

# THE COASEAN FRAMEWORK OF THE NEW YORK CITY WATERSHED AGREEMENT

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Over 50 years ago, in “The Problem of Social Cost,” Ronald Coase (1960) attempted to reorient the economics profession’s treatment of externalities. He wanted to draw economists’ attention away from the world of pure competition as a policy standard and investigate the consequences of transaction costs and property rights for the operation of markets. In 1991, he was awarded the Nobel prize in economics “for his discovery and clarification of the significance of transaction costs and property rights for the institutional structure and functioning of the economy” (Royal Swedish Academy of Sciences 1991). The Academy cited both his 1960 article and his 1937 article “The Nature of the Firm.”

Still, critics question both the relevance and applicability of the Coasean framework for analyzing, explaining, and ameliorating harmful effects associated with economic activities, reflecting the degree to which the profession’s treatment has remained unchanged. Nalebuff (1997: 35–37), for example, has argued that for environmental problems “as the scope of the externality affects more and more people, it becomes increasingly difficult to assign property rights.” Moreover, “even when property rights have been assigned, exclusion is difficult

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if not impossible.” In this article, we argue that the New York City Watershed Memorandum of Agreement (MOA) proves the usefulness of the Coasean framework—even when there are a large number of affected parties from nonpoint source pollution.

In 1997, nearly a decade after the Environmental Protection Agency ordered New York City to filter its water to remove contaminants originating in upper New York State watersheds, NYC entered into a MOA involving the State of New York, a number of local governments and environmental groups in the Catskills, and the EPA. In Coasean terms, the MOA is the consequence of the State of New York’s assignment of property rights to the Catskill/Delaware Watershed communities to continue with regional development and current practices, although some of those activities degrade NYC’s drinking water. This rights assignment positioned NYC as the responsible party for initiating negotiations and programs protecting the Watershed system. Once responsibility was established, NYC opted to buy lands contributing to water quality degradation (for example, farmlands on riparian corridors), instead of building a multibillion-dollar filtration system. Residents and landowners upstream were compensated for development restrictions incurred from the MOA. New York State’s role as mediator eliminated bargaining barriers and effectively reduced the transaction costs of arranging negotiations, demonstrating potential economic benefits to all parties, and providing alternative options to unilateral regulatory decisionmaking.

## Externalities and the Pigouvian Tradition

Externalities exist when the effects of a transaction between two parties spill over to nonparticipants. Effects can be either beneficial (positive externalities) or harmful (negative externalities) to nonparticipants. When externalities are unaccounted for in the decision-making of the participants, transactions will result in either “too much” or “too little” consumption or production. This very language, which economists use, derives from modern welfare economics founded on Pigou’s extension of marginal analysis to the utilitarian market-failure analysis of J. S. Mill and Henry Sidgwick (Medema 2009).

In the history of welfare economics, the classical approach to solving negative externality problems, such as pollution, was through the use of regulation, or what Mill (1871) termed “authoritative” solutions, “in which certain types of conduct are prescribed or proscribed”

(Medema 2009: 37). Sometimes referred to as “command and control” policies, authoritative solutions prohibit firms from producing a negative externality, require a certain standard of emissions of a negative externality be reached, or require firms to employ specific externality-reducing technologies, all backed by legal penalties. The costliness and difficulty of obtaining information tailored to specific firm production methods, in conjunction with the nondiscriminatory or universality requirement of legal standards, generally yield uniform standards across all firms in an industry. Yet, this type of policy response often imposes solutions that are more costly than alternatives, inhibit innovations in pollution-reduction technologies, and deter economic growth (Marlow 1995, Davis 1992).

Modern welfare economics, based on the work of Pigou in *The Economics of Welfare* (1932), offers “corrective” taxation as another solution. Pigou raised the solution specifically in relation to spillovers, where he assumed there was a divergence between private and social net products. Pigou (1932: 174) also addressed spillovers due to “the separation between tenancy and ownership of certain durable instruments of production.” This divergence, he believed, could be removed by renegotiating the landlord-tenant contract. However, Pigou (1932: 192) argued that spillovers could not “be mitigated by a modification of the contractual relation between any two contracting parties, because the divergence arises out of a service or disservice rendered to persons other than the contracting parties.” He did not address the reasons why a contract could not be concluded by the contracting parties with those “persons other than the contracting parties.”

The Pigouvian tax solution to a pollution externality places responsibility on the firm producing the pollution. The government then imposes a tax on emissions of a magnitude equal to the divergence between social and private marginal costs, so that the external costs are internalized into the decisions of the polluting firm. Pigouvian taxation differs from authoritative regulation because firms that pollute above a set amount are forced to pay an emissions tax.<sup>1</sup> Although Pigouvian taxation reduces pollution at a very low cost, there are problems that may arise. First, Pigouvian taxation will achieve pollution reduction only as long as the tax level is set equal to or above the marginal cost of abatement (MCA). In the event the tax rate is set

<sup>1</sup>An alternative to taxation is a subsidy of the appropriate magnitude. For brevity, this alternative is not presented.

below the MCA, pollution reduction will not take place. Second, because some firms may have “modern, well-maintained pollution control equipment,” while other (typically, older) firms possess outdated pollution control equipment, it is inefficient “for all firms to carry identical burdens” (Marlow 1995: 96). Third, even if those harmed by the pollution are compensated from corrective taxes, further complications may arise. Compensation is bound to be difficult when not all affected parties suffer from the problem equally. Fourth, it is costly to discover the appropriate level of the corrective tax, and the information costs may exceed the benefits from implementing the Pigouvian tax. Fifth, “compensation policies may also create a perverse incentive for individuals or firms to move into areas for the sole purpose of receiving compensation payments” (Marlow 1995: 96).

In sum, Pigou’s analysis in both *The Economics of Welfare* and his earlier *Wealth and Welfare* (1912) provided a list of examples where self-regarding behavior creates divergences of private and social net product (benefits, costs) providing “a strong sense that market failure is a pervasive problem” (Medema 2009: 64).<sup>2</sup> The Pigouvian framework, as further developed by Bergson (1938), Lange (1942), Meade (1952), Graaf (1957), and Bator (1958) in mathematical form, gave to modern welfare economics a seemingly powerful tool and standard for welfare improvement:

The rhetorical, persuasive force of this analysis should not be underestimated. What this theory demonstrated, in a nutshell, was that perfect markets work perfectly, imperfect markets work imperfectly, and perfect government can cause imperfect markets to also function perfectly. This became the textbook model [Medema 2009: 76].

