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Additional Strategies to Reduce Phosphorus in the Falls Lake Watershed

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Phosphorus is an important element for plant growth but is a pollutant when there is too much in water. North Carolina, similar to most states, is working to reduce the amount of phosphorus pollution in its waters. One strategy to reduce phosphorus used by a few other states and communities is to regulate phosphorus in turf fertilizers and automatic dish detergents. The states choose to reduce phosphorus in turf fertilizers and dish detergent because phosphorus is unnecessarily used these two products and can be reduced. Emissions reductions could be achieved by improving the efficiency of existing coal plants or by shifting, or "redispatching," generation from existing coal plants to existing natural gas-fired plants. New natural gas plants that are already slated for construction could be built earlier than planned to reduce emissions more quickly. Reductions could also be achieved within the existing natural gas- or coal-fired fleets by shifting generation from higher-emitting to lower-emitting plants within those fleets.

Several states have passed legislation regulating the sale and use of phosphorus fertilizers in an attempt to reduce phosphorus pollution from turf runoff. The states to pass such regulations are Minnesota, Maine, Illinois, as well as a few counties and cities in New York, Michigan, and Florida. The laws require:

1. A soil test indicating a phosphorus deficiency in order to buy or use phosphorus fertilizer
2. Education of the public through posters, and media campaigns about sources and prevention strategies of urban phosphorus pollution
3. Lawn care professions to participate in additional nutrient BMPs education

Legislations passed by 16 states restrict automatic dish detergents to less than 0.5% phosphorus by weight. In the past four years the 16 states have amended or passed new laws that restrict the use or sale of phosphorus in dish detergent. The legislation which went into effect July 1, 2010 has made phosphorus free detergents more available nationwide. The uniform date of enactment gave the detergent manufactures time to successfully create products phosphorus free products that meet consumer satisfaction.

INTRODUCTION

This working paper will examine the restrictions implemented in various states on phosphorus content in turfgrass fertilizers and dish detergents. Excess phosphorus degrades water quality in bodies of fresh water. Phosphorus is a natural occurring element needed by plants and animals to grow but when there is too much in surface waters it causes eutrophication. Wastewater dischargers and other point sources contribute the majority of the phosphorus in water. The largest nonpoint sources of phosphorus are sediment runoff from construction sites, agriculture, runoff from turf grasses and plant and animal waste. Fertilizers used on turfgrass and dish detergents are two sources of phosphorus entering surface water that can be reduced (Barten).

This working paper will provide a brief review of the issues associated with phosphorus levels in soil followed by an outline of legislation related to restricting phosphorus use in two areas: fertilizer and dish detergents use. Beginning with fertilizer use, the paper will analyze similarities and differences in legislation, specific programs and actions, as well as assess the effectiveness of the legislation. The paper will next examine laws associated with restricting phosphorus in dish detergents, focusing on history of detergent regulation, the development of phosphorus free detergent and its and its impact on water quality.

Background: Phosphorus levels in soil

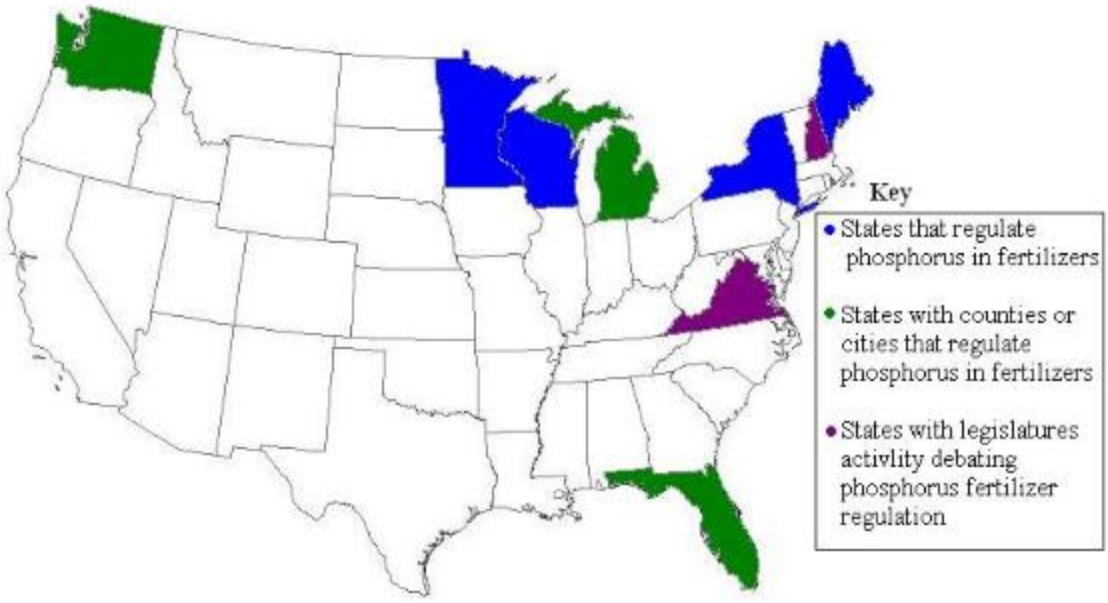
Some soils are naturally high in phosphorus but extensive use of the nutrient in fertilizer over time can also cause high levels of phosphorus in soils. Phosphorus is used in turf fertilizers because it is a critical nutrient for new plants yet it does not benefit established lawns and landscaping as the nutrient is not critical for mature growth. Many people unintentionally spread phosphorus fertilizer where it is unnecessary and do not know that excess phosphorus in soil has no or a negligible impact on the health of lawns. The relationship between phosphorus concentration in soil and the total phosphorus concentration in lawn runoff is documented in a 2002U.S. Geological Survey study conducted in Wisconsin. The study found the total phosphorus concentration in lawn runoff with soil phosphorus concentrations ranging from medium (25-65 parts per million) and high (65 ppm or more) was double the average concentration of soils with low phosphorus (0-24 ppm) (Garn, Herbert, 2002: 5). Soils with higher concentrations of phosphorus had runoff with greater amounts of the nutrient.

