Great Lakes Water Quality Agreement: Sources of Nonpoint Source Pollution

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I. Introduction

Changes in the urban and agricultural landscape of the Great Lakes have resulted in an increased threat to the water quality of the lakes. Increased urbanization throughout the basin has resulted in substantially more surface area that is impermeable to rainwater and runoff.[1] As a result, nutrients, pathogens and sediment, all of which are being produced in increasingly large volumes, are transported into the lakes in greater amounts. Agriculturally, global market forces are shifting farming practices away from small family farms towards large, intensive operations such as confined animal feeding operations (CAFO).[2] Both the urban and the agricultural changes highlight shifts in land uses that are resulting in increased pollution in the Great Lakes.

Both urban and agricultural land uses are causing severe problems in the Great Lakes. Two of the largest problems faced are eutrophication[3] and siltation. Eutrophication occurs in rivers, lakes, estuaries and coastal oceans due to the addition of phosphorus and nitrogen to the

[1] Workgroup on Parties Implementation, Great Lakes Science Advisory Board. *Nonpoint Sources of Pollution to the Great Lakes Basin.* Section 1.3, p. 4. February 2000.

[2] Id.

[3] Eutrophication is when an increase in nutrients leads to an increase in primary productivity of an ecosystem, specifically manifested in algal blooms.

waterways.[4] Siltation of waterways caused by erosion of sediment, which is by volume the single largest pollutant being added to the Great Lakes.[5]

Pollution in the Great Lakes is generally classified as coming from one of two sources: point or nonpoint. Point sources are more easily identified and managed, since they are confined to a single location like an oil refinery, sewage or industrial treatment plant. [See http://www.epa.gov/owow/nps/qa.html]. The Clean Water Act[6] requires point sources to be regulated under the National Pollutant Discharge Elimination System (NPDES) program, which prohibits the addition of any pollutant to a waterway of the U.S. without a permit.[7] (CWA definition? Nonpoint sources, in contrast, are primarily regulated at the state and local levels through water quality planning programs.[8] Historically, phosphorus and nitrogen loading from point sources were of particular concern for Great Lakes water quality, since the lakes were experiencing extensive eutrophication.[9] In recent years substantial progress has been made

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[4] Ouyang, Da, Yung-Tsung Kang, and Jon Bartholic. *Agricultural Phosphorus Assessment in the Great Lakes Basin: A Case Study.* Presented at The Great Lakes Agricultural Summit, April 23-24, 1996, East Lansing, MI: p. 1.

[5] Burris, Robert L. *Sediment*. Great Lakes Nonpoint Source Workshop: A Post PLUARG Review, November 8-9, 2004, Ann Arbor, MI: p. 1.

[6] 33 U.S.C. 1251 et seq.

[7] Environmental Protection Agency, NPDES program page: http://cfpub.epa.gov/npdes/. Last visited 7/25/10.

[8] Mandelker, Daniel R. *Controlling Nonpoint Course Water Pollution Can it be Done?* 65 Chi.-Kent L. Rev. 479, 479 (2009).

[9] Ouyang, Da, Yung-Tsung Kang, and Jon Bartholic. *Agricultural Phosphorus Assessment in the Great Lakes Basin: A Case Study.* Presented at The Great Lakes Agricultural Summit, April 23-24, 1996, East Lansing, MI: p. 1.

towards controlling phosphorus and nitrogen point sources in the Great Lakes region, partially through phosphorus-detergent restrictions and improved wastewater treatment facilities.[10]

In contrast to the overall success experienced with controlling point sources, nonpoint source pollution is still a major concern for Great Lakes' water quality, so much so that the EPA considers it "the most important remaining source of water pollution" in the Great Lakes Basin.[11] Nonpoint source pollution is pollution that comes from a variety of diffuse sources, consequently making them difficult to identify and control. Substantial effort has been made to identify and control nonpoint sources in the Great Lakes, including Annex 13 of the Great Lakes Water Quality Agreement (GLWQA) and the creation of the Pollution from Land Use Activities Reference Group (PLUARG). The United States and Canada agreed on June 22, 2009 to renegotiate the GLWQA, a negotiation in which nonpoint source pollution will play a prominent role.[12] This paper is an analysis of that nonpoint source problem.

