

Stormwater Quality and Local Government Innovation

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This article investigates how local governments in Kansas approached planning for and implementing Phase II of the National Pollutant Discharge Elimination System (NPDES) storm water program, which required them to take measures to control nonpoint source pollution in order to improve surface water quality. We find that though these local governments undertook many new activities, there were few differences between those that acted early and those that waited until they were required to act, though the governments acting early had higher quality responses. Limitations on funds and personnel appear to have posed the most significant challenges to effective local innovation.

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Local governments need innovative practices to address nonpoint source pollution, which has proven to be the Achilles heel of efforts to improve surface water quality in the United States. Studies by the U.S. Environmental Protection Agency (EPA) determined that 45% of assessed lakes and 39% of assessed rivers in the nation are polluted, and that agricultural and urban runoff were the primary sources of these problems (EPA, 2000, 2002). New approaches to address runoff are clearly necessary, and their success will depend on local government practices, yet we know little about how and why local governments innovate, particularly in response to a federal mandate.

Thus in this article, we study innovation by Kansas local governments responding to Phase II of the National Pollutant Discharge Elimination System (NPDES) stormwater program, a direct effort to spur new activities by local governments. This Clean Water Act program addresses urban runoff pollution by requiring localities with small municipal separate storm sewer systems (MS4s) to develop plans and adopt best management practices (BMPs) in six areas, called minimum control measures (MCMs). Local governments that meet established criteria then receive permits allowing them to continue to discharge stormwater runoff into U.S. waters. This program represents a new approach to addressing nonpoint source pollution in the United States.¹

Because the NPDES Phase II stormwater program allows flexibility in how MS4s respond, local governments can satisfy the six MCMs with existing activities. In previous research we analyzed Phase II compliance (White & Boswell, 2006), but not the extent to which Phase II led local governments to adopt new practices as opposed to relying on activities already in place. We aim in this paper to identify the degree to which this mandate produced new activities, whether communities that adopted most of their stormwater BMPs prior to the Phase II planning deadline differ from those that adopted them in response to the mandate (after the deadline), and the possible links between innovation and stormwater management plan quality.

The NPDES Phase II Stormwater Program: Prompting Innovation

NPDES is a multifaceted permitting program administered as part of the federal Clean Water Act. The original focus of NPDES was industrial point sources of water pollution, but the ongoing problem of nonpoint source pollutants (i.e., those with diffuse sources) led to the development of another approach. Phases I and II of the NPDES stormwater program bring the permitting process to bear on stormwater pollution, attempting to manage runoff at discharge points, namely, storm sewer outfalls. Phase I, developed in 1990, affects MS4s in cities or counties with populations over 100,000, and at certain industrial locations, including construction sites larger than five acres. EPA published the final rule for Phase II, the focus of this study, in 1999. It affects small MS4s in urbanized areas and construction sites of one to five acres. Both of these programs require NPDES discharge permits for MS4s (to be obtained by their local governments) and construction sites (to be obtained by their owners). Local governments and site owners must develop stormwater management plans in order to receive such permits. The plans were due in March 2003.

The NPDES Phase II stormwater program required regulated MS4s to submit a Notice of Intent (NOI) that described a 5-year stormwater management plan for implementing BMPs in the six MCM areas: (1) public education and outreach; (2) public involvement; (3) illicit discharge detection and elimination; (4) construction site runoff control; (5) postconstruction runoff control; and (6) municipal good housekeeping. Upon approving these stormwater management plans, EPA or the relevant state agency issued discharge permits. In Kansas, the Department of Health and Environment (KDHE) was responsible for the permitting process.