Legislation regulating phosphorus in turfgrass fertilizer

The concerns about the impact of phosphorus on water quality prompted many states and communities to adopt laws regulating the amount of phosphorus in fertilizers and fertilizer use. The first municipalities to regulate phosphorus were Shorewood and Plymouth, Minnesota in 1999. The state of Minnesota felt pressure from the communities who enacted legislation which resulted in Minnesota passing the first statewide ban on phosphorus in 2002 and affective2004 (Rosen, 2005).

Four other states have subsequently enacted Legislation of turf fertilizers; Maine in2007, Wisconsin in 2009, and most recently Illinois and New York in 2010. While only four states have statewide legislation some individual counties and cities within other states have passed similar laws, including; Whatcom County in Washington; at least5 municipalities in Florida; and 20 municipalities in the state of Michigan (Michigan) .Laws limiting the amount of phosphorus in fertilizers are currently being debated by the Virginia, New Hampshire and Washington state legislators but have not yet been made into laws (Hendrick, 2010).

State and County Regulation of Phosphorus in Fertilizers



Similarities

All of the laws examined for this briefing paper apply to fertilizer used on turfgrasses, meaning all non agricultural grasses, home lawns, golf courses, or athletic fields. The laws regulating phosphorus in fertilizer differs slightly in each state and municipality but they share a similar objective: to reduce unnecessary use of phosphorus. The bans on phosphorus fertilizer does not apply in the following conditions: phosphorus fertilizer can be used if a soil test, no more than three years old, indicates a phosphorus deficiency; the fertilizer is used for new plant growth trees or gardens. In all the states the turf fertilizer laws regulate not only the contents of fertilizer but also how and when they are used. General dates when fertilizers cannot be applied are set, usually December 1 to April 1, when the ground is frozen. A study found in Minnesota approximately 80% of phosphorus runoff occurs when the soil is frozen (Bierman 2010). Also, any fertilizers, with or without phosphorus, cannot be applied to impervious surfaces. If unintentionally applied it is the responsibility of the applicator to remove it immediately.

The laws regulating chemical fertilizers also apply to organic fertilizers such as manure or compost when used on turfgrass. Some people apply organic fertilizers because they have the misconception that organic automatically means the fertilizer is safer and better for the environment. If organic fertilizers are applied where they are not needed it can lead to excess nutrient runoff and degraded water quality. Phosphorus free organic fertilizers are available for consumers who want to use organic products and these products must also comply with state laws. Most low phosphorus organic fertilizers contain trace amounts less than 1% by weight of phosphorus because it is difficult to remove completely. To allow these types of organic fertilizers to be sold, Minnesota, Maine and Illinois defined “phosphorus free” as having less than 0.67% phosphorus by weight. The laws donot allow some compost or manure to be used as fertilizers but there are other options for organic fertilizers.

The review of these laws will cover the following sections, which will look at variations in the law specifically around: use restrictions of fertilizer containing phosphorus, education and regulation of lawn care professionals, and impact of the legislation. Table one provides a summary of the items discussed below.

