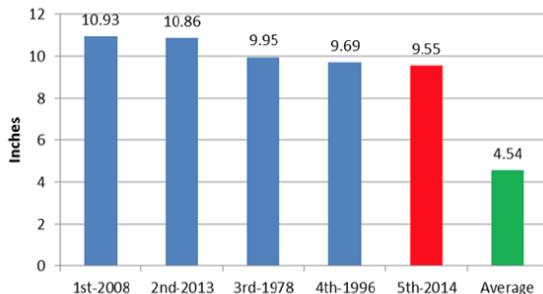


To: Lisa Helmuth, WDNR, Respectfully submitted by Joy Zedler, 2402 Lalor Rd., Town of Dunn. 2 April 2015.

### The chain of impacts that threaten Waubesa Wetlands

- **Sediment, nutrients and other pollutants flow off agricultural and developed lands and enter Swan Creek and Murphy Creek**, with net flow from Fitchburg into the Town of Dunn. As an example, Fitchburg ag land discharges runoff that is rich in sediment, N and P onto my sedge meadow, where Reed canary grass (RCG) invades along the stormwater flow path toward Murphy Creek.
- **More water runs off urban land than off agricultural land.** “Urbanization generally increases the size and frequency of floods and may expose communities to increasing flood hazards.... The hydrologic effects of urban development often are greatest in small stream basins where, prior to development, much of the precipitation falling on the basin would have become subsurface flow, recharging aquifers or discharging to the stream network further downstream. Moreover, urban development can completely transform the landscape in a small stream basin, unlike in larger river basins where areas with natural vegetation and soil are likely to be retained.” (Konrad 2003).
- **Results of increased runoff** are “increased frequency and severity of flooding, decreased base flow in streams, increased erosion, reduced natural filtration of the water, and negative impact on stream health” (Frankenberger Undated).
- There is an inconsistency between Fitchburg’s claim that they will reduce runoff by increasing runoff and their installation of multiple large culverts under Haight Farm Rd. to accommodate flood flows (see Memorandum from Benjamin Kollenbroich to Edmond Minihan, Town of Dunn Nov. 11, 2014). This memo indicates that DOT requested alternatives to low-flow estimates proposed by Fitchburg. The estimates in 2012 appear to be based on greater rainfall estimates. These differences need to be rectified, and the more recent, more credible estimates used to project future flooding. Please note the data below, provided by Cal DeWitt from the National Weather Service Forecast Office, July 2, 2014, for Madison, WI.

**Total June Precipitation - Madison**



As DeWitt pointed out in his testimony to the CARPC on 9 Oct. 2014, “planning for floodwater and stormwater for this site does not take into account the actual experience—from what we actually *measure*—about the increased intensity of rainfall events over the past one or two decades.” Between 1996 and 2014, June rainfall was 2.1 to 2.4 times higher than an average of 4.54 inches that represents a “climate normal.”



- If excess water is not considered a problem, why is Fitchburg installing giant culverts along their boundaries? New culverts are aimed at the Town of Dunn. New installations are on Haight Farm Road (on left; photo from memo by B. Kollenbroich) and Lacy Rd.

- **Urban runoff contains contaminants.** These include sediment, pathogens, nutrients, pesticides, oxygen-demanding substances, oil and other petroleum products, and road salt. Nonpoint source pollutants “are deposited on the land through normal application of fertilizer, pesticides, and road salt; atmospheric deposition; poor disposal practices; automobile emissions; and litter. In urban areas, these pollutants are usually deposited on impervious surfaces such as parking lots and roads. Impervious surfaces that are connected to streams through a pipe (typically a storm sewer) more directly affect water quality than do pervious areas, even if equivalent amounts of a pollutant are present. How much impervious area is too much? Many people have suggested that water quality deterioration begins when 10% to 20% of the watershed area is impervious” (Frankenberger Undated).