Although all affected local governments must demonstrate activity in the six areas described above, Phase II allows considerable latitude in the specific approaches that will satisfy its requirements. For example, EPA:

recognizes that there is often site-specific, regional, and national variability in the selection of appropriate BMPs, as well as in the design constraints and pollution control effectiveness of practices. The list of practices for each minimum control measure is not all-inclusive and does not preclude MS4s from using other technically sound practices. In all cases, however, the practice or set of practices chosen by the MS4 needs to achieve the minimum measure. (EPA, 2005, p. 8)

In addition,

EPA recognizes . . . that some MS4s may already be meeting the minimum measures, or that only one or two practices may need to be added to achieve the measures. Existing stormwater management practices should be recognized and appropriate credit given to those who have already made progress toward protecting water quality. There is no need to spend additional resources for a practice that is already in existence and operational. (EPA, 2005, p. 9)

The responses of stormwater management plans to the Phase II requirements are thus widely variable. If an MS4's preexisting activities were adequate, new activities were not necessary. We generally anticipated that local governments with stormwater management practices in place prior to Phase II (i.e., early adopters) would approach this federal mandate differently from those that did not act until required to do so (late adopters).

Local Government Innovation

As noted above, we seek to understand three aspects of innovation in the stormwater management plans local governments developed in response to the Phase II program: the degree of new activity that has occurred, the differences between how earlier and later adopters addressed the Phase II mandate, and the possible connections between early adoption and the quality of the stormwater management plans.

While the diffusion of innovation in general, and policy innovation in particular, have received considerable scholarly attention, innovation by local governments is a small subset of this literature. Although the term *innovation* has positive connotations, innovative practices at the local government level are not necessarily better than prior practices. According to Rogers (2003), an innovation is simply "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (p. 12). A policy or program that is innovative in one local government may have been in practice elsewhere for many years. In addition, innovations that are desirable in one place may be undesirable in another. A later adopter of a particular innovation may also alter it, thereby rendering it more effective (Hays, 1996). Innovation, its diffusion, and its ultimate desirability are therefore highly dependent on factors specific to the innovator.

With respect to policy innovation, most research has focused on the state level, and particularly on innovations adopted by state legislatures. Early work in this area (e.g.,

Gray, 1973; Walker, 1969) determined that certain states are more innovative than others when it comes to adopting new policies and programs. Both Walker and Gray found Kansas to be in the middle of the pack with respect to innovation. As Gray (1973) concludes, however, a state's propensity for innovation "is not a pervasive factor; rather, it is issue- and time-specific at best" (p. 1185).

Two broad models for understanding state-level innovation are the internal determinants and regional diffusion models (Berry & Berry, 1999). The internal determinants model suggests that diffusion occurs due to political, social, or economic variables specific to the state(s) in question. In contrast, the regional diffusion model suggests that diffusion occurs regionally; proximity to other states is the major influence on policy adoption.

Many recent studies of policy innovation seem to follow an internal determinants approach in identifying variables that explain the decision to innovate. This holds for both state-level analyses (e.g., Sapat, 2004) and those focused on local governments (e.g., Ihrke & Proctor, 2003; McLemore & Rose, 1997; Watson, 1997). Another local-level analysis (Godwin & Schroedel, 2000) blended both approaches, investigating the influence of regional, demographic, institutional, and contextual variables on adoption of gun control measures. The authors identified five factors (focusing events, the establishment of new interest groups, the presence and strength of regional associations, promotion of a new policy image, and the ability of interest groups and entrepreneurs to target activities properly toward receptive local governments) that explained the occurrence of local policy innovation.

It is clear that many factors influence policy innovation. In a comprehensive attempt to integrate these numerous variables into a coherent framework, Wejnert (2002) suggests that the factors that influence an entity's decision to adopt a particular innovation can be grouped according to whether they relate to: (1) the innovation itself; (2) the innovator; or (3) the environmental context in which the innovation occurs. While Wejnert's framework is not specific to local governments, we find it to be a useful tool. Because local governments are complex, diverse, and dynamic (Frederickson & Nalbandian, 2002), a broad evaluative structure seems appropriate.

Two factors distinguish our investigation of the NPDES Phase II stormwater program from other innovation research. First, as stated above, we emphasize policy innovation at the local government level, which is important given the critical role of local governments in carrying out certain federal policies. Second, our study investigates innovation in response to a federal mandate. We use Wejnert's framework to investigate the differences between the planning

and decision-making processes of local governments where innovation occurred early and voluntarily and those where the federal mandate was the impetus to act.