## The Coasean Argument and Framework

For Coase, the Pigouvian framework fails on several grounds, but most fundamentally, he notes:

Analysis in terms of divergencies between private and social products concentrates attention on particular deficiencies in

<sup>2</sup>To be fair to Pigou, however, Medema has recovered a “lost” or, at least, relatively unknown essay that Pigou wrote in 1935 entitled *State Action and Laissez-Faire*. Therein, Pigou’s examples of market failure produced by the existence of external benefits or costs are balanced by a consideration of problems in carrying out governmental solutions.

the system and tends to nourish the belief that any measure which will remove the deficiency is necessarily desirable. It diverts attention from those other changes in the system which are inevitably associated with the corrective measure, changes which may well produce more harm than the original deficiency [Coase 1960: 42–43].

What is necessary, according to Coase (1960: 34), is an approach comparing the total social product of alternative measures that gives attention to alternative specification of property rights and the transaction costs associated with different property rights regimes. He rejects the Pigouvian framing of the problem in terms of “restraining the producer” of the negative externality:

We are dealing with a problem of a reciprocal nature. To avoid the harm to B would inflict harm on A. The real question that has to be decided is: should A be allowed to harm B or should B be allowed to harm A? The problem is to avoid the more serious harm [Coase 1960: 2].

Indeed, making “restraining the producer” the problem to be solved dictates the solution—whether making the producer liable for damages, imposing a tax, offering a subsidy, or restricting the producer’s location. Such “solutions” take for granted that restricting the producer causes less harm than restricting the recipient. Coase (1960: 3) contends that the Pigouvian “courses of action are inappropriate, in that they lead to results which are not necessarily, or even usually, desirable.” According to Coase (1960: 3), “If we assume that the harmful effect of the pollution is that it kills the fish, the question to be decided is: is the value of the fish lost greater or less than the value of the product which the contamination of the stream makes possible.”

If the proper procedure is to compare the total social product of alternatives, then the assignment of property rights matters. However, Coase shows that the assignment of property rights or the assessment of damage liability only matters in a world of positive transaction costs (that is, the world we actually inhabit):

The argument has proceeded up to this point on the assumption . . . that there were *no costs involved in carrying out market transactions*. This is, of course, a very unrealistic assumption. In order to carry out a market transaction it is

necessary to discover who it is that one wishes to deal with, to inform people that one wishes to deal and on what terms, to conduct negotiations leading up to a bargain, to draw up the contract, to undertake the inspection needed to make sure that the terms of the contract are being observed, and so on. These operations are often extremely costly, sufficiently costly at any rate to prevent many transactions that would be carried out in a world in which the pricing system worked without cost [Coase 1960: 15; emphasis added].

And yet, the Pigouvian framework is firmly anchored within a world of zero transaction costs. In order to identify or measure the divergence between private and social costs (benefits, or net product), it is assumed that all necessary information is known, or at least knowable, by the outside observer, regulator, politician, or welfare economist at zero cost—a result of what Coase terms “blackboard economics” where “all the information needed is assumed to be available and the teacher plays all the parts” (Coase 1988: 19). Following Hayek (1945: 519), one might add that such information is best produced by market participants through individual interactions within the price-forming market process.

In a world of positive transaction costs, institutions matter, especially in the delimitation of property rights. Two questions arise regarding rights which Coase takes up in sections VI and VII, respectively, of *The Problem of Social Cost*: First, taking the initial specification of rights and the costs of market transactions as given, what possible changes in the economic environment can produce more efficient results? Second, what considerations will make the initial delimitation of rights more favorable to efficient results?

Aslanbeigui and Medema (1998) illustrate three possible solutions to the problem of externalities as outlined by Coase, *if participants find it too costly to reallocate resources through contracts/markets*. The first solution, in the case of producer-producer externalities, would be to have a single owner take into account “all costs (internal and external) and allocate resources in that light.” By doing this, the “allocation of resources by administrative fiat would allow the firm to overcome the transaction costs concerns that attend the use of the market” (Aslanbeigui and Medema 1998: 604). One way of alleviating the problem of externalities would be for the two separate firms to merge so that the externality is internalized and at a cost much less than if regulatory policies were instated. However, Coase (1960: 16)

recognizes that “it does not, of course, follow that the administrative costs of organizing a transaction through a firm are inevitably less than the costs of the market transactions which are superseded.” In addition, if consumers are involved, this remedy would not suffice. In cases

which may affect a vast number of people engaged in a wide variety of activities, the administrative costs [of firm organization] might well be so high as to make any attempt to deal with the problem within the confines of a single firm impossible. An alternative solution is direct government regulation. Instead of instituting a legal system of rights, which can be modified by transactions on the market, the government may impose regulations which state what people must or must not do and which have to be obeyed [Coase 1960: 17].

However, Coase (1960: 17) notes that while government has powers that might get things done at a lower cost than firms, the administrative costs of government itself can be “extremely costly.” Restrictions made by fallible humans subject to political pressure without competitive checks are unlikely to increase economic efficiency. He concludes that

direct governmental regulation will not necessarily give better results than leaving the problem to be solved by the market or the firm. But equally there is no reason why, on occasion, such governmental administrative regulation should not lead to an improvement in economic efficiency. This would seem *particularly likely when . . . a large number of people are involved* and in which therefore the costs of handling the problem through the market or the firm may be high [Coase 1960: 17; emphasis added].

While authoritative regulation of externalities is not likely to give better outcomes than markets or firms, it is more likely to do so in situations involving large numbers and high transaction costs.

In light of the imperfections of firms and authoritative regulation, Coase (1960: 17) suggests that a third solution might sometimes be best: “to do nothing about the problem at all.” This is the equivalent of the policy conclusion derived from what is sometimes referred to as the “Coase Theorem,” except that here it is derived not from an artificial assumption about transaction costs, but a comparative

analysis of the costs of organizing activity through the voluntary arrangements of markets and/or firms versus authoritative regulation. A policy of “doing nothing” is tantamount to leaving market participants to decide whether or not the costs of rights rearrangements exceed the benefits from rearranging those rights through market exchange. Coase argues that neither the Pigouvian solution of taxation nor the classical solution of authoritative regulation is necessary if transaction costs are low, allowing for an agreement that benefits all involved parties. Transaction costs are key, because even in the face of externalities, an efficient outcome can occur through bargaining as long as costs do not outweigh gains.