- **Nutrients reach Lake Waubesa and can flow upstream when the lake water-level regulators sequentially lower and raise Waubesa Lake water levels.** In my tributary to Murphy Creek, I observed low water on 1 April 2015, when Lake Waubesa’s water level was low and when the mouth of Murphy Creek was a mudflat (viewed from a canoe the same day). The water level will rise when Lake Waubesa is allowed to accumulate water, and some of the nutrient-rich lake water will move inland, spreading among the wetlands near the mouth of Murphy Creek, as well as and flowing upstream. This is one way that nutrients flowing down Swan Creek can disperse widely, including upstream into Murphy Creek. At the same time, Murphy Creek receives runoff from ag land upstream in Fitchburg, including the farm that discharges runoff to my small tributary. Farmers continue to cultivate patches of wetland that never produce a crop, needlessly contributing polluted runoff to Murphy Creek. Examples are visible from the Murphy Creek Bridge on Murphy Road.

- **Nutrients exacerbate the impacts of excess runoff water.** Excess stormwater runoff is a problem by itself, but it also carries excess sediment and nutrients, which cause weedy wetlands and algal blooms (Kercher et al. 2007; Lathrop 2007). Invasive plants are already present around the edges of downstream wetlands, poised to invade further, given limiting resources;

- **Nutrients help weed take over our wetlands;**

- Cattails invade and expand with nutrient additions; Woo & Zedler (2002) show that nutrients alone can cause cattail expansion.
- Cattails can take up P from soil in standing water and move the P into the water column (Boers et al. 2007; Doherty et al. 2014). The process is illustrated in Arboretum Leaflet 28.

- Wisconsin’s **worst wetland weed**, which dominates about half a million acres of Wisconsin’s mapped wetlands, is Reed Canary Grass (RCG) (Hatch & Bernthal 2008).

- RCG expands with excess water, nutrients and/or sediments (Kercher and Zedler 2004a, 2004b; Kercher et al. 2004, 2007; Green and Galatowitsch, 2002). Together, nutrients and sediment are synergistic in accelerating RCG growth and spread (Kercher et al. 2007).

- **Weeds displace native plant species**

- RCG **displaces half the species** in sedge meadows that it invades (Rojas and Zedler 2014; this paper also summarizes other data).
- Cattails displace native species to varying degrees, depending on the water depth and the strain of cattail that dominates.

- **Both N & P threaten wetlands**

- N and P cause invasive wetland weeds to expand. Boers and Zedler (2008) show that impounding water increases the uptake of P from flooded soil by cattails; this is called **internal eutrophication**.
- Green & Galatowitsch (2002) showed that **nitrogen addition increases RCG growth**.
- RCG thrives with excess water, nutrients, and sediment (especially topsoil). Kercher et al.
- RCG resists eradication (Healy & Zedler 2010); there is no easy way to control it; prevention is far cheaper.
- Swan Creek carries P and N downstream. Some say that more P comes from upstream lakes, but L Mendota and Monona are not likely responsible for all the RCG along Swan Creek and in West Waubesa wetlands.

