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Review and recommendations for the City of Cedar Falls, Iowa regarding Phase II compliance with the Federal Clean Water Act: The National Pollutant Discharge Elimination System

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Review and recommendations for the City of Cedar Falls, Iowa regarding Phase II compliance with the Federal Clean Water Act: The National Pollutant Discharge Elimination System

Abstract

As the United States developed into an urban and industrial economy, the physical landscape of the nation changed. Wilderness gave weigh to civilization and, over time, the urban lifestyle evolved. Since then, unpaved right-of-way has become impervious skeletons that hold modern cities intact. Lined with buildings and rooftops, parking lots and driveways, water can only be directed from above ground to other locations when it rains or snows. This paper is a literature review of the history of stormwater management practices, description of the Phase II program within the Federal Clean Water Act, and a descriptive analysis of structural and non-structural practices implemented in other cities. The objective is to offer suggestion to the city of Cedar Falls, Iowa as it develops and begins implementation of a stormwater management program. As a developing program, the city has the advantage of learning from others' experience, yet the disadvantage of approaching a compliance deadline with less implementation time. The practices and case studies in this paper are meant to guide the city through both positive and negative examples to make best use of remaining compliance time.

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Review and Recommendations for the City of Cedar Falls, Iowa Regarding Phase II Compliance with the Federal Clean Water Act: The National Pollutant Discharge Elimination System

May 31, 2006

Rebecca L. Kauten

As the United States developed into an urban and industrial economy, the physical landscape of the nation changed. Wilderness gave weigh to civilization and, over time, the urban lifestyle evolved. Since then, unpaved right-of-way has become impervious skeletons that hold modern cities intact. Lined with buildings and rooftops, parking lots and driveways, water can only be directed from above ground to other locations when it rains or snows. This paper is a literature review of the history of stormwater management practices, description of the Phase II program within the Federal Clean Water Act, and a descriptive analysis of structural and non-structural practices implemented in other cities. The objective is to offer suggestion to the city of Cedar Falls, Iowa as it develops and begins implementation of a stormwater management program. As a developing program, the city has the advantage of learning from others' experience, yet the disadvantage of approaching a compliance deadline with less implementation time. The practices and case studies in this paper are meant to guide the city through both positive and negative examples to make best use of remaining compliance time.

Historically, stormwater management has been, albeit somewhat subconsciously, at the forefront of land use planning. Debo and Reece site five early stormwater paradigms[*]. Each is an evolutionary step in how stormwater has been managed over time.[i] First, ditches and culverts emulated how liquid waste was carried away on the farm. From there, basic sewer systems carried a combination of storm and wastewater through pipes. Then in the 1960s, catch basins and pipes were installed, leading to streams became an "efficient stormwater system," but resulted in downstream flooding and channel erosion. According to Debo and Reece, this was the point where modern stormwater *quantity* management was born.

Stormwater ordinances were first introduced in the 1970s.[ii] Impacts on volume were starting to be addressed; the fourth evolution in stormwater management. In an analogy, Debo and Reece use the traffic jam after a football game ends in a large city. "There is a traffic jam for hours in the vicinity of the stadium…each parking lot lets out

[*] The book cites nine paradigms in total. For purposes of this paper, I am only working with the first five. The other four paradigms focus on ecological principles, whereas my research concentrates primarily on engineering, policy, and sociological principles related to stormwater management.

so many cars at once…the problem is a car volume problem, not a peak flow problem only."

The same can be said when it rains and water flows into a detention pond, which often can be seen located in a newly developed area. Detention ponds have been built to capture large quantities of water during and after storms. The focus was on "peak flow," or the point at which the largest amount of stormwater is moving toward a water body. As water collects in the pond, the peak runoff heading directly below the pond may be controlled and released at a slower rate with less volume. Downstream however, there may be water volume ten times its existing land area draining into the stream, with no additional pond to collect overflow. According to Debo and Reece, this is a runoff problem and not a peak problem. Runoff problems tend to be more common and cause for a more technical approach to solving the problem.

The fifth paradigm was established in the 1970s, with mainframe hydraulics and PC-based hydrology models. Stormwater management became a matter of structural design. The result was stormwater "master planning." The hydrology models helped determine how much water would flow, and how often. This information was then used in hydraulics models to determine how fast and how high the water flowed. The approach considered the entire watershed and applied "what if" scenarios to help troubleshoot some circumstances, avoiding potential flooding issues. Again, volume was the primary problem.

Only five things conspire to cause chronic flooding, say Debo and Reece: more water than before; a clogged or broken system; a system designed too small to begin with; homes located in the wrong place; and of course, the random "act of God." All remaining causes are institutional in nature. Therefore, it is important not only to have a well-structured engineering model in place. There also needs to be a focus on consensus building, financing for stormwater management, and public relations to keep people aware of the issues. As a financing mechanism, stormwater utilities were entering the fore during this fifth evolution as well.

The Clean Water Act and Phase II Requirements

Since 1972, the U.S. government has implemented measures to manage and to enforce water quality and quantity issues. On October 18, 1972, Congress passed the Clean Water Act as a nationwide initiative to address water quality issues. Within the Act, Section 402, the National Pollutant Discharge Elimination System, or NPDES, relates to issuing permits for pollutant discharge into what the bill describes as "navigable waters."[iii] The permits were to be administered by the relative states, usually by their Departments of Natural Resources. The permits have up to five year terms and provide a compliance guideline for those applying. That is, the permit determines what pollutants are acceptable, and how much can be discharged into water bodies due to each permit issued.