Data and Methods

We used interviews, surveys, and correlation analysis to investigate our research questions and to triangulate our findings. As part of our previous work we had conducted 10 semistructured, in-depth interviews with Kansas local government staff (White & Boswell, 2006). The interviewees, who were purposefully selected to represent a range of locations and community demographics, had different experiences with the new practices the NPDES Phase II stormwater program required of them. Three interviewees represented early adopting local governments, while the remaining seven represented late adopters. Our interview questions probed for detailed information concerning the processes local governments used to learn about, evaluate, and decide upon their Phase II planning responses. We identified and coded the themes we found in these responses (Patton, 1990; Robson, 1993), looking for broad commonalities, as well as systematic differences between early and later innovators. We also used the data gathered in the interviews to develop some of the variables in our second method, a survey.

To understand the degree of innovation that occurred, we developed and sent a survey to all 48 local governments who submitted complete NOIs to the Kansas Department of Health and Environment.² We sent these surveys directly to the individuals who were listed as primary contacts on the NOI forms. The response rate was 54%, or 26 out of 48 possible responses.

The survey asked respondents to indicate when their communities adopted specific BMPs. To assess innovation, we then developed a two-part index. First, we assumed that BMPs put in place after the March 2003 planning deadline had been adopted in response to the Phase II mandate, and might not have been undertaken without it. We characterized communities reported to have at least partially adopted the majority of their BMPs for a particular MCM prior to the March 2003 Phase II planning deadline as early adopters for that MCM. For example, if a community had 60% of its public education (MCM 1) activities at least partially established prior to submitting its stormwater management plan, and the remaining 40% were established only after the planning deadline, we categorized its MCM 1 response as early.³ Second, we characterized each local government as an early adopter or a late adopter overall based on whether its responses were predominantly

early or late. An overall late response, for instance, is one in which most MCMs were put in place only after the Phase II planning deadline.⁴

The survey also asked respondents about various factors that influenced the development of their stormwater management plans and BMP choices.⁵ These factors are listed in Table 1, grouped into three categories that reflect Wejnert's (2002) framework. We selected these factors based on responses gathered in the interviews, as well as our review of the relevant literature on local government innovation (e.g., Godwin & Schroedel, 2000). We then compared the mean responses of early and late adopters, as well as using census data to look for additional differences between these groups of communities.

Our third concern was to discover whether adopting BMPs early or late had a relationship to the quality of the stormwater management plan. To do this we correlated the two-part innovation index described above with a four-point index of plan quality we had developed previously to determine the degree to which each local government met EPA (2005) criteria for BMP development (White & Boswell, 2006).⁶

Findings and Discussion

How Much Innovation Did NPDES Phase II Prompt?

The NPDES Phase II program forced a considerable amount of innovation in Kansas (Table 2). Our analysis of survey responses revealed that 62% of BMPs adopted in Kansas were put in place after the planning deadline, and thus we presume in response to the Phase II program. The remaining 38% of BMPs were at least partially in place prior to the federal mandate. With respect to the individual MCMs, we found that BMPs for MCM 4 (construction site runoff control) and MCM 1 (public education and outreach) were most likely to have been established prior to the planning deadline. We speculate that these measures were comparatively straightforward and easy to implement, explaining their greater rate of early adoption.

On the other hand, BMPs for MCM 3 (illicit discharge detection and elimination) and MCM 5 (postconstruction runoff control) were least likely to be established prior to the planning deadline. MCM 3 is a comparatively complex requirement, involving mapping and monitoring of storm sewer systems, which may have delayed its implementation by local governments. With respect to MCM 5, our previous analysis (White & Boswell, 2006) showed a considerable degree of confusion concerning its implementation. It

Table 1. Factors potentially influencing local stormwater management planning and implementation.