- **Both N & P threaten lakes**

- Waubesa Lake and Wetlands are already threatened by species invasions and diversity loss. We have known since the 1960s that excess nutrients cause algal blooms in lakes, and managers have worked to reduce P inflows to lakes. Yet there are still algal blooms in our lakes. It’s not enough to address just P and it’s not enough to just reduce P loading.
- L. Waubesa is already highly eutrophic (Lathrop & Carpenter 2013). Being shallow, L. Waubesa may have greater internal loading, which is the remobilization of P in anoxic sediment, making it available to rooted plants, which then move the P into leaves and litter, where decomposition releases the P to the water (Loucks 1978, Lathrop & Carpenter 2013). Thus, P is not necessarily permanently stored in sediments. There is already too much P in L. Waubesa; Lathrop & Carpenter called the lake “hypereutrophic.”
- Fitchburg pollutants threaten L. Waubesa wetlands by polluting the lake (via Swan Creek inflows) and via the Murphy Creek inflows (where ag land discharges nutrients + sediment onto the wetland adjacent to 2406 Lalor Road).
- Lathrop (2007) addressed the role of both N and P in eutrophying Lake Waubesa: “Finally, DRP and inorganic N concentrations since 1980 have indicated that algal growth in the Yahara lakes during July–August may have been limited by not only P, but N (especially in the lower Yahara lakes). **Aggressive programs to reduce inputs from both nutrients will be important** to prevent scum-forming blue-green algal blooms and filamentous algal growths that could become problematic once zebra mussels become established in the Yahara lakes” (p. 345). [DRP = dissolved reactive phosphorus] “Thus, N has the potential to be a limiting nutrient for algal growth during summer in the Yahara lakes given three factors: (1) little Fe is available for N<sub>2</sub>-fixation, (2) denitrification rates are potentially strong throughout the entire eutrophic lake-river-wetland system, and (3) P loading rates are high. Indications of N limitation have occurred in the surface waters almost every summer in the lower Yahara lakes and many (but not all) summers in Lake Mendota since 1980” (p. 360). Thus, although it is uncertain when and where N limits or N+P co-limit algal blooms; both are indicated for L. Waubesa (Lathrop 2007). Lathrop (2007) continues: “The eutrophic Yahara lakes could be another system where **reducing both P and N inputs from the watershed would have short-term and long-term benefits** for controlling summer blue-green algal blooms” (p. 361).
- Lewis and Wurtsbaugh (2008) reviewed bioassays by many investigators in many lakes over 30 years and found that “N is at least as likely as P to be limiting to phytoplankton growth.” They list several flaws that have led to “an unrealistic degree of focus on phosphorus as a controlling element.” See also Lewis et al. (2011).
- N can trigger **toxic algal blooms**, especially bluegreens that cannot fix their own N (Paerl 2015). Example: Lake Erie recently had a toxic algal bloom that could poison those who drank its water. L. Erie had bluegreen algal blooms before the toxic bloom, but managers did not adequately address the issues identified by the IJC (2014) report on L. Erie. L. Waubesa could also develop a toxic algal bloom (with accumulation of microcystin or other cyanobacterial toxins). Nitrogen, not P, likely stimulated that bloom, because the alga that bloomed was *Microcystis*, which does not fix its own N and hence responds to N loading from other sources (Paerl 2015).
- One **death** in Wisconsin was caused by a bluegreen algal toxin according to the coroner’s report; the victim was a Cottage Grove teenager.

- **The irreplaceable Waubesa Wetlands** are gems that require extra precautions—higher standards and enforcement of clean water requirements. High-quality wetlands cannot accommodate low-quality inflows without converting to weeds.

### What is needed?

- **Planners need to predict impacts of climate change correctly:** Runoff problems will worsen with more intense more frequent extreme runoff events (NOAA IJC 2014). We look to CARPC and WDNR to protect the maximum quality and extent of L. Waubesa wetlands, including at least a 300-foot buffers around stormwater reduction facilities to handle future extreme events. The wetland west of Larsen Road needs to be mapped at its largest extent and area correlated with the rainfall history that was responsible. I have seen this “lake” full of

muddy water--enough to overflow into the ditch (before a drainage channel was dug). It almost overflowed Larsen Road. Future rainfall will have larger, more frequent extreme events. If records or aerial photos are not sufficient to identify the highest water level, staff could use the elevation of the road to map the "lake's" perimeter. This would suggest future flood levels under agricultural land use. Future water levels would be higher from increased runoff with urban hardscape. A 300-ft buffer would be needed as a safety factor where the downstream wetlands are irreplaceable wetland gems.

