THE FAILURE AND FUTURE OF POLICY INSTRUMENTS IN MANAGING HARMFUL ALGAL BLOOMS

Figure 1: NASA image of harmful algal blooms in Lake Erie as adapted from Lake Erie LaMP Work Group Nutrient Management Strategy, "Lake Erie Binational Nutrient Management Strategy: Protecting Lake Erie by Managing Phosphorus" (2011) online: <http://35.8.121.122/le/LakeErieBinationalNutrientManagementStrategy.pdf> .

Leslie Welts

Faculty of Law
McGill University, Montreal

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ABSTRACT

Harmful algal blooms threaten waters across the globe. The blooms degrade water quality, are toxic to humans, and threaten the health and habitat of aquatic biota. The blooms thrive in water bodies with excessive quantities of nutrients and their presence is exacerbated by climate change-induced weather patterns. Agricultural runoff is responsible for a majority of the excess nutrients in Lake Champlain and Lake Erie, but there are simple land use practices agricultural producers can implement to significantly reduce the amount of runoff leaving their land.

Despite the fact that there is scientific consensus about the primary cause of harmful algal blooms as well as the solutions for resolving the problem, legislatures grapple to regulate agricultural producers' land use practices. This struggle occurs mainly because legislatures lack the proper legal tools. Traditional policy instruments focus on resolving disputes between individuals or the government policing specific actors and are therefore ill-equipped to address widespread environmental issues that are not easily traceable to a single source.

Yet, there is hope: reflexive law theory advances policy instruments aimed to encourage producers to self-regulate. These policy instruments create incentive structures to align actors' goals with societal goals by harnessing the power of the market and by creating situations where social pressures will nudge actors toward more socially desirable behaviours. Watersheds that have implemented them to address agricultural runoff have seen largely encouraging results.

In this project, I trace the development of environmental policy instruments, using Lake Champlain and Lake Erie as prominent case studies that illustrate the inadequacies of traditional legal regimes in addressing widespread environmental issues. I also present reflexive law strategies that can compensate for these inadequacies. I argue that the current legal regimes in the Lake Champlain and Lake Erie watersheds are inadequate to curtail agricultural runoff and must be supplemented by reflexive law policy instruments if legislatures are to make progress in the battle against harmful algal blooms.

RESUME

Des fleurs d'eau d'algues néfastes menacent des plans d'eau à travers la planète. Les fleurs d'eau nuisent à la qualité de l'eau, elles sont toxiques pour les êtres-humains et elles menacent la santé et les habitats du biota aquatique. Les fleurs d'eau se répandent dans des plans d'eau ayant une quantité excessive de nutriments, et leur présence est exacerbée par les tendances météorologiques provoquées par les changements climatiques. La plupart des nutriments excessifs dans le Lac Champlain et le Lac Érié sont dus aux effluents d'élevage mais il existe des pratiques d'aménagement du territoire simples que les agriculteurs peuvent mettre en œuvre afin de réduire considérablement les effluents venant de leurs terrains.

Malgré le consensus scientifique sur la cause primaire des fleurs d'eau d'algues néfastes ainsi que sur les solutions pour résoudre le problème, les législatures peinent à règlementer les pratiques d'aménagement du territoire des agriculteurs. Cette lutte a surtout lieu car les législatures manquent d'outils juridiques appropriés. Les instruments de politique traditionnels mettent l'accent sur la résolution de différends entre particuliers ou sur la surveillance par le gouvernement de certains acteurs spécifiques. Ils sont ainsi mal adaptés pour faire face aux vastes problématiques environnementales pour lesquelles il est difficile d'identifier une seule source.

Pourtant, il y a une lueur d'espoir : la théorie du droit réflexif propose des instruments de politique qui ont pour objectif d'encourager les agriculteurs à s'autoréguler. Ces instruments de politique créent des structures de motivation afin d'aligner les buts des acteurs sur les buts sociétaux, en mettant à profit la puissance du marché et en créant des situations où des pressions sociales pousseront les acteurs à se comporter d'une façon plus socialement souhaitable. Les bassins versants qui les ont mis en œuvre afin de faire face aux effluents d'élevage ont obtenu des résultats globalement encourageants.

Dans le cadre de ce projet, je trace le développement des instruments de politique environnementaux en prenant le Lac Champlain et le Lac Érié comme

études de cas majeures qui illustrent les incapacités des régimes juridiques traditionnels à faire face à ces vastes problématiques environnementales. Je présente également des stratégies du droit réflexif qui pourraient compenser ces incapacités. Je défends le fait que les régimes juridiques actuels dans les bassins versants du Lac Champlain et du Lac Érié soient incapables de réduire les effluents d'élevage et doivent donc être complétés par des instruments de politique du droit réflexif afin que les législatures progressent dans la lutte contre les fleurs d'eau d'algues néfastes.

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This thesis is dedicated to Alan Panebaker (1983-2012), a talented legal mind, paddler, and advocate of clean waters who was taken too soon. In my lowest moments of self-doubt, I thought of him and tried to heed his advice not to be such a weenie.

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INTRODUCTION

According to Dutch legend, there once was a little Dutch boy who came across a dyke with a small leak.[1] The boy immediately understood the urgency of the situation: if the trickle of water leaking through the small hole was left unstopped, the size of the hole would increase and eventually the waters held back by the dyke would wash away Holland. So the boy plugged the hole with his finger, which stopped the leak and stemmed the flow of water. But after the satisfaction of solving the problem wore off, the boy realised he was stuck until reinforcements arrived. He cried out for help but to no avail. Soon night fell and as the cold water began to pain the boy, he started to fear for his life. But the boy stood fast, determined to stay because he knew that if he were to draw away his finger, the waters would rush forth and sweep away his country. Eventually, a man out for a morning walk caught sight of the boy and quickly sought help, relieving the boy from his duty.

The Little Dutch Boy parable is told to children to teach them that even the smallest individual can prevent disasters if they act quickly and are willing to make self-sacrifices for the greater good. The parable applies equally well our need to act quickly to prevent impending environmental disasters. Like the menacing waters behind the dyke, imminent environmental catastrophes loom over us, threatening to sweep away our world by making it uninhabitable.[2] But like the Little Dutch Boy, even seemingly small efforts can abate disaster if we act quickly and are willing to make sacrifices.

We can act quickly to abate environmental disasters if we focus on the issues that are relatively straight-forward. Many environmental issues have scientific consensus as to their threats, causes, and solutions, yet the law has proven inadequate in addressing them. If we are to halt bigger environmental disasters, we must plug these holes now. Harmful algal blooms that threaten water quality present the perfect cause for acting quickly. The blooms currently

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[1] *See* Mary Mapes Dodge, *Hans Brinker, or The Silver Skates* (Garden City, NH: Junior Deluxe Editions, 1954) at 136-140.

[2] *See generally* Bill McKibben, *Eaarth: Making a Life on a Tough New Planet* (New York: Times Books, 2010).

degrade waters across the globe, killing aquatic biota and poisoning our waters. Scientific studies have reached consensus as to the harms, the causes of these blooms (i.e., excessive nutrients from agricultural runoff and rising temperatures), and the solutions for preventing the blooms (i.e., land use practices that will reduce the amount of nutrients leaving agricultural fields). Moreover, there is scientific consensus that the blooms will worsen as a result of climate change-induced weather events, making their abatement all the more pressing. Yet our legal regimes have proven to be largely ineffective in handling the issue.

In this thesis, I embark on two tasks. First, I seek to understand why our policy instruments are failing so tragically to address such a scientifically well-understood environmental phenomenon. Second, I look to the future of policy instruments and suggest reflexive law as a way for legislatures to move forward to overcome traditional environmental law's shortcomings. In addition to serving as an example of an environmental problem we should tackle quickly, the harmful algal bloom issue provides a useful illustration of the inherent disconnect between ecosystem structures and legal regimes.

In Chapter One, I provide background on water quality concerns, and harmful algal blooms in particular, and trace legislatures' attempts to use the law to protect the environment. My research in this chapter reveals that although managing watersheds for harmful algal blooms is relatively straight-forward scientifically, it is an incredibly complicated legal task due to the structure of our current legal regimes. Reflexive law theory offers policy instruments that possess the potential to help legislatures overcome this discrepancy.

I conduct a doctrinal analysis in Chapter Two to assess how specific legislatures are regulating activities that cause harmful algal blooms. In particular, I examine the policy instruments currently being used to regulate agricultural runoff in the Lake Champlain and Lake Erie basins. My analysis reveals that both jurisdictions are moving in the direction of adopting reflexive law policy instruments, but the recentness of these policies makes it difficult to assess whether they are successfully curtailing pollution.

In Chapter Three, I look to other watersheds for clues as to how legislatures may implement reflexive law strategies. I contend that watershed managers must take an ecosystem-based management approach if they are to adequately address water quality threats and present five watersheds that have implemented different reflexive law-based ecosystem management plans.

Based on the lessons learnt in these chapters, I propose suggestions for how legislatures in the Lake Champlain and Lake Erie basins may implement additional reflexive law policy instruments to supplement their current legal regimes. These case studies may inform the way legislatures use policy instruments to address environmental issues in other contexts as well. Indeed, the legal regimes in Lake Champlain and Lake Erie demonstrate three important take-home messages for environmental legislatures everywhere: (1) our traditional environmental laws are inadequate for handling widespread environmental concerns, such as harmful algal blooms; (2) legislatures appear to understand these inadequacies and are beginning to adopt innovative policy instruments as a result; and (3) reflexive law policy instruments offer efficient ways to legislatures adapt to the changing world.

Importantly, reflexive law policy instruments cannot work without the support of our current legal regime and therefore legislatures should consider them as valuable supplements, rather than replacements, to our current command and control regulations. Moreover, in order for reflexive law policy instruments to have optimal results, legislatures must carefully tailor them to their jurisdiction's unique economic, geographical, social, and political features. For example, a policy instrument tailored for a rural economy may not be very effective in a booming metropolis. In addition, further studies are necessary before legislatures can truly understand the success of their policy instruments. It is easy to judge when a policy instrument is not working: just look to see whether the policy instrument is abating the pollution, or, to recall the Little Dutch Boy, whether the effort is actually stopping the water from crashing through the dyke. However determining just how successful a policy instrument has been is a more difficult matter.

Legislatures should not measure policy instrument success based on single factors alone because this method often results in inaccurate information. For instance, if a legislature enacts a policy instrument intended to influence actor behaviours and measures that policy instrument's success solely on the basis of behaviour changes, the policy instrument may be deemed successful on paper even if harmful algal blooms—or other environmental harms—continue to occur. Similarly, legislatures that measure their policy instruments' success based on lower levels of pollutions may be omitting other important variables, such as climate change impacts. Instead, legislatures must take care to consider the many variables that influence the environment and try to account for their individual pressures.

I present the need for further studies not as an argument to delay implementing reflexive law policy instruments, but rather as a reminder that legislatures must continually receive new information and adapt on the basis of this information. Indeed, this concept of adaptive management is a cornerstone of the ecosystem-based management approach, which is our best hope for addressing environmental threats.

In the meantime, there are various ways legislatures can make progress in shifting our legal regime to better address widespread environmental concerns. Legislatures should consider whether market-based, information-based, or communication-based policy instruments (all categorised under a reflexive law policy instrument classification) may be best-suited for their particular problems. Since many of these strategies do not impose strict obligations on regulated parties nor do they drain government resources, reflexive law policy instruments tend to be easier to implement. In essence, legislatures have little to lose by implementing reflexive law policy instruments, but much to lose if they do not. The dyke is threatening to burst if we do not act quickly.

CHAPTER ONE: ADDRESSING WATER QUALITY ISSUES WITH POLICY INSTRUMENTS

INTRODUCTION

Water quality is one of the most important environmental concerns of our time. Without clean water, we cannot survive. Yet we often overlook water quality for its more attractive counterpart, water quantity. Harmful algal blooms (HABs) are one of the primary concerns in freshwaters. They are toxic to humans and they threaten the health and habitat of the aquatic biota. HABs often occur in waters that receive excessive nutrients, such as phosphorus, and are exacerbated by rising temperatures linked to climate change. In particular, HABs need three things to grow: light, nutrients, and warm temperatures. If we reduce the occurrence of one of those three things, HABs will be less likely to occur. As such, reducing HABs in freshwaters is a relatively straight-forward issue scientifically: if you limit the amount of light, nutrients the water bodies receive or lower the temperature, HABs will be less likely to occur. Of the three, the most accessible strategy is to reduce the amount of nutrient loading. However, using the law to limit the amount of nutrients reaching the water bodies is immensely complex.

Historically, legislatures have designed legal regimes to take on discrete environmental conflicts. More specifically, legal regimes, which are the way in which legislatures structure the law, have progressed through three stages in addressing environmental concerns: formal law, substantive law, and reflexive law. Formal law provided a forum to resolve conflicts between individuals and substantive law relies on the regulatory state to set and enforce environmental standards for individual media, such as land, air, or water. These designs are unable to adequately address widespread environmental concerns that span jurisdictions and interact with other environmental media. Consequently, reflexive law has developed as new legal regime for overcoming formal and substantive law's shortcomings. More legislatures are considering reflexive law strategies as they realise their current laws are unable to further reduce phosphorus pollution.

In this chapter, I examine the theory underlying environmental policy instruments in order to provide the context for looking at current methods in Lake Champlain and Lake Erie, which I will examine in detail in Chapter Two. In Part I of this chapter, I present the environmental problem that policy instruments need to address. In Part II, I look to the history of legal thought and discuss the evolution of environmental law over time. I present specific policy instrument examples in Part III. In Part IV, I discuss some of the additional challenges legislatures face even after they select appropriate policy instruments, and conclude that legislatures need to further explore reflexive law strategies as they work to use policy instruments to resolve environmental concerns.

I. WATER QUALITY ISSUES

Water quality issues often unfairly take a backseat to water quantity issues. Water quantity concerns receive a good deal of attention, especially in light of predictions that dry climates will become even more arid as a result of climate change. However, this tendency to neglect water quality issues in favour of water quantity issues is short-sighted. Even as we battle to protect water access, we are polluting the very waters we seek to use, effectively reducing the amount of useable resources. In this section, I introduce some of the most common water quality concerns and describe one of the most harmful threats to freshwaters: harmful algal blooms.

A. Water Quality Threats

Our waters face several water quality threats, the biggest being polluted runoff. Runoff is water that flows over land surfaces carrying contaminants away with it, and eventually reaches lakes and rivers. Billions of pounds of contaminants are carried into the United States' waters during rainstorms and snowmelts. These contaminants include dirt, manure, fertiliser, farm and lawn chemicals, oils and grease from streets and parking lots, and nutrient and toxic contaminants. The runoff from sprawling developments, hydropower development, and farming and forestry operations make significant contributions to our degraded waters. Other water quality threats include sewer overflows and stormwater system discharges. When pollution from these various sources

reaches our waters, they cause beach closings, shellfish bed closures, and threaten our groundwater and drinking water supplies.

Agricultural runoff pollution was the leading source of water quality impacts on rivers and lakes surveyed by the U.S. Environmental Protection Agency (EPA) in 2000.[3] It is the second largest source of impairments to wetlands as well as a major contributor to estuary and groundwater contamination.[4] The activities that cause agricultural runoff pollution include poorly located or managed animal feeding operations; overgrazing; ploughing too frequently; and poorly timed application of pesticides, irrigation water, and fertiliser.[5] Agricultural producers commonly spread manure, sludge, and commercial fertilisers that contain nutrients such as phosphorus, nitrogen, and potassium to encourage plant growth. When large quantities of phosphorus and nitrogen leave the land by way of agricultural runoff, they eventually reach water bodies where they can cause harmful algal blooms and oxygen depletion.[6] Agricultural runoff occurs when farmers apply excessive fertilisers or leave crop residues to enhance future production, especially just before storm events.[7] In addition, agricultural pollutants attach to the soil particles that get washed into water bodies by storm events and erosion.

Agricultural operators can significantly reduce this type of erosion and sedimentation—even as much as 90 percent—by using more environmentally-sound management practices that control the volume and flow rate of runoff water, keep the soil in place, and reduce soil transport.[8] However, the incentive structure to encourage operators to implement these practices is out of balance. Nutrient fertilisers are inexpensive, whereas the failure to spread enough to fertilise crops will result in high costs to farmers. Moreover, the pollution caused by agricultural runoff is a production cost not borne by farmers, which means they

[3] U.S. Environmental Protection Agency, "Protecting Water Quality from Agricultural Runoff" Fact Sheet (2005), online: US EPA <http://www.epa.gov/owow/NPS/Ag_Runoff_Fact_Sheet.pdf>.
[4] Ibid.
[5] Ibid.
[6] Ibid.
[7] Ibid.
[8] Ibid.

have no financial reason to account for this cost in their operations. In addition, many jurisdictions subsidise agricultural commodities, which results in market prices being unrepresentative of the true costs associated with production.[9] The result of these factors is that farmers tend to over-produce and over-use fertilisers and manure in furtherance of this over-production.

B. Lack of Regulations on Agricultural Runoff

Despite the unbalanced incentive structure, there are ways to regulate agricultural operations to curtail runoff. Jurisdictions could require agricultural producers to follow land use zoning laws or mandatory best management practices. However, the historical approach to regulating agriculture is not to.

Agriculture has been referred to as "the Rubik's Cube of environmental policy."[10] This title is due to the fact that despite being a leading cause of pollution, agriculture has managed to successfully "dodge the bullet" of having to make environmentally-friendly advancements,[11] although many farmers have made such advancements in order to improve water quality.[12] In fact, the core principle that has guided agri-environmental policy for decades is that agriculture must not be harmed in the name of protecting the environment.[13] The U.S. federal Clean Water Act includes an explicit exemption for stormwater discharges from agricultural fields,[14] as well as many state jurisdiction water pollution regulations.[15]

There are important reasons why agriculture has enjoyed exemptions. For example, the agricultural industry brings tourism to rural areas, such as Vermont, which bolsters the local economy. Agriculture also provides local communities with food security and a sense of pride in local products. In addition, agricultural

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[9] Lara D. Guercio, "The Struggle Between Man and Nature—Agriculture, Nonpoint Source Pollution, and Clean Water: How to Implement the State of Vermont's Phosphorus TMDL Within the Lake Champlain Basin" (2011) 12 Vt J Envtl L 455 at 525-526.
[10] J.B. Ruhl, "Agriculture and Ecosystem Services: Strategies for State and Local Governments" (2008) 17 NYU Envtl L J 424 at 425.
[11] Ibid.
[12] Interview of Marli Rupe, Agricultural Water Quality Specialist, Vermont Agency of Natural Resources Department of Environmental Conservation (25 March 2013) at Montpelier, Vermont.
[13] J.B. Ruhl, "Agriculture and the Environment: Three Myths, Three Themes, Three Directions" (2002) 25-SPG Environs Envtl L & Pol'y J 101 at 102.
[14] *Clean Water Act*, 33 U.S.C. § 1362(14).
[15] For example, *see Stormwater Management*, 10 V.S.A. § 1264(e)(2)(A).

fields provide open spaces that provide others with a scenic view of a sunset or a place to cross-country ski in winter.

In jurisdictions where the laws do require farmers to use best management practices to eliminate discharges, the laws are often difficult to enforce due to resource limitations.[16] For example, the State of Vermont lacks a sufficient number of engineers available to consult with farm producers to determine best management practices appropriate for the land.[17] When engineers are able to make it to farms to make recommendations, the practices recommended sometimes take the form of costly-installations that could put a small farmer out of business.[18] As a result, the farms are often left with a choice to either ignore environmental concerns because they fear regulatory enforcement or to allow their business to go under. Thus, new regulatory approaches are necessary in order for jurisdictions to curtail agricultural runoff without driving small farms out of business. Before delving into these regulatory challenges more specifically, however, it is important to understand the specific harms excessive nutrients cause to fresh waters.

C. Harmful Algal Blooms

Harmful algal blooms are a particular threat to water quality. HABs plague waters around the world; they degrade water quality and are toxic to humans and aquatic wildlife.[19] Algal blooms are now known to be bacteria that photosynthesise, specifically cyanobacteria.[20] Cyanobacteria are not always toxic, but it is virtually impossible to differentiate harmful from non-harmful algal blooms.[21] The HABs produce toxins that can cause serious liver, digestive, neurological, and skin diseases in humans.[22] These blooms are also harmful to aquatic wildlife in multiple ways: they cloud aquatic ecosystems, smothering

[16] Interview of Marli Rupe, *supra* note 12.
[17] Ibid.
[18] Ibid.
[19] NOAA Center of Excellence for Great Lakes and Human Health, "Frequently Asked Questions", online: <http://www.glerl.noaa.gov/res/Centers/HABS/faqs_prevention.html>.
[20] 'Algal blooms' and 'blue-green algae' are common names for cyanobacteria. Ibid.
[21] Blooms occur when the number of algal cells increase to concentrations that are high enough to be visible to the naked eye. Ibid.
[22] Hans W. Paerl & Jef Huisman, "Blooms Like It Hot" (2008) 320 Science 57 at 57.

aquatic plants and thus diminishing habitats for invertebrates and fish.[23] Additionally, when the blooms die and decay, they consume vast amounts of oxygen, effectively suffocating other aquatic biota.[24]

Climate change serves as a catalyst for HABs.[25] Rising temperatures favour cyanobacteria growth in several ways. First, cyanobacteria grow better at higher temperatures than other phytoplankton, and thus receive a competitive advantage over non-harmful algae.[26] Secondly, warmer surface waters have stronger vertical stratification—the layers of varying water temperatures that occur in all water bodies—which means that HABs rise to the surface where they block the light from reaching other aquatic biota below.[27] Additionally, global warming means that temperatures are warmer for longer periods, which gives HABs a longer growing period than in past years.[28] Climate change also affects precipitation patterns by causing more intense and frequent storm events that lead to nutrient-rich fertilisers being washed off land and into surface waters.[29]

Harmful algal blooms afflict massive water bodies around the world, including Lake Victoria in Africa, Lake Erie in North America, Lake Taihu in China, and the Baltic Sea in Europe.[30] Although the problem abounds in various locations, the solution for reducing the occurrence of HABs is the same everywhere: reduce nutrient loading to the water. HABs need three things to prosper: nutrients, light, and warm temperatures.[31] It is difficult to control light and temperature, but it is relatively easy to reduce the amount of nutrients that reach waters. The methods for reducing nutrient runoff include: using only the recommended amounts of nutrient-rich fertilisers on land; properly maintaining

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[23] Ibid.
[24] *See generally* Stephen R. Carpenter, "Phosphorus Control is Critical to Mitigating Eutrophication" (2008) 105 PNAS 32; *and* Stephen R. Carpenter, D. Ludwig & W.A. Brock, "Management of Eutrophication for Lakes Subject to Potentially Irreversible Change" (1999) 9 Ecological Applications 751.
[25] Paerl *supra* note 22 at 57.
[26] Ibid.
[27] Stronger vertical stratification occurs when a water body's temperature layers become more pronounced than usual, and when this occurs in surface waters, there is less vertical mixing of the temperature layers. Ibid.
[28] Ibid.
[29] Ibid.
[30] Ibid.
[31] NOAA Center of Excellence for Great Lakes and Human Health *supra* note 19.

household septic systems; and maintaining a buffer of natural vegetation around ponds, lakes, and tributaries to filter incoming water.[32]

Given that there is scientific consensus as to how HABs are caused and the simplest methods for preventing them, the question becomes: how can we use policy instruments to reduce their occurrence? In order to understand how policy instruments address water quality issues, such as HABs, it is necessary to first look at the theoretical framework underlying environmental policy instruments.

II. HISTORICAL STAGES OF ENVIRONMENTAL LAW

Environmental law has developed in stages over time. In fact, law generally continuously evolves in response to new societal goals. In order to understand the environmental policy instruments available to legislatures, it is first necessary to understand the logic behind these policy regimes. This logic can be traced to the development of historical types of law.

German legal scholar and sociologist Gunther Teubner contended in 1983 that law develops historically according to different types of regimes that can be categorised as formal law theory, substantive law theory, and reflexive law theory.[33] Reflexive law has since gained momentum in the realm of environmental law and policy, and legal scholars, such as American Eric Orts, have focused on reflexive law's application to environmental issues.[34] This literature develops the specific theory of reflexive environmental law as an alternative to conventional methods of policy instruments. Orts argues that reflexive environmental law possesses certain features which make it uniquely well-suited to addressing widespread environmental problems.[35]

In this Section, I introduce the theoretical underpinnings of modern environmental policy instruments by describing the historical stages of environmental law. For each type of law theory, I present the theoretical

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[32] Ibid.
[33] *See generally* Gunther Teubner, "Substantive and Reflexive Elements in Modern Law" (1983) 17 Law & Soc'y Rev 239.
[34] *See generally* Eric W. Orts, "Reflexive Environmental Law" (1995) 89 Nw UL Rev 1227; *see also* Dennis D. Hirsch, "A Holistic Policy Agenda to Promote Green Business: Reflexive Law Fills the Gap" (2012) 42 Envtl L Rep News & Analysis 10228; *and* Warren A. Braunig, "Reflexive Law Solutions for Factory Farm Pollution" (2005) 80 NYUL Rev 1505.
[35] Orts, *supra* note 34.

concepts, introduce the policy instruments through which the theory is typically applied, and discuss the theory's limitations. Although I introduce policy instruments in this section as illustrations of theoretical application, I discuss these instruments in greater depth in Section III of this chapter.

A. Formal Law Theory

The first legal effort made to restrict environmental degradation involved the use of formal law.[36] The concept behind formal law theory is that the state's role is to establish basic rules by which private parties can resolve disputes over property rights by way of litigation.[37] In other words, environmental harms gave rise to private law causes of action, which could be enforced by the individuals directly harmed.[38]

The concept underlying formal law is that individuals have property rights that they can choose to enforce and the state is not involved other than its role establishing individuals' property rights. The individuals act as the enforcers and courts provide them with the legal forum to enforce their rights. In fact, some legal scholars refer to courts and legal institutions as the "umpires" in formal law theory because they establish and enforce the rules.[39]

1. Application of Formal Law

The policy instruments through which formal law theory was applied were traditional categories of private law, such as tort law and property law. The specific causes of actions most applicable for seeking remedies for environmental harms were negligence, trespass, and nuisance claims. Negligence and trespass are tort law claims and nuisance is a blend of tort law and property law. All three causes of actions are common law actions under which a plaintiff can seek a remedy if she has suffered an injury. In the environmental context, legal injury may be pollution on the plaintiff's land or pollution nearby that unreasonably interferes with the plaintiff's enjoyment of her land.

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[36] Dorit Kerret, "Don't Judge A Book By Its Cover: Use of an Analytical Framework and Empirical Data in Analyzing Environmental Policy Tools" (2012) 42 Envtl L Rep News & Analysis 10078.
[37] Ibid.
[38] Ibid.
[39] Orts, *supra* note 34.

2. Limitations of Formal Law

Private law principles have proven remarkably stable over time, but they are too narrowly focused to adequately address widespread environmental problems. For example, the ability to use nuisance law for environmental injuries has been stunted by its limited application to individuals directly injured. In particular, eligible plaintiffs must have suffered harm to a legally protected interest, which is typically expressed in terms of property rights.[40]

Some of these problems have been addressed by constitutional law rulings that recognise group standing for members of environmental organisations and class actions for groups of citizens suffering from identical injuries, but everyone in the organisation or class had to have been directly injured in order to recover.[41] The 'direct injury' standing requirement is a high threshold standard that has a chilling effect on potential plaintiffs.[42] Even when a nuisance claim reaches a courtroom, the court is limited to considering the specific dispute at hand rather than broader environmental policy problems that affect the general public.[43] Because formal law was unable to address growing social needs, a new type of law developed during the environmental movement of the 1970s and the "rise of the regulatory state."[44]

B. Substantive Law

The next legal attempt to use law to address environmental degradation was the use of substantive law. Substantive law is the law of the regulatory state directly regulating social behaviour by defining substantive prescriptions.[45] Unlike the model of formal law, substantive law does not rely on courts to resolve disputes in accordance with common law, but is instead more "aggressively

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[40] Nicholas A. Ashford & Charles C. Caldart, *Environmental Law, Policy, and Economics: Reclaiming the Environmental Agenda* (Cambridge, MA: The MIT Press, 2008) at 213.
[41] *See generally* Robin Kundis Craig, Standing and Environmental Law: An Overview (SSRN: FSU College of Law, 2009); *see also Sierra Club v. Morton*, 405 U.S. 727 (1972) (establishing that environmental interest organisations can sue on behalf of their members).
[42] For a more detailed discussion of standing issues that arise in environmental law, *see* Craig, *supra* note 41.
[43] Orts, *supra* note 34.
[44] Ibid.
[45] Daniel J. Fiorino, *New Environmental Regulation* (Cambridge, MA: MIT Press, 2006) at 158.

instrumental."[46] Under substantive law, the regulatory state intervenes directly in social processes that it deems likely to cause environmental harm by enacting statutes and delegating legal authority to specialised agencies.[47] By stepping in to set environmental standards and allowing agencies to prosecute violators, the regulatory state makes it possible to strive to achieve environmental goals without having to entirely rely on individuals to bring actions. In particular, substantive law is used for "purposive, goal-oriented intervention" and aims for "specific goals in concrete situations."[48]

1. Application of Substantive Law

Statutes enacted under substantive law regulate environmental degradation activities by imposing prohibitions and obligations on actors who engage in that activity and by penalising offenders criminally or financially.[49] Substantive law statutes are both more "general and open-ended" and "particularistic" than causes of action under the formal law model.[50] It is more "general and open-ended" than formal law because it aims to achieve broad and ambitious environmental goals whereas formal law methods were limited to private property or tort law injuries.

Command and control regulations exemplify substantive law statutes. Command and control regulations are "general and open-ended" because they tend to set broad environmental goals and delegate broad legal authority to administrative agencies to adopt and enforce regulations. For example, the Clean Water Act's text includes the lofty goal "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[51] Substantive law legislation is more "particularistic" than formal law because it is heavily administrative in nature, whereas formal law relied completely on private law methods. Additionally, command and control regulations are finely detailed and complex. Continuing with the Clean Water Act example, this law alone includes

[46] Orts, *supra* note 34.
[47] Ibid.
[48] Teubner, *supra* note 33 at 240.
[49] Kerret, *supra* note 36.
[50] Orts, *supra* note 34.
[51] 33 U.S.C. § 1251(a). The statute also delegates authority to the EPA to administer the law. Ibid § 1251(d).

six discrete parts that describe detailed programs for research, grants, standards and enforcement, permitting and licensing processes, and funding.[52]

Command and control regulations have become extremely popular in environmental law because, unlike formal law methods, they have the capacity to address prevalent environmental issues and do not rely on individuals for enforcement. Consequently, modern society has become increasingly reliant on substantive command and control methods, as illustrated by the expanding body of substantive laws. Although this expansion aids in solving some social problems, the expansion itself actually creates new problems.