It is interesting to note that the laws in Minnesota and Maine only regulate the use of phosphorus fertilizer, not the sale of it. Minnesota and Maine also require retailers to place posters informing customers of the new law and educating them on the impact of phosphorus to water quality where fertilizers are sold. Similar educational posters are also required in New York. Wisconsin, the counties in Michigan, and New York regulate not only the usage of phosphorus fertilizers but also the sale. In these jurisdictions it is illegal to buy fertilizer containing phosphorus if it is not intended for new yard growth, trees or gardens,

or the soil test indicates it is needed. In Muskegon County, Michigan and Westchester County, New York phosphorus fertilizers cannot be displayed on the shelves but must kept in the back of the store only available upon request.

The state of Florida does not directly regulate the sale or use of phosphorus fertilizers. Instead the state regulates the labeling and directions on the fertilizer bag. In 2007, the state passed a law regulating the labeling of turf fertilizers. All fertilizer bags in Florida must display the warning: "Do not apply near water, storm drains or drainage ditches. Do not apply if heavy rain is expected. Apply this product only to your lawn/garden, and sweep any product that lands on the driveway, sidewalk, or street, back onto your lawn/garden." The directions for application on bags of fertilizer containing phosphorus must reflect the best management practices (BMPs) given by the Florida Cooperative Extension. These BMPs are similar to other states and include only applying phosphorus fertilizers after a soil test has been performed and leaving a non fertilized buffer near a body of water. Florida counties and local governments can reduce phosphorus fertilizer to an even greater extent by making mandatory the requirement outlined above.

In many areas, special attention is given to the education and regulation of lawn care professionals. For example, the Illinois turf fertilizer law only applies to "an applicator for hire which means someone paid to spread fertilizer, golf course employees or landscapers must comply with the laws". Legislation also specifies the level of training required. In some states additional training is required for lawn care professionals. For example, Westchester County, New York requires all turf or lawn care professionals to participate in a Westchester County and Cornell Cooperative Extension approved turf management course to learn BMPs to reduce nitrogen and phosphorus runoff before they can spread fertilizer. Minnesota also has a similar program to train golf course managers on the proper use of fertilizers. These states focus on lawn care professionals in an effort to give the most comprehensive education about nutrient management to those entities who are the largest spreaders of turf fertilizers.

Table 1: Variations in Laws Regulating Turfgrass Fertilizers

	Year passed	Restrictions on use	Restrictions on sale	Restrictions on display	Informational posters in retailers	Requires education of lawn care professionals
Statewide						
Minnesota	2004	Yes	No	No	Yes	Yes
Maine	2007	Yes	No	No	Yes	No
Wisconsin	2009	Yes	Yes	Yes	No	No
Illinois	2010	Yes	No	No	No	Yes
New York	2010	Yes	Yes	No	Yes	No
Counties or Cities						
Florida	2007	Yes	No	Yes	No	No
Michigan	2006-2010	Yes	NA	NA	NA	NA
Whatcom County Washington	2006	Yes	Yes	Yes	Yes	No

Maine and Minnesota are the only places where a law limiting the amount of phosphorus in lawn fertilizer has been in place for more than a year and the reports on the effectiveness of the laws are positive overall. In these two states, manufacturers, retailers, and consumers have had little difficulties complying with the fertilizer regulation laws. The manufacturers of fertilizers were given a two year notice period to sell existing product and prepare to for the change in demand the law would create. Ten fertilizer companies were surveyed for a 2007 report to the Minnesota legislature: Effectiveness of the Minnesota Phosphorus Lawn Fertilizer Law." Six out of the ten companies surveyed reported some challenges creating new labeling and marketing but overall it did not change the price or availability of the fertilizer for consumers. Also surveyed in the report were fertilizer retailers which reported that 97% stocked at least one type of phosphorus free fertilizer. In Maine, a similar survey of fertilizer retailers showed that 94% of retailers had phosphorus free products (Welch2010).

A positive response to the change in legislation was reflected by the increase in the sales of phosphorus free-fertilizers. In Minnesota from 2003 to 2006, the sale of phosphorus-free fertilizers increased from 44% to 82% of the overall fertilizer market as measured by weight. "All of the top five lawn fertilizer products used in 2006 were phosphorus-free" (Struss, Ron. Report, 2007). The same is true for the state of Maine where over 97 tons of phosphorus free fertilizers where sold in 2009 compared to only 1.5 tons sold ten years prior. Pledges by large chain stores such as Wal-Mart and Target to only sell phosphorus free and starter fertilizers show the willingness of retailers to comply (Welch, 2009). There have been few problems reported in complying with the laws and reported instances of a need to enforce the law. The high use of phosphorus free fertilizers is an indicator the laws appear to be effective. According to Ron Struss from the Minnesota Agricultural Extension Services "Customers bought what the stores stocked, and by default, obeyed the law" (email).