This conclusion leads to a consideration of the original delimitation of rights. When private parties find it too costly to rearrange rights via market transactions, courts and legislatures directly influence economic outcomes by their decisions on who holds what rights. Those decisions influence both the allocation of resources and the distribution of income and wealth. Coase presents evidence that courts and legislatures in both Britain and the United States have often understood this aspect of their decisions and have taken the economic implications of their decisions into account. Moreover, Coase (1960: 19) notes that “even when it is possible to change the legal delimitation of rights through market transactions, it is obviously desirable to reduce the need for such transactions and thus reduce the employment of resources in carrying them out.” Likewise, “while statutory enactments add to the list of nuisances, action is also taken to legalize what would otherwise be nuisances under the common law” (Coase 1960: 28). On this latter point, Coase is once again highly critical of the “blackboard economics” approach of modern welfare economics and economists who too quickly see an externality as a result of market failure “requiring corrective government action [that] is, in fact, often the result of government action” (Coase 1960: 28).

“The Problem of Social Cost” was Coase’s attempt to get economists to pay renewed attention to the actual institutional framework within which economic decisions are made and economic activities are coordinated through markets and firms. He focused on how transaction costs altered the economic analysis suitable to mitigating harmful effects. His analysis stemmed from his earlier work on the Federal Communications Commission, which identified the factors that prevent efficient allocation of rights and resources generally

(Coase 1959: 27, n. 54). Coase clearly showed that the Pigouvian basis of modern welfare economics and its concentration on divergent private and social margins was inadequate for the task. Unless the role of transaction costs are made explicit, the policy responses derived from Pigouvian analysis will continue to be inappropriate and often undesirable.

## Responses to Coase

The response of economists to “The Problem of Social Cost” has almost uniformly been centered on the proposition that quickly came to be known as the “Coase Theorem,” rather than the argument Coase was making concerning the comparative evaluation of institutional frameworks. The Coase Theorem is typically presented as a proposition about a zero transaction cost world. In what is regarded as the first expression of the theorem, Stigler (1966: 113) stated: “Under perfect competition private and social costs will be equal.” Medema (2009: 177) gave an alternative rendition: “If rights are fully specified and transaction costs are zero, parties to a dispute will bargain to an efficient and invariant outcome regardless of the initial specification of legal rights.” There are two explicit assumptions and two results embodied in his specification of the theorem. The explicit assumptions are (1) full specification of rights and (2) zero transaction costs. The results are (1) Pareto efficiency and (2) invariance as to the initial rights distribution. Some discussions of the theorem are concerned with both results, others with just one (typically Pareto efficiency). Many discussions inadequately render the explicit assumptions and “can be dismissed under appropriate (some would argue ‘correct’) conceptualizations of the meaning of fully specified rights and zero transaction costs” (Medema 2009: 179).<sup>3</sup>

<sup>3</sup>In *The Applied Theory of Price*, McCloskey (1985: 335–39) correctly (in our view) identifies the “Coase Theorem” as follows: “In the presence of transaction costs the location of a pollution tax or of other liability for damages *does* matter for efficiency.” McCloskey also importantly emphasizes that traditional Pigouvian taxation schemes, by using damages rather than the appropriate minimum opportunity cost of abatement, are inefficient. Finally, McCloskey observes that what the profession usually terms the “Coase Theorem” is really nothing more than “Adam Smith’s Generalization” that if everything is owned and transactions are costless, then efficiency is obtained (“the Invisible Hand theorem”). The attempt to draw attention to Coase’s central message and away from Pigouvian analysis, unfortunately, has been resisted by the profession as a whole.

The primary criticisms directed at (these versions of) the Coase Theorem point to its limited applicability and a restrictive set of assumptions without which the theorem breaks down. Canterbury and Marvasti (1992: 1180) argue that the theorem “borders on circularity” because externalities arise due to transactions costs, but externalities persist because of the transaction costs of removing them, leading to “Ptolemaic epicycles extending the ‘Coase Theorem.’” Cooter (1982) questions the existence of a Coase Theorem because Coase never stated the theorem and other economists have generalized the examples developed by Coase. Further, Cooter argues that in the absence of a third party’s coercive force, parties will react to the harshest threats, so political power plays an enormous role in negotiation and may prevent efficient results. Samuelson (1963) contends that even in a zero transaction cost world, bilateral monopoly could prevent efficiency. Coase (1988: 161) responded that he believed “the proportion of cases in which no agreement is reached will be small,” and has been faulted for not using real-world examples in support of this assertion (Black, Grant, and Islam 2008: 2). This is but the tip of the iceberg of a vast literature, much of which seems irrelevant to the world of positive transaction costs. This literature is dealt with at some length in Medema and Zerbe (2000).

David Friedman (1990) offers a defense of Coasean bargaining in a world of positive transaction costs, using the case of airplane noise plaguing a nearby residential area. Alternative solutions, Friedman suggests, are mandating airlines to make quieter planes, closing the airport when residents are sleeping, or soundproofing homes. “Charging the airlines for the cost of the noise they produce gives them an incentive to reduce noise, but that may be the wrong solution—it might be less costly to soundproof the houses or pay their occupants to move out.” Unfortunately, when information is costly, it may be impossible to actually tell what will be the best solution for all of the parties involved. Since both parties essentially produce the problem, Friedman (1990) argues:

Where we do not know who can solve the problem at lowest cost, the best solution may be to fall back on Coase’s other idea: negotiations between the parties. . . . [T]he best solution to such problems may be for the legal system to clearly define who has the right to do what and then permit the affected individuals to bargain among themselves.

Regardless of whether the airline is held liable for noise damage or not, using Coasean bargaining may be the only way to discover the relevant alternatives toward finding a solution. Costly bargaining is preferable to uninformed guesses that mandate particular solutions, and may bring about a more efficient outcome once property rights are assigned. Using Coasean bargaining to resolve this issue will result in a more efficient allocation because whoever values the land the most will pay to use it.<sup>4</sup>

Criticisms of the viability of bargaining solutions within a Coasean framework, especially in addressing negative externality problems such as pollution, have been numerous. Some critics stress that it matters who owns the property rights in environmental pollution cases and that it may be difficult to assign such rights (Samuelson 1995, Abrego and Whalley 2004). Others point out that we do not live in a zero transaction cost universe (Varian 1995, Nalebuff 1997, Anderlini and Felli 2006). Moreover, Tybout (1972) argues that even in a zero transaction costs model, bribery to reduce pollution and compensation charges for it result in different total profits, so that long-run behaviors of parties may differ, negating any usefulness of the Coase Theorem. Frech (1973) refutes Tybout, arguing that zero transaction costs are based on a fundamental error in the analysis of costs for the polluting and polluted industries. He holds that a property right to the polluted area is a valuable asset with a definite market value. Because of this, when the rent of this asset is properly included in the costs of the industry holding the right, both marginal and total profits are shown to be identical regardless of who is assigned ownership of the asset.

