EXECUTIVE PROFESSIONALISM AND THE LOCAL IMPLEMENTATION OF FEDERAL ENVIRONMENTAL POLICY[1]

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Abstract

Many major national environmental laws in the United States are built upon federalist governance institutions that grant authority for regulation to the national government, enforcement to states, and implementation to local governments. Thus, the effectiveness of several American environmental laws depends on local government management. Building on theories of environmental federalism, policy implementation, and professionalism, this study analyzes the effects of executives' professions on American water utilities' compliance with the US Safe Drinking Water Act (SDWA). Using original data from a unique survey of American water utility chief executives, the EPA's Safe Drinking Water Information System, and a variety of other sources, I find that utilities that are led by professional engineers violate the SDWA significantly less frequently than do utilities led by non-engineers. Results indicate that executive professions are significant and heretofore little examined factors in the implementation of federal regulations.

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Introduction

Several of the most important environmental laws in the United States reflect political dynamics generated by the complexities of American federalism. Significant regulatory and administrative roles are accorded to state governments under several federal environmental laws, and political scientists have paid a great deal of attention to the state-federal relationship in the design and administration of American environmental regulations (Lowry 1992; Posner 1998, 2005; Rinquist 1993; Scheberle 2004, 2005). Recognizing the roles of states in American environmental regulation, recent studies have begun to examine how state bureaucratic agencies affect the implementation of environmental laws (e.g., Sapat 2004; Konisky 2005).

Largely left aside in the literature on environmental federalism is the role of local government agencies in the administration of federal environmental laws. States share administrative responsibility for the Clean Air Act (CAA), Clean Water Act (CWA), Safe Drinking Water Act (SDWA), and Resource Conservation and Recovery Act (RCRA), among others. However, much of the primary implementation for large portions of these laws falls to local agencies. For example, local governments own and operate the overwhelming majority of sewage treatment works regulated under the CWA and solid waste disposal facilities governed by RCRA. The success or failure of these environmental laws depends to a great degree on local government agencies and the bureaucrats who manage them. A separate line of research on "second-order devolution" in implementation takes up the local role in three-level federal policy regimes, but it remains heavily reliant on isolated case studies and is mostly unconnected with research on environmental policy.

This paper seeks to weave together research on environmental federalism, implementation, and public administration professionalism by examining the effects of local

agency executives on compliance with federal environmental regulations that share administrative responsibility with local governments. Building on a framework advanced by Cho, Kelleher, Wright and Yakee (2005), I argue that professions shape both federal legislation and bureaucrats' management priorities, and so agency executives who are engineers by profession are more compliant with environmental regulations than those who are non-engineers.

The empirical subjects of this study are the executives who lead local government water utilities in the United States and their compliance with the SDWA. The SDWA requires water utilities to comply with water quality standards, monitor water quality, and report water quality conditions to the public. American water utilities operate under a wide variety of institutional arrangements, and their executive leaders are similarly diverse, coming from a variety of professional and career backgrounds. Such diversity provides excellent leverage on the effects of professional background on agency performance. Using data from a new survey of American water utility executives and a variety of other sources, I show how executives' backgrounds affect their agencies' compliance with the SDWA. The results highlight the importance of local administration in effective environmental policy within a federal framework, and indicate that executive professions are significant and heretofore unexamined factors in the implementation of federal regulations.

The paper begins with a brief, synthetic review that integrates the literature on environmental federalism with research on local devolution in policy implementation. Discussion then turns to research on the role of professions in public administration. Rooted in these literatures, I argue that executives whose professional priorities align with those of a regulatory regime will emphasize regulatory compliance in agency management. An empirical evaluation of this theory follows with an analysis of SDWA compliance by local government

water utilities. I report my findings and conclude with a discussion of their implications for environmental policy and professions in public management.

Federalism and implementation in U.S. environmental policy

American federalism is central to many iconic environmental laws that were enacted in the 1960s and 1970s, as several of them establish shared responsibility for regulatory development and implementation between the federal and state governments. Beginning with the Air Quality Act in 1967 and the CAA in 1970, Congress built explicit roles for state-level administrators in the creation and administration of new environmental laws (Jones 1974, 1975). Under the CAA, the United States Environmental Protection Agency (EPA) establishes technology-based air quality standards, and then works with state regulatory agencies to develop monitoring and implementation plans to attain those standards. Although their details differ in important ways, the 1972 CWA, 1974 SDWA and 1976 RCRA took on the same basic federal-state relationship: under each of these laws, the EPA establishes technology-based environmental quality standards, which state agencies administer. State administration consists of monitoring polluters and enforcing their compliance with quality standards.

Political scientists' study of these laws reveals that shared state-federal responsibility for environmental regulation was more a consequence of legislative, inter-branch, and electoral politics than of concern for effective implementation (Ackerman and Hassler 1981; Hayes 2001; Jones 1974; Melnick 1983; Milazzo 2006). Whatever the reasons for federalism's prominent place in American environmental policy, scholars have paid a great deal of attention to its consequences; an extensive and robust literature on "environmental federalism" analyzes the effects and effectiveness of shared state-federal governance over environmental issues (e.g.,

Crotty 1987; Jones 1975; Konisky 2007; Lowry 1992; Oates 2001; Posner 1998; Rabe 1999; Scheberle 2004, among many others).