There is evidence to support regulation of fertilizers reduces the total amount of phosphorus in surface waters. Ron Struss, Minnesota Agricultural Extension Service, shared a study of two watersheds in Minnesota which compared the effects of a phosphorus fertilizer ban. The study was conducted from 2001 to 2006 comparing two water sheds, one located in the town of Plymouth which had a ban on phosphorus fertilizers since 1999, and the other in Maple Grove, which did not ban phosphorus fertilizers until the statewide ban went into effect in 2004. The two watersheds selected for the study are located less than ten miles apart so the differences in weather and soil type would be minimal. The study measured runoff from residential areas in underground storm sewer pipes and found a 12-15 % reduction in phosphorus from urban residential developments in Plymouth where phosphorus was restricted (Barten).

Another study conducted in Michigan cited compliance with the law resulted in lower concentrations of phosphorus in the water. This study found a reduction in dissolved phosphorus in surface water after the city of Ann Arbor passed a ban on phosphorus fertilizers.

The samples were taken from four sites along the Huron River in southern Michigan at intervals of four times a month for one year. The study found "within the context of our statistical model that phosphorus concentrations were lower in 2008 compared with the reference period 2003 to 2005 at experimental sites." The changes in phosphorus observed are attributed to not only reduced use of phosphorus fertilizers but also other BMPs including educating citizens to not discharge yard waste into storm sewers and greater maintenance of vegetative buffers (Lehman, 2009).

These two studies suggest a direct correlation between the passing of phosphorus fertilizer bans and a reduction in urban phosphorus runoff. However, there is little evidence that a reduction in urban phosphorus runoff has resulted in overall improved water quality. In the2007 "Report to the Minnesota Legislature: Effectiveness of the Minnesota Phosphorus Lawn Fertilizer Law" concluded "No discernible water quality trends could be determined due to the high variability of the data"(15). This finding is not particularly surprising, because the sediments at the bottom of lakes are high in phosphorus and leach back into the water. It will take at least eight years of reduced phosphorus loading to lakes to see a difference.

Any change in water quality will be minimal as a result of limiting phosphorus in turfgrass fertilizer. Turfgrass runoff contributes less than 5% of the total phosphorus entering surface waters. A reduction of phosphorus fertilizers will not be the isolated solution to the phosphorus problem. The phosphorus runoff from non or under-fertilized turf is greater than the runoff from fertilized healthy and thick turf. Though the laws emphasize reducing phosphorus use, it is important not to under-fertilize

turf. When turf is under-fertilized or not fertilized at all, it causes thinning and leads to greater sediment loss (Bierman et al. 2010). The phosphorus and nitrogen lost when lawns are under-fertilized should be stressed as much as over fertilizing especially in areas with low soil phosphorus concentrations. The phosphorus fertilizer laws are successful at educating citizens and lawn care professionals about best management practices for lawns and increasing awareness of sources of phosphorus and the associated problems with water quality.

Phosphorus in dish detergent

Phosphorus is also used as a cleaning agent in detergents. In the 1970s and early 1980s about half of the states in the United States passed legislation restricting the use or sale of phosphorus in laundry detergents and other household cleaning products. These types of laws permitted only trace amounts of phosphorus, usually 0.5%, in laundry and other household cleaning detergents but automatic dish detergents were not included in this legislation. Sixteen states have passed a law restricting the use of phosphorus in automatic dish detergents. California was very close to being the 17th state but the bill was vetoed by Governor Schwarzenegger (Legislative Landscape 2010).

During the 1970s and 80s, only a small percent of US homes had dishwashers and dish detergents for automatic dishwashers were not included in phosphorus detergent bans and were permitted to contain up to 8.7% phosphorus. Today, automatic dish washers are a common household appliance and thus a greater contributor of phosphorus. This caused 16 states to amend previous legislation to restrict the level of phosphorus to no more than 0.5% by weight in automatic dish detergents. The phosphorus detergent laws apply to non commercial and household automatic dish detergents. Detergents used for industrial, commercial or agricultural uses are exempt and are permitted to have up to 8.7% phosphorus (What the Law Says about Phosphorus).