Many detractors of the applicability of Coasean bargaining to environmental spillovers draw on Meade's (1952) case of honeybees. Meade argued that because bees cannot be convinced to respect property rights or keep contracts, contracts cannot be practically applied. The only solution would be to either subsidize farmers who grow nectar-rich crops or simply accept the inefficiency in the joint production of crops and honey. Two later articles, by Cheung (1973) and Johnson (1973), demonstrated that contracts

<sup>4</sup>Cooter and Ulen (1997: 89) argue that "the normative Coase theorem" consists of the claim that law should be structured to minimize the impediments to bargaining.

between beekeepers and farmers had been common practice since early in the 20th century, and Cheung also showed that the evident pricing pattern is actually efficient.

Hoffman and Spitzer (1985) published a paper empirically proving the relevance of Coasean bargaining in situations where there are two or three parties bargaining. Subsequently, the authors extended their work to report the results of controlled experiments designed to test the theorem for larger groups—an issue on which there is very little empirical work. Using 4, 10, and 20 parties with full and limited information, they found 93 percent of the bargaining outcomes to be efficient and that there was no deterioration of the results as the bargaining groups got larger. Although there was some deterioration in moving from full to limited information, almost 100 percent of the full-information bargains were efficient (Hoffman and Spitzer 1995). One implication of this result is that policymakers should recognize the power of voluntary negotiations to overcome negative externality problems, even in the absence of government intervention. But more relevant for our purposes, these results support the applicability of Coasean bargaining for disputes involving large numbers.

The world of zero transaction costs is, as Coase (1988: 15) remarks, “the world of modern economic analysis, and therefore economists feel quite comfortable handling the intellectual problems it poses.” Once transaction costs are recognized to exist, however, the evaluation of alternative economic arrangements for possible improvement must include a comparison of those costs. This is the basis for Coase’s argument for comparative institutional analysis and also the basis for his critique of Pigouvian taxation as a policy norm.

The Coasean framework has given rise to strong views both for and against its applicability. But the main weakness on the side of its supporters has been the scarcity of real-life scenarios of large number negative externalities where private Coasean bargaining resulted in externality mitigation. While a literature has developed in which “an assortment of cases . . . illustrates the voluntary internalization of externalities (both positive and negative) in history” (Higgs 2005: 407–08), no clear case of pollution mitigation involving large numbers of geographically dispersed affected parties has been forthcoming. This has prompted continuing debate on policy alternatives relying on Pigouvian taxation or forms of authoritative regulation to correct for inefficiencies caused by such large-number externalities. Interestingly, one recent public bargaining outcome confirms the

validity of Coasean bargaining in large-number situations that also involves nonpoint source pollution—factors that are traditionally considered to be inimical to its applicability. An examination of the recent New York City Watershed Agreement is a material example demonstrating the cogency of Coasean bargaining in providing a private solution to a negative externality problem, with only a limited role for government as mediator. In this solution, there was no need to implement any taxes, fees, or even “green payments” (Wu and Babcock 1996) to internalize the externality, as is the norm in addressing agricultural nonpoint source pollution.

### History of the New York City Water Supply System

Unlike most other cities that rely on ground water, modern New York City is one of the few places in the world where the water comes from surface sources—namely, the Croton or East of Hudson (EOH) and the Catskill/Delaware or West of Hudson (WOH) watersheds in upstate New York. Together, these two watersheds comprise 19 reservoirs and 3 controlled lakes, storing 580 billion gallons of water (Daily and Ellison 2002). Early settlers of NYC obtained water for domestic purposes from private and public wells, and beginning in 1800, the Manhattan Company pumped water into a reservoir. In 1830, a tank for fire protection was added. As the population grew and well-water became polluted, NYC looked for alternatives (NYC Department of Environmental Protection [hereafter DEP] 2012).

After exploring alternatives for increasing supply, NYC built and placed into service what is now known as the Old Croton Aqueduct, which carried water impounded from the Croton River, in what is now Westchester County, into the Old Croton Reservoir. Distribution reservoirs were located in NYC, with locations varying and number increasing over time. The New Croton Aqueduct, built from 1885 to 1893, was placed in service in 1890. The various water systems of the NYC boroughs were consolidated into the present water supply system. The New York State legislature created the Board of Water Supply in 1905, and the Board moved to impound the waters of Esopus Creek, one of four Catskill watersheds, and develop what is known as the Catskill System, which includes the Ashokan Reservoir and Catskill Aqueduct. This project was completed in 1915 and turned over to the NYC Department of Water

Supply, Gas, and Electricity for operation and maintenance. The Catskill System was completed in 1928 with the building of the Schoharie Reservoir and Shandaken Tunnel (NYC DEP 2012).

In 1928, the Board of Water Supply also received approval to develop the upper portion of the Rondout watershed and tributaries of the Delaware River within New York State. Work was delayed by a lawsuit brought by the State of New Jersey to enjoin NYC and the State of New York from using waters of any Delaware River tributary. The U.S. Supreme Court upheld NYC's right to augment its water supply from the Delaware River, and construction of the Delaware System began in March 1937, to eventually be completed in stages (Delaware Aqueduct, Rondout Reservoir, Neversink Reservoir, Pepacton Reservoir, and Cannonsville Reservoir) by 1964 (NYC DEP 2012).

New York City controversially used eminent domain to build reservoirs in the early and mid-20th century. Between 1907 and 1915, several hamlets were taken using eminent domain and used to build reservoirs, displacing roughly 2,000 people. Another 350 residents were displaced a few years later, and finally 1,500 more after WWII (Catskill Watershed Corporation 2005).