Characteristic	Explanation/definition
Characteristics of the innovation	How would the Phase II mandate likely affect local government resources?
Funding	New funding sources or reallocation of existing funds
Staff expertise	Get by with existing staff or need new hires
Staff numbers	Get by with existing staff or need new hires
Consultants	Possible need for consultants
Characteristics of the innovator	How did each local government prepare to meet the Phase II requirements?
Collaboration	Decision to work with other affected local governments
State officials	Decision to seek information from state staff
EPA officials	Decision to seek information from EPA staff
Stormwater engineers	Decision to have engineers involved in process
Planning staff	Decision to have planners involved in process
EPA website	Decision to seek information from on-line resources
Local context	How did local contextual factors influence Phase II responses?
Elected officials	Level of interest of and support from elected officials
Environmental interest groups	Level of interest and involvement of local environmental groups
Interested citizens	Level of interest of citizens
Community salience	Degree to which stormwater is seen as important local issue
Water quality data	Presence or absence of surface water quality data

requires efforts to control the quantity and quality of runoff from new construction, and may lead to one of the greatest impacts of Phase II by forcing innovation in the area of site design and land use planning.⁷

Importance Respondents Placed on Local Factors

Because adoption was mandatory, our study does not investigate the decision to adopt these BMPs. However,

Table 2. Percent of NPDES Phase II measures reported adopted before the planning deadline.

MCM	%
1 Public education/outreach	44.0
2 Public involvement	35.5
3 Illicit discharge elimination	25.8
4 Construction site runoff control	47.4
5 Postconstruction runoff control	32.2
6 Municipal good housekeeping	43.8
Total	38.1

Table 3 compares the mean importance survey respondents felt various factors had for community planning and decision-making processes. We were somewhat surprised to see only two significant differences between early and late adopters.

Concern over insufficient staff likely explains why late adopters reported staff numbers to be significantly more important to their policy responses. The interview data corroborate this finding. More than early adopters, late adopters spoke of getting by with existing resources, including staff. One interviewee described the situation as follows: “. . . we realize that . . . it’s the same broken record of a matter of time and staff. Our day is filled with so many other emergencies that this has been shoved to the back burner.”

Although early and late adopters did not report significant differences in the importance of funding to their NPDES Phase II efforts, both the survey and interview responses indicate that funding was very much on their minds. Half of the survey respondents indicated that their community was not prepared to meet the financial requirements of Phase II implementation. While 35% will use an existing stormwater utility to fund at least some of their efforts, and another 19% intend to establish a new stormwater utility for this purpose, cost concerns linger. Nine out of 10 interviewees revealed that cost was a very important factor in planning for their Phase II response. One interviewee did not mince words: “The whole world revolves around cost. I think that was our main focus. Everything is expensive.” It appears, then, that early and late adopters alike were concerned with what another interviewee described as the “unfunded mandate” aspects of Phase II.

Our survey also asked respondents to rate the importance to their community’s planning and decision-making process of involvement by professionals (stormwater engi-

Table 3. Mean importance^a of factors to early and late adopters.

Characteristic	Early adopters	Late adopters	Signif. of difference ^b (t)
Characteristics of the innovator			
Funding	3.00	3.06	
Staff expertise	3.13	3.29	
Staff numbers	2.75	3.35	ψ
Consultants	1.75	2.47	
Characteristics of the innovator			
Collaboration	3.38	2.76	
State officials	3.00	2.53	
EPA officials	1.75	1.71	
Stormwater engineers	3.63	2.94	ψ
Planning staff	2.88	2.41	
EPA website	2.13	2.35	
Local context			
Elected officials	2.25	2.18	
Environmental interest groups	2.00	1.94	
Interested citizens	2.25	2.00	
Community salience	3.00	2.24	
Water quality data	2.13	2.53	

Notes:

a. Importance was rated as follows: 1=Not Important; 2=Somewhat Important; 3=Important; 4=Very Important.

b. Calculated t-test for equality of means (interpreted using Levene’s test for equality of variances) using SPSS 14.0.

ψ $p < .10$

neers and planning staff), various sources of information and assistance (state officials, EPA officials, the EPA web site), and the choice of a collaborative approach (i.e., working with other local governments to evaluate and select BMPs). The role of stormwater engineers was significantly different between early and late adopters. Early adopters found the role of these stormwater professionals to be more important than late adopters. Again, interview data help explain this finding. Early adopters were local governments where stormwater and/or watershed specialists played key roles in developing the Phase II response. While some of these individuals also expressed concern in the interviews that Phase II took them slightly out of their professional “comfort zones,” counterparts in communities that were late adopters were more likely to comment on Phase II being far removed from their professional expertise. As one late

adopter put it, “My background is in wastewater, but when the stormwater regulation[s] were being tossed out as a possibility for our city, I was told ‘wastewater, stormwater, oh, you should probably take care of it.’” This finding suggests local expertise is important, and local governments may have floundered in their efforts where such expertise was lacking.