Three-level environmental federalism and second-order devolution. Largely neglected by an otherwise excellent body of research on environmental federalism is the role of local government in environmental policy. Local governments have little formal role in most federal environmental regulations *as local governments.* However, local governments own and/or operate vast numbers of enterprises that are regulated as polluters. For example, local governments own and/or operate more than 16,000 sewage treatment plants regulated under CWA, 32,000 drinking water systems regulated under SDWA, and nearly 2,000 solid waste landfills regulated under RCRA.[1] Although public and private polluters alike must comply with federal environmental regulations, local governments provide sewer, water, and solid waste services to the overwhelming majority of the U.S. population. Although the CWA, SDWA and RCRA formally lay out two-level federalism (national plus state government), in practice the these laws effectively establish three-level federal administration (national plus state plus local government). Consequently, effective administration of environmental policy in the United States begins at the local level in what scholars have termed "second-order devolution." To date, the large majority of research on second-order devolution in the United States has focused on welfare policies (e.g., Cho et al 2005; Gainsborough 2003; Kim and Fording 2010; Lurie 1997).[2]

Despite this critical role of local government, otherwise excellent studies on environmental federalism have done little to explore and less to explain the local government role in implementing American environmental policy. Of the studies cited above, only Jones (1975) devotes any serious attention to local government, and local governments have little theoretical role in his account. Scheberle's (2004) fine study of environmental federalism ignores

local governments entirely, and instead lays out a "tripartite model" that inserts federal government administrative regions as third players alongside the state and federal governments. The scant research on the local role in environmental federalism is largely descriptive (e.g., Weiland 1998). One important exception is Woods and Potoski (2010), who analyze state governments' decisions to devolve administration of air quality regulation to local governments under the CAA. However, Woods and Potoski analyze the *causes* of second-order devolution, not its *effects*.

To my knowledge, the only study of the *effects* of second-order devolution in environmental policy is Rasmussen's (2000) analysis of local solid waste management in New York State under RCRA. Rasmussen casts state governments as principals who contract with local government agents to administer environmental policy. Rasmussen's study is notable for present purposes because: 1) it seeks to explain variation in local government performance under second-order devolution; and 2) its empirical analysis focuses on *individual administrators.* However, Rasmussen's qualitative methodology and empirical focus on a single state limit the study's generalizability.

Implementation and the policy process. In some ways, Woods and Potoski's 2010 article is an effort to connect scholarship on environmental federalism with a significant research literature on implementation. Research on implementation of environmental laws blossomed in the 1980s, prompted in part, no doubt, by the proliferation of sweeping new environmental laws in the 1970s. Environmental regulations were subjects of Sabatier and Mazmanian's (1980) research on implementation, and much of the implementation research over the following decade focused on environmental laws. Unfortunately, research on the local implementation of federal environmental policy has remained largely divorced from the literature on environmental

federalism, even as data have become more available and political scientists' methodological toolkit has grown more sophisticated (but see Feiock and West 1993). Consequently, research on environmental federalism has proceeded from what Sabatier (1986) called a "top-down" approach, rather than one that integrates local factors from the "bottom-up."

A recognition of implementation's critical role in the policy process contributed to Sabatier and Jenkins-Smith's (1988) advocacy coalition framework (ACF), which seeks to integrate policy development, implementation, and enforcement across "policy subsystems" into a single theory. Among the ACF's most important features is an emphasis on *beliefs* about policy in motivating and unifying individuals' political behavior throughout the policy process and across levels of government (see Weible, Sabatier and McQueen 2009 for a comprehensive review of studies that use ACF, including several that apply the framework to environmental policy). Unfortunately, ACF research has proceeded almost entirely with single case studies that are difficult to replicate in ways that could falsify or help refine ACF as a theory. Consequently, this rich body of research has done little to build cumulative knowledge and contribute to a more rigorous, generalizable theory (Weible, Sabatier and McQueen 2009). Badly needed is a mechanism that might explain how beliefs affect policy formulation and implementation across the policy subsystems that Sabatier and Jenkins-Smith (1998) identify, in ways that are observable and testable across large numbers of cases.

Professionalism and environmental regulation

Public administration professionalism is perhaps one such mechanism. Professionals are persons with specialized formal education, whose labor value is reducible to their expertise in providing some knowledge-based service (Abbott 1988; Wilensky 1964). Professionals form organizations that facilitate information exchange, self-regulate, seek government protection for

their labor markets, and establish training and licensure regimes for new professions (Abbott 1988; Larson 1977; Polanyi 1957). To a greater or lesser extent, professionals observe a set of ethical principles held in common with other members of their professions, and the years-long process of selection, education, apprenticeship, and accreditation imbues individuals with the norms and values of their professions (Friedrich 1935; Polanyi 1957).

Executive professionalism and public management. Scholars have long recognized the influence of professionalism on bureaucratic politics. Not all administrators are professionals, but for professionals who work in government bureaucracies, the profession is an "external reference group" outside of their government agencies that shapes their preferences and incentives for behavior (Wilson 1989, 60). Researchers have identified at least three different but related ways in which professionalism might affect administrators' decisions. First, professional socialization may cause bureaucrats to hold different values about what are good and bad policies; that is, professionalism may shape preferences about policy choices (Brehm and Gates 1997; Meier and O'Toole 2006; Watson and Meiksins 1991). Second, because professions define career opportunities, professional bureaucrats may make decisions that are consistent with professional norms and values in order to build reputations pursuant to career advancement (Dewatripont, Jewitt and Tirole 1999; Teodoro 2010; Wilson 1989). Third, institutionally-structured isomorphism may occur when professions cause administrators to conform to the dominant behaviors of their communities of professionals through a variety of social rewards and sanctions (DiMaggio and Powell 1983).