The system impounds water in three upstate reservoir systems and three controlled lakes. The three water collection systems have various interconnections to increase flexibility by permitting exchange of water from one to another. Localized droughts and excess water supplies of the three watersheds are thereby mitigated (NYC DEP 2012). The NYC water supply system, with its sources (the "Watershed") that span 8 counties and 60 towns (CCCD 1997, Art. I, Sec. 4-5), is generally regarded as a monumental hydraulic and civil engineering achievement that provides approximately 1.5 billion gallons of water daily to the customer distribution system.

## Background to the New York City Watershed Agreement

For many years, NYC's water has been among the highest rated in the nation for quality (USEPA 1996). The quality of the water coming from the surface sources of the WOH watersheds remained high, though concerns over development in the areas surrounding the watershed mounted. Development had particularly been a problem around the Croton system (which accounts for approximately 10 percent of the total supply), which was, by the early 1990s, already

filtered. In 1989, the EPA expressed concern about the developments around the NYC watersheds that were primarily driven by growth in tourism in the area. “In 1989, EPA’s Surface Water Treatment Rule (SWTR), issued under the federal Safe Water Drinking Act, required filtration of all surface water supplies (rivers and lakes) to protect against microbial contamination of drinking water” (USEPA 1996). Specifically, the regulation required that all surface water systems serving populations greater than 10,000 filter their water for microbial contaminants and reduce turbidity (USEPA 1989). New York City officials were already concerned about water quality when the EPA released the SWTR. In January 1991, the New York State Department of Health, acting as the EPA’s designated agency to carry out the Safe Drinking Water Act, ordered NYC to build a water filtration plant for the Catskill/Delaware system—the watershed that supplies 90 percent of NYC’s water. A filtration system, however, would come at a high price. New York City “estimated that it would cost from \$4 to \$6 billion to filter the Catskill/Delaware supplies, which would more than double current water rates” (CCCD 1997: 3).

The high cost of filtration created economic incentives for NYC to seek alternatives. The regulation also provided an alternative to costly filtration. The “requirement can be waived if a water system’s treatment processes and natural conditions provide safe water and if the watershed is actively protected to ensure that safety in the future” (USEPA 1996). In 1990, hoping to attain a Filtration Avoidance Determination (FAD), the Department of Environmental Protection for NYC drafted a Watershed Protection Plan that updated watershed rules, proposing regulatory changes to restrict construction of roads, parking lots, and storage facilities for hazardous substances and waste. NYC received a conditional FAD in January 1993. One condition of the FAD was that NYC issue final proposed Watershed regulations, begin to acquire land and conservation easements by June 30, 1994, and upgrade sewage treatment plants in the Watershed (CCCD 1997: 3). In addition, SWTR criteria required NYC “to show, through ownership or agreements with landowners, that it could control human activities in the watershed with the potential to harm the microbiological quality of the source water” (NYC DEP 2006: 3).

Acquiring the needed land or easements on land, and imposing new Watershed regulations would prove difficult, given that in 1991

only 27 percent of WOH land was publicly owned. Recalling NYC's use of eminent domain to build reservoirs in the early and mid-20th century, communities feared that the proposed plan would stifle economic growth and damage property values (NRC 2000: 26). These communities organized in 1991, forming the Coalition of Watershed Towns (CWT) comprised of more than 30 watershed towns, villages, and hamlets (CCCD 1997: 3), with the goals of ensuring proposed regulations would not prevent reasonable community development and limiting the regulations to the minimum needed to protect water quality (NRC 2000: 26). In late 1993, NYC filed an application for a water supply permit with plans to acquire watershed acreage and submitted to the EPA a long-term filtration avoidance program for the Catskill/Delaware System. Uncertainty over NYC's intent to use eminent domain and the perception by upstate communities that costs were being shifted onto them led the CWT and others to file lawsuits to prevent NYC's plans being implemented, leading to an impasse in efforts to reach a compromise on watershed management plans (NRC 2000: 27).

According to the 1990 plan, New York City assumed the right to regulate its watershed, pushing many of the costs onto the residents of watershed communities. The CWT, charged with protecting the interests of watershed communities, towns, villages, and hamlets, prevented this move through litigation. The State of New York had recognized the right of watershed communities and of private landowners in the watershed to be free of NYC regulation. Determined to pursue an FAD, New York City and the EPA asked the State of New York for help. In April 1995, Governor George Pataki organized a meeting among the involved parties (representatives from New York City, the EPA, the CWT, Putnam and Westchester counties, and others) to resolve the multitude of issues involving the Watershed (CCCD 1997: 4). New York City was desperate to strike a deal, while the watershed communities were not interested in making any deal that pushed costs onto them.

## The Coasean Framework of the New York City Watershed Agreement

New York City and the State of New York wanted to assure the continued supply of high quality water for the eight million residents of NYC, the one million New York residents outside the City who

depend on the watersheds, and the millions of tourists who visit each year. However, New York City neither wanted to invest in the installation of the multibillion-dollar filtration system nor to incur future stream maintenance and upgrade costs. NYC suggested environmental regulations be prescribed for upstream, thereby reducing potential contamination. NYC also needed the watershed communities to cooperate with new rules and regulations in order to obtain the FAD which would lower NYC's costs of meeting the SWTR.

Because of the strict requirements of obtaining the FAD, any agreement reached between NYC and the watershed communities would have to be comprehensive. With the watershed communities having been recognized as holding the property right, NYC would have to compensate them for costs imposed by new rules and regulations. The Hudson RiverKeeper Fund, a local environmental group, argued that environmental protection could not happen without a strong economy. Farmers in the regional communities, represented by the CWT, were already feeling burdened by previous watershed restrictions and wary of new implementations such as nonpoint source pollution limits. Residents in the watershed communities also did not want to pay for upgrading their septic systems, a proposal from previous negotiations. The potential gains on both sides from bargaining were high, considering the immense cost of the proposed filtration plant.

Arranging negotiations between affected parties appeared cost prohibitive. The scope ranged from individual landowners to the State of New York, from residents of villages to the masses of New York City, and from environmental groups to the federal government. The magnitude of suggested pollution control efforts was on the order of billions of dollars. Nonpoint source pollution and water's physical nature amplified the circumstances. Agricultural runoff containing pesticides and fertilizers was increasing. Outdated septic systems were deteriorating, spilling contaminants into the flow. The regional residents portrayed a relaxed and uninformed stance about water pollution. Many parties were responsible for the degradation of water quality, but few were accountable. Generally, NYC found fault with the upstream landowners and government's lack of regulation. The Catskills region confronted a financial burden of maintaining livelihoods while meeting regulations that provided benefits only downstream.