II. Nonpoint source pollution

Unlike point source pollution, nonpoint source pollution is not directly defined in legislative control effort such as the Clean Water Act or the Great Lakes Water Quality Agreement. The generally accepted definition, however, is "NPS pollution occurs when rainfall, snowmelt, or irrigation runs over land or through the ground, picks up pollutants, and deposits

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[10] Id.

[11] Karkkainen, Bradley C. *"New Governance" in the Great Lakes Basin: Has its time arrived?* 2006 Mich. St. L. Rev. 1249, FN14 (2006).

[12] Environment News Service. *USA, Canada to Modernize Great Lakes Water Quality Pact*. Jun 15, 2009. Available at http://www.ens-newswire.com/ens/jun2009/2009-06-15-01.asp (last visited 7/25/10).

them into rivers, lakes, and coastal waters or introduces them into ground water."[13] Water law divides water into two separate areas: surface water and ground water. This division, while useful for legislation, does not accurately take into account the connection between to two.[14] In general, nonpoint sources are responsible for 76% of the pollution in the lakes.[15] Traditionally, agriculture was recognized as the prominent source of the nonpoint pollution, particularly since urban areas only account for around 5% of the land surface area in the continental United States.[16] More recently it has been acknowledged that this view is not necessarily correct in the Great Lakes region. In the lower Great Lakes (i.e. "the corn-belt"), nonpoint source pollution does come primarily from agricultural sources, but in the upper Great Lakes nonpoint pollution is primarily from forestry and urban sources.[17] In both cases, the simple solution would seem to be use less chemicals and apply those being used more efficiently, but in reality substantially more control needs to be in place.[18] Realistically, control needs to be tailored to the specific region being focused on rather than attempting to apply a general plan to all different regions.[19] Regardless of the source, nonpoint pollution is very difficult to control both due to its widespread origins and diffuse sources and because the amount of pollution being deposited varies

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[13] Environmental Protection Agency website, http://www.epa.gov/owow/nps/facts/point1.htm (last visited 7/25/10).

[14] *Supra* note 8 at 480.

[15] Id. at 481.

[16] Hirsch, Robert M., Timothy L. Miller, and Pixie A. Hamilton. *Using Today's Science to Plan for Tomorrow's Water Policies.* Environment, v. 43, n. 1., p. 12 (January/February 2001).

[17] *Supra* note 8 at 481-82.

[18] *Supra* note 16.

[19] Id. at 13.

temporally.[20] The only way to begin effectively controlling nonpoint source pollution is to scientifically quantify and pinpoint the sources to create a nationwide picture of water quality. While efforts have been made in this direction, the efforts have been made by a wide variety of players without a unifying goal.[21]

Nonpoint sources are the dominant source of phosphorus and nitrogen input into U.S. waters.[22] For example, in a study of the relative contributions of point and nonpoint source pollution, NPS was found to be responsible for more than 90% of the nitrogen input to more than half of the 86 rivers studied and more than 90% of the phosphorus to more than one third of the rivers studied.[23]

One of the primary effects of nonpoint source pollution is eutrophication which results from excessive amounts of phosphorus and nitrogen in the lakes.[24] The most obvious result of eutrophication is growth of nuisance algae, in freshwater more specifically cyanobacteria (blue-green algae).[25] The negative consequences of cyanobacteria range from fish kills to foul odors to undrinkable water.[26] While potable drinking water is a major concern throughout the Great Lakes

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[20] Id. at 10.

[21] Id.

[22] Carpenter, S.R., N.F. Caraco, D.L. Correll, R.W. Howarth, A.N. Sharpley and V.H. Smith. *Nonpoint Pollution of Surface Waters with Phosphorus and Nitrogen.* Ecological Applications: 8(3), 1998, pp. 559-568, 561.

[23] Id.

[24] Id. at 560.

[25] Id. at 561.