2. Limitations of Substantive Law

The trend to adopt more and more substantive law statutes has resulted in a massive amount of regulations, making it increasingly difficult for actors to comply with the laws and more difficult for the regulatory state to enforce the laws. These operational difficulties discourage actors from complying with the laws because they are unable to parse through all of their obligations. Furthermore, the sheer volume of regulations makes it more difficult for legislatures to review and harmonise the increasing amounts of legislation. Consequently, the regulations themselves frustrate legislatures' abilities to oversee and coordinate the various statutes. Another issue is that as legislatures face societal pressures to address increasingly complex and technical problems, they become tempted to assign greater discretion to administrative agencies in making and enforcing the law. As a result, executive agencies effectively gain legislative powers, raising questions of democratic legitimacy.

These operational challenges run the risk of distracting legislatures from the original goals their regulations were enacted to achieve. Legislatures become increasingly focussed on closing the loopholes and regulatory gaps at the expense of losing sight of the actors and environmental issues they were meant to address. Teubner explains this phenomenon as the "differentiation of society."[53] The concept of differentiation is that each discipline develops autonomously without

[52] *See generally* 33 U.S.C. § 1251 et seq.
[53] Orts, *supra* note 34.

interaction with other disciplines.[54] As these different systems of society attain more autonomy from each other, there is an increased possibility that they cease to take each other into account. As applied to law, increased differentiation results in legal theory ignoring the other disciplines and only reflecting its own ambitions rather than an understanding of social complexity.[55] Reflexive law theory was founded on the concept that it is necessary for legislatures to recognise that law has its limits and cannot address every problem completely.[56]

C. Reflexive Law

The concept underlying reflexive law theory is that actors are in a better position than the state to develop methods that improve their practices in accordance with societal goals. According to reflexive law theory, the state should focus on harnessing market power and using procedural requirements that will encourage actors to self-regulate.[57] This theory can be distinguished from substantive law theory in three important respects: it is a self-critical legal theory; it employs regulation meant to provoke problem-solving at the level of the actor; and it enlists intermediate social institutions.[58] I discuss each of these features in turn.

Reflexive law is a self-critical legal theory: that is, it acknowledges the limitations of law in accomplishing societal goals. Reflexive law is premised on the concept that the legal system is limited in its ability. Unlike substantive law, reflexive law does not attempt to force change on society via law, but views regulations as one of many available tools.[59] By acknowledging the limits of law in regard to environmental issues, reflexive law avoids falling victim to the blind spots suffered by formal and substantive law. For example, reflexive law theory

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[54] *See generally* Gunther Teubner, "Social Order from Legislative Noise? Autopoietic Closure as a Problem for Legal Regulation" in Gunther Teubner & Alberto Febbrajo, ed., *State, Law, and Economy as Autopoietic Systems: Regulation and Autonomy in a New Perspective* (Milan: Dott. A. Giuffrè editore, 1992). Although Teubner's systems theory is beyond the scope of this project, it is necessary to introduce the concept in order to understand the advent of reflexive law theory.
[55] Gunther Teubner, "After Legal Instrumentalism?" in Gunther Teubner, ed., *Dilemmas of Law in the Welfare State* (Berlin: Walter de Gruyter, 1988); Orts, *supra* note 34.
[56] Orts, *supra* note 34. As Orts contends, "the increasing differentiation of society sets the stage of the advent of a new type of law." Ibid.
[57] Teubner, *supra* note 33 at 2175.
[58] Orts, *supra* note 34 at 612.
[59] Ibid.

escapes substantive law's struggle to keep pace with our constantly evolving society because reflexive law theory focuses on procedure to encourage pollution reductions and generally avoids setting strict pollution limits. Substantive law also tends to use only one type of policy instrument, which may not be well-suited to a local environmental issue, whereas reflexive law theory appreciates that the best policy instrument choice depends on the circumstances of the environmental issue involved in each particular case.[60]

Another distinguishing feature of reflexive law theory is that it employs regulation to provoke learning and problem-solving at the level of the regulated entities rather than at the level of the regulation itself. In other words, regulations should require actors to use certain procedures that will encourage them to reflect on current practices and engage in problem-solving to be more efficient. This practice is in contrast with substantive law where the problem-solving is left to the regulatory state, which determines best management practices and enacts command and control regulations to require such practices. In order for reflexive law regulations to succeed in their goal of encouraging certain actor behaviour, the procedures should be carefully crafted to reveal how environmentally-sound practices are in the best interest of the actor. This is the reflexive law concept that "communication via organisation" will lead to better behaviour reform.[61]

The third feature that distinguishes reflexive law from substantive law is that reflexive law aims to enlist intermediate social institutions falling somewhere between the state and the regulatory state. According to reflexive law theory, including a variety of stakeholders in the process will help the various actors to build trust with one another. The result of the gained trust is that the actors will be more likely to adjust their behaviours to conform to societal goals. What is more, the involvement of various stakeholders ensures that regulators stay focussed on societal goals instead of getting distracted by regulatory gaps.

[60] Orts, *supra* note 34, citing Teubner, *supra* note 33 at 612.
[61] Orts, *supra* note 34 at 1267.

1. Application of Reflexive Law

The policy instruments through which reflexive law theory typically fall within four categories: market-based instruments; information-based instruments; communication-based instruments; and planning-based instruments. Market-based instruments include policies that encourage environmentally-sound behaviours by taxing environmentally harmful practices, subsidising environmentally beneficial practices, and creating pollution-trading markets. I describe each type of policy instrument in further detail in Section III of this Chapter. Information-based instruments are policies that require actors to monitor their practices and disclose the information to the state, the public, or consumers. The idea is that by having to release their environmental track-records, industry actors will be persuaded to improve their practices in order to avoid societal shame or consumer backlash. Moreover, the simple act of monitoring may prompt actors to find ways to improve efficiency within their business.[62] Communication-based instruments are similar to information instruments but require actors to directly communicate with other stakeholders rather than supply information to the government or the market. Such instruments are intended to create a dialogue between all stakeholders that will prompt actors to take responsibility for how their practices impact their neighbours.

Reflexive law theory is also applied via planning-based policy instruments. These instruments require actors to follow procedures intended to provoke self-reflection and regulation. An example of such a policy is the Quebec government's requirement that farmers file annual phosphorus reports. The reports are essentially balance sheets that track the amount of phosphorus used on the farm and the amount of phosphorus leaving the farm. There are no penalties for farms with large phosphorus outputs, but the policy seeks to ensure that farmers are aware of the amount of phosphorus they are losing. The regulation is meant to prompt farmers to determine ways to prevent wasting an important fertiliser that happens to degrade freshwaters.

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[62] *See* Hirsch, *supra* note 34 at 10229 (arguing that businesses that encourage employees to find environmentally-friendly means reduce waste and thus increase profits).

Although these policy instruments use different methods, they all focus on provoking actors to find innovative means for improving their behaviours to make them more environmentally sound. This approach has the potential to be much more efficient than substantive law, where the state has to research the industry's practices, research ways for the industry to reduce its pollution, enact new laws requiring the pollution-reducing practices, and enforce these practices. Reflexive law policy instruments bypass all of these steps by simply requiring actors to look at their own behaviours. Moreover, reflexive law regulations are better able to stay connected with societal goals because they enlist intermediate social institutions and recognise their own limits. However, critics of reflexive law point to the fact that it provides little assurance that actors will actually take any steps to improve.

2. Limitations of Reflexive Law

Critics of reflexive law often contend that it is essentially an honour system and that many of its instruments do not set baseline limitations on pollution. However, it is important to note that many reflexive law instruments do impose mandatory obligations on regulated actors, but often in a way that provides actors with certain flexibility. In particular, information disclosures via reporting or labelling and procedural requirements are mandates determined by legislatures. Such procedural requirements are intended to help actors identify discharges and encourage them to implement more environmentally-sound practices. However, critics of reflexive law argue that its denial to establish formal rules or direct substantive outcomes regarding limits on pollution means that it cannot assure a particular environmental protection goal.[63] In addition, critics argue that the premise of information-based approaches relies on consumer and stakeholder using their market powers to influence companies to improve their behaviour.[64] Specifically, information that is not disseminated in an adequately accessible, comprehensible, and clear manner runs the risk of being

[63] Richard B. Stewart, "A New Generation of Environmental Regulation?" (2001) 29 Cap UL Rev 21 at 130.
[64] Braunig, *supra* note 34 at 1525.

another set of meaningless data.[65] Even when this information is disseminated in a manner that meets these requirements, there are other concerns, such as the accuracy of self-reported information.

Reflexive law proponents contend these criticisms of the theory are not relevant because the theory itself is premised on the concept that employing regulation that provokes learning and problem-solving at the level of the regulated entities will encourage environmentally-sound behaviours. These policies focus on the stakeholders' ability to self-regulate or enable horizontal enforcement amongst themselves rather than relying on enforcement of environmental goals by state agencies. In contrast, command and control regulations instead rely on state agencies to set and enforce particular obligations. Proponents of reflexive law argue that the purpose behind reflexive law policy instruments is to reach actors and achieve environmental goals that command and control regulations have failed to manage.

Each stage of environmental law has attempted to use law to address environmental issues, although with mixed results. Formal law offered private law solutions to individuals seeking to protect their property from environmental harm. Private law remedies limited regulatory state involvement to providing individuals with a forum in which they could resolve their disputes. Substantive law sought to expand involvement of the regulatory state and allow it to step in and directly address environmental issues. The substantive law approach uses command and control regulations commonly thought of as traditional 'law' in which the regulatory sets and enforces environmental standards. However these traditional laws have become so prevalent that they actually create operational difficulties that distract legislatures, causing them to focus more on the regulations than on the environmental goals. Reflexive law aims to overcome these distractions by acknowledging the complexities of society and the limitations of law. Reflexive law methods focus on provoking actors to problem-solve ways to bring their behaviours into compliance with societal goals. Critics argue reflexive law's lack of formal obligations undermines any guarantee that

[65] Ibid.

actors will amend their behaviours, but proponents explain reflexive law is way to fill in the gaps left by substantive law and offers a much-needed supplement to command and control regulations.

Besides offering a unique outlook on how law can help achieve environmental goals, each theoretical framework includes various types of policy instruments for applying the theory. In practice, jurisdictions tend to use a mix of policy instruments that draw on concepts from multiple theories. Thus, I next examine various policy instruments and how they work in the context of addressing environmental concerns.

III. Environmental Policy Instruments

The basic goal of environmental law is to limit ecological impacts that threaten public health and biodiversity by regulating human activity.[66] However, it is intrinsically difficult to shape laws to protect the environment because the nature of ecological grievances tend to be incompatible with the structure of lawmaking institutions.[67] Ecological grievances cross jurisdictions and environmental media, whereas lawmaking institutions are structured to address discrete instances of environmental harms.[68] This incompatibility is demonstrated in the discussion above about the shortcomings of the various legal theories in using law to limit environmental degradation. In an effort to try to overcome this incompatibility, policymakers' approaches to environmental law and policy continually evolve. Previously, policymakers relied solely on private law to address environmental degradation. Policymakers now have more options available and can draw from a veritable toolbox of policy instruments. The most commonly used tools are the following five policy instruments: command and control regulations, market-based instruments, information-based instruments, communication-based instruments, and planning-based instruments. As previously discussed, command and control regulations may be categorised as the policy application of substantive law theory. Market-based, information-based,

[66] Richard J. Lazarus, Making of Environmental Law (Chicago: University of Chicago Press, 2004) at 1.
[67] Ibid.
[68] I discuss this incompatibility and the need for an ecosystem-based management approach in more detail in Chapter Three.

communication-based, and planning-based instruments fall under reflexive law theory. In Part A of this section, I provide a brief background on policy instruments historically used under formal law methods and discuss their difficulties addressing environmental issues. In Parts B and C, I introduce substantive law and reflexive law policy instruments and discuss their advantages and shortcomings.

A. Formal Law Methods

Before legislatures began enacting specific laws, environmental protection arose in the context of private law and particularly in cases based on theories of negligence, nuisance, trespass or strict liability for abnormally dangerous activity.[69] Plaintiffs could invoke private law claims against polluters to seek either: (1) compensation for harm done to the plaintiff's property or person; or (2) an injunction requiring the polluter to abate pollution or to stop the activity altogether.[70] For example, a downstream plaintiff might bring a negligence claim against an upstream industrial company for contaminating the plaintiff's water supply or a nuisance action against a neighbour whose pollution interferes with the plaintiff's enjoyment and use of their property.

Trespass and strict liability actions tend to arise less often than negligence and nuisance in the environmental context, but offer advantages in certain situations.[71] For instance, the statute of limitations for bringing a trespass claim might be longer than that for a negligence or nuisance claim and therefore affords the plaintiff more time in which to bring suit.[72] Strict liability applies less than the other actions in large part because it is restricted to activities that society considers abnormally dangerous or ultrahazardous,[73] and traditionally courts have

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[69] *See generally* Ashford, *supra* note 40 at 210-239.
[70] Ibid at 210.
[71] *See* Mark Latham, Victor E. Schwartz & Christopher E. Appel, "The Intersection of Tort and Environmental Law: Where the Twains Should Meet and Depart" (2011) 80 Fordham L Rev 737, 750 ("The primary tort theories that have been successfully used to remedy alleged environmental harms are rooted in the law of nuisance and negligence.").
[72] *See* Ashford, *supra* note 40 at 218.
[73] This concept is attributed to a British House of Lords case in a case in which a company was held strictly liable for the damage caused to the plaintiff as a result of the defendant placing a reservoir next to an abandoned coal mine. *See* ibid at 219, citing *Rylands v. Fletcher*, (1868), 3 LR 330 HL (Neg.).

been hesitant to classify many activities as such.[74] However, the strict liability theory offers an easy remedy for plaintiffs once they convince the court that the defendant's activities fall within this category and strict liability attaches because the court will dismiss any defences that the defendant used precautions as irrelevant.[75]

Nuisance is the most widely used private law claim in environmental cases, but its plaintiffs also face an uphill evidentiary battle.[76] Both public and private nuisance theories apply when there is an "unreasonable interference" with another's interest, which is typically expressed in the use and enjoyment of land.[77] The theories diverge based on the interest involved: public nuisance involves an "unreasonable injury to a public right" whereas private nuisance involves an unreasonable interference with another's right to the use and enjoyment of land.[78] Public nuisance claims may only be brought by public authorities, such as the Attorney General, or a private individual who has suffered a special physical injury.[79] Private nuisance claims are limited to those who have property rights and privileges in respect to the use and enjoyment of the land affected, including possessors of the land, owners of easements and profits in the land, and owners of nonpossessory estates in the land that are detrimentally affected by interferences with its use and enjoyment.[80]

Both private and public nuisance plaintiffs must convince the court that the polluter's conduct was intentional and unreasonable, overcome the plethora of defences available to the defendant, and prove the injury was caused by the

[74] For example, courts have left the determination of liability that should attach to nuclear power plants to legislatures despite strong arguments that such operations should fall within the abnormally dangerous activity classification. Ibid at 220 (discussing how strict liability has been more conceptual than practical in regards to the environment).
[75] Ibid at 219.
[76] Ibid at 213; *see also* Epstein, *supra* note 63.
[77] Latham et al, *supra* note 71 at 751.
[78] Ibid at 751-752.
[79] Restatement (Second) of Torts § 821C (1979) ("In order to recover damages in an individual action for a public nuisance, one must have suffered harm of a kind different from that suffered by other members of the public exercising the right common to the general public that was the subject of interference.").
[80] Ibid § 821E.

unreasonable activity.[81] Even if the plaintiff succeeds in meeting these requirements, the court may still determine that the benefit of the polluting activity (e.g., local interest in economic security) outweighs the costs of pollution.[82] Moreover, courts are hesitant to question industries as to the feasibility of installing pollution abatement technologies, which means courts often conduct their cost-benefit analyses based on flawed information.[83]

Although private law provided a useful instrument for handing certain environmental disputes, some of its concepts proved to be unworkable for addressing more widespread environmental harms.[84] For example, the tort law concept of joint and several liability[85] is impracticable for addressing air pollution caused by automobile emissions because holding one Los Angeles driver liable for drivers across California or the nation would be excessive and unworkable.[86] On the other hand, the transaction costs associated with suing every driver individually make the alternative prohibitive.[87]

Further complications arise due to the timing limitations in private law.[88] States typically have statutes that set limitations on the amount of time a plaintiff has to bring a lawsuit under private law theories, but many pollution-induced diseases have a long latency period.[89] Consequently, the lengthy delay between causation and injury prevents such plaintiffs from being able to seek redress under private law.[90]

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[81] Henry N. Butler, "A Defense of Common Law Environmentalism: The Discovery of Better Environmental Policy" (2008) 58 Case W Res L Rev 705 at 727.
[82] Ashford, *supra* note 40 at 233, citing *Boomer et al. v. Atlantic Cement Co., Inc.*, 26 N.Y. 2d 219 (1970).
[83] Ibid at 233.
[84] Latham et al, *supra* note 71 at 750 (discussing how Tort Law has traditionally provided a blunt instrument for remedying environmental harms, but has been successfully applied in areas where the harm is to a well-defined area or specific person or class of persons, is readily supported by causation, and closely fits the traditional elements of a tort cause of action.)
[85] Courts will often find tortfeasors jointly and severally liable, which means each joint-tortfeasor is liable for the entire damages awarded to the plaintiff on the theory that each tortfeasor can seek indemnity from the others. Richard A. Epstein, "Regulation—and Contract—in Environmental Law" (1991) 93 W Va L Rev 859 at 871.
[86] Ibid at 871.
[87] Andrew P. Morriss & Roger E. Meiners, "Borders and the Environment" (2009) 39 Envtl L 141 at 152-153.
[88] Ashford, *supra* note 40 at 232.
[89] Ibid.
[90] Ibid.

In addition to the challenges of applying private law concepts to widespread environmental issues, negligence and nuisance theories' evidentiary challenges particularly hinder environmentally harmed plaintiffs' likelihood of success in court. In particular, negligence plaintiffs have a heavy burden for convincing the court that the defendant's conduct was what caused the injury.[91] To succeed with a negligence claim, plaintiffs must prove two prongs of causation (factual causation and legal causation) and both prongs rely on concepts that are impracticable in an environmental injury context.[92]

The factual causation prong requires the plaintiff prove his injury would not have occurred 'but for' the defendant's conduct.[93] Since environmental science accepts uncertainty as part of the discipline, it is nearly impossible to prove that no other variables may have played a part in causing the injury.[94] Consequently, courts are hesitant to find, based on uncertain evidence, that the harm would not have occurred 'but for' the defendant's conduct.[95] Moreover, courts are sceptical of expert testimony about "novel" scientific concepts and may exclude important factual testimony about pollution-induced diseases as a result.[96]

Even if the plaintiff succeeds in convincing the court that their injury was in fact caused by the defendant, the court may find there is no legal causation and thus find the defendant is not liable for the injury.[97] This situation arises when the court determines that the defendant could not have reasonably foreseen the injury would occur or when the court determines the defendant adhered to the legally-required standards of conduct, which are often determined by industry standards.[98] This is especially problematic in terms of polluting industries because they can collectively set extremely lenient standards.[99]

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[91] Ibid at 230.
[92] Ibid.
[93] Ibid.
[94] Ibid.
[95] Ibid.
[96] Ibid at 232, citing *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 880 (1993).
[97] Ibid at 210.
[98] Ibid.
[99] Ibid.

Another problem that arises in cases using private law for environmental protection is that it is often limited to individual claims, which means property must be owned to be protected.[100] Certain lands and waters are public, which means individuals typically cannot bring a suit on their behalf.[101] Even when a property is owned, the property owner must have the desire—and the financial means—to protect that property in court.

Private law also has difficulty protecting the environment because it is a piecemeal way to make environmental policy.[102] Courts are limited to deciding the specific case or issue before them and therefore have a very limited role in developing policy.[103] Moreover, private law depends on plaintiffs seeking remedies for harms that have already occurred, which is unsuitable to preventing environmental harms before they occur.[104]

Eventually, legislatures came to the realisation that environmental protection required the aid of statutes.[105] In particular, it became clear that legislation was necessary to facilitate the remediation of environmental harms.[106] Statutes are capable of providing more comprehensive policies than private law cases and can incorporate important environmental protection policy objectives, such as the precautionary principle.[107] In light of the gaps left by private law, legislatures turned to command and control regulation as a means for addressing environmental harms.

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[100] Ibid at 213.
[101] *See generally* Christopher D. Stone & Garrett James Hardin, *Should Trees Have Standing?: Toward Legal Rights for Natural Objects* (Los Altos, CA: W. Kaufmann, 1974). However, it is important to note that under certain circumstances an individual may bring a public nuisance suit. Courts have gradually made the requirements for proving standing to bring such a suit increasingly difficult and therefore this option is virtually unavailable today. Ashford, *supra* note 40 at 215.
[102] Ibid at 228.
[103] Ibid at 189.
[104] Latham et al, *supra* note 71 at 754.
[105] Ibid.
[106] Ibid.
[107] Ibid.

B. Command and Control Regulation

Command and control regulation came as an answer to the flaws of private law and now dominates the environmental policy landscape.[108] These laws are the laws of the regulatory state and the policy instrument most people picture when they hear the term 'law.'

The government uses command and control regulations to prohibit or require certain behaviours, as well as the primary tool for punishing violators. Unlike private law, command and control regulations are enforceable by the state, which means polluters are pressured to improve by both their neighbours—who might use private law claims against them—and the government.

1. Command and Control Regulation Statutes

Command and control regulations take a top-down approach and aim to control pollution usually in one of two ways, sometimes using both.[109] The first method is to establish performance standards for polluters, which are monitored and enforced through a permit system.[110] These standards are typically set forth in quantitative limits on the amount of pollution an actor can discharge. Quantitative limits are an appropriate way to control pollution discharged by industrial or point source polluters who can easily track the amount of pollutants they are discharging because they leave the source through a pipe or a culvert. Such limits are much more difficult to enforce against nonpoint source polluters, such as farms producing agricultural runoff, because nonpoint source pollution is diffuse and difficult, if not impossible, to trace to the source. The government typically imposes civil fines on actors who violate their quantitative limits, but can also prosecute violators as criminals.[111] This approach to enforcement is commonly referred to as the "polluter pays" approach.[112]

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[108] Alfons Weersink, et al., "Economic Instruments and Environmental Policy in Agriculture" (1998) 24 Can Pub Pol'y 309 at 312; *see also* Robert N. Stavins, "Chapter 9: Experience with Market-Based Environmental Policy Instruments" in Karl-Göran Mäler & Jeffrey R. Vincent, ed., *Handbook of Environmental Economics* (Amsterdam, Boston: Elsevier, 2003) at 313.
[109] Orts, *supra* note 34.
[110] Ibid.
[111] Ibid.
[112] Citation: Grantham Research Institute & Duncan Clark, "What is the 'polluter pays' principle?" (2 July 2012) *The Guardian*, online: The Guardian <http://www.guardian.co.uk/environment/2012/jul/02/polluter-pays-climate-change>.

The second way a government can use command and control regulation to control pollution is by requiring uniform technology-based controls for certain types of pollution-causing activities.[113] Technology-based controls are appropriate for industrial plants or agriculture because certain technologies, when implemented, can help reduce the amount of pollution leaving a particular source. Similar to performance standards, the government can enforce these requirements by either holding violators liable for civil fines or via criminal prosecutions.[114]

The Federal Water Pollution Control Act, commonly referred to as the Clean Water Act, is a prime example of a command and control regulation statute.[115] The Clean Water Act uses both top-down methods for controlling pollution. It sets quantitative limits on the amount of pollution discharges by individual actors[116] and requires certain actors to adopt specified best management practices or best available technologies.[117] In particular, wastewater treatment plants that discharge phosphorus are required to have National Pollutant Discharge Elimination System permits that set quantitative limits on the amount of phosphorus the plants can discharge in a given period of time.[118] In addition to setting quantitative phosphorus limits, the Clean Water Act also uses a second top-down pollution control method by requiring wastewater treatment plants to use the best available technologies, as determined by the EPA.[119] Under the Clean Water Act, the EPA can bring criminal charges against or impose civil fines on regulated actors not in compliance.[120]

2. Advantages of Command and Control Regulation

Command and control regulation successfully overcomes the problems of using private law to address environmental pollution. Private law controls rely entirely on individual residents to bring actions against polluters. However,

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[113] Orts, *supra* note 34.
[114] Ibid.
[115] *Federal Water Pollution Control Act*, 33 U.S.C. §§ 1251-1387 (2006).
[116] 33 U.S.C. § 1342.
[117] 33 U.S.C. § 1314; *see also* Lance H. Gunderson & C.S. Holling, *Panarchy: Understanding Transformations in Human and Natural Systems* (Washington, DC: Island Press, 2002).
[118] 33 U.S.C. § 1342.
[119] 33 U.S.C. § 1316.
[120] *See* 33 U.S.C. § 1319.

command and control allows the government to bring actions on their behalf, on behalf of the public interest, and even on behalf of the government itself. This policy instrument greatly expands the government's standing in environmental matters, which was previously limited to the same limitations of individuals. Under command and control regulation statutes, the government has broad authority to set and enforce environmental standards and practices. As a result of this expansion of power, the government no longer has to sit idly by while an actor is polluting his own land. By using command and control regulation to implement top-down controls on environmental pollution, the legislature ensures that the state does not have to rely solely on residents to enforce their property.

Command and control regulation also overcomes private law's inability to address widespread environmental problems. Private law cases are limited to discrete issues and single cases. Although the judges may be conscientious about following and creating good precedent, they are unable to expand their decisions to address diffuse environmental problems that extend well beyond the issue at hand. Command and control regulation can. Falling under a substantive law theoretical framework, command and control regulation statutes are open-ended and have broad application. They set broad environmental goals, such as "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[121]

3. Criticisms of Command and Control Regulation

Command and control regulation overcame some of private law's major failings, including the narrowness of court decisions, the limitation of individuals who could bring suit, and the causation challenges discussed above. However, command and control regulation has shortcomings of its own. For instance, critics often point to command and control regulation as a "blunt instrument," despite its successes in certain cases.[122] Critics also argue that command and control regulation leaves agencies vulnerable to "capture," that it encourages

[121] 33 U.S.C. § 1251(a). The statute also delegates authority to the EPA to administer the law. *Ibid* § 1251(d).
[122] Orts, *supra* note 34 at 1236.

bureaucratic "rent-seeking," that it is too static, and that it is inefficient and sometimes even irrational.[123]

One criticism of command and control regulation is that it leaves the administrative agencies responsible for issuing regulations vulnerable to industry capture.[124] Industry capture is the term referring to the phenomenon in which regulated actors improperly attempt to influence the regulators, thus frustrating the very purpose of the commands. The issue also leads to concerns over the fairness of command and control regulation. For example, one industry may have vastly more influence than another industry, which could theoretically lead to the more influential industry receiving less regulation or enforcement.

Command and control regulation also comes with the danger of encouraging bureaucratic "rent-seeking," which follows whenever there is a centralised power responsible.[125] Specifically, bureaucratic "rent-seeking" occurs when the individuals in power hinder public policy in order to further their own interests.[126] The risk of "rent-seeking" is directly connected to the first criticism mentioned, that the success of command and control regulation largely relies on those in power to enforce the commands.

Command and control regulation is also often criticised as being too static.[127] The laws and regulations adopted may be stringent at the time they were enacted, but the laws are unable to adapt to changing circumstances as new scientific data and information is understood. Consequently, the laws may become less stringent or obsolete. For example, the information that climate change activities exacerbate harmful algal blooms means that less phosphorus is needed in a given body of water for harmful algal blooms to thrive. Former quantitative limits on the amount of phosphorus a water body can receive must then be adjusted accordingly, but with command and control regulation, this

[123] Ibid.
[124] Ibid.
[125] Ibid.
[126] Ibid.
[127] Michael Faure, Morag Goodwin & Franziska Weber, "Bucking the Kuznets Curve: Designing Effective Environmental Regulation in Developing Countries" (2010) 51 Va J Int'l L 95 at 113.

adjustment is not automatic and may even be difficult to accomplish depending on political will.

Command and control regulation is criticised for being inefficient in several ways. According to economic studies, command and control regulation methods are inefficient because they set environmental policy goals without fully considering the economic costs involved.[128] Moreover, the increased authority granted to the regulatory state means that the application and enforcement of the statute depends on the will and abilities of the current administration. When regulators are disinterested, unmotivated, or incompetent, the effectiveness of the regulation suffers.[129] For example, the George W. Bush Administration is widely regarded by environmentalists as having the worst environmental track record in American history.[130] The Bush Administration made a concerted effort to weakened existing environmental law, including gutting key sections of the Clean Water Act and dismantling protections afforded by the Endangered Species Act.[131] In addition, the Bush Administration reduced the enforcement efforts in the EPA and, according to Sierra Club spokesperson Josh Dorner, "introduced this pervasive rot into the federal government which has undermined the rule of law, undermined science, undermined basic competence and rendered government agencies unable to do their most basic function even if they wanted to."[132] Thus, successful command and control regulation can depend entirely on the administration in office.

Lastly, command and control regulation is often inefficient due to the reality that the government is typically not in as good a position to understand the

[128] Orts, *supra* note 34 at 1236.
[129] Ibid.
[130] "This is the worst environmental president we've had in American history." Robert F Kennedy, Jr., "Those of Us Who Know that America's Worth Fighting for Have to Take it Back Now from Those Who Don't", Proceedings of the Sierra Summit 2005, San Francisco, California, 10 September 2005.
[131] Suzanne Goldenberg, "The Worst of Times: Bush's Environmental Legacy Examined" The Guardian (16 January 2009) online: <http://www.guardian.co.uk/politics/2009/jan/16/greenpolitics-georgebush>.
[132] Ibid.

risks and the potential solutions as the regulated actors.[133] The result is that the government has to use financial resources to study the problem, study the solutions, and once the statute has been enacted, enforce the standards and requirements. Meanwhile, the industry actors may already be aware of the environmental issue and know what practice would best reduce pollution out of the range of options.

C. Reflexive Law Instruments

Reflexive law theory recognises that industry actors themselves are often in the best position to understand the environmental risks and determine the most efficient way to reduce those risks. With this in mind, the goal of reflexive law strategies is to use public disclosure of information to coerce polluting companies to internalise environmental harms.[134] Although reflexive law can take many forms, there are typically three main instruments used: market-based instruments, information-based instruments and communication-based instruments. Each of these instruments encourages actors to adopt environmental goals and find ways to achieve them.[135] The instruments take different approaches, but with the common aim to align actors' interests with societal interests.