This problem traditionally would have been relegated to Pigouvian taxation, subsidization, or authoritative regulation due to the scope,

magnitude, and dispersion of the pollutants. However, Pigouvian taxation would have been ineffective because the contamination is diffuse, making it difficult to pinpoint the responsible party. Subsidization would have resulted in inefficient and uncertain allocation of funds. Further authoritative regulation would have been fraught with market inefficiencies, monitoring difficulties, and enforcement costs.

Given that the State of New York recognized the right of watershed communities and of private landowners in the Watershed to be free of regulation from New York City, the foundation of a Coasean bargaining solution had been laid. Within the scope of a Coasean framework, property rights were decidedly held by the watershed communities. In this case, the multiplicity of externalities and the high potential gains for all parties indicates Coasean bargaining—contrary to the limitations described in literature—could provide for a more efficient solution, with government-assisted mediation, creating a partnership toward parallel, compatible goals.

Governor Pataki's bringing together of the interested parties eventually led to an announcement on November 2, 1995, that the parties "had reached an *Agreement in Principle* outlining the measures that would be taken to maintain and enhance the quality of the City's drinking water supply, while protecting the economic vitality and social character of watershed communities" (CCCD 1997: 4). The EPA played an important role during negotiations, remaining flexible with temporary FADs while the negotiations were under way, though still monitoring the drinking water in NYC, to verify it was within compliance with the Safe Drinking Water Act. The Agreement in Principle built the foundation on which the 1997 Memorandum of Agreement was erected. Table 1 provides a timeline of the important events in the MOA history.

The Memorandum of Agreement is a legally binding agreement enforceable in court. It was officially signed and accepted in January 1997 and gave New York City the comprehensive watershed management plan it needed to fulfill the requirements of the SWTR and obtain a five year FAD. The EPA issued a five-year Filtration Avoidance Determination on May 6, 1997, requiring "New York City to acquire environmentally-sensitive land in the Watershed, adopt strong watershed rules and regulations and institute and maintain a comprehensive watershed protection program" (USEPA 2010). During the negotiations of the MOA, the EPA set the minimum

TABLE 1  
NEW YORK CITY WATERSHED MOA:  
TIMELINE OF IMPORTANT DATES

Year	Events
1986	The Federal Safe Drinking Water Act Amendments are signed into law.
1989	The U.S. EPA promulgates the Surface Water Treatment Rule, requiring that all surface water systems serving over 10,000 people filter their water or obtain an exemption by ensuring the protection and quality of their water.
1990	New York City's Dept. of Environmental Protection releases a draft of its plan to protect the quality of the water (the Watershed Protection Plan).
1991	Coalition of Watershed Towns (CWT) comprised of 30 watershed towns is formed in response to NYC's proposed watershed management plan.
1992	New York State declares New York City may not use eminent domain or regulate watershed community activities.
1993	Jan.: EPA grants New York City a temporary Filtration Avoidance Determination. Dec.: EPA grants NYC an FAD effective until Dec. 1996.
1995	Governor Pataki brings together the CWT, NYC, and EPA to discuss the problem. Agreement in Principle is reached between New York City and other identified stakeholders.
1997	Jan: Memorandum of Agreement is signed and formally accepted. May: NYC is issued a five-year FAD, with ongoing monitoring and evaluation of the watershed.
2000	EPA conducts mid-term review of the 1997 FAD, provides feedback to the City, and makes further recommendations.
2001	NYCDEP submits to EPA its 2001 Long-Term Watershed Protection Program.
2002	Original five-year FAD is re-examined. WAP is expanded, and further regulations are recommended on storm water treatment and WWTPs, among other things. NYC receives another five-year FAD from the EPA.
2006	EPA passes new regulation requiring UV filtration of drinking water to prevent cryptosporidium outbreaks. Construction begins on the new UV filtration plant.

*Continued*

TABLE 1 (*cont.*)  
 NEW YORK CITY WATERSHED MOA:  
 TIMELINE OF IMPORTANT DATES

Year	Events
2007	NYC releases 2006 Long-Term Watershed Protection Program, which promotes better stream management. EPA reviews the FAD, and again makes recommendations. NYC receives a 10-year FAD, with regular reviews to be conducted and ongoing monitoring.
2011	NYC releases 2011 Long-Term Watershed Protection Program, which pushes for better riparian zone protection along streams and rivers.

standards and regulations necessary for obtaining an FAD, and facilitated provisions in the MOA that would allow NYC to attain it.

The specifics of the agreement demonstrate how the State of New York worked on each involved party's behalf. This assistance, particularly by Governor Pataki, facilitated meeting arrangements and negotiation, thereby reducing total costs below the perceived gains that would be garnered by an amiable resolution. The State allowed NYC to make direct payments to affected counties totaling \$250 million, enhancing the regional economy while making NYC appear philanthropic. The MOA determined, also with the State's insistence, a requirement that NYC purchase vast amounts of land around the Watershed. This acquisition program deemed New York City responsible for its water quality and simultaneously averted its potential expenditure on a new water filtration facility. Finally, the State supported the watershed communities by creating programs such as the Catskill Fund for the Future, managed jointly by the Catskill Watershed Corporation (also created specifically for the Agreement) and the State Environmental Facilities Corporation.

The New York City Watershed Agreement's main components fall broadly under three themes: (1) the land acquisition program, (2) distinct watershed rules and regulations, and (3) protection and partnership programs. Additionally, the Watershed Agricultural Program provided incentives for farmers and ranchers to implement practices that reduce water pollution.

### *Land Acquisition Program*

The purpose of the land acquisition program (Art. II of the MOA) is for NYC to acquire fee title or conservation easements on important land in the Watershed on a volunteer basis limited to 300,000 acres total or 30 percent of the Watershed. The MOA specifically prohibits NYC from obtaining land through eminent domain (Art. II, Sec. 59) as well as ensuring that all land is acquired from willing sellers (Sec. 61). In the MOA, New York City committed to set aside \$250 million for the land acquisition program (Sec. 74 [a]), to pay fair market value for property acquired (Sec. 61), and to provide due notification to the town or village and appropriate county before commencing solicitation (Sec. 60). New York City is also required to pay local and county taxes on property acquired or a portion of taxes on land under conservation easement. The Agreement allows for development-limiting conservation easements to be purchased by NYC. Land near intakes into the water system or located in sub-basins are highest priority while land located further from reservoirs and intakes are low priority.