[26] Id.

basin, unlike nitrogen based water standards, there are no drinking water standards in place for phosphorus because it does not directly impact human health.[27]

In order to reduce eutrophication in the Great Lakes, the first and most important requirement will be to reduce the phosphorus and nitrogen inputs.[28] In addition to reducing input, more substantial action may be required since the eutrophic state of the lakes is relatively stable. This stability is the result of effective internal recycling of P, loss of rooted aquatic plants leading to destabilization of sediments and changes in the food web that lead to a change in grazing on nuisance algae.[29]

In response to concerns about water quality in the Great Lakes water, the United States and Canada entered into the Great Lakes Water Quality Agreement (GLWQA) in 1972. The purpose of the GLWQA is to "commit[] to restore and maintain the chemical, physical and biological integrity of the Great Lakes Basin ecosystem."[30] In an effort to meet the requirements laid out in the GLWQA, the Pollution from Land Use Activities Reference Group (PLUARG) was created to research and report on specific issues facing the Great Lakes. In 1978 PLUARG produced a report focusing on nonpoint pollution sources, specifically agricultural sources.[31] That report can be viewed at http://gis.lrs.uoguelph.ca/AgriEnvArchives/download/PLUARG_env_man_strat.pdf.

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[27] Id. at 562.

[28] Id.

[29] Id.

[30] Great Lakes Water Quality Agreement of 1978, available at http://www.ijc.org/en/activities/consultations/glwqa/agreement.php. (last visited 7/25/10).

[31] PLUARG, Environmental Management Strategy for the Great Lakes System: Final Report to the International Joint Commission. Windsor, Ontario: July, 1978.

The research and knowledge currently available from PLUARG and other sources is sufficient to take substantial steps towards controlling nonpoint pollution. The main reason nonpoint pollution has not been controlled by the GLWQA at this point is not a lack of information, but a lack of accountability and an enforcement mechanism.[32] There is a lack of accountability because either country can pull out of the agreement with one years notice, making the agreement virtually unenforceable in the long term.[33] Also, as with all government programs, the question of where the funding will come from is a problem, with each branch of government cutting funding over time.[34] And finally, while the GLWQA sets forth admirable goals, the agreement itself lacks certainty about what needs to be done and by what date.[35] Just as important as the lack of accountability is the lack of a method to enforce the agreement. The one international agency created to implement the GLWQA, the International Joint Commission (IJC), has no power to enforce the agreement, a fact which leaves open the possibility that the GLWQA will be ignored all together.[36] Ultimately, nonpoint pollution is a problem at a local scale that requires federal control and financial assistance.

Urban nonpoint sources have historically been considered less important than agricultural sources because urban land use covers a much smaller surface area than does agricultural land use. While some urban nonpoint pollution could be reduced through land management or technological strategies, the North American preference for low-density suburban development

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[32] Tschorke, Alisa. *Great Lakes Water Quality Agreement: Is honesty without accountability or enforcement still enough?* 15 Mo. Envtl. L. & Pol'y Rev. 273 (2008).

[33] Id. at FN38.

[34] Id. at FN96.

[35] Id. at FN101.

[36] Id. at 295-96.

will prevent these measures from effectively handling the problem.[37] Three primary types of pollution come from urban nonpoint sources: nutrients, pathogens and sediment.

Most nutrients find their way into the Great Lakes through stormwater runoff from streets, parking lots, lawns, driveways or roofs.[38] In a 1993 Wisconsin study to determine critical source areas for contaminants, a source area was defined as any urban surface that contributes contaminants to runoff.[39] Overall, the results of the study showed that nutrient concentrations from a source area varied widely around the geometric mean, with the one exception being roof runoff.[40] Street runoff had the highest level of measured contaminants except zinc and phosphorus, with industrial roofs having the highest level of zinc and lawns the highest level of phosphorus.[41] Residential roof runoff had the lowest value for all contaminants measured, but contrasted with industrial roofs which had the highest zinc as a result of the galvanized roof material used in their construction.[42] While low in nutrients such as phosphorus and zinc, residential areas had the highest bacteria levels of all source areas studied, most likely as a result of animal waste.[43] The study found that source areas with the largest amount of connected impervious area, such as industrial parking lots, produced the most runoff.[44] In contrast, even

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[37] International Association for Great Lakes Research. *Linking Science and Policy for Urban Nonpoint Source Pollution*. November, 2002: p. 3.

[38] Bannerman, R.T., D.W. Owens, R.B Dodds and N.J. Hornewer. *Sources of Pollutants in Wisconsin Stornmwater.* Wat. Sci. Tech. v. 28, no. 305, pp. 241-259, 242 (1993).

[39] Id.

[40] Id. at 251.

[41] Id.

[42] Id.

[43] Id. at 253.