1. Market-Based Instruments

Market-based instruments involve laws and policies designed to encourage behaviour through market signals.[136] Sometimes called "free market environmentalism," market-based instruments have been lauded for their potential to make pollution control economically advantageous to industrial actors and to lower pollution abatement costs.[137] In short, market-based instruments aim to internalise negative environmental externalities. Negative environmental externalities are hidden costs not taken into account in the costs of production. As

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[133] Dennis D. Hirsch, "Green Business and the Importance of Reflexive Law: What Michael Porter Didn't Say" (2010) 62 Admin L Rev 1063 at 1085 (Discussing how many green business activities involve upstream changes that company employees, but not government officials, are in a position to identify).
[134] Braunig, *supra* note 34 at 1523-24.
[135] Hirsch, *supra* note 34.
[136] Stavins, *supra* note 108.
[137] J.D. Bernstein, "Chapter 6 - Economic Instruments" in Richard Helmer & Ivanildo Hespanhol, ed., *Water Pollution Control - A Guide to the Use of Water Quality Management Principles* (E. & F. Spon, 1997).

a result, these costs are not directly borne by either the producer or the consumer. For example, water pollution is a cost to the environment caused by agricultural practices for which neither farmers nor consumers directly pay.

Market-based instruments can be applied to a wide range of environmental problems and take various forms. Some are founded on the idea that the market must be structured to take the external costs of detrimental environmental effects into account in economic calculations. Other market-based instruments are more narrowly-defined and instead attempt to harness the power of the market to influence particular industries and actors. Some instruments do this by setting a cap and creating tradable permits to effectively create a market. Other market-based instruments assess taxes on environmentally-harmful activities or subsidise environmentally-sound behaviours.

Of the many market-based instruments, there are three types that are the most prominently used by legislatures: the Pigouvian approach; the Coasian approach; and the creation of tradable permits. The Pigouvian approach is attributed to British economist Arthur C. Pigou, who argued that the existence of externalities justifies government intervention.[138] Under the Pigouvian approach, the government assesses taxes and charges to activities deemed to be environmentally harmful. The idea is that by taxing such activities, actors will be discouraged from polluting. Like fees assessed on command and control violators, this approach follows the "polluter-pays principle."[139] Examples of this approach include The Netherlands' effluent charges in water pollution regulation and the Clinton Administration's proposal for a broad-based energy tax.

In The Netherlands, public authorities or Water Boards (nongovernmental bodies governed by stakeholder councils) can levy charges on anyone who emits waste, polluting or noxious substances directly or indirectly into surface water or into a collectively-used water purification plant.[140] The charge is based on the

[138] Arthur C. Pigou (1877-1959) studied, and then lectured at Cambridge until World War II. David R. Henderson, ed, "Arthur Cecil Pigou" (2008) online: Library of Economics and Liberty <http://www.econlib.org/library/Enc/bios/Pigou.html>.
[139] Bernstein, *supra* note 137.
[140] Ibid; *see also* Rafael Lazaroms & Dimitri Poos, "The Dutch Water Board Model" (2004) 15 Water Law 137.

quantity and/or quality of the pollutants and pollution is expressed in "population equivalents" (pe), which are predetermined for small enterprises and households and assessed using a table of emission coefficients for larger organisations.[141] The fees assessed provide an important source of finance for water purification plants.[142] In addition, the charge has had a strong incentive effect on polluters to reduce their discharges.[143] In the first 20 years after the charge was adopted, both the quality of the water and the number of treatment plants in The Netherlands rose considerably.[144]

Another example of a pollution tax is the Clinton Administration's attempt to tax carbon emissions. In 1993, the U.S. President Bill Clinton proposed a bill to tax the heat content of fuels. The tax was to be levied on coal, natural gas, liquefied petroleum gases, gasoline, nuclear-generate electricity, hydro-electricity and imported electricity at a base rate of 25.7 cents per million British Thermal Units (BTUs) and an additional 34.2 cents per million BTUs on refined petroleum products.[145] The proposal was strongly opposed by the Senate, who appealed to special interest groups, and was never passed into law.[146] The Clinton Administration was subsequently forced to heavily amend the bill before it passed into law as the limited "Transportation Fuels Tax" on October 1, 1993.[147] The original tax would have taxed industries emitting carbon into the atmosphere as a way to raise revenue and discourage unnecessary emissions. In theory, the tax would motivate industries to find innovative ways to carry out their businesses whilst reducing emissions.

Pigouvian taxes tend to be most successful when the following criteria are met: they are combined with command and control regulations; they are applied to stationary pollution sources; and marginal abatement costs vary amongst

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[141] Ibid.
[142] Ibid.
[143] Ibid.
[144] Ibid.
[145] Carbon Tax Center, "A Brief History of Energy Tax Efforts", online: <http://www.carbontax.org/progress/a-brief-history-of-energy-tax-efforts/>.
[146] TED Case Studies, "US Energy Tax", online: American University <http://www1.american.edu/TED/usbtutax.htm>.
[147] Paul F. Horvitz, "Clinton Retreats on Energy Tax in Fight Over Budget" *The New York Times* (9 June 1993) online: <http://www.nytimes.com/1993/06/09/news/09iht-plan_1.html>.

polluters because the cost-saving potential is greater with a wide variation.[148] Success also depends on the resources available for monitoring effluents, the ability of authorities to assess appropriate fees that will actually discourage pollution but not put industries out of business, and the ability of polluters to react to the charge and change their behaviours.[149]

The difficulty with the Pigouvian approach is that the government must set the fee schedule that adequately takes into account the potential amount of harm a pollutant is likely to cause as well as the likelihood that a certain monetary penalty will change actor behaviour. If the fees are set too low, polluters may opt to pollute and pay instead of change their practices. However, if a fee is set so high that it is unrealistic offenders can pay, they will go out of business or simply continue to pollute and not pay. Because of the fine balance necessary in setting adequate incentive structures, the Pigouvian approach is criticised as relatively difficult to implement.

Pigou's theory that government intervention was warranted in situations in which externalities occurred was the predominantly accepted economic approach until 1960 when British-born, American-based economist Ronald Coase persuaded economists that taxes and subsidies are not necessary if individuals who create and are affected by the externality can bargain.[150] The Coasian approach seeks to internalise externalities by expanding property rights broadly. The approach is based in the Coase theorem, which states that if it is possible for actors causing/affected by an externality to trade without any transaction costs, bargaining will produce the most efficient outcome.[151] The Coase theorem argues that expanding property rights so that ownership extends over the natural

[148] Bernstein, *supra* note 137. Marginal abatement costs can be likened to the concept of 'diminishing returns.' When companies initially implement technologies and practices to abate pollution, they are able to achieve substantial pollution abatement at minimal cost. As companies get closer to eliminating pollution, each additional abatement measure comes at increasing cost. Eventually, companies reach a cutoff point where abatement is no longer feasible as it increases to infinity. *See* Athanasios Kampas & Ben White, "Selecting Permit Allocation Rules for Agricultural Pollution Control: A Bargaining Solution" (2003) 47 Ecological Economics 135.
[149] Bernstein, *supra* note 137.
[150] Henderson, *supra* note 138.
[151] *See generally* Herbert Hovenkamp, "The Coase Theorem and Arthur Cecil Pigou" (2009) 51 Ariz L Rev 633.

environment will allow the market to accurately value the environmental resources.[152]

One example of this theory in practice is the Community Areas Management Programme for Indigenous Resources (CAMPFIRE) programme in Zimbabwe. The CAMPFIRE programme is a community based natural resources management programme designed and managed entirely by Zimbabweans. The programme allows local communities to manage their wildlife resources, including the ability to assign elephant hunting licences to tourists. Although the programme was originally intended to apply to forests, grazing, and water as well as wildlife, it was the ability to manage and exploit wildlife that attracted the most attention in part due to its financial potential.[153] The theory behind the programme is that if local communities are invested in their wildlife and natural resources, they will have incentive to care for them and the resources' value will be protected by their human owners. However, there are difficulties with this approach. First, attributing more property rights requires government resources. Registers need to record ownership and the government will need to establish methods of enforcing the new property rights against trespassers. Moreover, there are significant political and moral objections to "commodifying" certain kinds of resources.[154]

A third type of market-based instrument creates tradable pollution rights. This approach is a variant of the command and control regulation permitting system but with a Coasian element of assigning marketable pollution rights as property. The scheme has the potential to be economically efficient because it leaves the actors free to determine whether it is more cost-effective to upgrade to more environmentally-sound equipment and implement best management practices or to purchase more pollution rights. An example of this type of

[152] Ibid.
[153] Jocelyn Alexander & JoAnn McGregor, "Wildlife and Politics: CAMPFIRE in Zimbabwe" (2000) 31:3 Development & Change 605 at 607.
[154] For a more in depth discussion of moral arguments against commodifying natural resources, *see* Noel Castree, "Commodifying What Nature?" (2003) 17 Progress in Human Geo 273.

approach includes the nutrient trading programme in Chesapeake Bay.[155] The Chesapeake Bay trading programme, which is discussed in detail in Chapter Three, is a system in which the various jurisdictions in the watershed collaborated to establish a cap on the amount of phosphorus entering the Bay. Under the programme, the phosphorus source contributors can trade the 'right to pollute' amongst themselves, which will theoretically lead to the most efficient way to reduce phosphorus in the Bay.

Trading programmes have had great success in curtailing certain environmental harms, including air pollution.[156] However, it is important to distinguish the nature of air pollution from water pollution.[157] Air pollution trading programmes involve trading between two sources with the same type of pollution discharges.[158] Water trading programmes typically involve both point source polluters with measureable discharges and nonpoint source polluters with discharges measured in model estimates.[159] As a result, point source polluters may purchase quantifiable discharge credits from discharge sources that are best estimates.[160] Trading programmes that facilitate transactions between two different types of polluters must struggle to overcome the uncertainty of nonpoint source polluters' discharges.[161] This uncertainty involved in such a situation means these programmes run a risk of allowing more pollution discharges to occur than without such a trading programme. However, there are three ways to reduce the uncertainty and achieve a successful trading programme.

One way to reduce uncertainty associated with nonpoint source pollution is to have an independent entity verify nonpoint source credits.[162] These credit aggregators can arrange for the credits to be certified and facilitate transactions between smaller credit-generating pollution sources and credit purchasers. A

[155] Eleftheria Kampa R. Andreas Kraemer, Eduard Interwies, "The Role of Tradable Permits in Water Pollution Control" (2003).
[156] Suzanne Teller, "Trade Wars: Will Nutrient Trading Save or Spoil Our Streams?" (Spring 2011) Outdoor America 12.
[157] Ibid.
[158] Ibid.
[159] Ibid.
[160] Ibid.
[161] Ibid.
[162] Ibid.

second way to deal with the uncertainty is to limit credit-generating activities to those that are easily measureable, verifiable and permanent.[163] This can be done through the implementation of rigorous best management practices and a requirement that such practices be state certified. Finally, regulators can reduce the uncertainty associated with nonpoint source pollution by using trading ratios that require point source polluters to purchase more credits than they are seeking to offset.[164] One way that regulators might calculate trading ratios is to adjust the worth of nonpoint source credits depending on the quality of the water. The Great Miami River watershed has achieved an estimated 460 tonnes of nitrogen and phosphorus reductions by implementing such a trading ratio.[165]

The tradable pollution rights approach can be extremely successful in certain situations. However, it is important to recognise that trading does not always yield the most economically efficient results and its success largely depends on circumstances, including number of actors and industries in a given region. When there are many actors, the sheer cost of setting up such a program can be prohibitive.

2. Information-Based Instruments

In addition to market-based instruments, information-based instruments provide another reflexive law strategy for addressing environmental issues. Information-based instruments are intended to generate and provide information to the public and other stakeholders about the environmental performance of individual actors' management practices.[166] The idea is that disclosing information to the public will encourage actors to improve their behaviour in order to reduce negative publicity or consumer backlash.[167] It is important to note that this concept is based on the assumption that when the general public is aware of the environmental harms caused by particular products or processes, they will

[163] Ibid.
[164] Ibid.
[165] Ibid.
[166] Richard B. Stewart, "Chapter 8: Instrument Choice" in Jutta Brunnée & Ellen Hey Daniel Bodansky, ed., *The Oxford Handbook of International Environmental Law* (Oxford: Oxford University Press, 2007) at 152.
[167] Fiorino, *supra* note 45 at 160.

change their consumption accordingly.[168] Some information-based instruments include mandatory reporting schemes, mandatory hazard warning schemes, and certification-based eco-labels.[169] It is important to note that the mandatory nature of these instruments means that they rely on state agencies to require and enforce them via command and control instruments. However, the concept of information disclosure is a reflexive law strategy that employs command and control regulation's assets to achieve its purpose of educating stakeholders rather than a pure command and control regulation that focuses on setting and enforcing environmental outcomes.

Mandatory reporting schemes require certain industries to report their pollution discharges or patterns. The EPA's Toxic Release Inventory (TRI) exemplifies such a scheme. The TRI is a section of the Emergency Planning and Community Right-to-Know Act that requires certain companies with over ten employees to annually report their releases and deposits of covered chemicals.[170] The TRI has been praised by environmentalists, industry leaders, and leader scholars for its procedure and results.[171] Studies indicate that consumer and community activism as well as the "naming and shaming" of publicly reporting chemical releases have led to a marked decrease of chemicals released despite industry growth.[172] Further, certain studies revealed that the publication of negative TRI data lowered workplace morale and generated shareholder pressure to improve practices.[173]

Mandatory hazard warning schemes are similar to mandatory reporting schemes in that they require industries to report pollution patterns, but hazard warning schemes also require industries to explain the risks associated with such pollution. In California, Proposition 65[174] (Prop. 65) requires businesses to directly communicate environmental risks or dangers to the public. Specifically, Prop. 65 requires any business selling any product containing a chemical known

[168] Braunig, *supra* note 34 at 1524.
[169] Ibid at 1523.
[170] Emergency Planning and Community Right-to-Know Act, 42 U.S.C. § 11023(a)-(c) (2006).
[171] Braunig, *supra* note 34 at 1526.
[172] Ibid.
[173] Ibid.
[174] Cal. Health & Safety Code §§ 25249.5-.13.

by California to cause cancer or reproductive health problems to provide a "clear and reasonable warning," unless the manufacturer proves that the amount of the carcinogen is less than the *de minimis* level.[175] The law has been particularly effective in two ways. First, many businesses fear having to place a toxicity warning on their products and have removed toxic chemicals from their products in order to avoid doing so.[176] Secondly, the law has flipped the causation problems that plague private law actions by requiring business prove their way out of compliance, which has allowed Californian authorities to establish "safe" levels of exposure more quickly than the EPA.[177]

A third information-based instrument is certification environmental labels. These "eco-labels" harness the consciences of consumers to favour environmentally-friendly products.[178] In contrast to hazard warning schemes, eco-labelling programmes attempt to change consumer patterns by communicating positive information about a product in the form of an eco-label stamp or seal.[179] The international non-profit Forest Stewardship Council's (FSC) "checkmark and tree" logo is an example of a successful eco-labelling programme.[180] The FSC permits environmentally responsible timber products to bear their logo.[181] Home Depot and IKEA, the world's first and second largest timber supplier respectively, have each announced their preference for FSC wood. In fact, Home Depot expressed its ambition to supply only FSC-certified wood and now pressures its suppliers to seek FSC certification.[182] The FSC labelling programme's success may be attributed to several factors. First, many suppliers were already engaging in sustainable practices at its inception and therefore were

[175] Ibid.
[176] Braunig, *supra* note 34 at 1527.
[177] Ibid at 1527.
[178] Orts, *supra* note 34; s*ee also* Jason J. Czarnezki, "The Future of Food Eco-Labeling: Organic, Carbon Footprint, and Environmental Life-Cycle Analysis" (2011) 30 Stan Envtl LJ 3.
[179] Braunig, *supra* note 34 at 1528.
[180] Delcianna J. Winders, "Combining Reflexive Law and False Advertising Law to Standardize 'Cruelty-Free' Labeling of Cosmetics" (2006) 81 NYU L Rev 454 at 477 (discussing how the Forest Stewardship Council's eco-labeling provides a successful example of reflexive law at work).
[181] Forest Stewardship Council, "Mission and Vision", online: Forest Stewardship Council <http://us.fsc.org/mission-and-vision.187.htm>.
[182] Jared Diamond, Collapse: How Societies Choose to Fail or Succeed (New York: Viking, 2005) at 477.

eager to sign on to be certified. Second, the eco-label's synthesis of a great deal of information about the certification's requirements for environmental practices makes it more accessible and comprehensive for consumers than a long list of data, such as is provided by programmes like the TRI.

3. Communication and Planning-Based Instruments

In addition to market-based and information-based instruments there are communication-based and planning-based instruments. Like the other reflexive law instruments discussed, these instruments promote certain practices intended to encourage actors to continually improve their own practices. Communication-based instruments promote communication between farms and stakeholders in order to motivate farms to reduce their environmental impacts.[183] These instruments do not impose specific obligations on farmers—other than the requirement to join—and instead facilitate communication between farmers, the government and other stakeholders. In some cases, legislatures use a command and control regulation to require farmers to join coalitions. In other cases, legislatures do not require farmers to join, but reward the ones who do in the form of subsidies or tax credits.

Preliminary studies have shown that local policy networks have been successful in the policy arenas of watershed management[184] and agricultural conservation practices.[185] Such networks have been successful because they offer improved relations of reciprocity and trust between actors, which encourages the alignment of existing interests with the goals of society and government agencies. For example, these improved relations have been shown to effectively increase agency inspections and decrease violations.[186] However, it is important to note that only limited studies that have explored such issues and as a result,

[183] Hirsch, *supra* note 34.
[184] John T. Scholz & Cheng-Lung Wang, "Cooptation or Transformation? Local Policy Networks and Federal Regulatory Enforcement" (2006) 50 American Journal of Political Science 81 at 93-94.
[185] *See* Graham R. Marshall, "Polycentricity, Reciprocity, and Farmer Adoption of Conservation Practices Under Community-Based Governance" (2009) 68 Ecological Economics 1507.
[186] Scholz & Wang, *supra* note 184 at 93.

interpretations must be preliminary until more empirical examples are explored.[187] In particular, further studies are needed to determine the direct link between policy networks and environmental improvements and enhanced policy support.[188] Moreover, the literature that does exist has largely developed independent of environmental policy instrument theory.[189]

An example of such a communication-based instrument is the Sacramento Valley Water Quality Coalition, discussed in detail in Chapter Three. The Coalition aims to identify pollution from agricultural practices and help agricultural producers implement economically viable best management practices to solve these problems. In particular, the Coalition enables farmers to connect with each other to communicate innovative methods and assure individual farmers that they are not the only ones implementing expensive changes. Like eco-labelling programmes, the communication-based instruments impose social pressures on actors to improve their behaviours. Despite the risk that such a plan can lead to a race to the bottom, the Coalition has been extremely successful in encouraging farmers to implement best management practices.[190]

Planning-based instruments are similar to communication-based instruments in that they encourage actors to reflect on and determine how to improve their practices.[191] Instead of using communication with other stakeholders, however, planning-based instruments require or encourage actors to engage in planning processes.[192] Such instruments impose very few actual obligations other than requiring companies and farms to work through the

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[187] Ibid at 94; *see also* Douglas S. Kenney, "Are Community-Based Watershed Groups Really Effective? Confronting the Thorny Issue of Measuring Success", *in Across the Great Divide: Explorations in collaborate Conservation and the American West*, ed by Philip Brick et al. (Washington, DC: Island Press, 2001) at 188, 193.
[188] Scholz & Wang, *supra* note 184 at 94.
[189] Nikoleta Jones, Costas M. Sophoulis, Theodoros Iosifides, Iosif Botetzagias & Konstantinos Evangelions, "The Influence of Social Capital on Environmental Policy Instruments" 18 Environmental Politics 595 at 597 ("Despite the expanding literature, social capital has been weakly connected to environmental policy implementation and its instruments.").
[190] It is important to note that only few studies that have explored such issues and interpretations must be preliminary until more empirical examples are explored.
[191] Hirsch, *supra* note 34.
[192] Ibid.

planning process in hopes that it will lead to improved environmental performance.[193]

Quebec's requirement that farmers draw up and submit annual phosphorus reports is one example of a planning-based instrument. Quebec's phosphorus report, which is addressed in more detail in Chapter Three, is essentially a balance sheet for farmers to track their phosphorus inputs and outputs. There is no requirement that farmers achieve a zero phosphorus balance, but farmers must submit a report every year. The theory behind this requirement is that by engaging in this planning requirement, farmers will learn which practices cause the biggest source of waste to occur and will be motivated to improve those practices. The annual reporting aspect of the Quebec phosphorus report requirement is relatively new—farmers previously only had to file one every five years—and it is still unclear whether this new requirement will have a significant impact on farmers land use practices.

4. Advantages of Reflexive Law Instruments

Reflexive law instruments overcome some of the problems that plague command and control regulation. In particular, command and control regulations can be economically inefficient, excessively costly to implement, and they tend to discourage innovation in pollution control technology because there is no financial incentive for industries to exceed their control targets.[194] Command and control regulations have difficulty accommodating the growth of existing industries and the entry of new ones because addressing such growth requires a statutory amendment or enacting a new law. Command and control regulations also suffer from enforcement capacity limitations because the regulatory state has limited resources with which it can enforce the control targets.[195]

Reflexive law instruments—and market-based instruments in particular—have the capacity to be much more economically efficient than command and control regulations. Unlike command and control regulation, they allow polluters to respond flexibly and independently in line with market prices, which means

[193] Ibid.
[194] Bernstein, *supra* note 137.
[195] Ibid.

polluters can reduce pollution at the least cost to their operations. Command and control regulations take a "one size fits all" approach that does not account for such flexibility. Moreover, market-based instruments provide a continuing incentive for polluters to reduce pollution, in contrast to command and control regulation where polluters in compliance have little incentive to improve their practices to exceed those targets. Reflexive law's continuing incentive structure encourages polluters to continually develop and adopt new pollution control technologies in order to be more competitive in the market.

Further, unlike command and control regulation, reflexive law instruments can be implemented with relative administrative ease because they do not require vast government resources to determine best practices and enforce them. Reflexive law instruments avoid the high information costs involved determining the most feasible and appropriate level of control for each regulated plant or product.[196] In fact, information gathering is the sole goal of information-based instruments and, with the proper incentive structure, market-based instruments encourage industries to do this work themselves.

5. Criticisms of Reflexive Law Strategies

However, reflexive law instruments have certain drawbacks. These instruments are criticised for having unpredictable effects on environmental quality because the polluters are free to choose their own solutions, which may lead to a race to the bottom, rather than the top.[197] Various factors dictate the ability of market actors to influence industrial pollution practices, such as information accessibility and comprehensibility, the accuracy of self-reported information, and industry responsiveness.[198] Another criticism is that when the charges (such as taxes) are too low or the incentive structure is inadequate, polluters may opt to pollute and pay rather than change their behaviours.[199] And although reflexive law instruments require less compliance and administrative costs than command and control regulations once they are implemented, the start-

[196] Ibid.
[197] Ibid.
[198] Braunig, *supra* note 34 at 1525
[199] Bernstein, *supra* note 137 at 6.2.

up costs for certain market-based instruments (i.e., taxes and tradable permits) can be high because they typically require sophisticated institutions to implement and enforce them properly.[200]

Perhaps the biggest drawback of reflexive law instruments is that both government agencies and industries have consistently resisted their implementation.[201] The government agencies resist them because they afford the regulatory state less control over setting and enforcing industry standards.[202] Industries resist them because they have more negotiating power over the design of command and control regulations than they do with tax and trading regimes.[203] In addition, industries argue that reflexive law instruments used to supplement existing command and control regulations provide additional and unnecessary constraints.[204]

This long, though certainly not exhaustive, survey of policy instruments reveals that no one instrument is best suited to addressing environmental issues. Indeed, it is well-understood in administrative law scholarship on environmental regulation that no single instrument is even capable of addressing the full complexity of environmental concerns.[205] What is more, there is no single metric for determining what policy instrument is most appropriate for addressing a given problem, and it is possible to utilise any number of perspectives, principles and institutional forms on any governance question.[206]

To summarise the strengths and drawbacks of the policy instruments discussed above, private law claims allow residents with polluted property to seek remedies. However, these claims have limited use for addressing widespread environmental concerns because they are limited to individual injuries. Private law remedies also depend on the willingness and ability of an individual to bring a

[200] Ibid.
[201] Ibid.
[202] Ibid.
[203] Ibid.
[204] Ibid.
[205] Hoi Kong, "Sustainability and Land Use in Canada" (2012) 13 Vt J Envtl L 553 at 555.
[206] Ibid at 554, citing Roderick A. Macdonald, "The Swiss Army Knife of Governance," in *Designing Government: From Instruments to Governance*, ed by F. Pearl Eliadis, et al., (Montreal; Ithaca, NY: McGill-Queen's University Press, 2005) at 203, 214-24.

claim, and even when a plaintiff files suit, there are causation hurdles to overcome.

Command and control regulation offers the answer to some of these problems. Instead of relying on individuals to bring suit, the government can do it instead. Command and control regulation is also better suited for addressing widespread environmental issues because it develops in statutes, rather than court decisions that are limited to resolve the specific dispute at hand. However, command and control regulation statutes have become so popular and legislatures have been so prolific in enacting them that they run the risk getting caught up in the operational challenges of dealing with the sheer quantity of laws and losing sight of the original environmental goal. Moreover, these statutes involve high costs to the government in identifying and studying pollution sources, determining feasible methods for reducing these sources, enacting the law requiring these methods, and enforcing the newly-required methods. These costs arise every time the government has to undergo this process, so enacted statutes are not always promptly revised in response to new scientific information or understanding.

Reflexive law strategies overcome these challenges because they enlist the actors to set environmental goals themselves and find innovative ways to achieve these goals. Because reflexive law strategies do not require as much government involvement, they are much easier and less expensive to administer. Reflexive law strategies are founded on the concept that the actors are in the best position to understand the environmental risks and how to reduce them. Although legislatures must face the front-end challenge of setting an incentive structure that will adequately encourage actors to engage in environmentally-sound behaviours, once such an incentive structure is in place, legislatures can leave these actors to self-regulate.

But reflexive law strategies are not the sole answer to bringing law to bear on environmental issues. They come with no guarantee that environmental quality will improve because the government has no means for enforcing any particular standards with the exception of a cap-and-trade approach where the

government may set an across-the-board limit on pollution discharges. In addition, industries and governments alike have resisted their implementation and shown a strong preference for the certainty afforded by command and control regulation.

Given that each policy instrument has such unique strengths and weaknesses, it is sensible that a mix of instruments will yield better results than would strict adherence to one. In fact, reflexive law strategies would not exist in practice if not for command and control regulation's ability to establish requirements for disseminating information and planning procedures. As a result, one of legislatures' biggest challenges is determining where command and control regulations should end and reflexive law strategies begin.

IV. ADDRESSING WATER QUALITY

A. Water Quality Goals

With the framework for environmental policy instruments in mind, I turn to two important questions for addressing water quality issues: what goals do we want to achieve for water quality and how do we achieve these goals?

1. Setting Water Quality Goals

Determining water quality goals is complicated and fraught with uncertainties. Generally, the overall goal is to have clean water, but it is not often clear *how much* cleaner the water needs to be. Even once legislatures agree on a particular goal, they face further complications in their decision as to how to implement standards to achieve the goal.

So how clean should the water be? The Clean Water Act uses a combination of narrative and numeric criteria to set goals for particular waters.[207] Narrative criteria are features that legislatures determine they want the water to support, such as for a drinking water supply or for the waters to be swimmable and fishable.[208] Numeric criteria are specific levels of pollution that should not be exceeded.[209] Such criteria initially appear to be an ideal way of setting water quality goals because it is easy to measure success. If the phosphorus levels are

[207] 33 U.S.C. § 1313(c)(2)(B); 40 C.F.R. § 131.3(b) (2011).
[208] 33 U.S.C. § 1313(c)(2)(B); 40 C.F.R. § 131.3(i) (2011).
[209] 33 U.S.C. § 1313(c)(2)(B).

below the targeted amount, the goals have been achieved. However, HABs may still occur in waters that have achieved their goals if the numeric criteria are set too leniently. The criteria are established with a command and control regulation based on current scientific understanding of the standards necessary to improve or maintain the health of the water. Yet, the understanding may change with new information and the criteria are not designed to automatically adapt. What is more, the criteria may actually be developed based on a goal intended to directly reverse the effects of pollution, which may not be possible due to broad changes in environmental conditions.[210] This is a problem of "shifting baselines."[211]

Narrative criteria, such as eliminating HABs from occurring in the water, thus appear to be a better approach. By setting a goal to clean up the water enough that HABs no longer occur, there will be an easy way to determine success, i.e., if HABs appear, the goal has not be met. Narrative criteria are more difficult to implement, however, because it is challenging to specify by how much we need to reduce phosphorus loads.

Setting exact numbers fails to recognise the changes in concentration created by climate change activities; however, setting narrative criteria makes it difficult to specify precisely how much less phosphorus we should be loading into the waters. This predicament echoes the arguments in favour of and against command and control regulations versus reflexive law instruments. The amount of phosphorus the water body can handle is constantly changing, and so our goals appear to be a moving target. However, this environmental issue has a relatively clear need: reduce the phosphorous loading to the point where HABs stop appearing. Although this level will continue to change as temperatures rise, there is actually a relatively clear starting point for setting goals.

2. Implementing Water Quality Goals

Once a specific water quality goal is determined—here, it is to prevent HABs from occurring—legislatures face the challenge of having to determine

[210] Daniel J. Conley Carlos M. Duarte, Jacob Carstensen & María Sánchez-Camacho, "Return to Neverland: Shifting Baselines affect Eutrophication Restoration Targets" (2009) 32 Estuaries & Coasts 29.
[211] Ibid.

how to implement laws to achieve the goal. There are various policy instruments to choose from, as detailed above, and they each carry particular strengths and drawbacks. However, choosing policy instruments is not the last challenge facing legislatures. Once a particular policy instrument has been chosen, the instrument must then be translated into laws and implemented in the real world. The policy instruments used in particular watersheds will be discussed in detail in later chapters. This chapter is limited to examining how we can use law to prevent HABs from occurring generally.

The first step requires legislatures choose policy instruments. Because each policy instrument carries its own unique strengths and weaknesses, legislatures typically adopt a mix of instruments. In particular, many legislatures have adopted command and control regulations to establish a cap for a nutrient trading programme. Other examples include command and control regulations that require industries to report their pollution data, warn consumers of hazards, or communicate with neighbours and other stakeholders.

When a legislature elects to use command and control regulations, the next challenge is determining how to implement them.[212] The two forms implementation typically takes are either as procedural laws or outcome-based laws. Procedural laws are laws that set forth particular procedural requirements for regulated actors. These requirements provide actors with a sense of certainty because they know that they will be protected if they follow the requirements even if the pollution still occurs. Outcome-based laws take the opposite approach by not setting any specific procedural requirements, but instead holding everyone accountable if pollution occurs. Actors can do everything in their power to reduce pollution, but if it occurs anyway they have violated their obligation. Unsurprisingly, regulated actors prefer procedural laws and environmentalists favour outcome-based laws.