Cho et al. (2005) put administrative professionals at the heart of second-order devolution in their study of welfare policy implementation. Rejecting an easy assumption of hierarchical, top-down relations between national, state, and local governments, Cho et al. adopt a network

perspective on implementation that highlights the roles of "program policy professionals" (PPPs) at each level of government. Policy professionals are distinguished from elected officials and appointed "generalists" by their expertise. According to Cho et al., policy professionals "…are the program managers (or departmental directors) whose access to the position(s) of authority is chiefly through professional education and experience in a career specialization" (2005, 35). Cho et al. use an array of parallel planes to depict the roles of popularly elected generalists (PEGs), appointed administrative generalists (AAGs), and PPPs in three-level federalism (see Figure 1). Cho et al. place a cylindrical core in the middle of the figure, which "connects the three planes of governance from national to local," and so depicts the boundary-spanning, networking roles that professional administrators play in the local implementation of federal policy (2005, 35). As members of a policy-focused community that traverses levels of government, these professionals shape and are shaped by fellow professionals at other levels of government. Cho et al. find that the backgrounds and behaviors of these policy professionals significantly affect local agency performance in welfare program implementation.

The model that Cho et al. (2005) advance is intriguing and potentially applicable to several policy arenas beyond welfare, including environmental protection. However, their analysis carries some important empirical limitations. First, their study measures *perceived* program performance (according to a survey of officials at various levels of government) rather than actual performance. Second and more critically for the present purposes, Cho et al. assume that every one of the program administrators at the heart of their theory are part of a common professional community. In other words, although they measure important individual characteristics of administrators (such as education and years of experience), they do not capture variation in *profession itself*. Therefore, it is safe to infer from Cho et al.'s findings that local

program administrators significant actors in the implementation process under three-level federalism. However, their findings do not offer direct leverage on the effect of professionalism.

Engineering and the development and implementation of environmental regulation. Following Cho et al., I argue that professionalism—in particular, the engineering profession—helps account for variation in local implementation of certain federal environmental policies. In many ways, the norms and values of professional engineering is hardwired in the major American environmental laws of the 1960s and 1970s. Prominent professional engineers were heavily involved in the development of these policies (Ackerman and Hassler 1981; Milazzo 2006; Powell 1999). Not coincidentally, several of the principal environmental policies of that era—especially the CAA, CWA, SDWA, and RCRA—mandate the measurement of environmental pollution and technology-based solutions to remedy pollution problems. In casting environmental issues as technological problems that require technological solutions, federal environmental laws are consistent with a dominant culture of professional engineering that values quantitative assessment, technological acumen, and systems design over solutions that require social control or cultural changes (Layton 1986; Robinson and McIlwee 1991; Wilson 1989).

To the extent that federal environmental policies embody the norms and values of the professionals who developed them, professions are likely to affect the local implementation of those policies (Tummers, Steijn and Bekkers 2012). Professional influence over federal environmental policy may cause professional engineers who lead local government agencies to place a higher priority on compliance with federal regulations than do non-engineers. Whether this alignment of local management priorities with federal regulation occurs due to professional socialization, labor market pressures, or institutional isomorphism, the expected result is the

same: stronger regulatory compliance under professional management than under non-professional management. The result is a three-level federal system of regulation in which development and implementation of policy are heavily influenced by professional engineering. A simple hypothesis follows: *local government agencies that are headed by engineers will comply more strictly with federal environmental regulations than similar utilities that are led by non-engineers.*

Engineers and SDWA implementation. The present examination focuses on local government drinking water utilities, their executives, and their compliance with the SDWA. All public water systems (PWS) in the United States are regulated under the SDWA, and nearly 80 percent of the U.S. population is served by local government-owned water utilities (see Table 1). A variety of local governments run water utilities, including general purpose municipalities, counties, and special districts. Utility chief executives are at-will employees of the governments that they serve; they are hired and/or fired by mayors, city councils, or legislative councils depending on the utility's governance structure. Although they usually are appointed by politicians, the local utility executives analyzed are full-time career administrators. Thus, these executives are unlike elected officials or the partisan political appointees who typically head state and federal agencies and whose jobs are closely tied to the electoral cycle. Nonetheless, the utility administrator's job is irreducibly political (Gormley 1983; Teodoro 2011).

Water utility management is an excellent field in which to assess the impact of professionalism because it is a relatively "open" labor market: there are relatively few barriers to entry to utility management for individuals and there is no single dominant career path that aspiring executives must follow (Abbott 1988). Although the provision of drinking water is a highly technical and capital-intensive endeavor, no specific educational credentials are required

for appointment to most water utility executive jobs. Some utility executives began their careers as high-school educated street-level utility operators and work their way up through the ranks over many years. Others are newcomers to the water industry, with backgrounds in other industries or private sector management. The executives who lead water utilities come from a variety of professional backgrounds: engineering is the modal profession of utility chief executives, but less than a third of them are professional engineers (Table 2). The ranks of utility executives include many professional scientists, accountants, and attorneys, as well as quasi-professionals with general business or public management backgrounds who might be considered "generalists" rather than "professionals" in Cho et al.'s (2005) terms. Utility management therefore offers empirical traction on the effects of administrative professionalism itself on agency performance.

Data and Model

The present study uses data from a new survey, analyzed in combination with data drawn independently from the EPA's Safe Drinking Water Information System (SDWIS), the 2010 U.S. Census, and other sources.