[44] Id. at 255.

though lawns covered the most surface area in residential and industrial land use, they produced a relatively small volume of runoff.[45]

In a more focused study that specifically centered on nutrient movement from residential lawns, the authors analyzed the effects of "complete" lawn fertilizers, which are fertilizers that contain nitrogen, phosphorus and potassium.[46] The chemical composition is based on the need for nitrogen to stimulate leaf growth, phosphorus to enhance stem and root strength and potassium to encourage seed-ripening and stress tolerance.[47] Fertilizer use in general exploded during the 20th century, with the amount recommended by some experts increasing from 44 pounds of nitrogen per acre per year before 1940 to 283 pounds of nitrogen per acre per year by 1965.[48] While professional recommendations have decreased in recent years, partially due to knowledge that excess nutrients can degrade streams and partially due to a shift to hardier grasses, there are still large amounts of fertilizers being added to residential lawns.[49] The best way to control nutrient input into lawns and ensure the right amount of fertilizer is being added is to understand the nutrient cycle.

The nutrient cycle of the lawn is divided into 3 parts: input, output and storage. Inputs include fertilizers, atmospheric deposition, runoff from impervious areas, nutrient content in

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[45] Id.

[46] Stormwater Managers Resource Center. *Nutrient Movement from the Lawn to the Stream*. Watershed Protection Techniques, Article 4 in The Practice of Watershed Protection, 2(1): pp. 23-30, 23.

[47] Id.

[48] Id.

[49] Id.

irrigation water, nutrient fixation by plants and decomposition of clippings.[50] At the other end of the cycle, outputs include volatilization into the atmosphere, denitrification by bacteria in the soil, surface runoff, subsurface leaching and clippings.[51] Finally, storage includes storage of nutrients in soil and thatch storage.[52] Because of the wide variety of inputs and outputs, individual owners should undertake soil tests before applying fertilizers.[53] A compilation of surveys carried out in the U.S. show that 70% of all lawns are fertilized regularly, regardless of whether there is in fact a need for the excess nutrients.[54] In one Minnesota study, while 85% of the homeowners reported they used fertilizers, only 18% had their soil tested before application.[55] Adding to the over-application problem, most homeowners apply fertilizer according to what is stated on the label, even though there is no standard for specificity of the labels.[56]The unnecessary application of excess nutrients to lawns could easily be controlled through soil tests, but this type of policy response is difficult to implement since the amount being applied individually seems too minute to be having a substantial impact.[57]

In addition to nutrients that are being applied directly as fertilizer, nutrients deposited from the atmosphere also find their way into the waters of the Great Lakes. Atmospheric deposition is one of the largest nonpoint sources of nitrogen being deposited in the lakes, with

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[50] Id. at 25-26.

[51] Id. at 27-28.

[52] Id. at 27.

[53] Id. at 24.

[54] Id.

[55] Id.

[56] Id.

[57] Id.

nitrogen coming specifically from gases released from agriculture and the burning of fossil fuels.[58] Airborne pollutants also come from street dust and natural sources such as pollen.[59] Atmospheric deposition in general is much more of a problem in urban watersheds, due to the amount of impervious cover.[60] As a result, one study by NOAA's Undersea Research Program found that atmospheric deposition was responsible for 70-95% of nitrogen in urban runoff and 20-35% of the phosphorus.[61]

While nutrients are a major concern for Great Lakes water quality, other serious concerns include pathogen and sediment pollution. In urban areas, non-human waste (such as pet or wild animal feces) that becomes part of stormwater runoff can result in levels of bacteria high enough to be hazardous to human health.[62] Bacteria can also come from wastewater discharges from septic systems and combined sewer overflows, though this varies from location to location.[63] In addition to polluting rivers and streams, septic systems also have the potential to contaminate subsurface drinking water, posing serious health risks.[64]

Nutrients and pathogens are of great concern for water quality, but the most significant polluter by volume in the Great Lakes is sediment.[65] Sediment enters urban streams from one of

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[58] *Supra* note 22 at 564.

[59] *Supra* note 1 at 12.

[60] Id.

[61] Id.

[62] Id. at 14.

[63] Id.

[64] Id.