As ideal as outcome-based laws sound to environmentalists, this approach still has a significant weakness: the government has to determine exactly what

[212] Market-based instruments and reflexive law strategies are meant to be self-regulating and thus do not need the implementation attention required by command and control regulations.

quantity of pollution will be tolerated. This is problematic because it requires vast government resources, including financial and scientific, to gain information about available and feasible ways to reduce pollution, and then enforce the standards once they have been established. The government must also invest resources to continuously evaluate environmental goals in response to new scientific data. As a result, outcome-based laws are often out-dated and un-enforced, which means they are functionally weaker than laws or policies that appear less stringent.

B. The Limits of Law

The law is useful creating goals for water quality and setting requirements to implement those goals, however it has inherent limits. First, in enacting laws and regulations, there must be political will. Additionally, the legislators must have jurisdiction over the region in which the pollution is occurring.

1. Political Will

Change cannot be enacted without political will. If the public does not see HABs as a concern, there will be no pressure on politicians to address the problem. Although the scope of this project does not delve into political science, it is necessary to acknowledge that political will is a necessary ingredient for setting water quality goals and implementing these goals. Indeed, some of the conclusions I reach advocate adding reflexive laws to encourage farms to self-regulate rely greatly on the public's desire to protect water quality. Without public concern for water quality protection, they will certainly not apply any consumer pressure on farms, let alone political pressure on politicians.

2. Jurisdiction

Even if political will exists to protect water from the occurrence of HABs, legislatures cannot impose requirements on farms and actors outside of their jurisdiction. Most watersheds extend beyond political boundaries. As a result, even the most ideal laws will be impossible to implement in these watersheds. This is of particular concern for water bodies that receive pollution from a source located in another jurisdiction.

It may be possible to regulate such a situation using formal law, meaning waterfront owners could potentially use private law remedies to recover from polluters upstream. However, this method would be limited to extremely specific circumstances and would not be particularly useful for setting future environmental goals and laws. In some instances political bodies across multiple jurisdictions have managed to cooperate for the sake of the water body. However, this sort of cooperation does run a risk that requirements will be lenient as a result of trying to get a hold-out party to participate. For instance, in 2009, international climate change talks had to be watered down enough for large party actors to sign on.[213] As a result, these talks produced soft agreements, to which parties have no binding obligations.

V. CONCLUSION

Water pollution poses risks to human health, wildlife health and habitats, and greatly reduces the world's clean water supply. One prominent polluter is excess phosphorus that primarily enters the water via agricultural runoff. Heavy phosphorus loads encourages harmful algal bloom growth, which degrade water and kill aquatic biota. Studies show that HABs are increasing in frequency as a result of rising temperatures and more frequent and intense storm events linked to climate change. However, there are simple changes farmers can make in their management practices to reduce their phosphorus outputs.

Although managing watersheds for HABs is relatively straight-forward scientifically, it is an incredibly complicated legal task. Scientists may have trouble understanding why HABs continue to plague waters unchecked by the legal restraints whilst jurists are frustrated by the complications that arise from jurisdictional boundaries, proving causation, and lack of political will. Moreover, even when legislatures can successfully enact laws, our policy regimes have great difficulty addressing phosphorus inputs—particularly nonpoint source contributions—because the regimes have historically been limited to addressing disputes between individuals or setting and enforcing environmental standards.

[213] John Vidal, Allegra Stratton & Suzanne Goldenberg, "Low Targets, Goals Dropped: Copenhagen Ends in Failure", *The Guardian* (18 December 2009) online: The Guardian <http://www.guardian.co.uk/environment/2009/dec/18/copenhagen-deal>.

But it is not a lost cause. Reflexive law strategies may supplement existing command and control regulations to reach actors previously overlooked. Reflexive law strategies may also resolve some of the administrative costs associated with implementing command and control regulations. Additionally, market-based reflexive law strategies may lead to more environmentally-sound practices if the incentive structure is properly designed to reward actors who improve their practices.

Reflexive law strategies can offer assistance to substantive law statutes in certain situations, but I do not suggest that they are the answer for every environmental problem. As my survey of environmental policy instruments reveals, legislatures have a veritable toolkit at their disposal for addressing environmental issues. Each policy instrument has various shortcomings that prevent it from addressing environmental harms on its own; therefore, for the instruments to work optimally, legislatures should adopt a blend of various policy instruments that can compensate for one another's weaknesses. In any event, legislatures should explore the possibility that reflexive law strategies may be the key to unlocking the door to cleaner water.

Some legislatures are doing just that. Lake Champlain and Lake Erie watershed managers have been dealing with harmful algal blooms for decades with varying levels of success. Both jurisdictions have taken on a mix of policy instruments to address agricultural runoff's phosphorus contributions, some based in substantive law and other in reflexive law. In order to understand how jurisdictions can blend these policy instruments to address agricultural runoff, it is helpful to take a closer look at their legal structures.

CHAPTER TWO: WATER QUALITY LAW IN LAKE CHAMPLAIN AND LAKE ERIE BASINS

INTRODUCTION

Watershed managers in both Lake Erie and Lake Champlain have striven to reduce harmful algal blooms for decades. Lake Erie has been combating HABs since the late 1960s and Lake Champlain since the 1990s, both with mixed results. Although Lake Erie is surrounded by a good deal more industry than Lake Champlain, studies reveal that agricultural runoff is a primary source of excess phosphorus in both of the water bodies.

I recommend three different ways for evaluating a policy's success in relation to its goals: (1) whether actors' behaviours have changed since the policy's adoption; (2) whether there has been a reduction in phosphorus concentrations since the policy's adoption; and (3) whether there has been a physical reduction in the occurrence of harmful algal blooms since the policy's adoption. Due to the limited scope of this project, I do not delve in to evaluate of the policies in Lake Champlain and Lake Erie basins under all three of these methods. However, certain inferences can be made by examining phosphorus levels against the policies' implementation dates.

In this chapter, I examine these two specific watersheds to shed light on their struggles with HABs and the policy instruments their jurisdictions use to try to reduce HAB occurrence. In Part I, I describe the history of HAB occurrence in each watershed. In Parts II and III, I describe and classify Lake Champlain and Lake Erie's policy instruments, respectively. I discuss the challenges of assessing policy success in Part IV and I conclude that since HABs continue to occur in these watersheds, managers should look to supplementing their current laws with additional reflexive law strategies.

I. HISTORY OF HARMFUL ALGAL BLOOMS IN THE LAKES

Lakes Champlain and Erie are vastly different lakes in many respects, including geographic and economic features. However, they both suffer from harmful algal blooms and increasingly so in recent years. The harmful algal blooms are commonly understood to occur as a result of nutrient loading to these

waters. Both lakes are cooperatively managed by multiple jurisdictions, including the federal governments of the United States and Canada. As a result, the agencies managing the waters encounter significant jurisdictional challenges. Although these lakes have important distinctions, their similar environmental plights and jurisdictional challenges make them meaningful case studies in understanding how watershed managers regulate activities that lead to harmful algal bloom occurrence.

A. Occurrence of Harmful Algal Blooms

1. Lake Champlain

Lake Champlain is a freshwater lake that has suffered from harmful algal blooms since before the year 2000. In 1999, a dog died after ingesting harmful algal blooms in the lake.[214] Two more dogs died the following year.[215] The State of Vermont Department of Health first posted a health advisory for the lake during a heat wave in August 2001, then another in August 2002.[216] The Quebec Montérégie Public Health Department also posted a health advisory during the summer of 2002 to warn residents on the Canadian side of the lake.[217]

The primary cause of harmful algal bloom growth in Lake Champlain is nutrient loading and the primary nutrient accelerating this growth is phosphorus. The Lake Champlain Basin Program (LCBP) has called phosphorus "the most serious nonpoint source pollutant facing Lake Champlain."[218] Phosphorus reaches the lake through various sources, including from wastewater treatment plants and various nonpoint sources.[219] Nonpoint sources account for approximately 90 percent of the total phosphorus load to the lake.[220] These

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[214] Lake Champlain Basin Program, "Blue-Green Algae (Cyanobacteria)", online: Lake Champlain Basin Program <http://www.lcbp.org/bgalgae.htm>.
[215] Ibid.
[216] Ibid.
[217] Ibid.
[218] Lake Champlain Basin Program, "Nonpoint Source Pollution: Fact Sheet Series Number 2", online: Lake Champlain Basin Program <http://www.lcbp.org/factsht/npsfactsheet2006.pdf>.
[219] The U.S. Environmental Protection Agency describes nonpoint sources pollution as pollution that comes from many diffuse sources, as opposed to pollution from industrial and sewage treatment plants, that is caused by rainfall or snowmelt moving over and through the ground. Environmental Protection Agency, "What is Nonpoint Source (NPS) Pollution? Questions and Answers", online: Environmental Protection Agency <http://www.epa.gov/owow/NPS/qa.html>.
[220] Lake Champlain Basin Program, *supra* note 218.

nonpoint sources include manure and fertiliser runoff from agricultural fields, soil erosion, construction site and development activities, forestry, and failing septic systems.[221] A 1999 technical report estimated that 56 percent of the nonpoint source load was derived from agricultural land.[222]

The proportion of phosphorus inputs by agricultural sources has rapidly increased in recent years. Government agencies in basin states give two reasons for this recent increase: (1) there is a trend toward a growing number of larger agricultural operations—especially dairy agriculture—in the area;[223] and (2) inputs from wastewater treatment plants are continually decreasing.[224] Figure 2 illustrates the different phosphorus inputs by source.

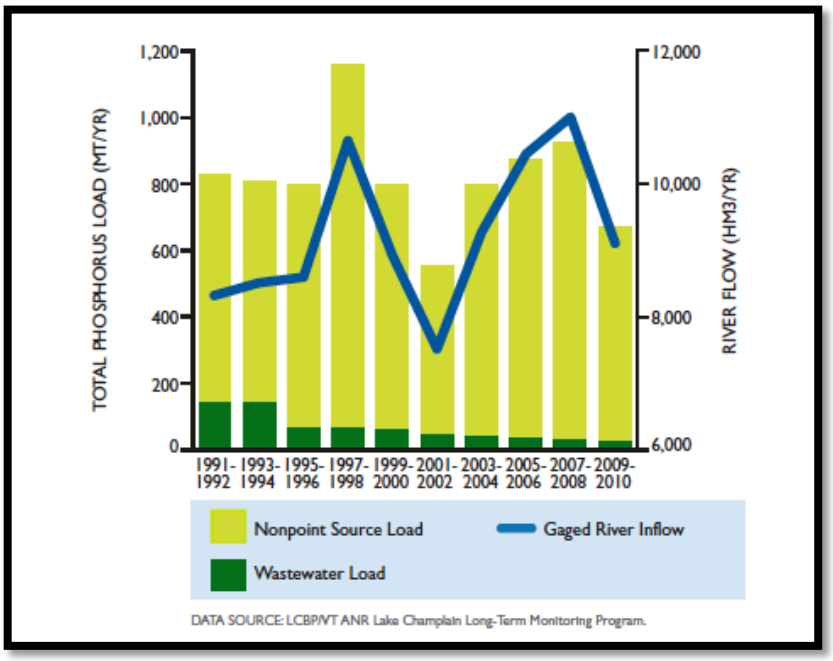

Figure 2: Phosphorus loading by source, adapted from Lake Champlain Basin Program, "State of the Lake and Ecosystem Indicators Report 2012" (2012) at 8, online: LCBP <http://www.lcbp.org/lcstate.htm>.

Tropical Storm Irene ravaged the State of Vermont during the spring of 2011, causing record floods that washed even more phosphorus from the land into

[221] Ibid.
[222] Vt. Agency of Natural Resources Dep't of Envtl. Conservation & NY State Dep't of Envtl. Conservation, "Lake Champlain Phosphorus TMDL" (2002) at 4 [Lake Champlain TMDL], citing William Hegman, D. Wang & C. Borer, "Lake Champlain Basin Program Tech. Rep. No. 21: Estimation of Lake Champlain Basinwide Nonpoint Source Phosphorus Export" (1999).
[223] Lake Champlain TMDL, *supra* note 222 at 54.
[224] Lake Champlain Steering Committee, "Opportunities for Action 2010" (2010) at 49.

the water than usual.[225] It is therefore unsurprising that reports show phosphorus levels were at an all-time high in Lake Champlain in 2011.[226] Figure 3 provides a visual of the sharp increases in 2011 in relation to previous years.

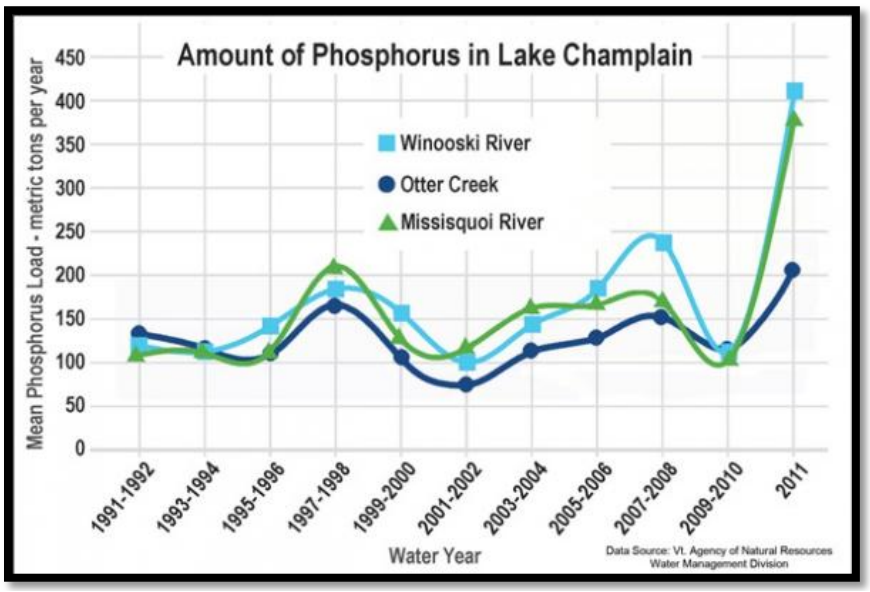

Figure 3: Amount of Phosphorus in Lake Champlain, adapted from Stein, *supra* note 226.

2. Lake Erie

Lake Erie is no stranger to pollution. Developing industries discharged directly into the lake and its tributaries during the Industrial Revolution. Decades later in the 1960s, the Cuyahoga River caught fire, leading to public outcry over the state of Lake Erie.[227] *Times Magazine* ran a poignant article in 1969 describing the sludge in the Cuyahoga River and declaring Lake Erie to be "in danger of dying by suffocation."[228]

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[225] John Dillon, "Lake Champlain Water Quality Gets Worse As Summer Winds Down" *Vermont Public Radio* (27 August 2012) online: Vermont Public Radio <http://www.vpr.net/news_detail/95691/lake-champlain-water-quality-gets-worse-as-summer/>.

[226] Andrew Stein, "Algae Blooms Hit Champlain in Wake of Record Phosphorus Runoff" *Addison County Independent* (9 July 2012) online: Addison County Independent <http://www.addisonindependent.com/201207cyanobacteria-blooms-hit-champlain-wake-record-phosphorus-runoff>.

[227] For example, talk-show host Johnny Carson referred to Lake Erie as "the place fish go to die" and children's author Dr. Seuss used Lake Erie as an example of an environmental disaster in his first edition of *The Lorax*. Peter H. Gleick, *Bottled and Sold: The Story Behind Our Obsession with Bottled Water* (Washington, DC: Island Press, 2010) at 29; Dr. Seuss, *The Lorax* (New York: Random House, 1971); Rick Smith & Bruce Lourie, *Slow Death by Rubber Duck: How the Toxic Chemistry of Everyday Life Affects Our Health* (Berkeley, CA: Counterpoint, 2010) at 14.

[228] "America's Sewage System and the Price of Optimism", *Time Magazine* online: Time, Inc. <http://www.time.com/time/magazine/article/0,9171,901182,00.html>. ("Each day, Detroit,

Like Lake Champlain, excessive phosphorus is the major water quality issue in Lake Erie.[229] As the Lake Erie Lakewide Management Committee has noted, "Lake Erie water quality has taken a turn for the worse. The algal blooms that threatened the Lake Erie ecosystem in the 1960s and the 1970s have returned, and the extent and duration of anoxia/hypoxia [. . .] continues to increase."[230]

Total phosphorus loads to Lake Erie have steadily decreased since the 1970s; however, this appears to be attributed to regulations on point sources rather than nonpoint source reductions.[231] As Figure 4 demonstrates, point source contributions dropped dramatically in the 1970s into the 1980s whereas nonpoint source contributions have remained nearly unchanged over time. Unregulated nonpoint sources are now responsible for approximately 60 percent of total phosphorus in Lake Erie.[232]

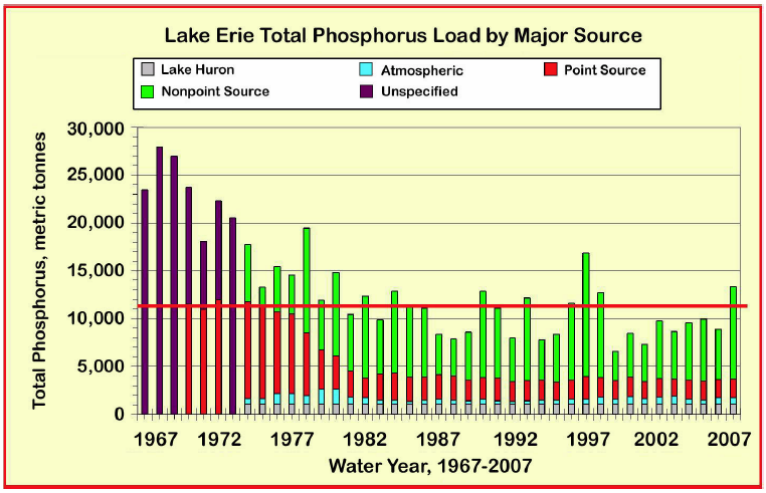

Figure 4: Data of annual loading of total phosphorus to Lake Erie, Ohio Environmental Protection Agency Division of Surface Water, *supra* note 229 at 14.

Cleveland and 120 other municipalities fill Erie with 1.5 billion gallons of inadequately treated wastes, including nitrates and phosphates. These chemicals act as fertilizer for growths of algae that suck oxygen from the lower depths and rise to the surface as odoriferous green scum. Commercial and game fish—blue pike, whitefish, sturgeon, northern pike—have nearly vanished, yielding the waters to trash fish that need less oxygen. Weeds proliferate, turning water frontage into swamp. In short, Lake Erie is in danger of dying by suffocation.").

[229] Ohio Environmental Protection Agency Division of Surface Water, "Ohio Lake Erie Phosphorus Task Force Final Report" (2010) at 11, online: OHEPA <http://www.epa.ohio.gov/portals/35/lakeerie/ptaskforce/Task_Force_Final_Report_April_2010.pdf>.

[230] Ibid.

[231] Ibid at 13.

[232] *See* ibid at 18.

Additionally, a recent Heidelberg University study reveals that although the phosphorus loads have been reduced, phosphorus concentrations are actually increasing.[233] The study indicates that the problem stems from changes in the forms of phosphorus entering the lake rather than an increase in the total amount of phosphorus entering the lake.[234] The study notes that, like Lake Champlain, the phosphorus entering Lake Erie from its large agricultural watersheds during storm events is of particular concern.[235]

Policymakers have taken a number of legal approaches to deal with the excess phosphorus problem in both Lake Champlain and Lake Erie. Initially, legislatures left enforcement responsibilities to property owners who could use private law remedies to recover for environmental harms. As it became increasingly clear that private law's focus on individuals made it inadequate for addressing pervasive environmental problems, the state stepped in to regulate. The regulatory state set and enforced standards meant to reduce harm to the environment. Most recently, governments have taken more innovative approaches to persuade actors it is in their best interest to reduce their pollution contributions. In this next Section, I revisit the progression of legal regimes in the context of addressing harmful algal blooms in Lake Champlain and Lake Erie.

B. The Inadequacies of Formal Law

Before delving into the specifics of each watershed's policy instruments, it is important to recall the theoretical frameworks described in Chapter One that provide the foundation for the phosphorus regulations. These theoretical frameworks have their unique strengths and weaknesses in addressing environmental issues and the theory underpinning the bulk of current phosphorus regulations in the Lake Champlain and Erie watersheds are based in substantive law theory. This may be interpreted as a consequence of formal law's difficulties addressing widespread environmental harms.

As we saw in Chapter One, there are various difficulties in using formal law theory policy instruments to protect the environment. Recall that private law

[233] Ibid at 4.
[234] Ibid.
[235] Ibid.

claims have timing problems when the injury occurs after the statute of limitations has run, heavy evidentiary burdens especially in regards to proving causation, and plaintiffs must have a legally recognised property interest to protect before they have standing to bring suit.[236] In the context of Lake Champlain and Lake Erie, the standing issue is of particular concern because the water bodies are classified as public waters.[237] Consequently, they are not owned by individuals and thus, there is no easy avenue under which an individual can pursue an action against industries polluting the lakes.[238] Even if an individual had proper standing to bring a private law action, it would be impracticable to sue every polluter in the watershed—the sheer number of polluters makes the transaction costs prohibitive. Recall also that the tort concept of joint and several liability is unworkable in the environmental context due to the impracticability of holding one polluter responsible for the harm caused by a large number of joint-tortfeasors.

When formal law avenues fail to provide residents with adequate legal relief, legislatures turn to political processes as "a substitute for the legal system" and provide assistance through environmental protection legislation.[239] Indeed, command and control regulation is commonly thought to be a response to the failure of private law to adequately address environmental harms.[240]

C. The Rise of Substantive Law

The 1970s marked the rise of the regulatory state in addressing widespread environmental issues. As discussed in Chapter One, substantive law theory advocates the regulatory state stepping in to intervene in social processes likely to cause environmental harm. The state does so by enacting statutes, regulations, and delegating legal authority to specialised agencies. To be categorised as a substantive law policy instrument, the instrument must be purposive, goal-

[236] *See infra* Chapter One, Section (A)(2) for additional discussions of the challenges associated with using private law to address environmental concerns.
[237] The Vermont Institute for Government, "The Law of Water" (2001), online: <http://www.sec.state.vt.us/municipal/pubs/Water.pdf>.
[238] As mentioned in note 101, individuals with special injuries can bring suit on the public's behalf, but this practice is exceedingly rare.
[239] Morriss, *supra* note 87 at 152-153.
[240] Butler, *supra* note 81 at 727.

oriented, and aim for specific goals in concrete situations. Command and control regulations typically possess these qualities.

Although harmful algal blooms in Lake Champlain did not reach public awareness until the late 1990s, the burning Cuyahoga River and Lake Erie's proclaimed "death" in 1969 spurred changes in environmental regulation.[241] These changes consisted of a shift from private law to command and control regulations. The regulatory state stepped in to set specific and general guidelines by requiring industrial and other point source polluters to seek permits. Although there remains controversy over the specifics, legal scholars often cite this incident as evidence that private law is inadequate for protecting the environment.[242]

In 1972, the United States and Canada signed the Great Lakes Water Quality Agreement (GLWQA), and each country also enacted their own laws to implement the goals of the GLWQA. The United States also enacted the Clean Water Act that same year, which established federal pollution guidelines and requirements, and set forth measures implementing the GLWQA. The GLWQA and the Clean Water Act have each been amended several times since their initial enactment. However, the underlying theory behind the laws remains based in substantive law.

The GLWQA can be classified as a command and control regulation because it sets specific guidelines for the Great Lakes and is purposive, goal-oriented, and aims for specific goals in concrete situations. The GLWQA is purposive and goal-oriented because it aspires "to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem."[243] The GLWQA also aims for specific goals in concrete situations because it sets phosphorus targets for each individual lake. For example, the

[241] Ibid. ("Rachel Carson's Silent Spring is often credited with launching the modern environmental movement, yet the ultimate catalyst for passage of federal environmental legislation was probably the infamous "burning river" incident when the Cuyahoga River in Ohio caught on fire on June 22, 1969.").
[242] Ibid.
[243] U.S.-Canada Great Lakes Water Quality Agreement, as Amended, U.S.-Can., Nov. 22, 1978, 30 U.S.T. 1384, Art. II, online: U.S. EPA <http://epa.gov/greatlakes/glwqa/1978/index.html> [GLWQA].

agreement established a total phosphorus load target for Lake Erie as 11,000 metric tons per year (mt/yr).[244]

Similarly, the Clean Water Act is a command and control regulation because it is purposive, goal-oriented, and aims for specific goals in concrete situations. The Clean Water Act's purpose is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[245] Although this purpose is quite broad, the lengthy piece of legislation sets forth specific goals for specific waters based on their classifications (e.g., swimmable, fishable, for purposes of recreation, etc.). The Clean Water Act also requires point source polluters to seek permits for their activities and delegates authority to state agencies to set water quality standards for specific waters within their boundaries.

The command and control regulations had a great impact on reducing the amount of pollution coming from point sources in the early 1970s, as illustrated by Figure 4, which indicates a significant drop in phosphorus inputs to Lake Erie. However, point source polluters can only reduce phosphorus inputs to a certain extent. Agricultural producers have gone largely unregulated, but this needs to change if Lake Erie managers want to further reduce phosphorus concentrations. Command and control regulations have historically had little success reaching nonpoint source polluters, and especially agriculture, because it is difficult, if not impossible, to trace which tract of land is the origin of the runoff. Additionally, the sheer costs of enforcing command and control regulations on agricultural producers would be prohibitive because of the fact that there is no easy way to trace the pollution to the source. For example, if the government were to set standards and try to enforce them, the government would have to send someone to monitor the farms nearly every day to ensure that producers are engaging in the required practices. But reflexive law theory may be able to pick up where substantive law theory leaves off. Reflexive law does not impose requirements on actors, but instead uses alternate methods to encourage actors to change their

[244] Ohio Environmental Protection Agency Division of Surface Water, *Ohio Lake Erie Phosphorus Task Force Final Report Executive Summary* (April 2010) at 3.
[245] 33 U.S.C. § 1251 (2006).

behaviours. As such, reflexive law may serve as the perfect complement to existing command and control regulations.

D. The Potential of Reflexive Law

Even though the GLWQA and Clean Water Act of the 1970s may be broadly categorised as command and control regulations, they include attributes of reflexive law theory. For example, the Clean Water Act allows states to set permitting requirements. However, these requirements may be merely to monitor and report pollution levels. Monitoring and reporting requirements are an information-based policy instrument that may be classified under reflexive law. Further, the Clean Water Act includes the possibility of setting a specific limit on the nutrient levels a water body may receive and allowing polluters to trade. This method creates a market-based instrument that may also be classified as a reflexive law approach.

The GLWQA also possesses certain reflexive law attributes. Recent amendments to the agreement outline measures for stronger transparency and accountability measures.[246] These measures include increasing public and stakeholder engagement, establishing a Great Lakes Public Forum to present, discuss, and receive public input on trends in environmental quality, and creating the Canada-United States Great Lakes Executive Committee to allow for participation from various stakeholders in order to coordinate action.[247] Such transparency measures are another information-based approach because they encourage cooperation and accountability to the community. Because these measures place their focus on stakeholder coordination and communication, they may also be categorised as a communication-based approach.

II. LAKE CHAMPLAIN POLICY INSTRUMENTS

The policy instruments currently governing pollution activities in the Lake Champlain and Lake Erie basins are certainly grounded in substantive law principles. However, as these examples suggest, there is a clear trend towards

[246] Great Lakes Water Quality Protocol of 2012 (signed by Environment Minister Peter Kent and EPA Administrator Lisa Jackson in Washington on September 7, 2012).
[247] The Protocol lists the various stakeholders as including federal, state, tribal, provincial and municipal governments, First Nations, Métis, watershed management agencies and other local public agencies.

incorporating reflexive law strategies in these command and control regulations. A closer examination of the policy instruments in each watershed will reveal the extent of this trend.

A. Phosphorus Regulations in the Lake Champlain Basin

Given that the majority of nonpoint source pollution to Lake Champlain is from agriculture, it seems like an obvious industry to regulate. However, agricultural runoff is difficult to regulate largely due to its diffuse nature.[248] Even when it is apparent that nutrient loading is entering surface waters as a result of agricultural runoff, it is impossible to determine the source for the pollution. Further, there are economic reasons to avoid restricting agricultural activities. For example, the Lake Champlain Basin's economy was traditionally a rural resource-based economy, with agriculture playing a central role.[249] The region's economy has since diversified, but agriculture still makes significant contributions to local economies and is the economic mainstay in the Missisquoi Bay drainage basin in Quebec.[250] As discussed in Chapter One, the causation problem makes it extremely difficult for regulatory authorities to trace the specific source of pollution when it originates from a nonpoint source pollution. Moreover, there are other reasons regulators shy away from restricting agricultural operations, including food security concerns or because agriculture is a local heritage. As a result of the difficulties regulating such a nonpoint source and the economic reasons to avoid doing so, agricultural operations have gone largely unregulated for their phosphorus contributions to Lake Champlain.

Despite freedom from regulations, the Lake Champlain Basin Program[251] (LCBP) has created various incentives to encourage farmers to improve their

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[248] Cynthia J. Aukerman, "Agricultural Diffuse Pollution Controls: Lessons for Scotland from the Chesapeake Bay Watershed" (2004) 20 J Land Use & Envtl L 191 at 223. (Diffuse pollutants are difficult to prevent or predict and hence are difficult to effectively control.").

[249] Lake Champlain Basin Atlas, People & Economy, Economics of the Basin, <http://www.lcbp.org/atlas/html/so_econ.htm>.

[250] Ibid.

[251] In 1990, Congress designated Lake Champlain as a resource of national significance and established the Lake Champlain Basin Program (LCBP) to coordinate and fund pollution prevention, control, and restoration efforts. H.M. Zamudio, "Predicting the Future and Acting Now: Climate Change, the Clean Water Act, and the Lake Champlain Phosphorus TMDL" (2011) 35 Vt L Rev 975 at 983 (citing 33 U.S.C. § 1270 (2006)).

practices and reduce the amount of phosphorus that runs off from their land. Under the LCBP, New York, Vermont, and Quebec coordinate water quality management and set water quality standards for the Lake Champlain Basin in keeping with the Clean Water Act.[252]

1. The Missisquoi Bay Agreement

On August 26, 2002, Vermont and Quebec signed the Missisquoi Bay Phosphorus Reduction Agreement.[253] The two jurisdictions share Missisquoi Bay and its 3,000 km^2 watershed. Under the agreement, Vermont agreed to take on 60 percent of the responsibility for reducing phosphorus loads to the bay and Quebec agreed to assume 40 percent of the responsibility.[254] In keeping with this division of responsibility, Vermont's target phosphorus load was set at 58.3 mt/yr and Quebec's load at 38.9 mt/yr.[255]

The agreement also called for various actions in order to meet these targets, including wastewater treatment plant upgrades, best management practices on farms to reduce nutrient runoff, the stabilization of stream banks and stream channels, better stormwater management, and erosion control on developed land and roadways. The Missisquoi Bay Agreement was incorporated into the Lake Champlain Phosphorus Total Maximum Daily Load (TMDL) plan, which was approved by the EPA in 2002.