Survey methodology. Data on utility executives are drawn from a survey of American water utility executives, conducted in 2011 as part of a study by the Water Research Foundation. A randomized sample of 300 utility executives were invited to participate in the survey. The survey sampling frame was defined using the SDWIS, a database maintained by the U.S. Environmental Protection Agency (EPA) that includes every public water system in the United States. As Table 1 shows, a large majority of utilities are very small, serving populations of fewer than 3,300; the minority of utilities that serve more than 3,300 customers provide water to the overwhelming majority of the U.S. population. Simple random sampling would yield little

data on executives of the medium-sized and large utilities that serve most of the U.S. population and offer the best leverage on the theoretical questions at hand, and so the sample was stratified to ensure inclusion of utilities of many sizes while maintaining sufficient randomization to allow for generalizable results (Dziegielewski and Opitz 2004).

The survey instrument was administered in the summer of 2011 through a structured telephone interview with a follow-up online questionnaire. The survey instrument was comprised of two parts: 1) a structured telephone interview; and 2) an online questionnaire. The interview asked directly for career path information, including length of tenure on the job. The online questionnaire gathered a variety of demographic and behavioral data. Participants were guaranteed that their identities would be held in confidence. A total of 169 utility executives participated for a response rate of 56.3 percent; a total of 120 interview participants completed the online questionnaire, for a completion rate of 71.0 percent. An appendix to this paper offers additional details on survey administration.

Dependent variables. The phenomenon of interest here is local administration of federal environmental policy, which I measure as local utility compliance with the SDWA. Among many other provisions, the SDWA requires water utilities to meet water quality standards set by the EPA. The EPA's water quality standards establish limits for various chemical and biological contaminants that are dangerous to human health. If a utility's drinking water exceeds these limits, it commits a *health violation* under the SDWA and is subject to a series of civil penalties. The EPA also establishes minimum water quality testing frequency and public reporting requirements. Monitoring requirements vary as a function of a utility's size, its source of supply (groundwater versus surface water), and other aspects of its system. Utilities also must publish

annual drinking water Consumer Confidence Reports and publicly announce health violations in a timely manner. Utility failures to comply with these requirements are *monitoring violations*.

Both health and monitoring violations are valuable to study as indicators of organizational performance. Health violations represent failures to carry out the core purpose of the SDWA, and can indicate important threats to human health. However, as health violations as a measurement of management performance is problematic: health violations may occur for a variety of reasons, many of which are beyond the control of administrators. For example, a failure of treatment processes or facilities due to poor management can cause health violations, but sources of water supply vary in initial quality and vulnerability to natural and industrial sources of pollution in ways that can cause SDWA health violations (Levin et al. 2002; Pike 2007). On the other hand, monitoring violations are organizational failures that are attributable in whole or in large part to utility management. Monitoring violations typically occur when utility personnel fail to gather water samples with the required frequency, analyze samples adequately, or report violations to the public and/or state agencies in a timely manner. The resources and systems necessary to comply with monitoring and reporting requirements all fall within the public executive's traditional POSDCRB span of control (Gulick 1937).[3] Although monitoring violations are less serious than health violations, they are perhaps better indicators of professional influence on implementation of federal environmental regulations. Therefore, in the present study I analyze both *health violations* and *monitoring violations* committed by a utility during an executive's tenure as head of that utility as dependent. Because health violations are more likely to occur for reasons beyond the control of administrators, I expect that the effect of professionalism will be more pronounced on *health violations* than on *monitoring violations*.

Table 2 reports descriptive statistics for *health* and *monitoring violations,* as well as the independent and control variables used here.

Data for ten years of SDWA *health violation* and *monitoring violation* records (2002-2011) for each sampled utility were gathered from the EPA's online SDWA enforcement database following completion of survey administration.[4] As expected, *health violations* and *monitoring violations* are poorly correlated among the public utilities in the sample (ρ=-.05, sig=.79), indicating that significantly different factors drive variation in each type of violation. Using data on executive career path gathered from the survey, I counted the total number of each type of violation that occurred during each executive's tenure. Executives who had served for more than ten years at the time of survey administration (about 25 percent of the sample) were assigned all ten years' violations. Thus, I measure the dependent variables as *health violations* and *monitoring violations* in utility *u* from 2011 to 2011-*t,* where *t* is the lesser of number of years that the executive *j* has led the utility for ten years. In this way, an executive only receives "blame" for violations that occur under his or her administration.[5]

Independent variable. The key independent variable of interest here is the utility executive's profession, which I measure with a binary dummy coded one if the executive is an *engineer,* and zero if (s)he is not. Academic credentials are central elements of any profession because they help establish legitimacy for a labor market (Abbott 1988), and professional education has a potent socializing effect on members of a profession (Athanasiou 1971; Schleef 2006). Executives who hold one or more academic degrees (typically BS or MS) in engineering are coded one for *engineer,* regardless of whether they are currently licensed professional engineers; executives who do not hold formal degrees in engineering are coded zero.

Controls. Other executive characteristics also might inform the local utility management in ways that affect compliance with environmental regulations. First and most obviously, SDWA violations are expected to be strongly correlated with executive *tenure*: the longer that an executive leads a utility, the more likely it is that monitoring violations will occur on his or her watch, ceteris paribus. According to conventional wisdom, an executive's *water utility experience* might be expected to be negatively correlated with violations.[6] I include executives' *tenure* and *water utility experience,* measured in years, in the present models. Conventional wisdom also suggests that management should improve as an administrator's level of education increases (Cho et al., 2005), although empirical research on the effects of executive education on organizational performance has yielded limited evidence that executive education has any significant relationship with management quality (Gottesman and Morey 2010; Jalbert, Rao and Jalbert 2002). Nonetheless, *education* is expected to be negatively correlated with SDWA violations. I gauge *education* as the highest level of formal education completed by the executive, measured in years (i.e., bachelor's degree = 16 years, master's degree = 18 years, etc.).