Two other results deserve mention. First, a large majority (73%) of respondents participated in some type of collaborative planning and decision-making process in which their community worked with other Kansas local governments to develop their Phase II NOIs. Eighty-four percent of those involved in such collaborations listed cost savings as the most common motivation for engaging in such efforts, underscoring the importance of cost for both early and late adopters. The other most common motivations for collaborating were time savings, the opportunity to learn from others, and belief in the effectiveness of a regional approach to stormwater management. In addition to prompting new stormwater management practices, then, it appears Phase II may have sparked new cooperation among local governments.

The role of planners is also of interest. Although planners’ involvement did not explain differences between early and late adopters, 62% of survey respondents noted an important or very important role for planners in the development of the NOIs. The interviews, however, imply that planners’ involvement was superficial. All 10 interviewees worked for departments of public works, and only one described a specific, thorough dialogue about NPDES Phase II between public works and planning staff. Seven others mentioned fairly minimal efforts to keep local planners informed of the process. (In two small communities, the person interviewed served in both engineering and planning roles.) Five interviewees also indicated that their local planning departments will almost certainly play a more visible role in protecting their community’s water quality from stormwater runoff in the future. To date, though, this role seems negligible. We cannot explain the discrepancy between the survey and the interviews, but there appears to be confusion concerning the appropriate role for planners in responding to the Phase II requirements.

Finally, we found no significant differences between early and late adopters with respect to input from elected officials, environmental interest groups, interested citizens, and any water quality data they might have collected for their watersheds. Similarly, we asked them to consider how important an issue their citizenry considered water quality to be. Early and late adopters showed similar views with respect to the importance of these factors in their NPDES Phase II planning processes.

The interview data strongly suggest that the guiding forces in most local governments’ Phase II responses were pragmatism and caution. Early and late adopters alike spoke of interest in minimizing costs and developing simple, easily implemented measures, using words such as “common sense,” “feasibility,” and “affordability” in responses to questions concerning the selection of BMPs and development of stormwater management plans.

We also looked at census data for relationships between other community characteristics and the timing of BMP adoption. As Table 4 shows, early-adopting communities were more populous, more highly educated, and wealthier than the late adopters. This is consistent with our earlier findings that fiscal resources and a well-educated public are important to a high-quality policy response to the NPDES Phase II stormwater program (White & Boswell, 2006).

Timing and Quality of the Phase II Stormwater Management Plans

The last element of our analysis concerned possible linkages between timing and the quality of local governments’ stormwater management plans. We found that local governments who acted earlier had significantly higher (–0.434 correlation, significant at the 0.05 level) quality responses than communities which put measures in place later, after the planning deadline (Figure 1 illustrates this relationship.) This is also generally true within individual MCMs.

Table 4. Mean characteristics of early- and late-adopting communities in 2000.

	Early adopters	Late adopters	Signif. of difference ^a (t)
<i>N</i>	8	17	
Total population	50,496	28,398	
Percent high school graduates	96%	85%	**
Median household income	\$57,636	\$44,292	
Median home value	\$141,700	\$91,924	*
Percent of families with incomes below poverty	2.9%	6.9%	**

Note:

a. Calculated t-test for equality of means (interpreted using Levene’s test for equality of variances) using SPSS 14.0.

Source: U.S. Census Bureau (2005).

p < .10 **p* < .05 ***p* < .01

These findings raise important issues for the EPA. On one hand, Phase II seemed to benefit early adopters, since they could take credit for existing practices and spend the time it took late adopters to evaluate and select appropriate BMPs satisfying all details of the federal mandate. On the other hand, the Phase II mandate provided late adopters an opportunity to develop comprehensive, locale-specific BMPs even though they had not taken the initiative to do so earlier. If previously existing practices were insufficient and this program spurred innovation and improvement, we would expect later adopters to perform better than those who acted earlier. That was not the case. Instead, plans created by communities that changed their practices earlier appeared to be of higher quality.