2. The Lake Champlain Phosphorus TMDL

Under the Clean Water Act, the EPA can delegate duties to states to set water quality standards and list waters as impaired if they fail to meet those standards.[256] States must then develop total maximum daily loads (TMDLs) for

[252] Specifically, the LCBP is jointly administered by the US Environmental Protection Agency (New England and Region 2), NY State Department of Environmental Conservation, Vermont Agency of Natural Resources, Quebec Ministry of Environment, and New England Interstate Water Pollution Control Commission. *See* 33 U.S.C. § 1270(b) (2006); *see also* Lake Champlain Basin Program, About the LCBP, <http://www.lcbp.org/lcbpsumr.htm>. Although Quebec is not bound by the Clean Water Act requirements, the province has a great interest in protecting the basin's water quality since the water flows north.

[253] *Agreement Between the Gouvernement du Quebec and the Government of the State of Vermont Concerning Phosphorus Reduction in Missisquoi Bay*, online: LCBP <http://www.lcbp.org/PDFs/missbay_agreeEN.pdf>.

[254] Ibid at Art. 2.

[255] Ibid.

[256] 33 U.S.C. § 1313 (2006).

impaired waters, which provides waters with a 'pollution diet' that determines the pollution limit a water body can handle and still achieve the state's water quality standards.[257] Under TMDLs, states allocate waste load allocations (WLAs) and permits to point source polluters and load allocations (LAs) to nonpoint source polluters. These allocations can be traded between polluter-types, but the total maximum daily pollutant load to the water must adhere to the TMDL budget.[258]

In the Lake Champlain Basin, both Vermont and New York are delegated states. In 1993, the state agencies coordinated with Quebec under the LCBP to set water quality standards.[259] The agencies developed a Lake Champlain Phosphorus TMDL, which was approved by the EPA in 2002. Under this TMDL, point source polluters such as wastewater treatment plants get permits which set limits on the amount of phosphorus they may emit.

In 2008, a New England environmental advocacy organization called the Conservation Law Foundation filed a complaint against EPA Region One and the regional administrator in the United States District Court for the District of Vermont.[260] Conservation Law Foundation sought a declaration that the EPA's 2002 approval of the Lake Champlain Phosphorus TMDL was unlawful.[261] Conservation Law Foundation also called for an order setting the approval aside and called for the EPA to establish a new TMDL.[262] Conservation Law Foundation proffered two notable reasons in its complaint as to why the EPA violated the Clean Water Act when it approved the Vermont Agency of Natural Resources' (VTANR) Lake Champlain Phosphorus TMDL. The first reason was that VTANR failed to give reasonable assurances that it would reduce nonpoint

[257] Ibid.
[258] US EPA Office of Water, Final Water Quality Trading Program, s. III (D) (13 January 2003), online: US EPA <http://water.epa.gov/type/watersheds/trading/finalpolicy2003.cfm>.
[259] Lake Champlain Basin Program, Phosphorus Reduction Strategies, <http://www.lcbp.org/phosconc.htm>.
[260] US Environmental Protection Agency, "Section 303(d) Lists and TMDL Litigation (Challenges to EPA Establishment or Approval)" (2009) online: US EPA <http://www.epa.gov/owow/tmdl/pdf/section303d_listsandtmdl_litigation.pdf>.
[261] Ibid.
[262] Ibid.

source pollution and the second reason was that VTANR failed to account for climate change impacts.[263]

The EPA officially disapproved the 2002 TMDL in early 2011[264] and is currently in the process of developing a new phosphorus TMDL for the basin.[265] As part of this process, the EPA is working with VTANR to review the phosphorus model and update loading capacities using updated water quality and flow data; complete the study of potential effects of climate change on flows and phosphorus loads; estimate/quantify phosphorus loads coming from nonpoint sources and estimate reductions potentially achievable in each watershed; establish programs and requirements to provide reasonable assurance that nonpoint source reductions will occur; and develop LAs and WLAs for sources using information generated through the prior steps.[266]

3. Other Phosphorus Reduction Programs

Aside from the TMDL, which is currently being overhauled by the EPA, Vermont has various programs aimed at reducing phosphorus loading from agricultural sources to achieve the TMDL target levels, including the Vermont Accepted Agricultural Practice Regulations (AAPs), best management practices (BMPs), and cost-sharing funding programs. The AAPs and BMPs are different levels of agricultural practices.[267] The AAPs are mandatory statewide restrictions designed to reduce runoff through implementing improved farming techniques.[268] The BMPs are more stringent voluntary practices that typically require installation of structures and equipment.[269] The AAP requirements must be technically feasible and cost effective for farmers without governmental financial aid.[270]

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[263] Zamudio, *supra* note 251.
[264] EPA Lake Champlain Disapproval Decision, Letter from H. Curtis Spalding, EPA Regional Administrator to VTANR Secretary Deborah Markowitz (24 January 2011), online: US EPA <http://www.epa.gov/region1/eco/tmdl/pdfs/vt/LakeChamplainTMDLDisapprovalDecision.pdf>.
[265] US Envtl Prot Agency Region 1, "Lake Champlain TMDL Development Process--Some Key Steps and Schedule" (2011) online: US EPA <http://www.epa.gov/region1/eco/tmdl/pdfs/vt/LakeChamplainTMDLDevelpmtProcess.pdf>.
[266] Ibid.
[267] "Accepted Agricultural Practice Regulations, Introduction", (2006) online: ARMES <http://www.vermontagriculture.com/ARMES/awq/AAPs.htm>.
[268] Ibid.
[269] Ibid.
[270] Ibid.

BMPs, however, are generally not affordable to implement without assistance from government cost-sharing programs.[271]

The AAPs were adopted by the Vermont Department of Agriculture, Food, and Markets (AAF&M) in 1995 to establish farming practice requirements for all farming operations throughout Vermont regardless of size or type.[272] Vermont's Division of Agricultural Resource Management and Environmental Stewardship calls the AAPs the "base level of management required for all farms in Vermont. The AAPs are designed to be easy to implement, low-cost solutions for addressing water resource concerns."[273] In particular, the AAP Rules establish minimum requirements for vegetated buffer zones between certain crop lands and surface waters.[274] The AAPs also prohibit spreading fertilisers on land from December 15 to April 1 each year to prevent operators from spreading on frozen land that does not absorb the fertiliser. If the Secretary of AAF&M finds a farm is in violation of the AAPs, the farm may be liable for administrative penalties of $1,000 per day per continuing violation up to a total of $25,000.[275]

AAF&M defines BMPs as site-specific on-farm remedies implemented either voluntarily or as required in order to address water quality problems and in order to achieve compliance with state water quality standards.[276] The purpose and policy behind BMPs is for the State of Vermont to assist farmers with implementing practices that will protect and maintain water quality by reducing agricultural nonpoint source pollution in supplement to the AAPs.[277] Eligible

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[271] Ibid.
[272] Lake Champlain TMDL, *supra* note 222, at 52.
[273] Vermont Division of Agricultural Resource Management and Environmental Stewardship, "Accepted Agricultural Practices," online: ARMES <http://www.vermontagriculture.com/ARMES/awq/AAP.html>.
[274] Lake Champlain TMDL, *supra* note 222, at 54.
[275] Accepted Agricultural Practice Regulations, *supra* note 273 at Introduction, s. iv. It is interesting to note that AAF&M is responsible not only for enforcement duties against non-compliant farms, but is also responsible for protecting the interests of the agricultural community. Vermont Agency of Agriculture, Farms, and Markets "Divisions," online: AAF&M <http://www.vermontagriculture.com/about/divisions.html>. As a result, there is an inherent conflict of interest in asking the same agency to simultaneously promote and restrict agriculture.
[276] Vermont Agency of Agriculture, Food, and Markets, Best Management Practices Regulations, s. 2.3 (27 January 1996), online: AAF&M <http://www.vermontagriculture.com/ARMES/BMP.htm#regulations>.
[277] Ibid at s. 1.1.

BMPs include implementing waste storage facilities, silage leachate systems, milkhouse waste systems, and barnyard runoff collection.[278]

State and federal cost-share funding is available to farmers to assist them in complying with the AAPs and to encourage voluntary agricultural BMPs.[279] According to the Lake Champlain Basin Program, $9.6 million USD was spent on agricultural nonpoint source pollution control programs between 1996 and 2001 and an additional $62.7 million is required to implement agricultural BMPs on the remaining basin farms contributing phosphorus loads.[280]

B. Classifying Phosphorus Regulations

The policy instruments introduced do not necessarily fall into one single category. Instead, they tend to adopt features that draw from various theories. For example, the instruments described above use command and control regulations to implement market-based and information-based policy instruments. As such, I discuss how the Lake Champlain Phosphorus TMDL, AAPs, and BMPs integrate features from substantive and reflexive law theories.

The Lake Champlain Phosphorus TMDL is a genuine mix of substantive and reflexive law theories because it incorporates command and control regulation, information-based, and market-based instruments. The TMDL's permitting system is in some ways a classic example of a command and control regulation. In order to track compliance, the permits require their holders to monitor and report their discharges in daily monitoring reports. This requirement is an information-based policy instrument because it seeks information disclosure. However, it is important to note that this requirement is implemented via a command and control regulation. The TMDL also contains a possibility of trade between nonpoint source polluters and point source polluters because the TMDL's concern is the water quality of the lake—the outcome—rather than

[278] Vermont Agency of Agriculture, Food, and Markets, Available Resources, online: AAF&M <http://www.vermontagriculture.com/ARMES/awq/Available_Resources.htm>.
[279] Lake Champlain TMDL, *supra* note 222 at 54. The state funds are governed and administered by the Best Management Practice Regulations that were adopted by the Vermont Department of Agriculture, Food, and Markets in 1996. Ibid. Federal funds are provided through the U.S. Department of Agriculture Environmental Quality Incentive Program. Ibid.
[280] Ibid.

specific adherence to permits and best management practices. This possibility is a prime example of a market-based policy instrument.

The AAPs are a type of command and control regulation. The AAPs are mandatory statewide practice requirements imposed and enforced by the state. Farmers in Vermont must implement certain practices, such as riparian buffer zones. Violators of the requirements are subject to an administrative fine. This prohibitive aspect and the role of the state signify the requirements status as a command and control regulation.

The BMPs, however, do not incorporate command and control regulations. Instead, the BMPs use subsidies as an incentive for farmers to implement environmentally-sound practices beyond the base required by the AAPs. The cost-sharing programs are a market-based instrument because they create incentives for environmentally-sound behaviour. As described in Chapter One, reflexive law theory is based on aligning actors' interests with societal interests. Here, we have an example of a cost-sharing program that encourages farmers to reduce their nutrient runoff, which aligns with societal interests for a clean Lake Champlain.

III. Lake Erie Policy Instruments

Much like the policy instruments in the Lake Champlain watershed, the Lake Erie watershed policy instruments are founded in substantive law theory, but incorporate aspects of reflexive law theory.

A. Phosphorus Regulations in the Lake Erie Basin

1. The Great Lakes Water Quality Agreement

The Great Lakes Water Quality Agreement (GLWQA) is the main piece of legislation governing water quality in Lake Erie. The GLWQA was originally signed by the United States and Canada in 1972 "to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem."[281] The GLWQA was renewed in 1978 and amended by protocol in 1987 to strengthen the programs and practices set forth in the 1978 Agreement

[281] GLWQA, *supra* note 243 at Art. II.

and to increase accountability for their implementation.[282] In 2010, the parties called for new amendments to the GLWQA to bring it up to date with current environmental challenges.[283] U.S. Secretary Hilary Clinton and Canada's Foreign Affairs Minister Lawrence Cannon began official negotiations in June 2010 and the Great Lakes Water Quality Protocol of 2012 (2012 Protocol) was signed by EPA Administrator Lisa Jackson and Environment Minister Peter Kent on September 7, 2012.[284]

The GLWQA specifically established a total phosphorus load target for Lake Erie as 11,000 mt/yr.[285] Specific targets for the regions were set at 15 μg/l for the western basin and 10 μg/l for the central and eastern basins.[286] The 2012 Protocol set substance objectives calling for parties to develop achievable, science-based phosphorus reduction targets for Lake Erie to be drafted within three years in order to take action in combating harmful algal bloom occurrence.[287]

The 2012 Protocol's other important amendments call for the parties to develop stronger transparency and accountability measures and to implement restoration conservation strategies that use adaptive management approaches. The latter requirement is noteworthy because it reflects a scientific understanding as to how to approach ecosystem management.[288]

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[282] US Environmental Protection Agency, "The Great Lakes Water Quality Agreement", online: <http://epa.gov/greatlakes/glwqa/1978/index.html>.
[283] Great Lakes United, "Frequently Asked Questions: Great Lakes Water Quality Agreement Renegotiation 2011-2012," at 1, online: Great Lakes United <www.glu.org/en/system/files/GLWQA%20FAQ%202011.pdf>.
[284] Environment Canada News Release, "United States and Canada Sign Amended Great Lakes Water Quality Agreement," Washington, D.C. (7 September 2012), online: Environment Canada <http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=5A95C196-43F9-450D-97F1-7364665DDD3F>; *see also* Environment Canada, "Protocol Amending the Agreement Between Canada and the United States of America on Great Lakes Water Quality, 1978, as Amended on October 16, 1983 and on November 18, 1987," online: Environment Canada <http://www.ec.gc.ca/Publications/9DD80B8C-7E7A-4131-8055-D47B0B3E004F%5CEN-Canada-USA-GLWQA--FINAL_web.pdf>.
[285] Ohio Environmental Protection Agency Division of Surface Water, *supra* note 244 at 3.
[286] Ibid.
[287] *Protocol Amending the Agreement Between Canada and the United States of America on Great Lakes Water Quality, 1978, As Amended on October 16, 1983 and On November 18, 1987*, 7 September 2012 (not yet entered into force) at Annex 4(C) [GLWQA 2012 Protocol].
[288] I discuss the necessity of using ecosystem approach in managing waters for harmful algal blooms in detail in Chapter Three.

The GLWQA requires the parties to continue to develop and implement programs and measures to meet the GLWQA general and specific objectives.[289] The two main programs include Lakewide Management Plans (LaMPs)[290] and Remedial Action Plans (RAPs).[291] The programs are also mandated under the Great Lakes Critical Programs Act[292] amendment to the U.S. Clean Water Act.[293]

a. Enabling Legislation in the United States

Section 118 of the Clean Water Act provides that "the United States should seek to attain the goals embodies in the GLWQA […] with particular emphasis on goals related to toxic pollutants."[294] Under the Clean Water Act, the EPA "should take the lead in the effort to meet these goals, working with other Federal agencies and State and local authorities."[295] Consequently, the EPA and Environment Canada are the lead agencies in developing programs to meet the GLWQA's objectives. In the United States, Ohio serves as the lead state with participation from Michigan, Pennsylvania, and New York.[296]

b. Enabling Legislation in Canada

Canada's primary programs for advancing the GLWQA's goals include the Canadian Federal Great Lakes Program, the Great Lakes Action Plan, and the Canada-Ontario Agreement. The Canadian Federal Great Lakes Program provides the framework for working towards Canada's GLWQA commitments.[297] The Great Lakes Action Plan focuses on restoring degraded sites, preventing and controlling pollution, and conserving and protecting human and ecosystem health. The Canada-Ontario Agreement (COA) delegates responsibilities for achieving

[289] GLWQA, *supra* note 243 Art. VI(1).
[290] Ibid at Art. VI(1)(o).
[291] Ibid at Art. VI(1)(n). The GLWQA also requires the parties develop and implement watershed management plans to reduce non-point sources of pollution, but such plans are folded in to the LaMP and RAP requirements. *See* ibid at Art. VI (1)(e)(vii), Annex 13.
[292] Great Lakes Critical Programs Act of 1990, 101 PL. 596, §104, 104 Stat. 3000, 3003 (1990).
[293] Ohio Environmental Protection Agency, Division of Surface Water, Lake Erie Programs, online: <http://www.epa.ohio.gov/dsw/lakeerie/index.aspx>.
[294] 33 U.S.C. § 118(a)(1)(B).
[295] *Ibid* § 118(a)(1)(C).
[296] Ohio Environmental Protection Agency, Division of Surface Waters, LaMP Resources, online: <http://www.epa.ohio.gov/dsw/ohiolamp/whatis.aspx>.
[297] Environment Canada, Canadian Federal Great Lakes Program, online: <http://www.ec.gc.ca/grandslacs-greatlakes/default.asp?lang=En&n=B390F88B-1>.

the goals and objectives under the GLWQA.[298] In particular, the COA assigns responsibilities local authorities for restoring areas of concern (AOCs) so that they may be delisted.

2. Lake Erie's Lakewide Management Plan

The LaMPs are meant to address persistent bioaccumulative toxic substances by establishing ecosystem objectives specific to each lake.[299] The LaMPs then provide a binational structure for achieving these ecosystem objectives by addressing environmental issues, coordinating research, pooling resources, and making joint commitments to improve water quality.[300] The Lake Erie LaMP is still under development.[301] This effort is being co-led by EPA Region 5 and Environment Canada with participation from various administrative agencies in the states and Ontario.[302]

Although the LaMP has not been finalised, the Lake Erie LaMP Management Committee has made progress developing its Lake Erie Binational Nutrient Management Strategy. The strategy recommends targets and identifies priorities for additional research and monitoring, and facilitates coordination of binational programs for managing nutrients.[303] The Management Committee has now set endpoint targets for total phosphorus concentrations for surface water: 15 µg/l for the western basin, 10 µg/l for the central and eastern basins (all in

[298] Environment Canada & the Ontario Ministry of the Environment, "The Canada-Ontario Agreement: Respecting the Great Lakes Basin Ecosystem" (2007), online: <http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079836.pdf>.

[299] Lake Erie LaMP Work Group Nutrient Management Strategy, "Lake Erie Binational Nutrient Management Strategy: Protecting Lake Erie by Managing Phosphorus" (2011) online: <http://35.8.121.122/le/LakeErieBinationalNutrientManagementStrategy.pdf> at 4.

[300] Ibid.

[301] Ohio EPA, Division of Surface Water, LaMP Resources, <http://www.epa.ohio.gov/dsw/ohiolamp/whatis.aspx>.

[302] Ibid. These agencies include: in the United States, the lead state Ohio with participation from Michigan, Pennsylvania, and New York; and in Canada, the Department of Fisheries and Oceans, Agriculture Canada, the Ontario Ministry of Natural Resources, the Ontario Ministry of Natural Resources, the Ontario Ministry of Agriculture, Food, and Rural Affairs, and eth Ontario Ministry of Environment and Energy. Ibid.

[303] Environment Canada "News Release: Backgrounder, Great Lakes Priorities – April 2010 to March 2011" (21 March 2010), online: Environment Canada <http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=20865856-5CC3-40AB-B7F4-08B152748D19>.

keeping with GLWQA target requirements), and 32 µg/l for the tributaries.[304] The endpoint targets are based on best available science and the Management Committee anticipates algae blooms will be reduced if the levels are achieved.[305] The Lake Erie Binational Nutrient Management Strategy identifies the strategic actions required to move towards achieving their targets.[306] Meanwhile, the Management Committee will continue to monitor research advancements and recommend adjustments to the targets.[307]

3. Remedial Action Plans

The RAPs identify degraded Great Lakes Areas of Concern (AOC), their specific problems, and determine methods for correcting them.[308] The GLWQA defines the term "area of concern" as a geographic area that fails to meet the general or specific objectives of the GLWQA where such failure has caused or is likely to cause impairment of beneficial use or the area's ability to support aquatic life.[309] The United States and Canadian governments have identified 43 such areas: 26 in U.S. waters and 17 in Canadian water (five are shared between U.S. and Canada on connecting river systems).[310] For example, there are four RAPs in Ohio.[311] Ohio's RAP Program seeks to restore beneficial uses[312] in the four AOCs via an ecosystem approach in keeping with the GLWQA.[313]

The GLWQA's lack of specificity in RAP organisation allows them to be shaped to the unique challenges facing each region within the lake basin. According to the Ohio Environmental Protection Agency, Ohio's RAPs are

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[304] Lake Erie Lakewide Management Plan Annual Report 2011, 2, online: Binational <http://binational.net/lamp/le_ar_2011_en.pdf>.
[305] Ibid.
[306] Ibid.
[307] Ibid.
[308] GLWQA, *supra* note 243 Annex 2.
[309] Ibid at Annex 2(1).
[310] Great Lakes Information Network, "Remedial Action Plans for the Great Lakes Areas of Concern", online: <http://www.great-lakes.net/envt/pollution/rap.html#overview>.
[311] Ohio Environmental Protection Agency Division of Surface Water, "Ohio's Remedial Action Plan Program", online: <http://www.epa.ohio.gov/dsw/rap/rap.aspx>. Ohio's RAPs address AOCs in Lake Erie tributaries, including the Ashtabula River, the Black River, the Cuyahoga River, and the Maumee River. Ibid.
[312] Beneficial uses include uses such as fish and wildlife consumption, fish and wildlife habitat, and drinking water consumption. Ibid.
[313] Ibid.

organized differently depending on the nature of the environmental problems, available resources, political climate, public interest, and the volunteer base.[314]

B. Classifying the Phosphorus Regulations

Like the Lake Champlain Phosphorus TMDL, the GLWQA incorporates elements of substantive law and reflexive law theories. The GLWQA uses command and control regulations to establish specific requirements to reduce phosphorus loads but also to disclose information.

The GLWQA provides Canada and the United States with specific obligations and rights. In particular, the GLWQA provides a framework and specific outcome for various programs and initiatives to work towards. The requirements set forth under the GLWQA and enabled by the domestic legislation are command and control regulations because they set quantitative limits on the amount of pollution that can be discharged into the Great Lakes. The requirements limiting phosphorus loads to Lake Erie are specific and carry certainty. However, the GLWQA also incorporates a degree of flexibility by its requirement that its objectives be carried out under programs and measures. The programs and measures, including LaMPs and RAPs, may be developed differently depending on the specific region within the watershed. This adaptive management strategy perfectly captures reflexive law theory because it allows the specific regions to tailor and adapt their programs as they receive more information.

The Lake Erie LaMP and Binational Nutrient Management Strategy are information-based policy instruments because their purpose is to identify research priorities and they call for monitoring and reporting of phosphorus levels. Such information-based instruments are helpful in providing relevant stakeholders with the information necessary to adjust management practices. However, they have no mechanism to enforce that such management practices come about or are subsequently enforced.

[314] Ohio Environmental Protection Agency, "Delisting Targets For Ohio Areas of Concern" (2008) at 4.

IV. Measuring the Effectiveness of Regulations

There is no one method for measuring the effectiveness of these regulations. Rather, there are several ways to assess their success. I suggest three specific ways to determine whether the Lake Champlain and Lake Erie policies are successful. First, I set forth a method for determining a correlation between actor behaviours and policy instruments. This method is intended to infer whether actor behaviours have changed in response to the regulations. Next, I present a method for analysing a correlation between changes in phosphorus concentrations and policy instruments. This approach allows me to infer whether there has been a drop in phosphorus concentrations since the policy instruments' enactment.

Finally, I present a method for inferring a correlation between the occurrence of harmful algal blooms and policy instruments. I present this method as a simple way to determine whether the occurrence of harmful algal blooms has declined since the policies were enacted. Even though these methods shed some light on the success of the current policies in Lake Champlain and Lake Erie, they all require making assumptions and at best, only inferences can be made.

Moreover, each method of assessing success requires consideration of the other factors as well. If we ignore changes in actor behaviours and simply question whether phosphorus concentrations or harmful algal bloom occurrence have reduced, we are overlooking how regulations can influence actors to engage in environmentally-sound practices. By turning a blind eye to actor behaviour, we run the risk of crediting actors with changes that might have been caused by natural changes in the environment. Similarly, looking only to actor behaviour changes ignores the possibility that the regulations may be too lenient to actually make a difference. As a result, the regulation would appear successful on paper even if harmful algal blooms were occurring more frequently than ever.

Adding further complications is the fact that gathering the data on each of these methods requires time and financial resources beyond the scope of this project. As a result, I can only propose certain studies and analyses in certain instances.

A. Changing Actor Behaviours

The first method of analysing policy success is by inferring how influential the policy has been on actor behaviours. This method is purely procedural because it looks to how the policy's goals are carried out through procedures, such as best management practices, rather than looking to whether the water quality has improved. I present the process for conducting this analysis, and then discuss the benefits and drawbacks of using this method to assess a policy's level of success.

The process involves three steps: (1) compiling data; (2) cross-referencing this data; and (3) drawing inferences from the cross-referenced data. First, it is necessary to compile data of actor behaviours. The data needs to reflect actor behaviours prior to the policy's implementation as well as behaviour after the policy was enacted. The information can then be cross-referenced with the dates the policy was enacted. This may involve charting both sets of information on a graph or merely outlining a timeline of events. It will then be possible make inferences based on pattern observations. For instance, if actor behaviour has dramatically changed in the dates immediately following a policy's implementation, it is reasonable to infer the policy had some influence on actor behaviours. Similarly, if there are no observable changes in actor behaviour even after a policy has been implemented, it is likely the policy had no effect.

There are a couple benefits of using this method to measure policy success. One is that this method examines whether the policy directly influences actor behaviour rather than focusing on water quality data that may be a result of other non-actor influences, such as changes in climate or storm events. Another benefit is that it is relatively easy to collect the necessary data. Farmers could report their management practices annually by completing a simple survey about how large they keep their riparian buffer zones, what times of year they spread fertilizer, and whether they have built waste storage facilities.

The drawbacks involve access to current data and the risks associated with focusing on a policy's procedural success rather than outcome-based success. First, the data on farmers' practices is not easily accessible. It is possible to

submit freedom of information requests to agencies to which farmers must report. This is a typically a long and involved process. Moreover, as discussed above, farmers do not have any blanket obligations to report their practices, but rather must only do so in order to gain access to subsidies attached to best management practices. As a result, the available data will only be for farmers who sought subsidies. It may be assumed that the non-reporting farms have not implemented any best management practices, but this is adding another assumption to an analysis based on observation rather than causation.

This method of analysing a policy's success is beneficial because it looks to procedural success, but this strength is also a weakness. This can be particularly problematic in situations where the procedural obligations are too lenient to actually achieve environmental goals of the policy. For example, it is possible that farmers have dutifully implemented best management practices, but these practices may be out-dated and the water remains loaded with phosphorus. In such circumstances, farmers' compliance makes the policy appear to be highly successful in influencing actor behaviour; however the water body the policy intends to protect remains polluted with no one on the hook.

B. Phosphorus Reductions in the Lake

Assessing whether phosphorus concentrations have changed after a particular instrument has been implemented is perhaps the most accessible way to infer a policy instrument's success. Watershed groups and task forces have compiled imperial data of phosphorus levels in both Lake Champlain and Lake Erie. Although there may be several other factors contributing to a reduction in phosphorus concentrations, it is possible to infer that a regulation is successful if phosphorus concentrations have dropped in the years after legislation is passed. In this part, I present the process to use this method of analysis, discuss the benefits and drawbacks of this method, and analyse the data compiled for Lake Champlain and Lake Erie.

The process for drawing a correlation between policy instruments and phosphorus concentrations is similar to the process for assessing policy influence on actor behaviours. First, it is necessary to compile phosphorus concentration

data in the lakes prior to and following implementation. Many watershed groups have done this, although the data on phosphorus concentration prior to policy enactment is somewhat more limited. The next step is to cross-reference this data with policy enactment. Again, watershed groups have provided charts that demonstrate this cross-reference. Finally, it is possible at this point to infer whether the policy has had any impact on phosphorus concentrations by observing whether the concentrations decreased after the policy was implemented.

This method for measuring policy success is beneficial because it tracks the policy goal more closely than the procedural method of determining influences on actor behaviours. In particular, it avoids the pitfall that a policy may be deemed successful regardless of phosphorus concentrations as long as the actors comply with the requirements. However, this method has a significant drawback in the fact that reduced phosphorus concentrations do not necessarily equal fewer harmful algal blooms. For instance, the studies show that climate change impacts exacerbate harmful algal bloom occurrence, which means that less phosphorus may actually be required for harmful algal blooms to thrive. This method focuses only on reduced phosphorus concentrations a measurement for success, rather than on harmful algal bloom occurrence.

1. Phosphorus Reductions in Lake Champlain

The AAPs were established in 1995. The State of Vermont's BMP policy was adopted one year later in 1996. The TMDL was approved in 2002 (although it has since been disapproved). The line graph in Figure 3 demonstrates there has been an upward trend of total phosphorus loads in Lake Champlain since 1991. The graph spans from 1991 to 2006, which includes the time since adoption of the AAPs, the BMPs, and the TMDL. It is quite likely that the increased phosphorus is a result of climate change impacts discussed above. Given the rising temperature trends over recent years, it is possible that the phosphorus loads would be even higher if not for the policy instruments in place.

It is possible, based on these observations, to infer that the policies have had an impact on reducing phosphorus concentrations. Nevertheless, it remains clear that the policy instruments are not doing enough to bring Lake Champlain's

total phosphorus loads down to the targeted baseline limits set by these policies. For example, the 2002 TMDL set the target load for the lake at 427.1 mt/yr.[315] The phosphorus levels in the lake were measured as 631.3 mt/yr in 1991[316] and increased to an average of 776.7 mt/yr between 2000 and 2006.[317] Although the phosphorus levels have increased overall, the point source contributions, such as wastewater treatment plants, have steadily decreased. It is the nonpoint source contributions, such as agricultural runoff, that have as a whole increased since the early 1990s. Consequently, nonpoint sources now contribute a larger proportion of phosphorus to the lake than point sources.

Moreover, climate change impacts are exacerbating harmful algal bloom occurrence in Lake Champlain. As described in Chapter One, warm temperatures favour harmful algal bloom growth in several ways.[318] As temperatures are expected to continue rising at an exponential rate in forthcoming years, Lake Champlain will likely suffer increasingly worse conditions if nonpoint source phosphorus contributions are not curtailed. Hence, it is necessary to re-evaluate the instruments governing agricultural runoff to Lake Champlain.

2. Phosphorus Reductions in Lake Erie

Although water quality regulations helped Lake Erie to achieve lower phosphorus levels in the mid-1980s through the 1990s, in-lake concentrations of phosphorus have increased over the last decade.[319] Studies reveal a few reasons for the increased levels, including more frequent and intense storm events.[320] Given that the phosphorus loading has decreased, but the concentrations are

[315] Lake Champlain TMDL, *supra* note 222 at 15.
[316] Ibid.
[317] Lake Champlain Basin Program, "State of the Lake and Ecosystem Indicators Report 2012" (2012) at 5, Figure 4, online: LCBP <http://www.lcbp.org/lcstate.htm>. This data does not include one section of the lake—the Northeast Arm—because no tributaries are currently monitored in that watershed, yet the phosphorus levels still exceed the targets. Ibid at 6.
[318] *See* Chapter One for a complete description of climate change impacts on harmful algal blooms.
[319] Lake Erie LaMP Work Group Nutrient Management Strategy, *supra* note 299 at 3.
[320] Ibid.

increasing, it is clear that Lake Erie's existing phosphorus controls are no longer sufficient to protect the lake.[321]

C. Harmful Algal Bloom Reductions in the Lake

The third way to assess policy success is to determine whether there is a correlation between the frequency at which harmful algal blooms occur and policy enactment. This method is purely outcome-based because it measures the policy's success against its goals to reduce harmful algal blooms. I first set forth the process for inferring a correlation between harmful algal blooms and a policy, and then I discuss the benefits and drawbacks of using this method to measure policy success.