[65] *Supra* note 5 at 1.

three sources: channel erosion, construction site erosion and stormwater washoff from impervious surfaces.[66] Channel erosion is the most significant source of sediment pollution.[67] Stream channels erode as a result of urban land development, because the development causes a shift in the hydrologic cycle that results in an increase in stormwater runoff.[68] One study showed that at 10% impervious cover, most stream channels become unstable, leading to significant erosion.[69] Construction is another activity that leads to significant erosion, with impact varying widely between watersheds depending on the amount of construction, the watershed size and particle size.[70] Many technologies have been developed to help minimize the impact of construction, but effectiveness is dependent on actual implementation within construction sites.

Currently, a wide array of management practices are in place to control urban nonpoint source pollution. The most common technique is the best management practice (BMP), a control measure that slows, retains or absorbs pollutants in surface water runoff.[71] Some of the most used BMPs are detention ponds and infiltration trenches.[72] Both detention ponds and infiltration trenches have high estimated removal rates, but face difficulties throughout the process. To begin, the implementation of BMPs requires either mandatory or permissive statutory authority, specifically at the local level.[73] Several states have adopted soil and erosion measures for

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66 *Supra* note 1 at 14.

67 Id.

68 Id.

69 Id.

70 Id. at 14-15.

71 *Supra* note 8 at 483.

72 Id.

73 Id. at 484.

agricultural and forestry uses or construction sites, with some of those states requiring local governments to act while others simply authorize the local government to act.[74] Even after the legislation is in place, the effectiveness of BMPs is often limited by poor design and/or poor maintenance.[75] One study found the effectiveness of a BMP was drastically affected by how much volume was used to treat the runoff: a pond detaining stormwater that was 1.4 acre-feet of storage per impervious acre suspended around 92% of solids, while a pond that was 0.1 acre-feet per impervious acre only suspended about 62%.[76] In addition to poor design difficulties, many BMPs also do not incorporate design features that encourage maintenance, resulting in the effectiveness of many BMPs declining over time.[77] In addition to problems with design and maintenance while removing solids, BMPs do not control channel erosion or remove bacteria at a rate that meets water quality standards.[78]

As an alternative to BMPs, use and density controls can be used to reduce nonpoint pollution.[79] Use and density controls can work in two ways: zoning ordinances can control the rate and type of growth, and subdivision controls that manage individual or specific sources of nonpoint pollution.[80] One difficulty with zoning ordinances is that the question of what is the

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[74] Id. at 484-85.

[75] *Supra* note 1 at 15.

[76] Id. at 16.

[77] Id.

[78] Id. at 16-17.

[79] *Supra* note 8 at 4.

[80] Id.

best form of urban growth is subject to interpretation and therefore not easily answered.[81] A decrease in impervious surfaces is clearly preferable, but whether compact development or low-density development is preferable is a matter of opinion and experience.[82] Two methods used as part of comprehensive land use controls are performance zoning and carrying capacity analysis. Performance zoning regulates nonpoint pollution by regulating land development according to performance criteria, taking into account environmental and other impacts.[83] Performance zoning does not use pre-determined land use regulations, but instead uses set criteria to determine how the land should be developed.[84] Carrying capacity analysis, in contrast, evaluates the ability of the land to handle new development by analyzing its physical capacity.[85] While carrying capacity analysis has a strong following among many environmentalists, it is still criticized for not taking into account the full extent of ecological relationships that exist between water quality, water flow and land use.[86]

In addition to the legislative control and policy efforts that are in place, many techniques implemented on an individual scale exist as well. In an effort to control sediment from construction, construction site phasing is a method which minimizes soil erosion because it only disturbs one area at a time when building the infrastructure, and it allows that area to stabilize

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[81] Heathcote, Isobel W. and Christine Zimmer. *Current Trends and Emerging Issues: Urbanization Pressures on Great Lakes Water Quality.* Available at http://www.glc.org/postpluarg/documents/Heathcote_Plenary_Trends.pdf.

[82] Id.

[83] *Supra* note 8 at 4-5.

[84] Id. at 5.

[85] Id.