#### What will reduce impacts?

- Studies of small watersheds near the Twin Cities led Detenbeck et al. (1993) to conclude that "In both urban and rural landscapes, wetland extent can counteract the nonpoint source loadings of nitrogen, phosphorus, sediment and lead and thus help to maintain lake ecosystem health" (p. 57). Detenbeck et al. (1993) offer the following advice for small watersheds near Minneapolis/St. Paul: "Wetlands should be preserved throughout the watershed, but when nonpoint source loading to a lake within the watershed is a problem, restored or created wetlands could be sited strategically in the lower reaches of a watershed close to the lake of interest. Natural wetlands situated closest to surface waters should receive special protection. Replacement of drained or filled wetlands in areas away from surface waters in the watershed will not achieve the same reduction in nonpoint source loadings to a lake. Although our results suggest that seasonally-flooded streamside wetlands or wet meadows are less effective than cattail marshes in reducing total phosphorus loadings to downstream lakes, these wetlands contribute to lake color, and thus may moderate the response of downstream lakes to a given level of loading by limiting transparency." (p. 58 in Detenbeck et al. 1993).
- Restore wetlands upstream of Waubesa Lake, e.g., west of Larsen Rd. and along Swan Creek. Let ec hydrologists and biologists design restoration efforts so that wetlands can remove N and P. Engineering models ignore the biotic components that actually add N and P to the water. Such models do not include "internal eutrophication," which is the uptake and transport of nutrients from wetland soil to the water column (Loucks 1978). Still, restoration of selected wetlands will only reduce inflows; not eliminate inflows.

**What's the solution:** Every upstream property owner/manager must take responsibility for sediments, N and P, and other pollutants and make sure none leaves his/her land.

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- Leaflet #28. How ponded cattail marshes can export phosphorus: A conceptual model. Online at [uwarboretum.org/leaflets](http://uwarboretum.org/leaflets).
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## **Zedler Letter: From ltr: 5 September 2014**

We have known since the 1960s that excess nutrients cause algal blooms in lakes, yet there are still algal blooms in our lakes. We also know that nutrients cause weeds to take over our wetland gems, and Wisconsin's worst wetland weed now dominates half a million acres of our wetlands. RCG.

CARPC staff assure me that nutrient discharges will be regulated.

Using my words, eutrophication won't be as bad as it could be. But eutrophication will still be bad—bad for Waubesa wetlands and bad for L. Waubesa.

Given my experience with muddy agricultural runoff that flows from a Fitchburg farm onto my sedge meadow, the assurance that "it could be worse" is not good enough to protect a Wetland Gem.

The irreplaceable Waubesa Wetlands require extra precautions during extreme rainfall events—higher standards and enforcement of clean water intentions.

Despite regulations and TMDLs, P and N flow down Swan Creek, where these nutrients eutrophy the Waubesa wetland gems. It's convenient to say that more P comes from upstream lakes, but we can't blame L Mendota and Monona for all the RCG along Swan Creek and the damages to Waubesa wetland gems.

If it's good enough to regulate nutrients, why are there still algal blooms in lakes? It should be obvious that regulations are not good enough or the enforcement regimens are inadequate. L. Erie has TMDLs; yet L. Erie experienced a toxic algal bloom that threatened to poison anyone who drank its water.

What will you say when L. Waubesa develops a toxic algal bloom (microcystin). Would you say it could be worse, since we don't rely on L. Waubesa for drinking water? The lake's toxic water could still poison pets, wildlife, and swimmers.

In my words, "it could be worse" is not an acceptable approach to managing the waters of the US.

It could be better if the pollutants were actually measured and regulations enforced.

It could be a lot better if upstream property managers would compensate downstream landowners who are stuck with their pollutants.

It could be a whole lot better if every upstream property manager took responsibility for every gram of N and P that left his/her land and prevented it from leaving his/her land. Then all of us who depend on water would benefit.

How is that possible?

The Swan Creek watershed should restore a large wetland upstream of Waubesa Lake, just west of Larsen Rd. This would be a working wetland, designed to remove N and P, and to keep our wetlands and lakes healthy.

That's what Naomi Detenbeck, Carol Johnston, and Gerry Niemi advise.