### *Watershed Rules and Regulations*

Article III of the MOA covers watershed rules and regulations on wastewater treatment plants to product use and storage. Article V creates several key partnership programs that administer NYC funds to the watershed communities and residents for the purpose of assisting them in observing the new regulations. These grants can be used to assist in upgrading and replacing equipment, or building new facilities necessitated by the new regulations. While the State of New York is responsible for enforcing the new restrictions, funds are available for upgrading septic systems, salt and other snowmelt material storage, as well as community education programs and forestry management programs. This portion of the Agreement served the original EPA stipulation for the City's drinking water standards. The regulations also require continued water quality monitoring and studies.

### *Watershed Protection and Partnership Programs*

The protection and partnership programs (Art. V of the MOA) comprise an array of Agreement-initiated projects for land management, waste treatment, economic development, and education, each

cluster having access to financial aid. Many of the opportunities provide assistance creating best management practices for land and resource management. The MOA allocates \$75 million for new sewage treatment infrastructure facilities for towns, villages, and hamlets. The Catskill Water Corporation (CWC) is allocated \$3.5 million to fund its operating expenses, and administer or consult for New Sewage Infrastructure Funds, the Catskill Fund for the Future, the Stormwater Fund, the Septic System and Rehabilitation Program, Sand and Salt Storage Facilities, Stormwater retrofits, Stream Corridor Protection, the Alternative Design Septic Program, Public Education, and the Economic Development Study (CCCD 1997: 20–22). The aforementioned Catskill Fund for the Future is a loan and grant program for qualified development proposals. Fund-supported projects must enhance the economic base of the community in a manner not inimical to protection of regional water quality.

Finally, the MOA provides for “Good Neighbor Payments” by New York City that can be used for a variety of specified purposes within the municipalities to which the gift is paid, including “capital costs of designing, constructing and installing public works or public improvements, or purchasing public equipment, except for automobiles for six or less passengers, which will benefit the public at large” (Sec. 147[b][iii]).

Table 2 displays a list of the protection and partnership programs and the funds allocated to each respectively and indicates whether it is administered by or facilitated in consultation with the CWC.

### *Watershed Agricultural Program*

Farm runoff, as nonpoint source pollution, is difficult to regulate (Hardy and Koontz 2008: 301–02). Instead of regulating agricultural practices in the MOA, the New York City Department of Environmental Protection and the EPA pushed for the establishment of the Watershed Agricultural Program (WAP). Article V of the MOA establishes and funds the WAP, the goal of which is “to refine and demonstrate an environmentally sound approach to farm management” (NRC 2000: 522). The function of the WAP is to provide economic incentives for farmers and ranchers of larger operations in the WOH watershed to develop Whole Farm Plans on a voluntary basis. “Whole Farm Plans are intended to reduce pollutant loadings by using innovative best management practices (BMPs)” (NRC 2000: 28).

TABLE 2  
OVERVIEW OF MAJOR PARTNERSHIP PROGRAMS

Protection and Partnership Programs	Allocated Funds
Sewage Treatment Infrastructure*	\$75.0 M
Catskill Fund for the Future*	\$59.7 M
Stormwater Fund*	\$31.7 M
Septic Rehabilitation & Replacement*	\$13.6 M
Sand and Salt Storage Facilities*	\$10.25 M
Sewer Extensions	\$10.0 M
Good Neighbor Payments	\$9.765 M
Stormwater Retrofits*	\$7.625 M
SPDES Upgrades	\$5.0 M
Catskill Watershed Corporation	\$3.5 M
Stream Corridor Protection*	\$3.0 M
Tax Consulting Fund	\$3.0 M
Alternate Design Septics*	\$3.0 M
Public Education	\$2.0 M
Forestry Management Program	\$0.5 M
Economic Development Study*	\$0.5 M
<b>Total</b>	<b>\$238.14 M</b>

\*Indicates a program in consultation with or administered by the Catskill Watershed Corporation.

SOURCE: CCCD (1997: 19).

## Implementation, Enforcement, and Early History of the MOA

Because the MOA is a legally binding agreement, it was necessary to implement some mechanism to ensure ongoing compliance and cooperation. The purpose behind the establishment of the CWC is for the nonprofit, locally-administered corporation to oversee, authorize funding for, or act as consultants for many of the programs provided for in the MOA (CCCD 1997: 26). Local enforcement of regulations and administration/implementation of programs is important to ensure compliance and cooperation.

In addition to the CWC, the Watershed Protection and Partnership Council (WPPC) is established in the MOA. This Council, which consists of representatives from city and state government agencies,

watershed counties, environmental groups, the CWC, the EPA, and the Watershed Agricultural Council, serves as a forum for the exchange of views, periodically reviews efforts undertaken by governments and private parties to protect the Watershed, and solicits input from agencies and private organizations and persons with an interest in the Watershed and New York City drinking water (NRC 2000: 123).

The oversight by the CWC and WPPC is supplemented by EPA Region 2 along with the NYC DEP and NYC Department of Health continuing to monitor water quality. Specifically, NYC implemented an ongoing water quality monitoring program, and the FAD is subject to continual review by the EPA, which ensures that sufficient progress is being made on MOA agreements and that EPA regulations are met. A May 2000 EPA review of the 1997 Filtration Avoidance Determination (FAD) concluded that, although NYC had made significant progress in many of its watershed protection programs, a number of corrective actions for specific FAD tasks as well as program enhancements needed to be implemented for the long-term viability of filtration avoidance (USEPA 2002). Due to the mid-term review and recommendations, NYC expedited its efforts on WWTPs in the Watershed region and acquired the needed land and easements to satisfy the EPA. On December 15, 2001, NYC DEP submitted to EPA its Long-Term Watershed Protection Program, emphasizing watershed protection as a long-term commitment (USEPA 2002). The EPA viewed the 2001 Long-Term Watershed Protection Program as a significant improvement upon the original MOA and applauded NYC's long-term commitment. The City released updated Long-Term Watershed Protection Programs based on mid-term reviews and recommendations in the year prior to the end of the FAD period in 2006 and 2011, respectively.