Conclusions and Directions for Future Research

This exploratory study cannot yield absolute conclusions with respect to local government innovation in response to a mandate like the NPDES Phase II stormwater program. We do note, however, that Phase II did prompt a

considerable degree of new activity among Kansas local governments.

Still, we found that over one third of the BMPs used to meet this program’s requirements were partially or fully in place prior to the planning deadline, and the Phase II responses of earlier adopters were higher quality than those of late adopters. If the federal mandate was imposed because existing local practices were inadequate, this is puzzling. Although we hoped to learn what conditions brought about early, voluntary innovation in communities, we discovered few significant differences on factors that can be altered by policy, though it may be valuable to support early adopters with evaluation, recognition and praise, and provision of resources (Borins, 2002).

Our research suggests that a lack of resources may be the biggest challenge to undertaking new practices. Earlier, higher-quality stormwater management plans came from more populous, wealthier, and more highly educated communities. NPDES Phase II is an “unfunded mandate,” and local governments can do little without sufficient financial and personnel resources for carrying out the required plans. The pragmatic, cautious planning and decision-making processes our interviewees described illustrate the struggles

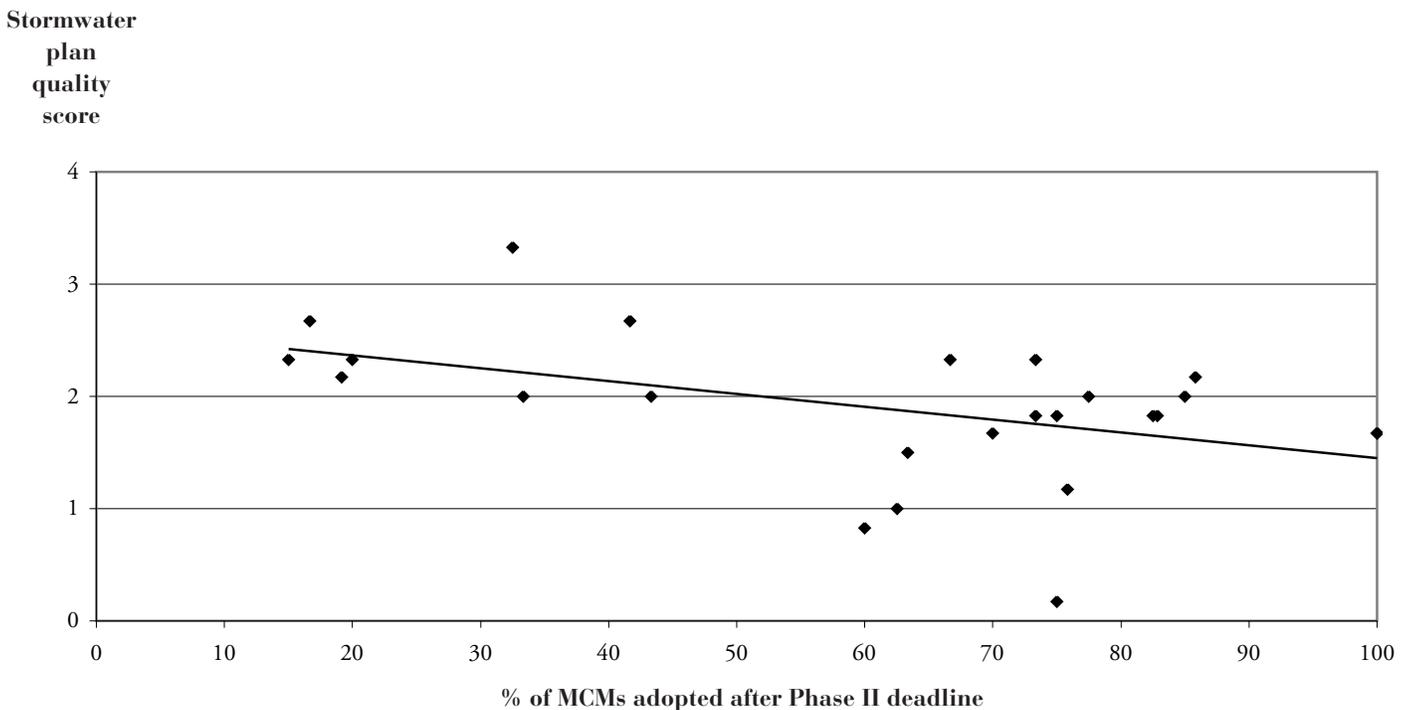


Figure 1. Relationship of stormwater management plan quality to share of MCMs adopted late.