[86] Id.

before moving on to a new area.[87] The purpose of construction site phasing is erosion prevention, rather than sediment control, since preventing the sediment loss in the first place is much more effective.[88] When applied correctly, construction site phasing can reduce sediment loss by as much as 40% over the typical, mass-graded site.[89] The difficulties in implementing well phased projects are primarily the result of the practical difficulties associated with construction.[90] Good planning is difficult because there are a number of unknown factors, stormwater management during the project is complicated and the impact of the overall size of the project.[91] Construction site phasing is much easier with large projects, because there it is possible to focus work in a substantial enough area.[92] The main problem for all types of urban nonpoint pollution control is that most control measures focus on one impact at one stage of development, which does not take into account the complexities of the environment.[93]

Unlike urban nonpoint pollution (historically believed to only be a small contributor to the Great Lakes water quality problem), agricultural sources have long been understood to be a major problem. At the most fundamental level, more nutrients are being added as fertilizer than removed as produce, which causes the excess nutrients to end up in surface waters.[94] Phosphorus

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[87] Stormwater Manager's Resource Center. *Practical Tips for Construction Site Phasing.* Watershed Protection Techniques, 2(3): pp. 13-18, 13.

[88] Id.

[89] Id.

[90] Id. at 14.

[91] Id. at 14, 16.

[92] Id. at 16.

[93] *Supra* note 1 at 17.

[94] *Supra* note 22 at 562.

in particular has historically been a limiting nutrient for growth, which results in farmers adding mass quantities to the soil in the form of fertilizers.[95] Agricultural sources of nonpoint pollution include "non-irrigated crop production, irrigated crop production, specialty crop production, orchards, pasture land, range land, all types of feedlots and animal holding or management areas."[96] While pollutant elimination programs could be developed and implemented to control nonpoint sources, unlike industrial polluters who can pass the additional costs of the program to their customers, farmers are forced to shoulder the cost themselves.[97]

Phosphorus agricultural nonpoint pollution comes primarily from fertilizer and manure, and can be delivered into surface waters either as soluble phosphorus or sediment bound phosphorus.[98] Phosphorus loaded fertilizers have been added to croplands for decades, resulting in a net accumulation of phosphorus in U.S. soils.[99] One study determined that between 1950 and 1995 around 600×10^6 Mg of fertilizer was added to the Earth's croplands, while at the same time only around 250×10^6 Mg was removed through harvesting.[100] On a smaller scale, in the U.S. only about 30% of the phosphorus input is removed through harvest.[101] Even though there is still an accumulation of phosphorus in the soil, due to awareness of the dangers of over-

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[95] Id.

[96] Heil, Theresa. *Agricultural Nonpoint Source Runoff- The Effects Both on and off the Farm: An analysis of Federal and State regulation of agricultural nonpoint source pollutants.* 5 Wis. Envtl. L.J. 43, 49-50 (1998).

[97] Id. at 52.

[98] *Supra* note 4 at 1.

[99] *Supra* note 22 at 562.

[100] Id. at 562-63.

[101] Id. at 563.

fertilization, application of fertilizers in the Great Lakes basin declined 35% between 1981 and 1991.[102]

Manure, in contrast to the intentional application of fertilizers, is a by-product of farming practices. In recent years there has been a shift away from small, family owned farms to large, confined animal feeding operations (CAFO), a shift that has resulted in the production of a large amount of manure in a concentrated area.[103] One control method that has been implemented is to require permits through the National Pollutant Discharge Elimination System (NPDES), but since permits are only required for CAFOs that make a "significant contribution" to pollution, the effects of smaller operations are not being accounted for at all.[104] One possible solution is for manure to be recycled and applied as fertilizer to crop land, but for this method to be effective the manure from a feedlot would need to be applied to land that is ~1000 times greater than the feedlot area it is coming from.[105] This space requirement presents a large problem when the source of the manure is a CAFO (a large area to start). In addition to the problem of there not being enough surface area to distribute the manure on, from a farmer's point of view having high levels of phosphorus in the soil is preferable since it stimulates growth.[106] This preference provides little incentive for farmers to expend the finances to control nutrient runoff from their field.

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[102] *Supra* note 4 at 3.

[103] *Supra* note 1 at 4.

[104] *Supra* note 96 at 53.

[105] *Supra* note 22 at 563.

[106] *Supra* note 4 at 5.