Executive characteristics are unlikely to be the only determinants of variation in SDWA violations, of course, and past research has identified several correlates of SDWA compliance. SDWA violations are expected to increase with utility size, since larger utilities tend to have larger, more complex infrastructure systems and are subject to greater scrutiny from state regulatory overseers (Botelho et al. 2005; Rahman et al. 2010). Therefore the present analysis controls for utility size with the *log population* served by each utility. Climatic conditions can also affect SDWA violations, especially under extreme drought or flood conditions, and so I control for relative water scarcity with Willmott and Feddema's (1992) *climatic moisture* index

as a measure of water resource scarcity. The *climatic moisture* index ranges from -1.0 (no climate moisture) to +1.0 (abundant climate moisture), with zero representing perfect balance of moisture demand and availability. Recent research on environmental justice also suggests that, for a variety of reasons, enforcement of environmental regulation declines as a community's income falls and its racial and ethnic minority population increases (Konisky and Schario 2010; Lavelle and Coyle 1992; Lynch, Stretesky and Burns 2004). Median household income and unemployment rates were statistically and substantively insignificant in models of *monitoring violations*, but I include a control for *percent nonwhite population* in each utility's service area using data from the 2010 U.S. Census.

Pike (2007) finds that utilities that rely on surface water sources are more likely to violate the SDWA's health standards. Analysis of the present data found no significant correlation between *surface water* sources and *monitoring violations,* and so water source is not included in the analysis of *monitoring violations.* However, *surface water* source was a significant predictor of *health violations,* and so its effects are reported here. Controls for special district governance structure and other institutional variables also were non-significantly correlated with both types of violations in alternative specifications, and so they also are excluded from the present analyses.

Model. The dependent variables in the present analysis are discrete event counts that occur over a fixed period of time, and so I use negative binomial regressions to estimate the number of each type of violation that occurred during each administrator's tenure. It is worth noting that the distribution of both *health* and *monitoring violations* are heavily skewed because the modal value in the dataset is zero: 80 percent of the executives analyzed had no health violations and 57 percent had no monitoring violations their tenure at the helm of their present

utilities.[7] It is possible, perhaps even likely, that the causes of variation in the number of violations differ somewhat from the causes in the likelihood of a violation occurring in the first place. In the present analysis, all of the independent variables are expected to affect the likelihood of zero counts in the same ways that they would affect the distribution of non-zero counts. The most important unobserved causes of zero-counts are differences in state-level SDWA enforcement. Ideally, violations would be estimated with a zero-inflated model with dummy variables for states, or a hierarchical model that includes both state and local-level variables. Unfortunately the size of the present sample precludes analysis of state-level variation. Negative binomial models fitted with constant zero inflator generated effects and fits that were virtually identical to non-zero-inflated models. In the interest of simplicity, I report only the results of the non-zero-inflated models.

Because the data are drawn from stratified samples, I employ post-stratification weights and robust standard errors in their models to correct for bias introduced by the sampling method. Controls that were not statistically significant but improved fits were retained in the models reported here. Tables 3 and 4 report the results of the best-fitting models for *health* and *monitoring violations,* respectively.

Results and Discussion

The effect of administrator profession on compliance with the SDWA is pronounced in both sets of estimates: utilities that are headed by *engineers* commit significantly fewer *health violations* and *monitoring violations* than utilities led by non-engineers. With other variables evaluated at their mean values, the model reported in Table 3 estimates that an executive who is an *engineer* will experience .06 fewer health violations and 1.70 fewer total monitoring violations during her tenure than a non-engineer in a similar utility and similar level of

education. Designing, building, and maintaining water treatment, transmission and distribution systems are complicated tasks that an engineer might be expected to perform more effectively than a non-engineer, and so the effect of professionalism on *health violations* could simply be a consequence of expertise. By contrast, sustaining monitoring and reporting protocols that are externally defined does not require creativity or a high degree of technical acumen, so it does not seem likely that engineers' technical training accounts for the significant effect of executive profession *monitoring violations* under the SDWA. It seems more likely that, on average, executives who are engineers simply emphasize SDWA compliance in the management of their utilities. That is, engineering *as a profession* has an independent effect on policy implementation. Figure 2 illustrates the marginal effect of the presence of an engineer as an executive on *monitoring violations* across a range of utility sizes.

Professionalism is the main phenomenon of theoretical interest here, but model results for some of the controls merit mention here inasmuch as they affect the local implementation of federal environmental policy. *Tenure* on the job is weakly correlated with *health violations,* but as expected it is significantly and positively associated with *monitoring violations.* Similarly, *water utility experience* has little effect in the model of *health violations,* but it positively predicts *monitoring violations,* which contravenes Cho et al. (2005), who found that experience improved performance.

The effects of executive *education* are inconsistent across the two models. Table 3 indicates that the number of *health violations* declines as the administrator's *education* increases, just as Cho et al. (2005) find. However, the estimated number of *monitoring violations* increases as administrator *education* increases. This counterintuitive finding does not necessarily indicate that greater industry experience causes poor management, but it is consistent with earlier

research on the negligible effects of executive education and experience on organizational performance. Coupled with the findings on *engineering* profession, the effects of *education* and *water utility experience* suggest that non-engineer executives with otherwise similar qualifications place less emphasis on regulatory compliance than their peers who hold engineering degrees.