The process is relatively simple. The first step is to compile harmful algal bloom data for water bodies before and after a policy is implemented. The next step is to cross-reference this data with the dates the policy went into effect. Finally, it is then possible to draw inferences about the policy's effect on harmful algal bloom occurrence. For instance, if there are fewer instances of harmful algal blooms since the policy's enactment, it is likely that the policy played a role in reducing them. Conversely, if there has been no change in harmful algal bloom occurrence or, worse yet, there has been an increase in their occurrence, then it may be inferred that the policy is having no effect.

This method is beneficial because it holds the policy's success directly against its own goals, rather than on whether it influences particular procedures implemented to help achieve the goals. This aspect is what makes this policy outcome-based, rather than procedural like the inferring changes in actor behaviour assessment method.

For the main policy instruments introduced above (the GLWQA and the Clean Water Act), the main goal is to restore and maintain the chemical, physical, and biological integrity of the waters. Implementing best management practices and requiring licences for point sources to pollute are procedures meant to achieve this goal. However, once farmers and point source polluters are in compliance

[321] Lake Erie Nutrient Science Task Group for the Lake Erie Lakewide Management Plan, "Status of Nutrients in the Lake Erie Basin" (2009), ii, online: U.S. EPA <http://www.epa.gov/lakeerie/erie_nutrient_2010.pdf>.

with these procedures, they are not liable even if the water remains polluted. Using an outcome-based method for assessing a policy's success avoids this pitfall. Moreover, this method avoids the risk of omitting climate change impacts as a factor. A policy may be deemed successful if the harmful algal blooms decrease in frequency after a policy is enacted. The other two methods look only to whether actors' behaviours have changed or whether phosphorus concentrations have reduced. Climate change impacts may mean that behaviours and phosphorus levels that were previously successful in reducing harmful algal bloom occurrence are no longer enough. By examining the frequency of the blooms themselves, climate change effects are inherently considered.

The major drawback of using this method to assess policy success is that there is not enough available data on harmful algal bloom occurrence in Lakes Erie and Lake Champlain. There is data on the frequency in recent years, but it is difficult to find data prior to the policies enacted in the Lake Erie basin in 1972 or Lake Champlain in 2002. For example, the U.S. National Oceanic and Atmospheric Administration's Center of Excellence for Great Lakes and Human Health releases a weekly bulletin on harmful algal blooms in Lake Erie, these bulletins only date back to 2009.[322] Vermont's Department of Environmental Conservation, New York's Department of Environmental Conservation, and the Lake Champlain Basin Program have coordinated a long-term monitoring program since 1992.[323] Although this program regularly reports on the state of the lake, the data compiled in the reports reflects phosphorus and other pollutant trends, but does not compile data on harmful algal blooms themselves. This program does, however, provide weekly reports on harmful algal blooms in Lake Champlain to the Vermont Department of Health during the summer months.[324]

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[322] Center of Excellence for Great Lakes and Human Health, Harmful Algal Blooms in Lake Erie – Experimental HAB Bulletin Archive, online: <http://www.glerl.noaa.gov/res/Centers/HABS/lake_erie_hab/lake_erie_hab_archive.html>.

[323] Vermont Dept. of Envtl. Conservation, Watershed Management Division, "Lake Champlain Long-term Water Quality and Biological Monitoring Project," <http://www.vtwaterquality.org/lakes/htm/lp_longterm.htm>.

[324] Vermont Dept. of Health, "Status of Blue-green Algae on Lake Champlain", online: <http://healthvermont.gov/enviro/bg_algae/weekly_status.aspx#status>.

Given the lack of past data on harmful algal blooms, it is difficult to draw inferences about the success of the current policies. However, this method could prove very useful in evaluating future policies and policy amendments.

V. CONCLUSION

Harmful algal blooms are still occurring in the lakes despite legislatures' best efforts. However, progress is being made as governments adopt more innovative legal approaches that incorporate reflexive law strategies in the lake basins. Policymakers in both lake basins have recently enacted new policies intended to recognise past policies' shortcomings and set goals for the future.

In the Lake Erie watershed, the GLQWA 2012 Protocol sets specific goals for Lake Erie and delegates responsibilities to local mangers for implementing adaptive management strategies to strive to achieve these goals. The information-based programs implemented under the GLWQA identify research priorities and call for member states to monitor and report phosphorus levels. In the Lake Champlain watershed, policy-makers have adopted subsidies for agricultural producers who implement best management practices and the Lake Champlain Phosphorus TMDL has the capacity to support a nutrient trading programme, although that has not been implemented just yet.

It is encouraging that policy-makers are beginning to use reflexive law strategies to address agricultural runoff. However, they are still merely testing the waters. Lake Champlain had a record high occurrence of HABs during the summer of 2011 and Lake Erie has not seen any signs of HABs slowing in its waters either. With the additional pressures of climate change impacts, legislatures are going to have to act quickly.

There are many more ways they can supplement existing laws with reflexive law strategies, such as considering a nutrient trading programme in the Lake Erie watershed or a communication-based strategy between stakeholders in the Lake Champlain watershed. Indeed, many other watersheds have made the determination that reflexive law strategies are necessary to address nonpoint source pollution contributions. In this next chapter, I look to other watersheds to offer insights as to how reflexive law strategies work in practice.

CHAPTER THREE: INNOVATIVE APPROACHES FOR REDUCING AGRICULTURAL RUNOFF

INTRODUCTION

Watersheds are ecosystems that provide important services, and their destruction can adversely affect human health, security, and general human welfare.[325] Watersheds are a unit particularly in need of a plan that acknowledges the complexities of the ecosystem because water pollution is often caused by poor land use practices. As it currently stands, the traditional environmental law approach is inadequate for protecting watersheds and needs to evolve. Traditional environmental law struggles to address watershed concerns because it regulates water as an independent issue separate from surrounding land use and air quality. Moreover traditional environmental law uses command and control regulations that require governmental enforcement and agricultural runoff can be difficult, if not impossible, to trace to a single source that can be charged with violating the law. Reflexive law can fill this gap by enlisting intermediate actors and encouraging actors to self-regulate. Watershed managers must be progressively more aware of this opportunity because they are increasingly choosing to adopt adaptation plans that are modelled on the ecosystem-based management approach that integrates reflexive law theory.

Each reflexive law-based watershed management plan takes a unique approach, but there are certain strategies common to all watersheds: the plan should be adaptive, meaning it embraces self-conscious experimentation so that it can adjust as new information is understood; the plan has foundations in good science; and the plan allows for broad human participation. As the examples in this chapter illustrate, to work best, these strategies must be tailored to the specific geology, ecology, economy, and political boundaries of the affected watershed.

In this chapter, I look to other watersheds as illustrations of watershed management plans that invoke reflexive law to reduce water pollution caused by runoff. In Part I, I introduce ecosystem-based management theory, discuss its

[325] Sherry A. Enzler, "How Law Mattered to the Mono Lake Ecosystem" (2011) 35 Wm & Mary Envtl L & Pol'y Rev 413; *see also* Robert Costanza, et al., "The Value of the World's Ecosystem Services and Natural Capital" (1997) 387 Nature 253.

intersection with reflexive law theory, and contend that watersheds are a unit in particular need of an ecosystem-based management approach. I present five case studies in Part II to illustrate the variations in watershed management plans and discuss how these plans comprise the three features common to reflexive law-based watershed management. In Part III, I discuss some of the lessons that can be extracted from the case studies. I conclude that the features of each plan consider that watershed's unique geographical, economic, and political features and that there is no 'one-size-fits-all' solution to managing agricultural runoff.

I. THE ECOSYSTEM-BASED MANAGEMENT APPROACH

Before discussing ecosystem-based management theory, it is necessary to provide some background on ecosystems[326] and their services. Ecosystem services include provisioning services, regulating services, cultural services, and supporting services. Provisioning services are the products and commodities that we obtain from ecosystems, such as food, fibre, fuel, fresh water, and energy.[327] Regulating services are the way the ecosystem helps maintain good air quality, regulates climate and hydrology (e.g., groundwater recharge and flooding regulation), purifies water, treats waste, regulates diseases and pests, pollination and regulates natural hazards.[328] Cultural services are the contributions ecosystems make to spiritual and religious values, to education and inspiration for cultural heritage, and to our aesthetic and recreational values.[329] Ecosystems also provide supporting services, which include soil formation, photosynthesis, nutrient cycling, water cycling, and primary production.[330]

In this section, I introduce ecosystem-based management theory, the general indicators of ecosystem approaches, and discuss ecosystem-based management theory's intersection with reflexive law theory.

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[326] There are many definitions of the term "ecosystem," but the Millennium Ecosystem Assessment Board perhaps most eloquently defines an ecosystem as "a dynamic complex of plant, animal, and microorganism communities and the nonliving environment, interacting as a functional unit." Millennium Ecosystem Assessment Board, "Ecosystems and Human Well-Being: General Synthesis" (2005), V.
[327] Enzler, *supra* note 325.
[328] Ibid.
[329] Ibid.
[330] Ibid.

A. Ecosystem-Based Management Theory

The ecosystem-based management approach is founded in the concepts of scientific uncertainty and emerging scientific understanding.[331] The theory was developed by environmental law scholars in response to the work of scientists.[332] These environmental law scholars advocate adopting a comprehensive approach to ecosystem protection.[333] The outlook underpinning the ecosystem approach places emphasis on sustainability and advocates shifting focus away from the anthropological view embraced in traditional environmental governance—that humans should control the environment—toward the view that we should be managing human activities instead.[334]

Further, the ecosystem approach calls for managers to acknowledge that ecosystems are not fixed entities and their boundaries, their substance, and their interrelationships may change over time.[335] Delving deeper into this notion, eminent Canadian ecologist C.S. Holling developed the concept that nature should be as series of nested systems that move at different scales of time and space.[336] A body of water, or an area of land, is considered to be an individual system with connections between its inhabitants and physical elements that result particular events or processes on a short-term timescale.[337] However, these systems are also impacted by long-term events, such as changes in global weather patterns.[338] Consequently, nested systems must be considered from perspectives of time and space. It is also important that ecosystem managers consider humans as existing within the nested scales, as part of the ecosystem's interrelationships.[339] As a

[331] Annecoos Wiersema, "A Train Without Tracks: Rethinking the Place of Law and Goals in Environmental and Natural Resources Law" (2008) 38 Envtl L 1239 at 1245.
[332] Ibid.
[333] Ibid.
[334] C.S. Reynolds, "The Ecosystems Approach to Water Management. The Main Features of the Ecosystems Concept" (1993) 2:1 Journal of Aquatic Ecosystem Health 3.
[335] Wiersema, *supra* note 331.
[336] *See* Gunderson, *supra* note 117.
[337] Wiersema, *supra* note 331.
[338] Ibid.
[339] Ibid.

result, the ecosystem approach promotes collaboration among various stakeholders, rather than centralised governance.[340]

The term "ecosystem-based management" itself has no one, fixed definition.[341] However, the approach itself can be broadly defined as a strategy for managing land, air, water, and living resources in an integrated way that promotes conservation and sustainable use.[342] The approach considers the cumulative impacts from various sources, balances conflicting uses and includes multiple factors, including pollution, development, harvest pressure, and other ecological interactions.[343]

Although each ecosystem is unique and thus requires its own unique implementation of the ecosystem management approach, ecosystem management writers agree there are central tenets in every ecosystem management plan.[344] These central tenets comprise three key components: (1) adaptive management; (2) foundations in good science; and (3) recognition of humans as part of the ecosystem.[345] Each of these components is indicated by various features.

Some of the features that indicate adaptive management in an ecosystem management plan include: (1) mechanisms for continuous monitoring; (2) operational goals or benchmarks; (3) mechanisms for re-evaluating goals and means in response to new information; and (4) the plan is flexible enough to cope with surprises that are inevitable due to the scientific uncertainty involved in an ecosystem.[346] In short, an adaptive management approach is one that "explicitly embraces self-conscious experimentation in the design of policy measures."[347]

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[340] Bradley C. Karkkainen, "Collaborative Ecosystem Governance: Scale, Complexity, and Dynamism" (2002) 21 Va Envtl LJ 189.
[341] Wiersema, *supra* note 331 at 1250.
[342] UN Convention on Biological Diversity, "Ecosystem Approach," online: <http://www.cbd.int/ecosystem/>.
[343] National Oceanic and Atmospheric Administration, "Ecosystem-based Fisheries Management," online: <http://chesapeakebay.noaa.gov/ecosystem-based-management/ecosystem-based-fisheries-management>.
[344] Wiersema, *supra* note 331.
[345] Ibid.
[346] Ibid at 1252.
[347] Karkkainen, *supra* note 340.

Ecosystem management plans must also have foundations in good science.[348] A plan can is arguably founded in good science if it focuses on connections between species and between species and their habitats rather than on protecting individual species.[349] Additionally, the plan should use nested scales of management in both space and time.[350] In other words, the plan should take into account not just high level spatial considerations, such as the broad watershed, or narrowly focussed spatial considerations, such as an individual species, but rather both as well as every level in between.[351] The plan must also bear in mind temporal considerations to ensure that all events—including short-term, medium-term, and long-term projections—are factored into decisions.[352]

An ecosystem management plan's third key component is that it should regard humans as part of the ecosystem.[353] In doing so, the plan should recognise human impacts, including social and economic forces, on all parts of the environment.[354] Managers who duly recognise humans as part of the ecosystem are in a better position to anticipate the ways in human activity will directly and indirectly affect the ecosystem.[355] Moreover, managers who engage in collaborative decision-making with multiple stakeholders will learn more about the human influences, both known and unforeseen, whilst they simultaneously provide a forum for determining the best policy based on societal values.[356]

The features that indicate an ecosystem approach may indicate the influence of reflexive law theory as well. The bodies of literature have developed independently—the literature on ecosystem approaches are written by science scholars and the literature promoting reflexive law by legal scholars—yet both disciplines purport similar ideas. Primarily, both schools of thought are founded on the idea that the world is complex and constantly changing. Thus, adapted

[348] Wiersema, *supra* note 331.
[349] Ibid.
[350] Ibid.
[351] Ibid.
[352] Ibid.
[353] Ibid.
[354] Ibid.
[355] Ibid.
[356] Ibid.

management and self-criticism are necessary in order to achieve environmental goals. Both disciplines advocate information feedback mechanisms to ensure that management is appropriately adaptive.

B. Intersection with Reflexive Law Theory

The ecosystem management writers and reflexive law writers have both reached consensus on two key propositions:[357] that environmental law must be responsive to ecological insights about the complexity of natural systems;[358] and that traditional environmental law approaches[359] are insufficiently responsive to ecological insights and, what is more, not flexible enough to develop the necessary responsiveness.[360] In this section, I discuss why traditional environmental law approaches are insufficient for managing ecosystems and how the modern trend among jurisdictions is moving towards adopting reflexive law strategies in an attempt to overcome these inadequacies.

1. Inadequacies of Traditional Environmental Law

As discussed at length in Chapter One, the traditional approach to environmental law involves minimising human impacts on the environment from the perspective of individual environmental media, such as air, land, and water.[361] As a result of this piecemeal perspective, the Environmental Protection Agency (EPA) regulates each medium through a separate statutory scheme rather than assessing the overall health of ecosystems.[362] These schemes consist of command and control regulations that the EPA administers through technology-based standards and enforces by rule-of-law litigation.[363]

The EPA's command and control regulations are beneficial to their regulated actors because they provide clear obligations and certainty. In addition,

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[357] Ibid at 1245.
[358] Ibid.
[359] Author's note: Legal scholars refer to the terms "substantive law" and "traditional environmental law" interchangeably. Ecosystem management writers do not specify the legal theory behind the term "traditional environmental law," but refer to command and control regulations as exemplary of traditional environmental law.
[360] Wiersema, *supra* note 331 at 1245.
[361] Enzler, *supra* note 325.
[362] Ibid at 418.
[363] Craig Anthony (Tony) Arnold, "Fourth-Generation Environmental Law: Integrationist and Multimodal" (2011) 35 Wm & Mary Envtl L & Pol'y Rev 771 at 773.

command and control regulations are an important mechanism for setting baselines for the amount of environmental degradation society will tolerate. However, the certainty offered by these regulations also means they tend to have trouble adapting to new scientific understandings. Moreover, the structure of current command and control regulations prevents them from providing the comprehensive plans necessary to protect the environment.

Scientists have criticised the Clean Water Act and similar command and control laws on the grounds that these laws fail to provide a framework for identifying research priorities, making decisions or directing broader statutory attention.[364] EPA scientists and managers have also acknowledged that the single greatest failing of traditional environmental law is its inadequate protection of ecosystems and the services they provide.[365] Unfortunately, these regulations' fixed nature prevent them from becoming more responsive to ecological insights. In particular, they are ill-equipped to deal with the surprises that will inevitably occur as a result of scientific uncertainties.

In addition, command and control regulations are limited by their jurisdictional boundaries, which may or may not coincide with the boundaries of a given ecosystem. Some jurisdictions that share watersheds have acknowledged this discrepancy and have entered into cooperative agreements with respect to their command and control regulations. Watershed managers for both Lake Champlain and Lake Erie are prime examples of such cooperative efforts. As presented in Chapter Two, leaders from Quebec, Vermont and New York cooperate in administering and enforcing command and control regulations for the protection of Lake Champlain and leaders from Ontario, Ohio, Pennsylvania, New York, Michigan and the federal governments of Canada and the United States have entered into several cooperative agreements to manage the health of Lake Erie. Such cooperation is not uncommon for jurisdictions that share

[364] Robert J. Naiman, et al., "Freshwater Ecosystems and Their Management: A National Initiative" 270:5236 Science, New Series 584.
[365] James Salzman, Barton H. Thompson Jr. & Gretchen C. Daily, "Protecting Ecosystem Services: Science, Economics, and Law" (2001) 20 Stan Envtl LJ 309.

common water bodies and I discuss another example in the Chesapeake Bay case study below.

Besides these inherent jurisdictional difficulties, command and control regulations are designed to address pollution by focusing on individual media, such as land, air or water, rather than integrated networks of systems. In Chapter One, I address how command and control regulations traditionally take this approach which means they have great difficulty adopting the ecosystem-management notion that nature is a series of nested systems.

All told, the traditional substantive law approach to environmental law has proven inadequate for managing ecosystems on its own. However, the current command and control regulations have various strengths that make abandoning them altogether unwise. For instance, the Clean Water Act has been enormously successful in reducing excessive phosphorus discharges from industrial polluters.[366] These successes have not been lost on legislatures and thus, policymakers have sensibly opted against supplanting current command and control regulations and instead have begun supplementing them with reflexive law strategies intended to foster adaptive management approaches.

2. The Modern Trend toward Adaptive Management

The above discussion reveals that the biggest challenges facing environmental policymakers in managing ecosystems are that: (1) the current laws are unable to keep pace with environmental changes and progressing scientific understandings; and (2) the current laws are limited by jurisdiction, whereas ecosystems are not. Although each jurisdiction uses its own unique blend of policy instruments to overcome these challenges, they are using an increasing number of reflexive law strategies to fill the gaps. In this section, I discuss certain reflexive law strategies that jurisdictions have adopted to overcome pacing and jurisdictional issues.

[366] For example, Chapter Two's Figure 4 illustrates drastic phosphorus reductions discharged by point sources since the Clean Water Act's enactment in 1972.

As discussed at length in Chapter One, reflexive law theory advocates implementing policies and procedures that promote self-regulation.[367] In particular, reflexive law promotes policies intended to provoke learning and problem-solving at the level of the regulated entities. Reflexive law policies are also intended to enlist intermediate social institutions, making best environmental practices a collaborative effort rather than purely an imposition from the state. Indeed, legal scholars emphasize the importance of public participation in regulatory regimes as necessary for the regimes' effectiveness and democratically legitimate.[368]

Environmental law's traditional piecemeal approach has proved unable to keep up with the pace and magnitude of ecological changes on its own, and policymakers have had to adopt progressive solutions to make management plans more adaptive. There is particular pressure in areas where current methods have been ineffective, such as nonpoint source pollution of waters.[369] One way in which policymakers have addressed these challenges is by implementing what certain legal scholars refer to as a "rolling-rule regime," which is a governance arrangement that allows local units or actors to experiment within broad limits that are subject to rolling minimum performance benchmarks.[370] The broad limits are also subject to detailed monitoring and reporting requirements.[371] These performance benchmarks and monitoring and reporting requirements are intended to continuously inform policymakers with relatively real-time data so they can adapt to ecosystem conditions and stressors.[372]

The rolling-rule regime is one example of a reflexive law strategy. To qualify as reflexive law, the strategy must provoke problem-solving at the level of the regulated actor and enlist intermediate social institutions. A rolling-rule

[367] Teubner, *supra* note 33; Orts, *supra* note 34; Hirsch, *supra* note 34.
[368] Kong, *supra* note 205 at 555-556 (discussing concepts of administrative law scholarship on environmental regulation relevant to land use policy instruments).
[369] Arnold, *supra* note 363.
[370] Charles Sabel, Archon Fung & Bradley Karkkainen, "Beyond Backyard Environmentalism" in *Beyond Backyard Environmentalism*, ed by Joshua Cohen & Joel Rogers (Boston: Beacon Press, 2000) at 6-7, 13-15.
[371] Ibid at 6-7, 13-15.
[372] Karkkainen, *supra* note 340.

regime sets broad limits and allows local units to experiment, which encourages problem-solving because the local units have the financial incentive to find the most efficient method to stay within the broad limits. The rolling-rule regime illustrates how jurisdictions can overcome traditional law's difficulty keeping pace with constant developments in scientific understanding using reflexive law strategies.

Policymakers also face the challenges presented by ecosystems that span across multiple jurisdictions. Traditional environmental laws are command and control regulations with limited jurisdiction outside the boundaries in which they were enacted. As a result, certain polluters are outside the reach of the jurisdiction in which the polluted lake is located. However, there is a school of legal scholars who propose using "nested regimes" to overcome this predicament.

Nested regimes are multifaceted and dynamic governance approach designed to address the full range of activities in an ecosystem, rather than using numerous piecemeal regimes.[373] This approach is criticised because overlapping regimes have the potential to involve conflicting or incompatible arrangements.[374] Yet, proponents argue that it more often leads to the development of effective regimes.[375] Nested regimes tend to succeed because they stimulate efforts to perceive the ecosystem as a whole, rather than limiting regimes to jurisdictional boundaries.[376] It is interesting to note that nested regimes have been advanced by legal writers independently of ecosystem-based management writers given the shared elements between nested regimes and nested systems.

Nested regimes are another example of a reflexive law strategy. They illustrate how managers can enlist intermediate social institutions by employing overlapping regimes that reflect the local needs of sub-ecosystems while maintaining a governance regime for the ecosystem as a whole. Nested regimes can have many variations, with municipalities or watershed managers setting local goals that nest within the regime for the ecosystem as a whole. Additionally,

[373] Jennifer Jeffers, "Climate Change and the Arctic: Adapting to Changes in Fisheries Stocks and Governance Regimes" (2010) 37 Ecology LQ 917 at 966.
[374] Ibid.
[375] Ibid.
[376] Ibid.

nested regimes are dynamic, which means they avoid the rigidity that has made traditional environmental law unsuccessful.

The substantive law approach to environmental law is inadequate for managing ecosystems, but certain adaptive management approaches can help jurisdictions overcome these shortcomings. In particular, jurisdictions are adopting reflexive law strategies that illustrate ways to encourage regulated actors and intermediate social institutions to get involved and find creative ways to meet the goals of the ecosystem as a whole.

C. Watershed Management Plans

1. Watersheds Require an Ecosystem Approach

Certain units are in particular need of an ecosystem approach. Watersheds[377] are one such unit for two important reasons.[378] First, a good deal of water pollutants originate on land or in air. For example, fertilisers containing phosphorus wash off of land flow into tributaries that reach water bodies. Similarly, certain chemicals that are emitted into the air by smoke stacks at coal-fired power plants and other air polluters fall back to earth in the form of acid rain. Often that earth includes surface waters, which are sensitive to such chemicals. Under our current piecemeal approach, we regulate watersheds by holding one agency responsible for protecting fisheries,[379] another agency responsible for reducing pollution deposits in the form of acid rain,[380] and yet another agency responsible for land use in the watershed unit.[381] It is to be expected that each agency prioritises its goals and duties above the others. For example, the fisheries agency looks out for the best interest of the aquatic biota,

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[377] The term "watershed" refers to a geographical unit with hydrological boundaries generally defined by a common drainage basin that contributes runoff to a common body of water. Melanie Shwab, "Crossing the Home-Rule Boundaries Should Be Mandatory: Advocating for a Watershed Approach to Zoning and Land Use in Ohio" (2010) 58 Clev St L Rev 463 at 475.
[378] Guercio, *supra* note 9 at 508.
[379] The U.S. Fish & Wildlife Service has jurisdiction over fisheries in the United States.
[380] The U.S. Environmental Protection Agency has jurisdiction over air pollution matters.
[381] If the land is federal, the U.S. Bureau of Land Management and Environment Canada will have jurisdiction. For local lands, there is a wide variety of local agencies and ministries that may have authority to limit land use.

which may not align with the land use agency's interests.[382] Watershed managers must instead base their decisions on an understanding of the entire freshwater ecosystem in order to develop workable water protection plans.[383]

The second reason why watersheds require an ecosystem approach is because they often lie across political boundaries. This can be of particular concern when the water body is in another jurisdiction from the polluter. In order to appropriately restore and conserve such environments, it is necessary for all levels of government to cooperate and coordinate. Thus, a comprehensive ecosystem approach is particularly well-suited for addressing the challenges of transboundary watersheds.

2. Features of Watershed Management Plans

Watershed managers agree that watersheds require an ecosystem approach and accordingly watershed management is accepted as one way of implementing an ecosystem approach.[384] Like ecosystem-based management plans, there are various ways to manage watersheds and each watershed requires its own unique plan to address that region's specific challenges. Actions in watershed scales depend on socio-cultural and political forces and demands, the structures and functions of the relevant institutions, the available resources as well as expertise and legal authority, and the ways by which the community frames watershed problems.[385] The EPA has boiled down these variables to three features indicative of a watershed approach: (1) well-integrated partnerships between private and public stakeholders; (2) hydrological boundaries as the geographic

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[382] The U.S. Fish and Wildlife's mission is to work with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. U.S. Fish & Wildlife Service, "Employee Pocket Guide: FWS Fundamentals", online: <http://www.fws.gov/info/pocketguide/fundamentals.html>.

[383] Naiman, *supra* note 364. In fact, American water law legal scholar Dan Tarlock has referred to watershed management plans as "ultimately land use plans." A. Dan Tarlock, "The Potential Role of Local Governments in Watershed Management" (2002) 20 Pace Envtl L Rev 149 at 152.

[384] Ontario Natural Resource Management Division, "Watershed Management on a Watershed Basis: Implementing an Ecosystem Approach," iv, (Ontario: Ontario Government, Ministry of Natural Resources, 1993), online: ON Ministry of Natural Resources <http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@water/documents/document/mnr_e002319.pdf>. ("The primary boundary for an ecosystem approach to land use planning should be the watershed. . . . An appropriate vehicle for this integration is the watershed management plan.").

[385] Arnold, *supra* note 363 at 842.

focus; and (3) action driven by environmental objectives and by strong evidence.[386]

These features roughly align with the general indicators of an ecosystem approach—adaptive management, foundations in good science, and recognition that humans are part of the ecosystem. The well-integrated partnerships feature corresponds with the need to recognise humans as part of the ecosystem. The prerequisite that watershed managers use hydrological boundaries as the geographic focus exhibits foundations in good science. Specifically, focusing geographically on the hydrological boundaries demonstrates managers are looking at a watershed as a nested system. And the requirement that watershed managers foster actions driven by environmental objectives and strong evidence matches the need for an adaptive management plan that sets and regularly re-evaluates operational goals.

The concepts of the watershed approach, and ecosystem approaches for that matter, are generally agreed upon, but transitioning from policy to application can be problematic.[387] In order to better understand this disparity and identify ways for managers to overcome this hurdle, I examine five case studies of watersheds that use a watershed management approach to address nonpoint source pollution their waters.

II. WATERSHED MANAGEMENT CASE STUDIES

Watershed management approaches may be classified in two categories: pollution prevention approaches and restoration approaches. Pollution prevention approaches attempt to reduce or prevent pollution entirely. Examples of pollution prevention approaches include the Chesapeake Bay Program where the government agency encourages best management practices on land by creating a nutrient market for trading credits, the Sacramento Valley Water Quality Coalition where the local government creates transparency in best management practices implementation through local policy networks, and in the Lake

[386] Tarlock, *supra* note 383, citing US Environmental Protection Agency, "Guidance for Water-Quality-Based Decisions: The TMDL Process" (1991), online: <http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/decisions_index.cfm>.
[387] Reynolds, *supra* note 334.

Massawippi watershed where the government encourages voluntary best management practices by offering subsidies and requiring producers to draw up phosphorus balance sheets.

In contrast, restoration approaches focus on restoring an already polluted watershed. Examples of approaches that focus on restoration efforts include Lake Winnipeg, where a non-governmental organisation harvests phosphorus-laden cattails in order to make room for new phosphorus-absorbing vegetation, and Kezar Lake, where the government is restoring water quality through the injection of aluminium salts and the planting of new vegetation species to absorb phosphorus upstream. Many watershed management plans incorporate elements of both pollution prevention and restoration; therefore, I have classified the following case studies according to their dominant traits. It is also important to note that there are countless other ways to implement a watershed approach. I have limited the scope of this chapter to case studies in North American watersheds due to time and space constraints.

In this section, I highlight five watershed management plans to provide insight as to how differing geographies, economies, and legal frameworks dictate different watershed management approaches. In Part A, I introduce approaches that focus on preventing the pollution from entering the bodies of water. In Part B, I describe approaches that focus instead on how to restore already-degraded waters. For each case study, I introduce the management plan, describe how the plan demonstrates a watershed management approach, and discuss the aspects of the plan that draw on reflexive law theory. Although some of these case studies do not exhibit all characteristics of a watershed approach or features of reflexive law theory, I include them nonetheless because they illustrate creative methods for addressing harmful algal blooms.