The dish detergent laws were passed by states at various times in the last four years but they all went into effect on the same date July 1, 2010 (Phosphorous ban). The only exception was the state of Washington the first state to ban phosphorus dish detergent in 2006. In 2008, the law went into effect in some areas of Washington, "counties east of the crest of the Cascade mountains with populations greater than 400,000 and counties located west of the crest of the Cascade mountains with populations greater than 180,000 and less than 220,000." The sale of phosphorus dish detergent was not banned statewide until July 1, 2010 when the laws in the other 15 states went into effect. The uniform enactment is the result of negotiation between detergent industry and the states. The detergent industry wanted to give manufacturers and retailers time to sell existing products and develop phosphorus-free versions that complied with the regulations.

The industry needed time to create a better formula for the dish detergent because the early detergents were more expensive and did not clean as well. Phosphorus is used as builders in dish detergent. Meaning they bind Magnesium and aluminum ions to make the water "softer" so it cleans better and does not leave spots on dishes (Harahan, 2004). When the first restrictions went into place in Washington, early users of phosphorus free detergent complained about a white film that was left on their dishes. There were frequent reports of unhappy customers who bought dish detergent in a different county or state to avoid the phosphorus free ban. An August 2009 Consumer Reports study tested 18 dish detergents and only 2 phosphorus free detergents, Method and Simplicity were rated in the ten best (Brunt, Jonathan). This year, 2010, has been a turning point in the performance of phosphorus-free detergents. Companies have refined their products and the quality has improved. The September 2010 Consumer Reports evaluation reflects the changes in quality citing, "several low-phosphate products from different brands were very good this time around" (Phosphorous Ban Consumer Reports).

It took companies a few years to create substitutes for phosphorus and produce them on a large scale. Some replacements for phosphorus are Acusol 425N created by Dow Chemical; Clariant's SKS-6, a layered sodium silicate; or BASF's trisodium salt of methylglycinediacetic acid, trade-named Trilon (McCoy). There is not one but a combination of elements now used as a substitute for phosphorus. There is greater availability of phosphorus free products in response to the regulation. In the past, the eco-friendly brands such as Seventh Generation and Method were the only companies to produce phosphorus free automatic dish detergent. Larger brands are transitioning their entire stock because it is cheaper and more efficient for companies to make one product. Brands such as Cascade and Palmolive have pledged to make all of their products phosphorus free by July 1, 2010 even in states that do not regulate dish detergents (Cascade Phosphate Free). These two products make up over half the market

for automatic dish detergents. Other manufacturers such as Finish, the makers of Electrasol; and generic brands such as Costco's Kirkland Signature and Wal-mart's Great Value, only offer phosphorus free products in states that have passed laws (Sue) and (Flynn). The market is moving in the direction of total phosphorus free dish detergents but it has not happened yet.

The ban of phosphorus in detergents reduces the amount of phosphorus flowing into water treatment plants and septic tanks but its effect on water quality is still unknown. The average dishwasher contributes an average of 10.2 grams of phosphorus per week (Harahan, 2004). Spokane County, Washington banned the use of phosphorus dish detergents in 2008. One year later the water coming into the sewage treatment plant had an average of 10.7% or about 181 pounds of phosphorus less a day than the average from the previous three years (Brunt, Year). The sewage treatment plants will save money because fewer chemicals are required to remove phosphorus but the phosphorus levels in the water they release into the rivers will be about the same. Septic tanks or drain field systems where water seeps back into the ground may see the greatest impact on the reduction of phosphorus. In New Hampshire, where the law has been in effect no more than a month, Jody Connor, Director of the Environmental Services Limnology Center, estimated that a ban on phosphorus in dish detergents would reduce septic system phosphorus by 30% (Connor, 2010). The actual results have not been measured and they are significantly higher than the results seen in Spokane, Washington.

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Nicholas Institute for Environmental Policy Solutions

The Nicholas Institute for Environmental Policy Solutions at Duke University is a nonpartisan institute founded in 2005 to help decision makers in government, the private sector, and the nonprofit community address critical environmental challenges. The Nichols Institute responds to the demand for high-quality and timely data and acts as an "honest broker" in policy debates by convening and fostering open, ongoing dialogue between stakeholders on all sides of the issues and providing policy-relevant analysis based on academic research. The Nicholas Institute's leadership and staff leverage the broad expertise of Duke University as well as public and private partners worldwide. Since its inception, the Nicholas Institute has earned a distinguished reputation for its innovative approach to developing multilateral, nonpartisan, and economically viable solutions to pressing environmental challenges.

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