Note:

Points to the left of 50% represent early adopters, points to the right of 50% represent late adopters.

some of these local governments faced in developing new activities. Policy makers should be aware of these difficulties and look for opportunities to alleviate them.⁸

Half of Kansas local governments feel less than prepared to pay to implement their stormwater plans. Our research shows that 54% of Kansas local governments intend to rely heavily on the use of stormwater utilities as a primary funding mechanism, though their success is not guaranteed, since citizens who oppose new taxes may resist the development of stormwater utilities even in cases where the process is transparent and inclusive (Merrill, 2005; Woolson, 2005). Without additional federal guidance on how to resolve these resource constraints, many Phase II communities will continue to struggle to implement their programs. If federal policy will not provide grant funds, policymakers could assist by presenting and analyzing funding options.

Finally, stormwater engineers have played a primary role in dealing with NPDES Phase II in Kansas, and local planners have so far played only minor roles. However, implementing MCM 5 (postconstruction runoff control) will involve planning professionals to a greater degree. Overall, planners have the appropriate training and expertise to contribute to the evaluation of many of the BMP options, to involve stakeholders in their development and implementation, and to facilitate the collaborative approaches important to both early- and late-adopters' decision processes. Harris & Kinney (2003) have suggested that resource constraints may prompt innovation as local governments are forced to look for ways to do more with less. Though the benefits of communication and knowledge sharing among local governments are well documented (Davies, 2003; Newland, 2002; Walters, 2006), increased communication within local governments is also vital. Local officials should encourage both engineers and planners to participate, and planners themselves should take the initiative to become involved in their communities' stormwater management plans and programs, both to stretch available personnel resources and to contribute to ongoing innovation.

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Notes

1. The efficacy of BMPs in improving stormwater quality in any specific context is not well documented (see EPA, 1999; Strecker, Quigley, Urbanas, Jones, & Clary, 2001). Therefore, even a full implementation of the NPDES Phase II stormwater program may not achieve the broader goals of the Clean Water Act.

2. We initially attempted to include local governments from a particular region of California in this study. Despite our efforts, the response rate was quite low in California, and so we have dropped it from this study. We believe that Kansas's reputation as a middle-of-the-road innovator, that is, neither early nor late (Gray, 1973; Walker, 1969), make it a useful case example.

3. When a locality's response on one MCM fell on the dividing line between early and late, we assumed it would follow the overall pattern for that local government. For example, if the majority of other MCMs in that locality were established early, we categorized a measure that was 50% newly established as early also.

4. Essentially, we are treating this as a time series analysis in which the NPDES Phase II mandate is the intervention. Thus we have divided the communities into those responding primarily before the planning deadline (early adopters) and those acting after the planning deadline (late adopters). Making this distinction clearer, our survey questions asked respondents to distinguish between activities they undertook because of Phase II and those independent of it. We also know from our interviews and previous research that many Kansas communities only learned they were subject to Phase II requirements shortly before the March 2003 deadline.

5. The scale was as follows: 1 = Not Important; 2 = Somewhat Important; 3 = Important; 4 = Very Important.

6. We believe our interview and survey samples were representative of the average quality of Phase II response among Kansas local governments because the average quality score for survey respondents was 1.89, exactly the same as the state average. The local governments with the highest (3.33) and lowest (.17) scores were both among our respondents. The average quality score for the interviewees was 1.92.

7. According to EPA's online description of the various activities that could be used to satisfy NPDES Phase II requirements (2005), MCM 5 includes such structural BMPs as grass swales, detention ponds, and stormwater wetlands, as well as nonstructural BMPs such as open space design, conservation easements, and narrower streets.

8. Examining the financial and personnel costs of early and late responses was beyond the scope of this study.

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