A. Pollution Prevention Approaches

The simplest way to reduce harmful algal blooms in a body of water is to limit the amount of phosphorus that reaches the water. In this part, I introduce three pollution prevention projects that focus on stopping the pollution at its source. The Chesapeake Bay Program uses nutrient trading to encourage

regulated actors to find creative solutions to bring their pollution levels down and thus earn credits. The Sacramento Valley Water Quality Coalition illustrates how watershed managers can facilitate local policy networks to provide regulated actors with a forum for discussing efficient land management techniques and to aid them in improving their practices. The Lake Massawippi example demonstrates how a government can implement nested regimes to provide local authorities with the ability to set local standards while maintaining a collaborative effort to ensure there is regulatory conformity. Each case study offers valuable insights as to how watershed management approaches incorporate reflexive law strategy to stop pollution at the source.

1. Case Study: Chesapeake Bay Program

The Chesapeake Bay, which is located in south-eastern United States, has been afflicted by harmful algal blooms since the late 1970s and perhaps even earlier.[388] The shallow Bay is plagued by nutrient loading and particularly high levels of phosphorus and nitrogen.[389] The Bay's watershed covers several states, including New York, Pennsylvania, Maryland, Delaware, Virginia, West Virginia, and the District of Columbia. Figure 5 provides a visual of the watershed basin.

Figure 5: US Environmental Protection Agency, "Chesapeake Bay TMDL" (2010) online: <http://www.epa.gov/chesapeakebaytmdl/>.

[388] Chesapeake Bay Program, "Chesapeake Bay Program History", online: Chesapeake Bay Program <http://www.chesapeakebay.net/about/how/history>.

[389] The bay is surprisingly shallow considering it is long and wide. Its average depth is 14 meters and it is 63 meters deep at its maximum depth. Chesapeake Bay Program, "Bay 101: Facts & Figures", online: Chesapeake Bay Program <http://www.chesapeakebay.net/discover/bay101/facts>.

There are several pollution sources in the watershed that contribute phosphorus to the Bay, including wastewater treatment plants, large-scale animal operations, air pollution, and other industrial sources such as power plants.[390] However, the overwhelming source of pollution is from agricultural runoff.[391] Agricultural runoff is responsible for 40 percent of the nitrogen and 50 percent of the phosphorus entering the bay.[392] The Chesapeake Bay Program uses creative a watershed management approach to try to address these challenges.

The Chesapeake Bay Program was formed to lead and direct the restoration of the Chesapeake Bay.[393] The Bay Program is a regional partnership comprised of nineteen federal agencies, nearly 40 state agencies throughout the six Bay states, a tri-state legislative body called the Chesapeake Bay Commission, numerous local governments that are represented by the Local Government Advisory Committee, over 20 academic institutions, and numerous citizen advisory groups. These partners collaborate, share information, and set collective goals.[394] The Bay Program was first established by the Chesapeake Bay Agreement of 1983, an agreement with modest goals to coordinate efforts to address the Bay's pollution problems. Through subsequent agreements in 1987, 1992, 2000, 2009, and 2010, the Bay Program has expanded to a comprehensive watershed plan with specific pollution reduction goals, deadlines, and procedures for re-evaluating these goals and deadlines. The partners have been very successful in reducing pollution from certain sources. However, they have only made limited progress toward reducing nutrient pollution from agriculture and urban areas. Thus, they had to find a new approach.

In order to address the agricultural pollution, the partners had to overcome the environmental law tradition of exempting agriculture from water quality regulations. The EPA took the lead and developed the Chesapeake Bay Total

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[390] Chesapeake Bay Foundation, "Water Quality Issues: Nitrogen and Phosphorus Pollution", online: Chesapeake Bay Foundation <http://www.cbf.org/page.aspx?pid=913>.
[391] Ibid.
[392] Ibid.
[393] Chesapeake Bay Program, "About the Bay Program", online: Chesapeake Bay Program <http://www.chesapeakebay.net/about>.
[394] Chesapeake Bay Program, "How We Work", online: Chesapeake Bay Program <http://www.chesapeakebay.net/about/how>.

Maximum Daily Load (TMDL) in 2010. The TMDL is a pollutant "diet" for the Bay that sets criteria for how much pollution the Bay can receive daily and still meet its water quality standards.[395] Aside from the fact that this TMDL is the largest water cleanup plan by the EPA, the TMDL is notable because it: (1) extends to nonpoint source polluters the nutrient trading that typically only occurs between permitted polluters; and (2) requires the seven Bay jurisdictions to create Watershed Implementation Plans that spell out detailed, specific steps to be taken by the jurisdiction to implement the TMDL nutrient trading program in order to meet specific pollution reductions by the year 2025.

The TMDL nutrient trading program, which is called TMDL Phase II, allows point sources to pay nonpoint sources to "play ball" by compensating them for reducing discharges.[396] The idea is that it is more cost effective for nonpoint sources to reduce their discharges than for point sources to implement costly treatment processes.[397] The concept is sensible, but there are practical problems that arise because it is difficult for watershed managers to measure, monitor, and corroborate farm practices.[398] As a result, Phase II creates the alarming risk discussed in Chapter One that point source polluters will pay farmers to implement best management practices that may never happen and, since the point source polluters will have paid for their credits, the point sources will not be liable for the pollution. The worst case scenario is that more pollution enters the Bay than before Phase II was implemented. However, the Chesapeake Bay TMDL is conscious of these risks and uses a procedural approach to try to significantly reduce them. This approach consists of detailed criteria with safeguards such as objective measures, credit calculation, verification, legal authority, and enforceability.[399]

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[395] For a more detailed discussion of the TMDL development process under the Clean Water Act framework, *see* Chapter Two, in which I describe the Lake Champlain Phosphorus TMDL.
[396] Oliver A. Houck, "The Clean Water Act Returns (Again): Part I, TMDLs and the Chesapeake Bay" (2011) 41 Envtl L Rep News & Analysis 10208.
[397] Ibid.
[398] Ibid.
[399] US Environmental Protection Agency, "Chesapeake Bay TMDL: Implementation and Adaptive Management" Section 10.1.2, 10.1.3, and 10.2, and Appendix S, online: US EPA <http://www.epa.gov/reg3wapd/pdf/pdf_chesbay/FinalBayTMDL/CBayFinalTMDLSection10_fin

The Bay Program follows a watershed management approach and draws on reflexive law theory in implementing its policies. The Bay Program possesses the three key features of a watershed approach. First, the plan has foundations in good science. This is indicated by the fact that the hydrological boundaries take precedence over political boundaries—the jurisdictions began their cooperative efforts as early as 1983 and are now bound by a single federal EPA TMDL. Second, the plan has well-integrated partnerships. The Bay Program's partners comprise various levels of government, private individuals, academic institutions, and various other stakeholders. These partnerships demonstrate that the Bay Program uses collaborative decision-making processes with multiple stakeholders to allow for broad participation and to facilitate learning about human influences. Finally, the Bay Program uses adaptive management, as indicated by its consistent amendments and new agreements that set new operational goals and constantly monitor and re-evaluate these goals in response to new information.

The Bay Program is also innovative because its watershed approach draws on tenets of reflexive law theory. Reflexive law theory advocates implementing policies and procedures that promote self-regulation.[400] One method for encouraging such self-regulation is by employing policies that will provoke learning and problem-solving at the level of the regulated entities. Reflexive law approaches also possesses the distinct feature of enlisting intermediate social institutions falling somewhere between the state and the market.

The Bay Program's TMDL Phase II is a nutrient trading program that provokes problem-solving at the level of the regulated entities in the watershed. The TMDL sets a cap on the amount of phosphorus entering the Bay and leaves it to point source and nonpoint source polluters to work out the most efficient way to stay below this cap. This approach is likely to lead to polluters finding new, more efficient ways to reduce their pollution discharges in order to save costs and gain credits. Thus, the TMDL acts as a financial incentive for the regulated entities to become more environmentally efficient.

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al.pdf> ("Offsetting New or Increased Loadings of Nitrogen, Phosphorous, and Sediment to the Chesapeake Bay Watershed").

[400] Teubner, *supra* note 33.

The Bay Program also enlists intermediate social institutions through its well-integrated partnerships. The state and the market are partners, but the collaboration does not end with them. Rather, various Bay stakeholders are included as partners in the Bay Program, which means that the Bay Program has successfully recruited all levels of actors to its cause.

In short, the Chesapeake Bay Program uses a watershed management approach influenced by reflexive law theory to reduce phosphorus inputs to the Bay. This case study demonstrates that a nutrient trading program may be workable in a watershed where there are jurisdictional challenges and/or different types of polluters, meaning both point source and nonpoint source polluters. It has yet to be seen whether the TMDL Phase II adequately protects against the risk that nonpoint source polluters will fail to implement the best management practices for which point source polluters pay. Since the jurisdictions only submitted their Watershed Implementation Plans to the EPA in 2012, it is still too early to tell whether the TMDL will be successful in reducing agricultural runoff to the bay.[401] However, as discussed in Chapter One, nutrient trading programs have been proven to work when they adequately reduce the uncertainty of nonpoint source pollution.[402] The TMDL Phase II incorporates safeguards to reduce this uncertainty by requiring that nonpoint source pollution credits meet objective measures before being verified. Since credit verification is a mechanism that has adequately reduced uncertainty for other programmes, the TMDL Phase II has a high likelihood of succeeding in reducing phosphorus in the Bay.

The Sacramento Valley Water Quality Coalition offers an example of a different watershed approach that focuses more on communication than on setting a cap on pollution to facilitate nutrient trading.

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[401] US Environmental Protection Agency, "Chesapeake Bay TMDL," online: <http://www.epa.gov/chesapeakebaytmdl/>.

[402] Specifically, two examples where such programs have worked include the Susquehanna River in Pennsylvania and the Great Miami River watershed in Ohio. *See* the discussion of trading programmes as a policy instrument *infra* Chapter One, Section III(C)(1).

2. Case Study: Sacramento Valley Water Quality Coalition

The Sacramento River suffers from pesticide contamination.[403] The River is not plagued by harmful algal blooms like the other case studies; however, its water quality concerns do stem from agricultural land use practices.[404] Hence, it is still useful to examine how watershed managers enlist farmers and orchard growers to prevent water pollution.

The Sacramento River Basin is the largest river and watershed system in California.[405] The Basin spans 27,000 square miles and drains the majority of northern California, including the eastern slopes of the Coast Range, Mount Shasta, the western slopes of the southernmost region of the Cascades, and the northern portion of the Sierra Nevada.[406] The Basin provides drinking water for residents of northern and southern California, industrial and agricultural water supplies, and serves as a home to two million northern Californians.[407] The major land uses in the watershed are forestry, agriculture, urban settlement, mining, and recreation.[408] Agriculture is the largest industry in the Sacramento Valley and its major crops include rice, orchards, grain, pasture, tomatoes, and vineyards.[409]

Pesticides are heavily used in the Basin's agriculture industry.[410] Not only is pesticide use high, but it occurs during as much as 75 percent of each calendar year.[411] Like fertilisers, pesticides enter waters when they are transported from fields by irrigation and storm runoff.[412] Since agriculture is the major source of pesticide contamination in the Basin, watershed mangers face the same challenges of regulating nonpoint source polluters as watershed managers in the Chesapeake Bay watershed. However, instead of using a nutrient trading program,

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[403] California Water Science Center, "SACR NAWQA: Study Unit Description", online: USGS <http://ca.water.usgs.gov/sac_nawqa/study_description.html>.
[404] Mark Lubell & Allan Fulton, "Local Policy Networks and Agricultural Watershed Management" (2007) 18 J Pub Admin Res & Theory 673.
[405] Sacramento River Watershed Program, "The Sacramento River Basin: A Roadmap to Watershed Management Executive Summary" (2010).
[406] Ibid.
[407] Ibid.
[408] Ibid.
[409] Ibid.
[410] California Water Science Center, *supra* note 352.
[411] Ibid.
[412] Ibid.

Sacramento River Basin managers rely on local policy networks to encourage nonpoint source polluters to implement best management practices on their land.

In the State of California, the State Water Resources Control Board has jurisdiction to protect water quality by setting statewide policy and coordinating and supporting regional water quality control boards.[413] There are nine regional water quality control boards, including the Central Valley Regional Water Quality Control Board, which exercises rulemaking and regulatory activities in the Sacramento River Basin.[414] Prior to the year 2003, agricultural sources operated under conditional waivers granted by the regional water quality control boards. These conditional waivers had minimal regulatory requirements. In 2003, the Central Valley Regional Water Quality Control Board adopted a new conditional waiver program that required agricultural producers to either: (1) join watershed management coalitions that work together to conduct water quality monitoring and implement water quality management plans; or (2) obtain an individual permit from the regional board.[415] Perhaps unsurprisingly, the overwhelming majority of orchard growers and farmers chose to join the watershed management coalition called the Sacramento Valley Water Quality Coalition (Coalition).[416]

The Coalition's mission is to enhance and improve water quality in the Sacramento River whilst sustaining the economic viability of agriculture.[417] In an effort to achieve this mission, the Coalition aims to identify any existing nonpoint source pollution resulting from agricultural practices and encourage agricultural producers to implement best management practices to solve these problems.[418] Agricultural producers and local watershed managers prefer the Coalition to a permitting process because it allows for sharing of monitoring costs, facilitates local oversight, takes advantages of local knowledge, and is less intrusive on individuals.[419] The Coalition uses a nested watershed management regime and

[413] State Water Resources Control Board, "California Water Boards: Fact Sheet" online: <www.waterboards.ca.gov/publications_forms/publications/factsheets/docs/region_brds.pdf>.
[414] Ibid.
[415] Lubell, *supra* note 404.
[416] Ibid.
[417] Sacramento Valley Water Quality Coalition, "Home Page", online: <http://www.svwqc.org/>.
[418] Lubell, *supra* note 404.
[419] Ibid.

divides the larger watershed into ten watershed groups.[420] The subwatershed groups carry the responsibility for the on-the-ground implementation, including encouraging agricultural producers to enrol in the program, participate in management activities, and implement best management practices.[421] The subwatershed groups also lead collaborations with other local stakeholders, such as resource conservation districts, UC Cooperative Extension, and the Natural Resource Conservation Service.[422]

The concept behind the Coalition is that it provides stakeholders with a local policy network in a polycentric governance system that will theoretically promote actors to change their behaviour for the benefit of the watershed as a whole.[423] Local policy networks play a critical role in improving actors' practices in several ways. First, networks facilitate information dissemination, which is useful in diffusing innovations for implementing best management practices among farmers.[424] Second, networks develop social capital—the credibility that is gained when you get to know your neighbour and learn how your practices impact his land.[425] This social capital ensures farmers that they will not be the only ones taking on the costs of implementing best management practices and therefore the playing field will remain level.[426] Further, nested watershed management regimes (sometimes referred to as polycentric governance) that defer down to the most local level have been found to be effective in addressing complex environmental management issues because they improve trust between local and regional scales of activity.[427] All of these attributes promote transparency and cooperation.

Local policy networks also play a role in promoting cultural change via social learning.[428] Cultural evolution theorists hypothesise that social learning

[420] Ibid.
[421] Ibid.
[422] Ibid.
[423] Ibid; *see also* Marshall, *supra* note 185.
[424] Lubell, *supra* note 404.
[425] Ibid; *see also* Jones, *supra* note 189.
[426] Ibid.
[427] Marshall, *supra* note 185 at 1519.
[428] Lubell, *supra* note 404.

from others is a key mechanisms of cultural change.[429] Such social learning typically occurs when one actor makes their decisions on the basis of another member (or members) of the same social system.[430] Sometimes people choose to imitate the most successful individuals and other times individuals may be persuaded by the other members of the group.[431] In the context of agriculture, social learning has the potential to play a vital role in changing culture towards agricultural producers' acceptance of environmental concerns.[432] Local policy networks will enable producers to look to local agricultural leaders for cues as to the most effective best management practices or whether to support a new governmental policy.[433] Thus, if government agencies can foster networks with the agricultural leaders, it will have better success garnering support of new policies.[434]

The Coalition's network has been extremely successful in altering agricultural producers land use practices.[435] Professor Mark Lubell of the University of California, Davis Department of Environmental Science and Policy conducted a statistical analysis of best management practices adoption and demonstrating that exposure to local policy networks substantially increases the probability that producers will adopt environmental practices.[436] Although the Coalition has aimed to reduce pesticides runoff rather than phosphorus, it is a useful watershed management model because the goal of reducing nonpoint source pollution runoff is the same. Moreover, the Coalition is a good example of how watershed managers can successfully implement a nested management regime in recognition of the nested systems within a large watershed basin.

The Coalition follows a watershed management approach and draws on reflexive law theory in implementing its policies. The Coalition possesses the three key features of a watershed approach. It has foundations in good science,

[429] Ibid at 677.
[430] Ibid.
[431] Ibid.
[432] Ibid.
[433] Ibid.
[434] Ibid.
[435] Ibid.
[436] *See generally* ibid.

well-integrated partnerships, and it uses adaptive management. The Coalition's foundations in good science are demonstrated by its nested scales of management. Rather than attempting to manage the watershed from the statewide level, the State Water Resources Control Board has delegated responsibility for the regional watershed needs to the regional water quality control board, which delegated local on-the-ground responsibilities to the Coalition. The Coalition created more nested institutions by dividing the larger watershed into ten subwatershed groups. By creating a nested management regime, the State of California has explicitly recognised nested systems within the large watershed basin, despite the fact that regulating from a centralised agency would be much easier. This regulatory decision demonstrates that the Coalition has foundations in good science.

The Coalition has many well-integrated partnerships. It enlists agricultural producers as well as various nonpoint source polluters, academic institutions, and local stakeholders. The aim of the Coalition is to identify nonpoint sources of pollution and promote best management practices to reduce or eliminate the pollution. This aim implicitly recognises human impacts on all parts of the environment. Moreover, the Coalition is premised on collaboration in decision-making and providing a forum for determining the best management practices and the values society seeks to enhance. Thus, the Coalition possesses all the features indicating well-integrated partnerships.

The Coalition also uses adaptive management. It creates social capital and facilitates information dissemination, which promote transparency amongst actors. This transparency aids communication between actors as to how the others are implementing best management practices and facilitates government agencies or other stakeholders in distributing information on how to make changes most efficiently. The network model provides an ideal forum for actors to share information as they implement new forms of technology and become more efficient.

The Coalition's watershed approach also draws on reflexive law principles. It incorporates procedures to provoke problem-solving at the level of the regulated entities and it enlists social institutions falling between the state and

the market. The network provokes problem-solving through sharing information about implementing best management practices. Each agricultural producer has a responsibility to pull his weight by implement best management practices. The responsibility is not enforced by prohibitions and punishments, but rather it is a product of social capital. If an actor fails to fulfil this responsibility, they lose social credibility among other actors in the network. Therefore, they are provoked to find a way to fulfil their obligations as efficiently as possible. The Coalition also draws on reflexive law theory because its network inherently enlists social institutions falling between the state and the market. Agricultural producers may be considered market actors, but local academic institutions and non-profit organisations are not. Further, agricultural producers and other nonpoint source polluters may include sustenance farmers for private individuals who use pesticides on their lawns.

Thus, the Sacramento Valley Water Quality Coalition uses a watershed management approach influenced by reflexive law theory to reduce nonpoint source pollution. This case study demonstrates that local policy networks may be an effective method for provoking actors to find solutions to help reduce their pollution outputs and to encourage collaboration among various stakeholders. There are command and control regulation aspects to this case study, such as the fact that farmers had to choose to join the coalition or get an individual permit, but the restraints among coalition members is largely informal. The next example illustrates how a jurisdiction can implement a more formal network by using nested regimes.

3. Case Study: Lake Massawippi[437]

Lake Massawippi is a freshwater lake located in southern Quebec east of Montreal. The Lake receives severe amounts of phosphorus annually and has endured widespread harmful algal blooms over the last decade.[438] Studies show

[437] The author gathered the information about the Lake Massawippi case study as a result of prior research conducted for a term paper for a McGill School of Environment course entitled Environment 610: *Foundations of Environmental Policy* during Fall 2011 semester.

[438] International Law Environment Committee, "Massawippi Lake", online: ILEC <http://www.ilec.or.jp/database/nam/nam-49.html>. Lake Massawippi, which is 19 kilometres long, is located in Quebec's eastern townships among rolling hills and farms, just east of Lake

that runoff from agricultural operations contributes the primary source of excess phosphorus to the Lake, which makes sense because agriculture and tourism are the watershed's main economic industries.[439] Thus, watershed managers' biggest challenge is reducing phosphorus runoff from farm lands.

There are two important plans in place to address phosphorus pollution in Lake Massawippi. First, there is Quebec's provincial regulation that governs agricultural operations' land management practices.[440] Second, there is a watershed association called Everblue Massawippi that coordinates stakeholders in the Massawippi watershed.[441] These complementary plans illustrate one way to decentralise watershed management.

Quebec's provincial regulations require agricultural operators to prevent livestock waste from entering surface waters,[442] to complete agro-environmental fertilisation plans,[443] to draw up annual phosphorus reports,[444] and to comply with riparian buffer zone bylaws set by local municipalities.[445] Farmers are required to draw up and keep on file an agro-environmental fertilisation plan every five years in advance of spreading fertilisers.[446] These plans must include the farmers' proposed fertiliser doses, their planned spreading periods, and the methods they expect to use.[447] The phosphorus reports work as a phosphorus balance sheet in which farmers calculate the amount of phosphorus they use (inputs) against the amount of phosphorus they produce (outputs).[448] The aim is for farmers to eventually reach a zero balance, keeping all phosphorus in the farm's phosphorus

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Memphremagog. The towns along the lake include Bacon's Bay, Ayer's Cliff, Butternut Flat, North Hatley and Massawippi.

[439] Ibid.

[440] *Agricultural Operations Regulation*, RRQ, c Q-2, r 26. [AOR]

[441] Association pour la protection du lac Massawippi, "Accueil", online: <http://www.lacmassawippi.ca/en/accueil>.

[442] AOR *supra* note 440 at s 5.

[443] Ibid at s 22.

[444] Ibid.

[445] *Protection Policy for Lakeshores, Riverbanks, Littoral Zones and Floodplains*, RRQ, c Q-2, r 35.

[446] Ibid at s 22.

[447] It is important to note that the AOR limits fertiliser spreading to the months between May and October.

[448] AOR *supra* note 440 at s. 35.

cycle.[449] Farmers must annually file the phosphorus report with Quebec's Ministry of Sustainable Development, Environment and Parks.[450] The regulation holds farmers who not file liable for a fine, but there is no punishment for phosphorus reports with severe phosphorus outputs.[451]

In addition to these provincial requirements, the Financière Agricole du Quebec provides incentives to farms that comply in the form of subsidies.[452] Quebec's Ministry of Agriculture, Fisheries and Food also plays a supporting role by providing assistance to help farms come into compliance and encouraging them to implement best management practices.[453] As a result, farms are not only penalised financially if they do not comply with Quebec's regulations, but they are actually rewarded when they do successfully comply. Moreover, it is possible for farms to comply with the regulations without reducing their phosphorus outputs since it is the procedural requirement that they file annual phosphorus reports that is required.

Under the regulations, farms must adhere to the riparian buffer zone bylaws set by municipalities.[454] Riparian buffer zones are strips of land between a farm's production zone and surface waters, such as a stream, a river, or a lake. The idea is that by planting vegetation in this area and keeping it free of fertiliser, the vegetation will absorb excess phosphorus washed off the agricultural production fields. Under Quebec's regulations, the determination of zone width is determined by municipalities.[455] This can be difficult in a watershed like Massawippi where there are several municipalities. It is for this reason that Everblue Massawippi (formerly known as the Lake Massawippi Water Protection

[449] La Financière Agricole du Québec, "Phosphorus Report", online: FADQ <http://www.fadq.qc.ca/en/la_financiere_agricole/sustainable_development/phosphorus_report.html>.
[450] AOR *supra* note 440 at s. 35.
[451] Ibid at s. 44.
[452] La Financière Agricole du Québec, *supra* note 397.
[453] Fisheries and Food Ministry of Agriculture, "Bonnes Pratiques Agroenvironnementales Pour Votre Entreprise Agricole, 2nd edition" (2005) online: MAPAQ <http://www.mapaq.gouv.qc.ca/SiteCollectionDocuments/Agroenvironnement/BonnesPratiques2005.pdf>.
[454] Protection Policy *supra* note 445 at 1.
[455] Ibid.

Association) serves to coordinate municipalities and other stakeholders in the Massawippi Watershed.[456]

Everblue Massawippi's 2012 objectives include: to consolidate the riparian buffer zone bylaws and achieve 80 percent shoreline conformity; to plan, propose, and undertake a major project for Lake Massawippi's largest tributary, the Tomifobia River; and to determine eco-sensitive zones within the watershed.[457] Everblue Massawippi aims to be recognised by the population as the main resource for identifying the needs and necessary conditions for the healthy evolution of Lake Massawippi by the year 2016.[458] Its other goals for 2016 include: coordinating stakeholder cooperation by creating a round-table for the main social, political, and economic actors in the area; completing two major structural preservation operations to the eco-sensitive zones identified in 2012; and to increase its technical and scientific expertise by 70 percent.[459]

In April 2012, Everblue Massawippi made headway on its 2012 goals when it hosted a stakeholder roundtable event in which seventeen organisation representatives entered into a pact called the Tomifobia-Massawippi Watershed-Filter Project.[460] The project is named for the Tomifobia River, which is the main tributary and source of pollution to Lake Massawippi.[461] The project began on June 11, 2012 with the objective to change actors' mentalities through small actions throughout the watershed region.[462] These small actions are: (1) identifying riverside land in agricultural areas; (2) maintaining ditches; (3) teaching agricultural producers cover crop techniques; and (4) teaching agricultural producers environmentally-sound soil conservation growth techniques to limit phosphorus-laden sediment from entering the surface waters.[463] The project also includes close monitoring to document observed variations in the

[456] "The Massawippi" (Spring 2012), online: Lake Massawippi Water Protection Association <http://www.lacmassawippi.ca/sites/default/files/Spring_2012.pdf>.
[457] Ibid.
[458] Ibid.
[459] Ibid.
[460] Ibid.
[461] Ibid.
[462] Ibid.
[463] Ibid.

Tomifobia River and change methods where necessary.[464] Although it is still too early to tell whether this specific project will achieve its goals, the overarching legal regime in the Lake Massawippi watershed is another good example of how watershed managers can implement nested management regimes.

The Quebec government and Everblue Massawippi's efforts are complementary because each picks up where the other leaves off. Quebec's regulations explicitly state that agricultural operations must comply with municipal and local laws. Everblue Massawippi is the association leading the charge to achieve consistency among the local rules in the local watershed and is taking responsibility for the on-the-ground implementation of best management practices. As a result, the authorities have jurisdiction over different nested scales within Quebec.

The Massawippi nested management regime uses a watershed management approach and draw on reflexive law theory. The regime has the three features indicative of a watershed management approach. Its foundations in good science include its nested scales of management and within those scales, Everblue Massawippi coordinates actors within the watershed's hydrological boundaries. Furthermore, Everblue Massawippi's objectives include benchmarks and operational goals with monitoring mechanisms, which demonstrates adaptive management. The Quebec government also conducts monitoring via the annual phosphorus reports. Finally, the Massawippi nested management regime maintains well-integrated partnerships between the provincial government, the municipalities, Everblue Massawippi, and the local stakeholders. The collaborative round-table in April 2012 established goals for collaboration and specific targets for improving the health of the Lake.

This case study also illustrates a heavy reflexive law influence. As stated above, reflexive law strategies should provoke problem-solving at the level of regulated entities and enlist intermediate social institutions. Here, the annual phosphorus reports function as balance sheets that track the amount of phosphorus inputs and outputs. These balance sheets operate to encourage agricultural

[464] Ibid.

producers to improve their practices to keep phosphorus from being wasted. The idea is similar to tracking one's financial spending habits: once you become aware of bad habits, it is must easier to address them. The phosphorus reports are based in this concept. The nested management regime also enlists intermediate social institutions in that Everblue Massawippi works with the municipalities to create consistency among requirements and works with the farmers to help them come into compliance with these requirements. The Quebec Government, through its Ministry of Agriculture, Fisheries and Food and the Financiere Agricole du Quebec, also works with farmers to implement best management practices and encourage compliance with subsidies.

To come to the point, the approach in the Lake Massawippi watershed uses a watershed management approach influenced by reflexive law theory to reduce phosphorus inputs to the Lake. This case study demonstrates that nested regimes offer a workable solution for watersheds in which there are several jurisdictions. This particular example illustrates that jurisdictions do not necessary give up consistency by dividing responsibilities. This case study also demonstrates that simple procedural requirements, like phosphorus balance sheets, may succeed in provoking farmers to problem-solve methods to improve their practices.

The pollution prevention approaches all attempt to stop pollution at the source. The examples above focus on how watershed managers can target nonpoint source polluters and specifically the agricultural industry. This approach is ideal for protecting a watershed, but how does a jurisdiction restore a watershed that is already severely polluted? The next two case studies offer some solutions.

B. Restoration Approaches

Some bodies of water are beyond the point of merely needing to stop pollution from entering them. Instead, these waters require urgent attention to restore their ecological integrity. Restoration projects are necessary to improve water quality to a degree where a healthy ecosystem can be maintained with future pollution prevention approaches. What is more, sometimes the source of

pollution lies in a different jurisdiction than the water body. Principles of jurisdictional sovereignty mean it is impossible to for watershed managers to regulate outside one's jurisdiction. Consequently, these situations call for creative approaches for reducing pollution that has already entered the waters.

In this part, I introduce restoration projects that involve harvesting phosphorus-absorbing vegetation in Lake Winnipeg and aluminium salts injections to bind phosphorus and make it unusable to phytoplankton in Kezar Lake. The Lake Winnipeg case study offers insights as how watershed managers can capitalise on pollution that stems from sources outside political jurisdiction as a way to restore waters and make the most of a difficult situation. The Kezar Lake case study demonstrates a relatively simple method for reducing phosphorus in a thermally stratified lake, meaning the lake has layers where the water's warmth varies. Both case studies use a watershed approach, but only the Lake Winnipeg example appears to draw on tenets of reflexive law theory.

1. Case Study: Lake Winnipeg

Lake Winnipeg has suffered from severe harmful algal blooms for two decades.[465] The tenth largest—yet quite shallow—freshwater lake in the world receives water from a vast watershed spanning intensive agricultural regions, including Alberta, Saskatchewan, Manitoba, Montana, North Dakota, South Dakota and Minnesota.[466] There are many sources of excess phosphorus, including industrial farming and a hydroelectric dam network, but the lake's predicament is exacerbated by its small population and geographical location.[467] There are fewer than 30,000 in the population surrounding Lake Winnipeg, which is particularly small in comparison to the vastness of the watershed.[468] The fact

[465] Eric Rumble, "Blue-green algae plague Lake Winnipeg" *Canadian Geographic Magazine* (June 2011) online: <http://www.canadiangeographic.ca/magazine/jun11/lake_winnipeg_algae.asp>.
[466] International Institute for Sustainable Development, Water Innovation Centre, "Lake Winnipeg Basin," online: IISD <http://www.iisd.org/wic/lake_wpg_basin.asp>. The lake's depth is 12 meters on average and 36 meters in its deepest location. Water Stewardship Division, "Lake Winnipeg: Quick Facts", online: Manitoba Government <http://www.gov.mb.ca/waterstewardship/water_quality/lake_winnipeg/facts.html>.
[467] Rumble, *supra* note 465.
[468] Ibid. ("Fewer than 30,000 people actually have to live with the noxious beads of green scum that sporadically wash ashore as a result of the lake's eutrophication.").

that the phosphorus largely comes from other provinces and even another country means that local authorities have limited jurisdictional authority to implement legal restraints. As a result, a non-governmental organisation has adopted a water restoration approach.