The impact of manure and fertilizer on water quality varies greatly. A study that measured surface water phosphorus and nitrogen content after fertilizer and manure was applied to farmland indicate that the percentage of fertilizer and manure being lost to run off is relatively small, 5% and around 20% respectively, but they do not take into account all of the factors that influence runoff including "rate, season, chemical form and method of nutrient application; amount and timing of rainfall after application; and vegetative cover."[107]

One of the biggest problems facing control of agricultural nonpoint sources is that Congress has decided, based on the unique local dynamics of the sources, that control programs should be planned and implemented on the state level.[108] The consequence is a complete lack of direct national regulation over agricultural nonpoint pollution.[109] At the state level, two of the primary cultivation methods in place are conservation tillage and buffer strips.[110] Conservation tillage encompasses any farming practices that leave a minimum of 30% of the surface area covered in crop residue after planting.[111] Conservation tillage is currently in place for 48% of the acreage in the Great Lakes basin.[112] Similarly, buffer strips are strips of land that are left undeveloped in order to catch pollutants before they can be carried away from fields in the form of runoff.[113]

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107 *Supra* note 22 at 562.

108 *Supra* note 96 at 50.

109 Id.

110 Environmental Protection Agency. *Great Lakes Ecosystem Report.* Page 41.

111 Id.

112 Id.

113 Id.

The best method for calculating nutrient budgets is through a mass balance calculation.[114] Mass balance is calculated as the phosphorus input minus the phosphorus output.[115] Phosphorus inputs include fertilizer and manure, which phosphorus outputs include crop removal, sediment bound phosphorus, soluble phosphorus in runoff and leaching.[116] The main problem with this calculation is that it does not take into account what form of phosphorus is available, a fact which greatly affects the overall bioavailability of the nutrient.[117] In addition to calculating what the nutrient budget of a field is, it can be helpful to calculate the accumulation of phosphorus in the soil. Accumulation is calculated as FP + MP – HP where FP is fertilizer input, MP is manure input and HP is annual crop removal.[118] The current problem is that between fertilizer being added and manure as a bi-product of CAFOs there is still a net accumulation of phosphorus in the soil.

One of the largest scale policy responses to the water quality problems in the Great Lakes was the international Great Lakes Water Quality Agreement (GLWQA). The GLWQA is an international agreement intended to create binding obligations on the sovereign states (U.S. and Canada) to exercise their own authority in regulating polluting activities in the Great Lakes.[119] Because the primary activities that are polluting the Great Lakes are local, such as farms, factories, city streets and mines, the only way for the federal government to regulate at that level

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[114] *Supra* note 4 at 5.

[115] Id.

[116] Id. at 8.

[117] Id. at 6.

[118] Id. at 11.

[119] Karkkainen, Bradley C. *Managing Transboundary Aquatic Ecosystems: Lessons from the Great Lakes.* 19 Pac. McGeorge Global Bus. & Dev. L. J. 209, 221 (2006).

across an international border is through an international agreement.[120] The biggest problem with international agreements in general is that there is often no authority that can enforce the provisions: unless an institutional mechanism is put in place to enforce the provision, all that remains is a vision.[121] In the original version of the GLWQA in 1972, the 'vision' applied a narrow, one problem at a time approach that did not take into account the complexities of the ecosystem it was intended to protect.[122] The newer version of the GLWQA has adopted an ecosystem approach intended to address the previous version's problems, but still without an enforcement mechanism so that the regulation is not much more effective than the original version.[123]

The problems facing the regulation of Great Lakes water quality move beyond the traditional problems of a bi-national agreement. In addition to difficulties of international accountability, there are various "scale mismatches" that also greatly impact the ability to implement control provision under the GLWQA.[124] To begin, while the Great Lakes cover a relatively large region in both the U.S. and Canada, the issues that are prominent for the population living within the basin are still of less concern at the national level.[125] The level of awareness demonstrated on the national stage of the severity of the problems in the Great Lakes shows that the level of concern is much higher with those living in the Great Lakes basin than

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[120] Id.

[121] Id. at 220.

[122] Id. at 218.

[123] Id. at 218, 222.

[124] Id. at 222-24.

[125] Id. at 222-23.

those not.[126] In addition to the variation in levels of concern for the Great Lakes at the national level, there is a massive scale mismatch between the national and state/provincial governments.[127] Both the United States and Canada have federal systems of government with sub-national governments- state in the U.S. and provinces in Canada- that enjoy quasi-sovereign status.[128] This means that any agreements entered into on the national level also needs to be incorporated at the state/provincial level in order to be effective.[129] And finally, in addition to the relationship between the national government and the states/provinces, the relationship among states/provinces is essential since territorial boundaries are irrelevant with regards to water pollution.[130]

The Boundary Waters Treaty, the initial treaty that evolved into the GLWQA, created the International Joint Commission (IJC) as a mechanism that would resolve disputes between the U.S. and Canada that arose as a result of the treaty.[131] The IJC is composed of 6 commissioners, 3 from the U.S. and 3 from Canada.[132] While the IJC is an example of "an institution that has effectively and peacefully managed the boundary waters of two nations over ninety years", it is also an institution whose decisions are not legally binding and therefore limited in its

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[126] Id. at 223.