Some utility-level variables also generated interesting and statistically significant effects. As expected, both *health* and *monitoring violations* increase as utility size increases. *Percent nonwhite population* is strongly correlated with *health violations,* which may validate the expectations that emerge from the environmental justice literature. However, *percent nonwhite population* is negatively correlated with *monitoring violations*. These demographic results should be regarded with some caution, however, as the substantive sizes of the effects are small. Water resource availability as measured by *climatic moisture* is positively correlated with both types of violations, although the result is statistically dubious. Unlike Pike (2007), I find that *surface water source* reduces the number of *health violations.*

Limits and directions for future research. The present analysis contributes to the literature on implementation and connects it to research on environmental federalism by demonstrating a link between executive professionalism and regulatory compliance. Much more work is needed to understand the effects of executive professionalism and the local dimension of environmental federalism.

Perhaps the most serious limitation of this study is that the data provide little leverage on the reasons for the marked effects of the executive's profession on implementation of environmental policy. As discussed earlier, research on professions in public management suggests that several different mechanisms might link professionalism to bureaucratic behavior,

but it is not clear which (if any) of these causes the results observed here. Simply declaring that executives who are also engineers behave like engineers is not a particularly satisfying theoretical inference. Are engineers socialized to think about their work in significantly different ways from non-engineers? Are engineers socially or economically accountable to an external professional community in a way that that non-engineers are not? Do engineers' job markets provide incentives for regulatory compliance that non-engineers' job markets do not? The present data and analysis are silent on these questions. Case study research focused on professionalism, carefully-designed attitudinal surveys, and/or research on job mobility could help answer these questions.

More broadly, the present study points to a need for more extensive integration of implementation research with research on environmental federalism, following Woods and Potoski (2010). As noted earlier, the CWA and RCRA are broadly similar in structure to the SDWA, and so also result in de facto three-level federalism. What local-level variables (e.g., governance structure, economic conditions, demographics) affect the implementation of these federal environmental laws? Future research on environmental federalism should take seriously the oft-neglected local level, particularly with regard to SDWA, CWA and RCRA.

Conclusion

Some of America's most critical environmental laws effectively operate in a three-level federal arrangement, granting authority for regulation to the national government, enforcement to states, and implementation to local governments through "second-order devolution" The dynamics, merits, and drawbacks of three-level federalism deserve greater attention as state and federal lawmakers contemplate new laws on energy development, greenhouse gasses, and other

environmental issues. This study contributes to the neglected third level of environmental federalism by connecting it to research on policy implementation.

At a theoretical level, the present study contributes to the policy implementation and policy process literature by lending identifying and rigorously specifying professionalism as a variable. Professionalism lends traction and generalizability to theories that emphasize policy networks and beliefs in the processes of policy development and implementation. In particular, I show that executive professionalism conditions the effects of federal environmental regulations: professional engineering in the executive ranks of local government utilities leads to greater compliance with federal drinking water regulations. Such a reinforcing effect of professionalism indicates that professional engineers can bolster federal environmental regulation, at least to the extent that federal regulations align with the predominant norms and priorities of engineering as a profession.

However, what professionalism helps, it also can hinder. The federally-induced "vertical isomorphism" that occurs with engineering under the SDWA occurs in part because engineers were heavily involved in the development of regulations pursuant to it. Local professionalism may just as easily frustrate federal regulations that run counter to the dominant sensibilities of a profession charged with their implementation. Careful consideration of professionalism in local management is thus important for environmental policy design under three-level federalism.

Table 1: Public Water Systems in the United States (sampling frame)

	All utilities				Local Government Utilities				Sample	
Size Group, population served	Utilities	%	Population (000)	%	Utilities	%	Population (000)	%	Utilities	%
<500*	124,235	81.4	14,112	4.5	13,664	42.3	2,585	1.0		
501-3,300*	19,101	12.5	25,089	7.9	10,991	34.1	15,734	6.3		
3,301-10,000	5126	3.4	29,807	9.4	4,080	12.6	23,904	9.6	60	20.0
10,000-50,000	3,262	2.1	71,416	22.5	2,728	8.5	59,736	23.9	60	20.0
50,001-100,000	550	0.4	37,810	11.9	475	1.5	32,555	13.0	60	20.0
100,001-250,000	288	0.2	44,270	14.0	236	0.7	36,411	14.6	60	20.0
>250,000	126	0.1	94,392	29.8	104	0.3	78,786	31.6	60	20.0
Total	152,688	100.0	316,896	100.0	32,278	100.0	249,711	100.0	300	100.0

Frame data include all public water systems in the United States, drawn from EPA's January 2011 Safe Drinking Water Information System (SDWIS).

*Utilities serving populations less than 3,300 are excluded from the sampling frame.

Table 2: Descriptive statistics

Binary variable	Percent	95 percent C.I.	
Engineer	27.71	14.30	41.11
Surface water source	34.94	19.54	50.35
Continuous / cardinal variables	**Mean**	**95 percent C.I.**	
Annual health violations, 2002-2011	.16	.02	.30
Annual monitoring violations, 2002-2011	2.49	.70	4.28
Health violations during tenure	1.03	0.00	2.16
Monitoring violations during tenure	16.53	0.00	33.46
Tenure	8.93	6.59	11.27
Water utility experience	23.24	20.00	26.51
Education	14.60	13.91	15.28
Population	44,070.36	29,035.93	59,104.79
Percent nonwhite population	21.61	11.37	31.38
Climatic moisture (-1.0 to +1.0 scale)	.21	.11	.31

N=109. Parameters reflect post-stratification weighting.