In December 2011, the International Institute for Sustainable Development (IISD) proposed the bio-economy project to capture and recycle phosphorus in the Lake Winnipeg watershed. The IISD is a Manitoba-based, non-partisan, public-policy sustainable development research institute.[469] The IISD's project, which also receives funding from its partners the Manitoba government and the University of Manitoba, involves harvesting phosphorus-laden cattails (*Typha* spp.), which are a common wetland plant, to make room for new cattail growth, which will then absorb more phosphorus. The IISD also proposed recycling the phosphorus into fertiliser and biomass pellets that can be used for bioenergy, literally turning pollution into profit.[470] The IISD's goals for the proposed bio-economy project are to produce low-cost bio-energy, to achieve a 50 percent reduction in the phosphorus load on Lake Winnipeg by capturing phosphorus from watersheds and recycling it into fertiliser, to produce carbon credits, and to enhance wetland habitat.[471]

In June 2012, the Manitoba provincial government released for public comment a new green plan for the province entitled *Tomorrow Now* that includes the bio-economy project.[472] The *Tomorrow Now* plan was reportedly released as a trigger for public feedback rather than a specific step-by-step plan for the province, although the government refers to it as an "eight-year strategic plan for protecting the environment whilst ensuring a prosperous and environmentally

[469] Lake Winnipeg Foundation, "Congrats to IISD", online: <http://www.lakewinnipegfoundation.org/2012/06/24/congrats-to-iisd/>.
[470] International Institute for Sustainable Development, "Lake Winnipeg Basin Summit Follow-up Meeting (2011)", online: International Institute for Sustainable Development <http://www.iisd.org/wic/summit_followup_meeting_2011.aspx>.
[471] Lake Winnipeg Foundation, *supra* note 469.
[472] Government of Manitoba, "Tomorrow Now: Manitoba's Green Plan", online: <http://gov.mb.ca/conservation/tomorrownowgreenplan/index.html>.

conscious economy."[473] The deadline for public comment on the plan was October 31, 2012 and there have been no updates on the plan as of the December 10, 2012. As a result, it is too soon to determine whether the bio-economy project would be effective in restoring Lake Winnipeg, but it is an interesting example of how jurisdictions can combat pollution when the sources are outside their scope of authority.

The bio-economy project is a watershed management approach. The project has foundations in good science, well-integrated partnerships, and uses adaptive management. Its foundations in good science are apparent from the way it focuses on the connections between the nested systems within the watershed. For example, it aims to harvest cattails that no longer absorb phosphorus in order to make space available for new cattail growth. The project also has well-integrated partnerships as evidenced by its collaboration between various levels of government, academic institutions, and a call for public comments on Manitoba's *Tomorrow Now* plan. The project uses adaptive management as demonstrated by its proposed operational goals and benchmarks that can be re-evaluated in response to new scientific information. Since the plan has the three indicative features of a watershed management plan, it can be classified as such.

The project draws on certain aspects of reflexive law theory. Although the project does not provoke problem-solving at the level of the regulated actor because there are no regulations, the project does enlist intermediate social institutions. The *Tomorrow Now* plan calls for public participation, which is open to any and all stakeholders. Moreover, the plan uses creative solutions to restore the watershed without imposing any strict legal obligations on any actors. By omitting these obligations, the project has left itself free to be adapted as necessary. Consequently, the project draws on some aspects of reflexive law theory, but does not include obligations on actors to disclose information or monitor phosphorus outputs.

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[473] Ibid; *see also* "A Blueprint for Turning Green", *Winnipeg Free Press* (2012) online: <http://www.winnipegfreepress.com/arts-and-life/life/greenpage/a-blueprint-for-turning-green-174001021.html>

It is clear that the Lake Winnipeg bio-economy project is a watershed management approach influenced by reflexive law theory to extract phosphorus from the Lake. This case study demonstrates that there are ways in which watershed managers can capitalise on pollution stemming from sources beyond their control. The Kezar Lake example offers another method for extracting phosphorus that has already entered surface waters.

2. Case Study Kezar Lake

Kezar Lake has had persistent harmful algal blooms since the early 1960s.[474] The shallow New Hampshire lake was severely polluted by internal phosphorus sediment loading from a nearby wastewater treatment facility.[475] The EPA classified the lake as eutrophic in 1978 and ranked it first of 171 lakes surveyed for restoration.[476] The facility was decommissioned in 1981, reducing 71 percent of the external phosphorus load.[477] However, a diagnostic and feasibility study conducted in 1983 determined that internal loading from the sediments was the controlling factor determining the lake's tropic status.[478] The study also noted that the lake was thermally stratified and other such lakes benefited from aluminium salts injection.[479]

In response to the study's recommendations, the EPA began a restoration project in 1984 consisting of two components: aluminium salts injection and upstream riparian wetland manipulation.[480] The aluminium salts were injected into the hypolimnion to inactivate sediment phosphorus.[481] The aluminium salts inactivate the phosphorus by binding with it, thereby removing the phosphorus from the water column and depositing it in the sediment in a form that is unusable

[474] Jody N. Connor & Michael R. Martin, "An Assessment of Sediment Phosphorus Inactivation, Kezar Lake, New Hampshire" (1989) 25:4 Water Resources Bulletin 845. The lake's mean and maximum depths are only 2.7 m and 8.2 m, respectively. EPA Office of Water, "Watershed Protection: Clean Lakes Study: Phosphorus Inactivation and Wetland Manipulation Improve Kezar Lake, NH", online: US Environmental Protection Agency <http://water.epa.gov/type/lakes/kezar.cfm>.
[475] EPA Office of Water, *supra* note 474.
[476] Connor, *supra* note 474.
[477] Ibid.
[478] Ibid.
[479] Ibid.
[480] EPA Office of Water, *supra* note 474.
[481] Connor, *supra* note 474.

by phytoplankton.[482] The EPA conducted intensive monitoring from 1984 to 1988 to determine the effectiveness of the aluminium salts applications.[483] The monitoring method was to observe the response of several water quality parameters, including dissolved oxygen, pH, alkalinity, total dissolved aluminium, total phosphorus, chlorophyll *a*, transparency, phytoplankton, and zooplankton.[484] The New Hampshire state government assisted an additional monitoring volunteer program from 1988 to 1994 to supplement previous monitoring and to accumulate data over a longer period of time.[485]

For the second component of the restoration effort, the EPA manipulated upstream wetlands in two ways: by elevating water level in an upstream meadow and by planting new species to absorb phosphorus.[486] The watershed managers elevated the water by installing flashboards, which hold the water in place, thereby encouraging sedimentation of phosphorus-laden particles.[487] The wetland already had blue-joint grass (*Calamagrostis canadensis*), but managers planted wild rice (*Zinzania aquatica*) in 1985 and 1986 to supplement the vegetation that would absorb phosphorus from the soil.[488] The EPA monitored the wetlands from 1984 to 1988 to calculate changes in the phosphorus budget and measure the effects of the wetlands management activities.[489] The observations from the monitoring program also revealed how affordable the wetlands manipulation was, with costs totalling only $250.000 for the wild rice.[490]

Although the lake has had harmful algal blooms present in certain years since the restoration project was implemented, the overall trend is very positive.[491] As a general matter, phosphorus levels have been consistently decreasing in the lake since the mid-1980s.[492] The two years in which the

[482] US Environmental Protection Agency, supra note 386.
[483] EPA Office of Water, *supra* note 474.
[484] Ibid.
[485] Ibid.
[486] US Environmental Protection Agency, *supra* note 386.
[487] EPA Office of Water, *supra* note 474.
[488] Ibid.
[489] US Environmental Protection Agency, *supra* note 386.
[490] EPA Office of Water, *supra* note 474.
[491] US Environmental Protection Agency, *supra* note 386.
[492] Ibid.

phosphorus concentrations exceeded the pre-restoration efforts (1988 and 1993) were years in which annual precipitation considerably surpassed normal amounts.[493] The additional precipitation caused more nonpoint source runoff to contribute phosphorus to the lake.[494] Accordingly, the EPA deduces that the quality of Kezar Lake is now regulated by climatic conditions.[495]

The Kezar Lake restoration project follows a watershed management approach because it has foundations in good science, adaptive management, and well-integrated partnerships. Its foundations in good science are illustrated by the background studies conducted to determine the controlling factor determining the lake's trophic status. The watershed managers decided to use the aluminium salts injection method due to its success with other thermally stratified lakes. Further, watershed managers' decision to manipulate upstream wetlands demonstrates their recognition of the connections between neighbouring systems. Thus, it is clear the project has foundations in good science.

The restoration project also uses adaptive management. This is exemplified by the fact that the watershed managers set benchmarks and conducted monitoring to survey the effectiveness of the methods. Finally, the restoration project has well-integrated partnerships. The partnerships are not as apparent as they are in some of the other case studies, such as the Sacramento Valley Water Quality Coalition, but these partnerships are demonstrated in Kezar Lake by the fact that the watershed management plan recognises human impact on the environment. Moreover, the cooperation between the EPA, the State of New Hampshire, and the volunteers who continued the monitoring for several years demonstrates good cooperation from various stakeholders in the watershed. Thus, the Kezar Lake restoration project has well-integrated partnerships and therefore possesses all the indicative features of a watershed management approach.

However, the restoration project does not appear to draw on reflexive law. It does not implement procedures to encourage problem-solving at the level of regulated entities nor does it enlist social institutions falling between the state and

[493] Ibid.
[494] Ibid.
[495] Ibid.

the market. Nevertheless, the restoration effort does provide insight as to how to clean up a polluted body of water without imposing any formal legal restraints. As a result, the project avoids the rigidity associated with policy instruments anchored in providing certainty, such as command and control regulations. Thus, watershed managers can continuously adapt and amend the project's goals and methods in response to new scientific information.

The Kezar Lake project uses a watershed management approach to extract phosphorus from the Lake that does not appear to be influenced by reflexive law theory. This case study demonstrates that it is not always necessary to impose regulations to improve the integrity of an ecosystem. In many ways, it is ideal to leave behind formal restraints because this approach allows watershed managers to continuously change methods in response to new information.

III. LESSONS LEARNT

These five watershed examples demonstrate there are a variety of ways for managers to address nonpoint source pollution using a watershed management plan. The examples reveal some commonalities: all of these watersheds share the goal of reducing nonpoint source pollution, they all use a watershed management approach, and these approaches often draw upon reflexive law strategies.

Despite these commonalities, these watershed plans significantly differ. Some of the plans focus on preventing pollution from reaching the water and some focus on restoring already-polluted waters. And even though most of the plans draw on reflexive law theory, the particular strategies selected vary for each plan. For instance, the watershed plan in Sacramento uses a communication-based instrument to foster local policy networks among actors. Quebec's phosphorus reporting requirement is a hybrid planning and information-based instrument because it requires producers to undergo a procedure for disclosing specific information. The plans in both Chesapeake Bay and Quebec use market-based instruments, but the similarities diverge there: the Chesapeake Bay plan relies on a nutrient trading programme, whereas Quebec offers subsidies for agricultural producers who use best management practices.

Thus, the examples all have certain differences that play a role in determining which policy instruments will be most appropriate to addressing nonpoint source pollution in their respective water bodies. These variations may be indicative of each watershed's distinct physical, economic, and political features. In this section, I discuss the influences the local conditions and legal frameworks have in shaping the appropriate watershed approach.

A. Local Conditions

Based on the above examples of watershed management plans, it is apparent that local conditions, such as geography and economics, play a large part in determining the appropriate watershed management approach and policy instruments. First, it is worth noting the physical commonalities of the water bodies discussed above: they are relatively shallow and they are all severely impacted by agricultural runoff, although Kezar Lake's pollution from the nearby wastewater treatment plant overshadowed this source. Lake Massawippi is wedged between mountains and farmlands, which means there is little industry aside from agriculture and tourism. Lake Winnipeg receives inputs from agricultural practices across its vast watershed, but has a relatively small local population. In contrast, Chesapeake Bay is a watershed that is booming with industry.

Economics play a sizeable role in determining the appropriate policy instruments. For example, in a region like Chesapeake Bay there is significant industry—enough to successfully create a nutrient market. A similar approach could potentially work in the Lake Erie basin where there is comparable industry. However, Lake Champlain is too rural to create such a market—there is simply not enough industry with which agricultural operations could trade. Watersheds with less industry have fewer polluters with whom farmers can trade their nutrient credits. Thus, implementing a market-based trading programme in such watersheds could cause them to suffer a tragic irony of not having enough polluters to clean up the waters.

Rural watersheds such as the Lake Champlain Basin might fare better by using a communication-based instrument like the Coalition in Sacramento that

provides agricultural producers with a local policy network. This approach could potentially be extremely useful in a state such as Vermont, where community involvement and neighbour relations are a way of life.[496] The Lake Winnipeg Bio-economy Project and Kezar Lake aluminium salts injection method may also prove useful for rural watersheds because they do not rely on a local market or even attempt to place restraints on polluters. In addition, Quebec's phosphorus reporting requirement could be a useful procedure to encourage agricultural producers in rural watersheds to consider the amount of phosphorus leaving their land.

B. Legal Framework

Another lesson that can be drawn from the above examples is that the appropriate watershed approach and policy instruments depend on the political features, including jurisdictional boundaries.

1. Watershed Approach

The watershed approach depends on the jurisdictional boundaries of the watershed. The appropriate watershed management approach can use a pollution prevention approach if the policymakers have jurisdictional authority over the polluters. However, the approach must shift to a strictly restorative approach in instances where the pollution sources lie in a jurisdiction other than the jurisdiction of the water body.

From a jurisdictional point of view, it is relatively straight-forward to protect Kezar Lake in New Hampshire and the Sacramento River basin in California because these waters lie within a single U.S. state. However, even these cases diverge in regards to scope. California is much vaster than New Hampshire, and thus affects many more stakeholders who must be on-board with restoration and pollution prevention efforts.

The other jurisdictional extreme is Lake Winnipeg, which receives a majority of its excess phosphorus from its southern neighbours in the northern

[496] For instance, Vermont designates the first Tuesday of every March as "Town Meeting Day." Town Meeting Day is a state holiday for citizens across Vermont to come together in their communities to discuss the business of their towns. Vermont Secretary of State, "A Citizen's Guide to Vermont Town Meeting", online: <http://www.sec.state.vt.us/townmeeting/citizens_guide.html>.

U.S. states. The Manitoba government's hands are tied as to how to regulate activities that occur outside its jurisdictional authority, and thus has determined that a market-based instrument to capitalise on the incoming pollution is its best approach for restoring the lake. Chesapeake Bay lies somewhere in the middle of the spectrum: the watershed spans several U.S. states but is located in only one country.

Like Lake Winnipeg and Chesapeake Bay, Lake Erie and Lake Champlain face transboundary jurisdictional challenges. In particular, they both face cross-border polluters like Lake Winnipeg managers. However, they already have certain framework agreements in place, which facilitates cooperation across the borders. As a result, the lakes are not restricted to a restoration approach, but may be successful in pollution prevention approaches as well.

2. Policy Instruments

Assuming all watershed managers share the common goal of reducing the occurrence of harmful algal blooms in their respective waters, it follows that they would model their policy instruments after successful watershed plans. However, like the watershed approach, the appropriate policy instruments depend on the unique geographical, economic, and jurisdictional features of the region.

As seen in the Sacramento River Basin and Chesapeake Bay examples, command and control regulations serve as a good tool for establishing information-based instruments (local policy networks to create transparency and accountability in California) and market-based instruments (nutrient markets in Chesapeake Bay). However, command and control regulations that set standards and enforcement are fairly rigid and not easily adaptable, which often makes them a forced fit for an ecosystem approach in which adaptability is a cornerstone feature.

Information-based approaches are useful for sharing information regarding best management practices (local policy networks in California), but allowing reporting to remain voluntary frustrates the purpose. Market-based approaches have the capability of regulating themselves and relieving strain on public resources necessary for enforcement, but they are reliant on the presence of a

market. It is unclear whether there is a market for biofuel pellets produced by cattail harvesting in Lake Winnipeg, whereas there is a strong market for nutrient trading in Chesapeake Bay. Given the strengths and weaknesses of each policy instrument, it follows that a strategic blend of all three is necessary.

IV. CONCLUSION

Watershed managers are increasingly adopting watershed management plans that integrate reflexive law strategies. The strategy they select depends on the features unique to that watershed, such as geographical, economic, and political features. The appropriate strategy and policy instruments also depend on whether the water is already heavily polluted and needs significant restoration. The above case studies offer helpful illustrations of some of the various ways to managers can adopt such an approach to address agricultural runoff to water bodies.

Reflexive law-based watershed management plans are comprised of three major tenets: (1) adaptive management; (2) foundations in good science; and (3) human participation. Each of these components can take many forms and the case studies illustrate some of the methods available to watershed managers.

Adaptive management is management that explicitly embraces self-conscious experimentation in its own design. The case studies take different approaches for experimentation: the Chesapeake Bay Program, Everblue Massawippi, Lake Winnipeg bio-economy project, and the Kezar Lake restoration project all set operational goals and benchmarks and conducted monitoring to adjust these goals as necessary. However it is worth noting that these watersheds use different media to set the goals. For example, goals are set by the state governments in Chesapeake Bay, whereas they are set by a watershed association in the Lake Massawippi watershed. The Sacramento Valley Water Quality Coalition takes an entirely different approach. Instead of setting benchmarks and goals for its participants, the Coalition sets up a forum in which the participants and local stakeholders can exchange their own information about particular goals and means. These case study variations demonstrate that although adaptive management may take many forms, it is the regular re-evaluation and

experimentation that is necessary in implemented this ecosystem-based management component.

The second component of a watershed management plan is for the plan to have foundations in good science. All of the case study watersheds use good science by drawing their boundaries by hydrology rather than jurisdiction. The Lake Winnipeg and Kezar Lake projects also demonstrate their foundations in good science by their focus on the connections between the nested systems within the watershed: they both use vegetation to absorb excess phosphorus and the Kezar Lake project even manipulated upstream wetlands in acknowledgement of their connection with the Lake. The Chesapeake Bay Program, Sacramento Valley Coalition, and the Quebec Government instead take the 'Russian doll' approach of nested management regimes to delegate responsibility to the organisation closest to the environmental harm and coordinate actors to resolve these problems.

The case studies also all comprise the third component of a watershed management plan: human participation. Each case study has different stakeholders and thus, the method for collaboration varies. The collaboration high watermark, however, occurs in Sacramento Valley via the Coalition. The Coalition is premised on collaborative decision-making and it exists primarily to provide agricultural producers other local stakeholders with a forum for discussing goals and means for attaining them. The other case studies provide processes for broad voluntary participation in decision-making, whereas California agricultural producers must either seek a permit or join the Coalition. No other requirements are imposed on producers once they have joined, but the Coalition provides the forum in which producers can learn from successful producers and in some instances, exert peer pressure on each other to improve.

Each case study differs in approach, but they all incorporate the three features of a reflexive law-based watershed management approach. The fact that each watershed plan differs is a strength of the watershed management approach because it allows for flexibility in response to the needs of each watershed. Savvy watershed managers can look to other watersheds for innovative ideas and mix-

and-match the policies best suited for their particular circumstances. Tailoring a successful approach for other watersheds, including Lake Champlain and Lake Erie, will depend on the geographical, economic, social, and political features of those particular watersheds.

CONCLUSION

Harmful algal blooms are a serious water quality concern for freshwaters globally and scientists predict that their occurrence will only increase as a result of climate change impacts. However, this is a relatively straight-forward environmental issue with a relatively clear solution, which makes it an issue on which we can act fast. Given our scientific understanding of the issue, it is baffling that our legal efforts to address it continually fall short. Thus, the issue provides an ideal lens through which we can examine the gulf between environmental structures and legal regimes.

Lake Erie legislatures made headway in reducing phosphorus inputs in the early 1970s. They imposed strict regulations on industrial pollution sources and saw the phosphorus levels drop as a result. But these regulations are no longer adequate in light of aggravating climate change impacts and the reality that industrial source are down to minimal phosphorus contributions. As legislatures are well aware, their focus must now turn to nonpoint source pollution and agricultural runoff in particular.

Unfortunately, our current legal regime is a poor fit for regulating agricultural runoff. At present, we rely predominantly on command and control regulations that set and enforce environmental standards via industrial permitting. Agricultural runoff is diffuse and impossible to trace back to a single source, which makes a permitting system difficult, if not impossible. Indeed, for command and control regulation to be effective in curtailing agricultural runoff, enforcement officers would need to keep a constant eye on each agricultural producer to ensure the producer is using best management practices—an impracticable task with enormous administrative costs. In addition, the costs associated with the installations necessary for small farms to come into compliance may drive them out of business or force them to remain non-compliant. However, reflexive law theory offers a way for legislatures to supplement our current legal regime and compensate for its shortcomings.

Reflexive law strategies have the potential to encourage actors to engage in more environmentally sound goals. The concept underlying reflexive law is

that actors will self-regulate if their individual goals align with societal goals. It follows that the legislatures' task is to convince agricultural producers that it is in their best interest to reduce phosphorus runoff.

There are several types of policy instruments designed to align individual interests with societal interests. There are market-based strategies that reward good actors with subsidies or penalise polluters with taxes. Another policy instrument creates a nutrient trading programme in which nutrient contributors can find the most efficient way to stay under the pollution limit. Certain information-based strategies use a 'name and shame' method to encourage actors to improve their practices and other information-based strategies reward good behaviour with a stamp of approval that is attractive to consumers. And communication-based strategies rely on social pressures to encourage environmentally-sound behaviour. The underlying theory of these strategies is that if you know your neighbours better, you will be invested in those relationships and more aware of how your practices impact their well-being. In addition, you will be reassured that you are not the only one making expenditures to install best management practices.

Currently, both Lake Champlain and Lake Erie watershed managers are dabbling with reflexive law strategies. Lake Champlain Basin agricultural producers who implement best management practices are eligible for subsidies and legislatures in the Lake Erie Basin have set up several information-based programmes for identifying research priorities, setting operational goals, and assigning responsibilities to local agencies. These efforts are a solid start, but there are additional reflexive law strategies these managers could use.

A. Potential Reflexive Law Strategies for Lake Champlain

The bulk of the Lake Champlain watershed lies in the State of Vermont, which is a state known for its culture of stewardship and amity between neighbours. In fact, there is even an annual state holiday that exists for the sole purpose of allowing residents the time to attend their local town meetings. Given this local culture, it is likely that a communication-based strategy such as local policy networks similar to the Sacramento Valley Water Quality Coalition could

work for the Lake Champlain watershed. Indeed, there is already a social movement advocating greater communication between farmers and stakeholders. According to Jane Clifford, president of the Green Mountain Dairy Farmers' Cooperative, "Getting farmers and other members of the community talking to one another, rather than at one another, is critically important. [Harmful algal blooms in Lake Champlain are] everyone's challenge and opportunity. Farmer to farmer, how do we help our neighbors implement good practices? Use honey, not vinegar."[497]

In order to ensure farmers participate in such a coalition, legislators could require farms to choose between having to seek a permit from the state and participating in a coalition. In California, agricultural producers in Sacramento Valley were required to make such a choice and most chose to join the Sacramento Valley Water Quality Coalition that has since been lauded for its success in reducing pesticide runoff. Although this coalition has been praised as successful, it is important to note that there are only few studies that have been conducted on this organisation. Although the State of Vermont could certainly enact a similar statute as a means for ensuring local producers would join in such a coalition, it is necessary to first conduct further research to determine the methods the coalition used to require participation beyond merely showing up at the meetings.

However, previous coalition attempts in Vermont have shown agricultural water quality experts that coalitions achieve higher rates of success in membership if the founding members are farmers themselves rather than the state.[498] As a result, the watershed jurisdictions should seek ways to encourage farmers to initiate such coalitions. One method may be by using outreach to educate farmers of the success similar coalitions have enjoyed. Another could be to offer legal protections to farmers who are part of such a coalition if the

[497] Cindy Ellen Hill, "Cows, corn and cash: Lake Champlain water quality studies net frustration" *VT Digger* (6 May 2012), online: <http://vtdigger.org/2012/05/06/cows-corn-and-cash-lake-champlain-water-quality-studies-net-frustration/>.
[498] Interview of Marli Rupe, *supra* note 12.

coalition facilitates certain base level requirements, such as aid in implementing best management practices.

Eco-labelling offers another potential reflexive law strategy for Lake Champlain managers. The Forest Stewardship Council's certification programme has paved the way for future certification programmes. The programme could be designed so that producers would have to prove to a third party that they engage in particular environmentally-sound practices before they receive certification. For example, producers could provide proof to a non-governmental organisation that they meet both the AAP requirements and best management practices and receive recognition in the form of an eco-label. The organisation could certify the farm's environmentally-friendly practices and issue a label that the farm's products could bear or a sign that could be hung at the farm itself. The sign at the farm itself would be a better option for farms that sell their products to vendors outside the State of Vermont. It is likely that many producers already meet these requirements and therefore would meet the certification requirements upon the commencement of such a programme.

This strategy is dependent on adequate marketing and public relations in order for consumers to understand the relationship between the food they purchase and the quality of Lake Champlain. Moreover, the public has to understand the benefits of protecting Lake Champlain's water quality in order for an eco-labelling system to work. However, local newspapers devote a significant amount to the HAB issue, the phosphorus loading, and agricultural contributions to the problem. As a result, it is likely that such marketing would not require much effort. Moreover, farms that have put best management practices into place are likely defensive about their publicly-perceived contributions to the HAB problem and would welcome the opportunity to advertise their practices.

Finally, the State of Vermont could place a tax on nutrient-rich fertilisers and manure. The relatively-low costs of fertilisers and the high costs of insufficient spreading have encouraged farmers to over-produce and over-spread. Levying a tax on the product would help bring the incentive structure back into

balance and give farmers an incentive to strive for a zero phosphorus balance.[499] There are currently fees on fertiliser and pesticide purchases,[500] but they have been criticised for being too low to have much of a Pigouvian effect on farmers.[501] Manure could also be taxed by requiring farmers to report the amount of manure they spread on their land and charging them relative taxes based on the quantity of manure spread, the time of year in which it was spread, and the quality of the soil on which it was spread.

B. Potential Reflexive Law Strategies for Lake Erie

Lake Erie has a different economic and political structure from Lake Champlain and thus, different reflexive law strategies are appropriate. Lake Erie has certain similarities to Chesapeake Bay—namely the presence of industry—and therefore a nutrient trading programme may be an appropriate reflexive law strategy. As discussed in Chapter Two, the drop in phosphorus inputs from point source polluters but steady figures for nonpoint source polluters implicitly indicates the command and control regulations enacted in the early 1970s were successful in reducing point source inputs but failed to reduce nonpoint source inputs. The Chesapeake Bay Program created a market to compensate for its own version of this dilemma by setting a cap on the amount of phosphorus that can reach the bay and allowing point source polluters to trade with nonpoint source polluters. This tactic runs a risk that point source polluters will pay agricultural producers to engage in best management practices that may never occur, but the programme also has the potential to allow actors to find the most efficient way to reach a particular nutrient goal.

Lake Erie legislators could adopt a similar nutrient trading programme to allow its industry polluters to purchase credits from nonpoint source polluters. As discussed in Chapter Three, legislators would need to adequately reduce the uncertainty of nonpoint source pollution in order for the programme to be successful. Lake Erie managers could reduce such uncertainty by implementing a verification and certification programme where the nonpoint source polluters

[499] Guercio, *supra* note 9 at 525.
[500] 6 V.S.A. §§ 361-379 (2010).
[501] Guercio, *supra* note 9 at 531-532.

reported their plans to implement best management practices to either a third party or a state agency. Another way Lake Erie managers could reduce the uncertainty is by using trading ratios that recognise areas of the lake with the highest pollution. Credits from farms near Lake Erie's most polluted sections would be worth more than credits from farms near Lake Erie's healthiest regions. As a result, industry polluters would seek to purchase credits from the areas that most require improved land use practices.

Lake Erie legislatures could also adopt a Pigouvian approach and provide subsidies to actors who demonstrate they use environmentally sound practices and/or tax behaviours that legislatures determine are environmentally harmful (e.g., failure to implement best management practices). Although taxes may appear to be more draconian than subsidies, subsidies carry the unique advantage of flipping the evidentiary burden by requiring actors to prove they have earned them. Consequently, subsidies' administrative costs are much lower than for taxes, although it is arguable that the revenue gained from taxes counters their administrative costs.

A simple information-based requirement like Quebec's annual phosphorus reporting requirement, discussed in Chapter Three, or the Toxic Release Inventory, discussed in Chapter One, may provide Lake Erie legislatures with an additional tool for encouraging actors to implement best management practices. Legislatures could require agricultural producers to provide an annual phosphorus balance sheet, which could then stay on file with a government agency or be posted publicly. The information would then be available to the agency that could, for example, compile the reports to determine whether a nutrient trading programme cap is being exceeded. Allowing the public to access the data may place additional pressures on actors to improve their practices, especially if the data receives enough attention from the press.

There are many other ways to employ reflexive law strategies to address agricultural runoff and these are just a few of the suggestions for how Lake Champlain and Lake Erie legislatures might proceed to adopt additional policy instruments. In selecting the appropriate reflexive law policy instruments,

legislatures must consider the unique economic, societal, geological, and political features of their jurisdiction and tailor the policy instruments accordingly. Furthermore, further studies are needed before we can truly understand the effectiveness of these policy instruments. However, the low administrative costs of many of the reflexive law policy instruments suggested make them ideal options in times of tight state budgets. Many legislatures may balk at the idea of giving up enforcement and so it is useful to begin by applying reflexive law policy instruments to currently unregulated industries first, such as the agricultural community. As these policy instruments prove themselves to be workable and efficient, legislatures can then begin implementing them to address a wide range of environmental issues.

Like the Little Dutch Boy, legislatures have the opportunity to act fast to solve environmental issues that are well-understood scientifically while waiting for reinforcements (in the form of further studies on climate change impacts and other less understood environmental issues). The HAB issue is one example of an environmental concern poised for a swift resolution and legislatures should plug this hole immediately. Given the comparatively low cost to implement reflexive law policy instruments, legislatures have relatively little to lose by their implementation, but much to lose if we continue with our inadequate environmental legal regime. We may be unable to prevent all of the planet's environmental threats by using reflexive law policy instruments, but they provide legislatures with a means for plugging the hole to stave off disaster. As the Little Dutch Boy parable illustrates, staving off disaster does not require a perfect solution, but rather prompt and decisive action. The time has come for legislatures to act—and act fast.

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