At the end of the five-year FAD in 2002, the provisions of the MOA were again reexamined. Among the notable changes in the 2002 MOA were (1) the expansion of the Watershed Agricultural Program to include EOH watershed farms as well as small farms that previously did not meet the program's gross farm income participation threshold;<sup>5</sup> (2) updates to the treatment of storm water; (3) increased outreach and education programs; and (4) a new focus

<sup>5</sup>As a result, by January 2006, 28 whole farm plans and 42 small farm whole farm plans had been approved by the Croton EOH watershed (USEPA 2011).

on the Kensico river basin, through which as much as 60 percent of the water in the Catskill/Delaware watersheds flows (USEPA 2002). Additional funds were committed to the Septic System Program to more actively address problems with failing septic systems, and active stream management was also encouraged in the 2002 FAD, creating a Stream Management Program to increase riparian zones and thereby decrease turbidity in streams feeding surface water sources. The EPA determined that NYC's 2001 Long-Term Watershed Protection Program "if complied with, will achieve the objectives of the Safe Drinking Water Act and the Surface Water Treatment Rule for unfiltered systems" (USEPA 2002). New York City received another five-year FAD from the EPA based on its own 2001 Long-Term Watershed Protection Program and its commitments to the recommendations in the 2002 FAD.

During the 2002–07 FAD timeframe, new EPA regulations required NYC to build a UV filtration facility. Construction began in 2006 and finished in 2010, allowing NYC to filter all of the water for cryptosporidium and other microbial pathogens (USEPA 2011). The revised FAD was granted to NYC based on the plans to construct the UV filtration plant and for the City to provide an additional \$6 million to Wastewater Management Programs in the Watershed region (USEPA 2006a). A 2006 review of the progress on the various programs and implementation of MOA provisions notes, "Overall, the City has successfully satisfied the obligations specified in the 2002 FAD" (USEPA 2006b). Having made satisfactory progress during the 2002–07 FAD period, NYC was again issued an FAD, this time for 10 years (USEPA 2007).

Discussions surrounding the 2007 FAD received mixed input from various groups. Watershed communities expressed fear that further land acquisition by NYC would stifle local growth and economic activities while environmental groups urged an increase in land acquisition (USEPA 2007). The addition of the Stream Management Program was continued and bolstered in the 2007 FAD, along with a more comprehensive Riparian Buffer Protection Program designed to provide technical assistance to "streamside landowners who seek to implement stabilization and planting plans to enhance riparian buffers" (USEPA 2007).

In 2011, NYC released its renewed Long-Term Watershed Protection Program. The major update is a 15-year extension of the land acquisition program in conjunction with the New York State

Department of Environmental Conservation (NYSDEC) issuance of the City's Water Supply Permit. "The WSP resulted from extensive discussions among the City, NYSDEC, NYSDOH, the U.S. Environmental Protection Agency, Watershed counties, the Coalition of Watershed Towns, environmental groups, and other stakeholders" and extends financial and other commitments for MOA programs (NYC DEP 2011). Currently, NYC is in compliance with the MOA and the regulations promulgated by the EPA.

## Conclusion

The New York City Watershed MOA is the first of its kind. While most discussions of the Coasean approach describe it as applicable only to externality cases in which the number of actors is identifiable and few in number, the MOA exemplifies the possibility of successful Coasean negotiations for large-number, large-scale, high-impact externality problems. The consequences of this MOA could be measured in billions of dollars, and the impact measured in over 1,900 acres and by well over 9 million people. The negotiations forged a new method for dealing with externalities showing how Coasean solutions could be facilitated and used in wide-reaching economic conflicts.

Every component of the Agreement reveals support for the regional economy and places the burden of water quality on NYC. In Coasean bargaining terms, the State assigned the watershed communities the property rights to continue with regional development and current practices, although degrading to NYC's drinking water. This assignment positioned NYC as the responsible party for initiating negotiation and programs protecting the Watershed system. Once responsibility was established, NYC opted to buy lands that were contributing to water quality degradation, such as farmlands on riparian corridors, instead of building a multibillion-dollar filtration system. The residents and landowners upstream are compensated for development restrictions incurred from the Agreement. Furthermore, the role of the State as a mediator eliminated bargaining barriers by effectively reducing the transaction costs of arranging negotiations, demonstrating potential economic benefits to all parties, and providing alternative options to unilateral decisionmaking.

The negotiations of the MOA set a new precedent in addressing externalities that involve a large number of stakeholders. The parties

to the MOA included stakeholders from various communities including the CWT, NYC, governmental organizations such as the EPA and New York State, and environmental groups including the Catskill Center for Conservation and Development. Many of the stakeholders were identified prior to the negotiation process because of the aforementioned conflict between NYC and the CWT, which is comprised of more than 30 municipalities and towns within the Watershed region. Environmental groups were brought into negotiations because of the environmentally sensitive nature of the land and system under consideration. The farming community of the Watershed area, although not directly involved in the negotiations, was represented by the CWT.<sup>6</sup>

The New York City Watershed MOA raises the possibility that governments can perform the role of simplifying negotiations in a way that will meet the overall social objectives and lead to Pareto improvement. Overall, when we observe externality problems, “We should ask not merely where the problem comes from, but what the transaction costs are that prevent it from being bargained out of existence” (Friedman 2000: 40). As demonstrated by the MOA, the government’s role simplified negotiations for New York City by drastically reducing the costs of negotiation. Rather than the traditional regulatory approach to externality problems, a Coasean approach was facilitated by new forms of relationships between different branches of government and affected parties in the private sector.

Of interest here is the organic manner in which the reduction in externality losses was achieved. Although the participants were engaged in a process of the type envisioned by Coase, nowhere in the documents relating to the agreement and the follow-up is Ronald Coase or any version of the Coase Theorem mentioned. Rather, once property rights were established, participants did what people do whenever they have goals and must negotiate with others to meet them. The spontaneous order that arose is clearly Coasean, even though none of the participants were likely aware that they were engaged in activity suggested by a Nobel laureate.

The MOA and subsequent revisions serve as an example of how large-scale, large-number externalities can be successfully internalized through the kind of negotiation Coase advocated in his

<sup>6</sup>The originally proposed regulations created concern for watershed farmers due to the loss of as much as 25 percent of tillable land (NRC 2000: 28).

work. While the State of New York and the EPA facilitated the initial negotiations, subsequent discussions have taken place using the mechanisms established within the original MOA and from commentary solicited by the EPA. New programs and revisions are made on an ongoing basis with input from all concerned parties. Overall, the New York City Watershed Memorandum of Agreement is a huge success, and demonstrates the ability of the market to resolve externality problems with the help of minor state intervention.

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