[127] Id.

[128] Id.

[129] Id.

[130] Id. at 223-24.

[131] Paisley, Richard Kyle, Cuauhtemoc Leon, Boris Graizbord and Eugene C. Bricklemeyer, Jr. *Transboundary Water Management: An institutional comparison among Canada, the United States and Mexico.* 9 Ocean & Coastal L.J. 177, 183 (2004).

[132] Id.

effectiveness.[133] The IJC has also been criticized on several other fronts, including the question of whether its authority and the limits on that authority are a limitation to the ecosystem approach adopted as part of the 1987 GLWQA, whether it should be replaced with an institution that has real legal authority and how committed the IJC is to public participation.[134] Even with these critiques the IJC, it is currently the primary institution implementing the GLWQA.

While the creation of the IJC is a good starting place, controlling nonpoint source pollution must happen at the local level. The problem is local governments do not want responsibility, since control measures are expensive, and the pollution is easily exported out of the local jurisdiction.[135] Because of the characteristics of the hydrological cycle, the most effective way to regulate nonpoint source pollution is at the watershed level, with local governments within the watershed working together.[136] According to the General Accountability Office (GAO), nearly $3.6 billion was spent on basic specific projects between 1992 and 2001, but since the efforts (148 federal and 51 state programs) were not coordinated the money was not put to its best use.[137] To better determine what progress these programs have made, and what still remains to be done, there needs to be consistent indices used across the programs.[138] Most of the reports on Great Lakes water quality are voluntarily completed, which means there are also gaps

[133] Id. at 186-87.

[134] Id.

[135] *Supra* note 8 at 489.

[136] Kumble, Peter A. and Elizabeth A. Brabec. *Land Planning and Development Mitigation for Protecting Water Quality in the Great Lakes System: An evaluation of U.S. approaches.* Presented at Emerging Issues along Urban/Rural Interfaces: Linking Science and Society Conference. Atlanta, GA , March 13-16, 2005. Pp. 200-205, 203.

[137] Id. at 200-01.

[138] Id. at 201.

in the information available.[139] It has been suggested that the best way to bridge this gap and create an effective regulatory program is to use utilize existing state/regional planning authorities to incentivize local governments to help develop a coordinated watershed management plan.[140]

VI. Considerations for the new GLWQA

At this time, there is no shortage of information available on nonpoint source pollution. The consequences of the nonpoint pollution on water quality are well known, as evidenced by contaminated drinking water and algal blooms that seriously impact both the recreational and commercial fishing industries. At this point the sources are well known as well, with numerous studies quantifying how much pollution is coming from any given source. The issue has become, what will we do with the information we have? Nonpoint source pollution may be a local issue, but the solution must be implemented at the regional, national and international level if any headway is to be made. The GLWQA is a good vehicle to implement a solution, but to be truly effective it will need to deal with two large issues: enforcement and finances. The current enforcement mechanism is not working: a stronger mechanism with concrete consequences needs to be in place. The IJC, if it is to continue as the enforcing entity, needs to have the authority to compel compliance, whether that is through fines or judicial action or something else.

In addition to enforcement, the major issue that must be resolved is where the funding will come from and how it will be utilized. The GAO has established that, while not unlimited, there are resources available and being used to implement programs throughout the U.S. and

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[139] Id.

[140] Id. at 203.

Canada. These resources need to be used judiciously, with an eye on how individual programs fit into the bigger picture of the Great Lakes. But while these resources may need to be applied more stringently, there also needs to be a firm commitment from all levels of government to contribute additional funds to the cause. Until there are more incentives in place, whether in the form of funds or tax breaks, it will be difficult to convince local government or their constituents to make a concerted effort. And until there are efforts being made at the local level, as well as the national and international levels, this will continue to be a problem that is talked about and written about, but never fixed. And that is not in anybody’s best interest.