Table 3: Model of SDWA health violations

Negative binomial regression	DV: health violations during executive tenure		
Variable	Coefficient (Robust S.E.)	p	Marginal Effect*
Engineer	-3.81 (1.79)	.03	-.06
Tenure	-.06 (.13)	.64	-.00
Water utility experience	-.08 (.07)	.26	-.00
Education	-1.45 (.36)	<.01	-.03
Log population	2.34 (.68)	<.01	+.05
Percent nonwhite population	.10 (.04)	.01	+.00
Climatic moisture (-1.0 to +1.0 scale)	2.67 (2.30)	.25	+.06
Surface water source	-2.52 (1.40)	.07	-.05
Intercept	-3.33 (4.55)		
Log pseudolikelihood	-55.05		
Wald X^2	25.95	<.01	
Alpha	4.01		
McFadden's pseudo-R^2	.21		
N	109		

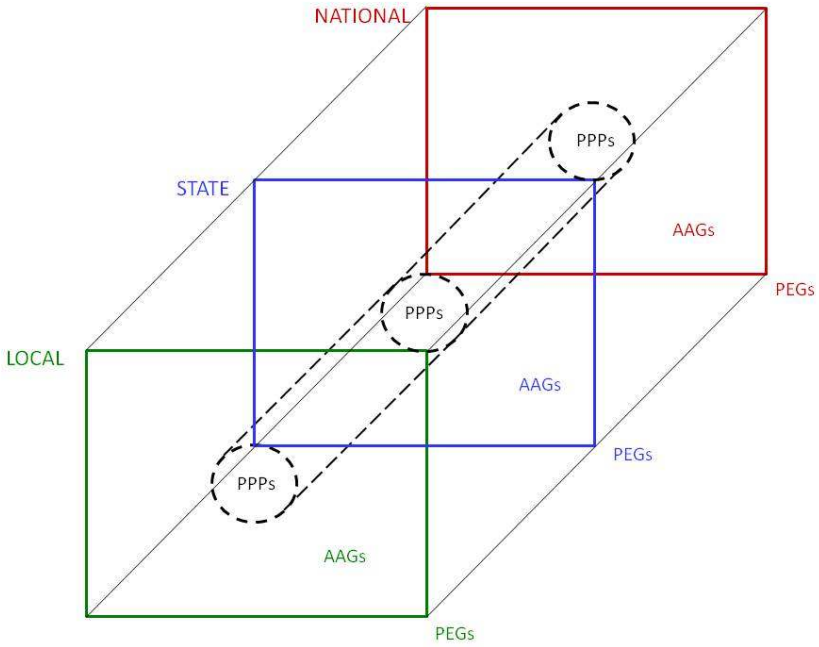
*Estimated change in number of *health violations* expected from one unit change in the value of a variable, with all variables evaluated at their means.

Table 4: Model of SDWA monitoring violations

Negative binomial regression	DV: monitoring violations during executive tenure		
Variable	Coefficient (Robust S.E.)	p	Marginal Effect*
Engineer	-1.91 (.82)	.02	-1.70
Tenure	.24 (.02)	<.01	+.28
Water utility experience	.03 (.03)	.03	+.04
Education	.32 (.11)	<.01	+.39
Log population	.38 (.18)	.04	+.45
Percent nonwhite population	-.04 (.02)	.04	-.05
Climatic moisture (-1.0 to +1.0 scale)	.96 (.80)	.22	+1.16
Intercept	-9.85 (2.64)	<.01	
Log pseudolikelihood	-145.68		
Wald X^2	170.00	<.01	
Alpha	2.45		
McFadden's pseudo-R^2	.19		
N	109		

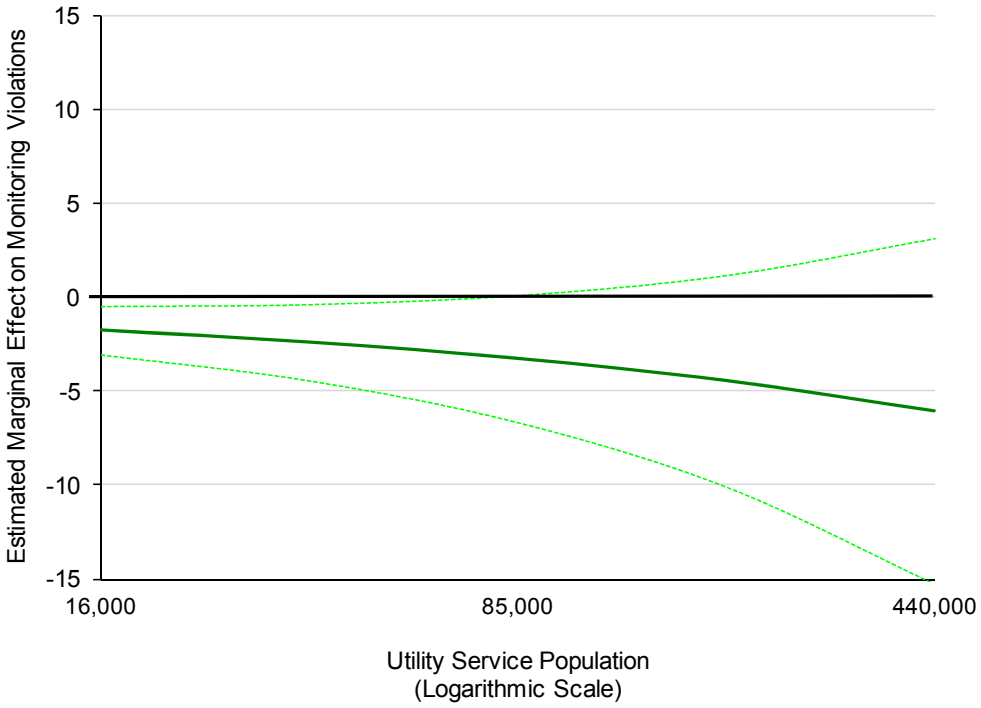
*Estimated change in number of *monitoring violations* expected from one unit change in the value of a variable, with all variables evaluated at their means.