"Wetlands should be preserved throughout the watershed, but when nonpoint source loading to a lake within the watershed is a problem, restored or created wetlands could be sited strategically in the lower reaches of a watershed close to the lake of interest. Natural wetlands situated closest to surface waters should receive special protection. Replacement of drained or filled wetlands in areas away from surface waters in the watershed will not achieve the same reduction in nonpoint source loadings to a lake. Although our results suggest that seasonally-flooded streamside wetlands or wet meadows are less effective than cattail marshes in reducing total phosphorus loadings to downstream lakes, these wetlands contribute to lake color, and thus may moderate the response of downstream lakes to a given level of loading by limiting transparency." (p. 58 in Detenbeck et al. (1993).

In my Sept. 5 letter to CARPC, I reported that my sedge meadow is being despoiled by water discharged by a Fitchburg farm just across Lalor Rd. The staff response was that there is a TMDL. They did not say when the TMDL was supposed to be in force (during baseflows, during storms, or during only a small subset of storms?). There was no indication of how TMDLs are tested or enforced. A regulation that applies only to baseflows and is not enforced does not reduce or eliminate damage. Half of my wetland plant species are being lost as reed canary grass expands into my sedge meadow in response to eutrophication (Rojas-Viada 2013).

The wetland west of Larsen Rd. should be restored to a wet meadow to clean the landowner's runoff in order to prevent discharging nutrients and sediments downstream.

We understand the problem, we know the solution. We also know that the problem will worsen with more intense more frequent extreme runoff events (IJC 2014, cited above). We look to CARPC to protect the maximum quality and extent of high-quality wetlands in the L. Waubesa watershed, including at least a 300-foot buffer around ALL of "lake Larsen" to handle future extreme rainfalls.

Current regulations and/or enforcements aren't good enough to keep nutrients out of urban runoff; if they were, weeds wouldn't dominate the downstream wetlands along Swan Creek, and algae wouldn't "bloom" in Lake Waubesa.

CARPC staff should map the wetland west of Larsen Road at its largest extent and analyze the rainfall history that was responsible. I have seen this "lake" when it was full of muddy water and large enough to overflow into the ditch and almost overflowing Larsen Road. If records or aerial photos are not sufficient to identify the highest water level, staff could use the elevation of the road (minus about 6 inches) to map the "lake's" perimeter. This would serve as the image for future flood levels under agricultural land use, and new water levels resulting from increased runoff from an urban hardscape could be added to predict the effect of urbanization. Then, map the 300-ft buffer to add a safety factor needed where the downstream wetlands are irreplaceable wetland gems. Then test water quality leaving the wetland to demonstrate when high-quality wetlands could accommodate inflows without converting to weeds.

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- Leaflet #28. How ponded cattail marshes can export phosphorus: A conceptual model. Online at [uwarboretum.org/research](http://uwarboretum.org/research) – publications menu.



## A wetland ethic?

Aldo Leopold (1949) encouraged a **land ethic**, wherein people would choose to live in harmony with the land in order to sustain natural resources. Much later, Jim Bohnsack (2003), a NOAA Fisheries Manager, advocated an **ocean ethic** to gain support for marine reserves to protect ocean fisheries, concluding that "Marine reserves not only protect marine resources but can help restore human expectations and provide a basis for new conservation ethics by providing a window to the past and a vision for the future."

Do we also need a **wetland ethic**? Yes, even though Leopold wrote comprehensively about the "land." Wetlands differ from both the drier land and the deeper waters in providing far more ecosystem services per area. Those services include biodiversity support, water quality improvement, flood abatement and carbon storage, plus esthetic, recreational, educational and scientific values.

**What sets wetlands apart** from drier lands and deeper waters is the amount of services provided per area (data in Costanza et al. 2014). Thanks to wetlands, the earth supports more biodiversity. And thanks to large wetlands, floodwaters are detained and absorbed, protecting downstream lands. Wetlands provide disproportionately more services, in large part by collecting water and materials from uplands and accumulating, storing, and transforming a wide variety of materials, then discharging cleaner water. Often called "nature's kidneys," wetland vegetation and soils remove both organic and inorganic matter. As wetlands accumulate sediment, they become flat, and water flows slowly. The ecosystem **processes more materials** where water-residence times are prolonged.

