality Advisory Council 1975, 8-27)