Figure 1: Levels of governance in the United States, positions and roles of intergovernmental actors



Adapted from Cho et al. (2005, 36). PEGs = Popularly Elected Generalists, AAGs = Appointed Administrative Generalists; PPPs = Program Policy Professionals.

Figure 2: Marginal effect of *engineer* on estimated monitoring violation



Marginal effects based on estimates reported in Table 3. All other variables evaluated at their means. Dashed lines indicate 95 percent confidence interval.

Appendix: Additional Survey Administration Details

Survey administration proceeded with four steps:

1. **Pre-notification.** The research team mailed to each sampled executive a letter approximately one week in advance of the survey to notify them about the study and offer informed consent and appropriate disclosure information. Letters were addressed personally to each individual (not addressed generically to "General Manager" or "Director of Utilities"). Each letter was signed by the principal investigator (PI) and the researcher assigned to the specific executive. The letters were printed on custom stationery and mailed via US Postal Service in envelopes designed specifically for this study. Experimental research demonstrates that pre-notification letters generate higher response rates in telephone surveys (Traugott, Groves and Lepkowski 1987), especially when the notification letters use a university letterhead (Brunner and Carroll 1969; Fox, Crask and Kim 1988).
2. **Scheduling.** Approximately 7-10 business days after mailing the pre-notification letter, a member of the research team contacted each sampled executive by telephone to schedule an interview. In a few cases, the executive was immediately available to participate in the interview upon the initial contact. However, in most cases a research team member left a telephone message and/or set up an interview for a later date and time. A few sampled executives explicitly refused to participate in the study; otherwise, research team members called each sampled individual up to three times before abandoning a case.
3. **Interviews.** The project team conducted a telephone interview with each participant. Interviews were audio recorded for transcription.
4. **Questionnaire.** At the conclusion of the interview, participants were asked to complete the online questionnaire. Respondents were emailed a survey link upon completion of the

interview; completing the questionnaire required approximately 15 minutes. Respondents were sent electronic reminders after three days if they did not complete the questionnaire. A total of over 700 telephone calls were made as part of the survey administration; an average of 2.10 calls was required for each participant.

Table A: Summary of survey participation

Stratum (Population Served)	Sample	Valid Cases	Participants	Percent Participation
One (3,301-10,000)	60	57	31	54.4
Two (10,000-50,000)	60	60	31	51.7
Three (50,001-100,000)	60	58	34	58.6
Four (100,001-250,000)	60	60	33	55.0
Five (>250,000)	60	57	40	70.2
Total	300	292	169	57.9

Table A summarizes participation in the survey. The water utility agency head position in eight of the 300 sampled utilities was vacant at the time of administration, leaving a total of 292 valid cases. The overall response rate was 57.9 percent of valid cases and 56.3 percent of total cases; a total of 120 interview participants completed the online questionnaire, for a completion rate of 71.0 percent. Response rates were non-randomly distributed, with the highest response rates among the largest utilities and lower response rates among smaller utilities. It is possible that managers of small utilities were more likely to be out of the office on field work and therefore less likely to be available for interviewing. It is also possible that the executives of medium-sized and large utilities were more familiar with the administering institution, its funding agency, and/or management research more generally and so were more likely to support the project. Vacancies appear to be randomly distributed across strata.

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Notes

[1] Data on EPA-regulated facilities are available at http://www.epa-echo.gov/echo/index.html.

[2] The origins of the term "second-order devolution" are unclear. The first use of the term in a scholarly publication appears to be in a 1997 article on welfare reform by Irene Lurie, published in *Publius.*

[3] **P**lanning, **O**rganizing, **S**taffing, **D**irecting, **Co**ordinating, **R**eporting and **B**udgeting (Gulick 1937).

[4] http://www.epa-echo.gov/echo/compliance_report_sdwa.html.

[5] A 2011 GAO report raised serious questions about the accuracy of compliance data in the SDWIS (GAO 2011). The EPA relies upon state reporting of SDWA violations by local utilities, and the GAO audit found that states tended to under-report violations. However, the GAO did not identify any systematic bias in state under-reporting. Thus, the present analysis assumes that under-reporting is randomly distributed in the SDWIS database and so does not introduce bias into the statistical model employed here. Even if under-reporting is non-randomly distributed, it is difficult to imagine that state under-reporting is significantly correlated with the professional backgrounds of utility executives.

[6] Cho et al. (2005) find that administrator experience and educational attainment positively predict local agency performance in welfare administration.

[7] These proportions reflect post-stratification weighting.