The ability of wetlands to remove nitrogen is especially notable. Wetland bacteria convert nitrate to harmless nitrogen gas (which makes up ~80% of the air we breathe). We call the amazing bacteria that are responsible, **denitrifiers**. A bit like Goldilocks, denitrifiers cannot do their job where soils have *too much* oxygen, as in uplands, or *too little* oxygen, as in deep waters. **Wetland conditions are just right**. Our wetlands are denitrification powerhouses that make downstream water safer for drinking. Given more and larger wetlands, all of these services could further improve human well-being.

**Is a wetland ethic necessary?** Yes. First, the lower 48 states have lost half their wetland area. Wetlands warrant extra protection for their high efficiency—providing more services per area while occupying <10% of earth's land area (Zedler and Kercher 2005). The loss of half our wetland area simultaneously eliminated their services.



Photo: Cal DeWitt

Second, we are not fully protecting or restoring our remaining wetlands. While the US Clean Water Act protects some wetlands from filling and discharges of pollutants, the regulations apply only to a subset, called *jurisdictional* wetlands. Ecologists and the US Fish and Wildlife Service consider a broader range of habitats to be wetlands. So, laws do not protect all wetlands. Nor do regulations reduce damages enough to sustain historical wetland services. And even where regulations are set, the management measures are not monitored to enforce regulations. Because the law protects only a subset, the damages regulated are only a subset, and regulations that are enforced are only a subset, the overall outcomes fall short of adequate protection.

Aldo Leopold said, "The land relation is still strictly economic, entailing privileges but no obligations." He went on to criticize the "clear tendency in American conservation to relegate to government all necessary jobs that private landowners fail to perform". Instead Leopold called for "a land ethic, or some other force which assigns more obligation to the private landowner." He argued that "a system of conservation based solely on economic self-interest is hopelessly lopsided. It tends to ignore, and thus eventually to eliminate, many elements in the land community that lack commercial value, but that are (as far as we know) essential to its healthy functioning. ....It tends to relegate to government many functions eventually too large, too complex, or too widely dispersed to be performed by government." He concluded that, "An ethical obligation on the part of the private owner is the only visible remedy for these situations."

Leopold also said that an ethic evolves; it is not written. Thus, a wetland ethic need not be restricted to private landowners or even to landowners. All people in all organizations benefit from wetlands; in return we can all respect wetlands and facilitate their ecosystem services. Here are four ways to facilitate the evolution of a wetland ethic: (1) acknowledge that wetlands provide multiple functions that enhance human-well being at rates far greater than their global area indicates; (2) accept obligations along with benefits of wetlands; (3) support conservation and restoration of wetland biota and natural functions for posterity; and (4) realize that watersheds upstream will also need restoration, in order for downstream wetlands to be more restorable.

A wetland ethic would foster understanding that protection means more than setting regulations and promising enforcement. A wetland ethic would add voluntary responsibility for ecosystems because they provide services well beyond the small area of earth that they occupy. At the same time, wetland restoration efforts could expand and strengthen.

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**Arboretum Leaflets on the web that summarize findings of peer-reviewed research: Relevant examples are:**

Leaflet #5: How and why reed canary grass invades and dominates wetlands

Leaflets #27-28: Cattails that invaded swales were productive but did not provide other valued wetland services. This was followed by a conceptual model of how constructed wetlands can be net sources of dissolved phosphorus.

Leaflet #31: Reed canary grass cut native plant diversity in half, regardless of sample plot size. This study involved seven sampling areas in and near Madison.

**Recent peer-reviewed science relevant to impacts of urban runoff on Waubesa Wetlands and Lake Waubesa**

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