Congress added Section 402(p) to the Clean Water Act in 1987 to require two implementation phases for NPDES compliance[iv]. The first phase was promulgated on November 16, 1990. Phase I related to cities with populations of 100,000 or more. At total of 260 stormwater permits, covering approximately 880 operators, such as local governments, state highway departments, etc. had been identified as permit applicants to comply with the Phase I NPDES requirements. As of late 1998, approximately 228 permits had been issued in final form.

Phase II was proposed on January 9, 1998, under a separate decree. Under Phase II, small municipalities with separate storm sewer systems located in urbanized areas are included. This statute impacts approximately 3,500 communities nationwide. Also included are construction activities that disturb equal or greater than one and less than five acres of land. Disturbance includes sediment and erosion conditions. About 110,000 sites each year were estimated to be included in Phase II compliance, requiring permits. Such facilities in either category would need to apply for NPDES stormwater permits by 2002.

Public hearings may be held before permits are issued, to allow for discussion and awareness of the possible pollution reaching a local water body[v]. Conversely, a permit applicant may also submit written recommendations to the state and the administrator. If the applicant violates NPDES laws, they are subject to both civil and criminal penalties

Each permit relates to a specific pollutant, such as nitrogen, phosphorous, sediment, or even colder or warmer water. If the applicant begins discharging other possible pollutants, new permits are necessary. Also, if there is a "substantial change in volume or character," there must be a new permit reviewed and issued.

Although agricultural practices do contribute to water quality issues, agricultural return flows, as they are described, are not covered by NPDES regulations. Also, stormwater runoff from oil, gas, and mining operations are exempt. Rather, the permits relate to industrial and municipal discharges. It is likely to assume Phase I and II are likely predecessors of other EPA statutes and phases intended to address issues related to these presently unaccounted factors.

Industrial and large municipal discharges were considered Phase I of the NPDES program. Starting February 4, 1987, permit application requirements were beginning establishment within the states. Each state had two years to comply. Phase II included other municipal discharges, and mostly targeted cities with populations below 100,000. States had four years from the February 4 start date to establish a relevant permit system.

Phase II NPDES requirements hit cities and municipalities hard. Many were not prepared technically or financially to comply with the rigid guidelines established by the EPA. Six major components were required within a set number of years for full compliance. Otherwise local governments could expect heavy fines and penalties for non-compliance. The six components were Public Education and Outreach; Public Involvement and Participation; Illicit Discharge Detection and Elimination; Construction Site Stormwater Runoff Control; Post-Construction Stormwater Management; and Pollution Prevention/Good Housekeeping.

Phase II NPDES Requirements:

1. **Public education and outreach** – cities are expected and required to hold public meetings, publish information and provide resources to educate and inform citizens on the impetus of a stormwater management program. In doing so, cities help change attitudes and behavior related to water quality and quantity management.
2. **Public involvement and participation** – citizen groups, committees and volunteers are expected to aid in the development and implementation of a city stormwater management system.
3. **Illicit discharge detection and elimination** – materials such as nitrogen, phosphorous and sediment are to be detected and eliminated as sources of water impairment as part of the statute.
4. **Construction site stormwater runoff control** – contractors and developers are expected to comply with erosion and sediment control practices to ensure no soil loss during the construction phase of a developing or redeveloping site.
5. **Post-construction stormwater management** – upon completion of a construction project, contractors and developers are required to ensure proper stormwater management. Newly developed sites can be heavily fined if they are found to contribute to water quality issues in urban watersheds.
6. **Pollution prevention and good housekeeping** – cities are required to implement "structural" and "non-structural" best management practices, or BMPs, as a means of preventing further environmental damage and proactively addressing stormwater issues.

Best Management Practices: Structural & Non-Structural "BMPs"

The ditches of early farmers as drainage systems may have been the inspiration for what engineers today describe as structural Best Management Practices, or BMPs. Between 1979 and 1983, the EPA conducted a broad analysis of stormwater runoff characteristics. The results were published in the agency's *Nationwide Urban Runoff Program*[vi]. During this study, the EPA's Engineering and Analysis division conducted a study on stormwater BMPs. Chapters cited within this report reflect their findings and identifies information gaps.

In 1996, the National Resources Defense Council (NRDC) recommended that the EPA develop guidelines to supplement the NPDES permit regulations, aiding the process for those who had to apply. The result was a preliminary study that, upon completion, the EPA further developed into recommended supplemental data for Phase II compliance.

Since 1995, the EPA and the American Society of Civil Engineers (ASCE) have worked together to develop a database of stormwater BMP design and performance. In

1999, the initial version of the database was in beta testing. At the time of publication, the report claims the database to be fully functional and available to the public by the end of 1999, and it includes a link to a national BMP database where structural BMPs are tracked for performance and maintenance details.

The EPA requires BMPs that address three main factors: flow control, pollutant removal, and pollutant source reductions[vii]. BMPs are categorized by “structural” or “non-structural” practices. Both are intended to improve the quality and/or control the quality of stormwater runoff.

Structural methods are further organized into three categories: site design features, street construction features, and construction practices. Each involve engineering and design elements that directly relate to stormwater at the point of contact with the ground or impervious surfaces. For purposes of this report I will concentrate only on-site design features related to structural BMPs.

Structural methods are described as they related to both new development projects on bare land and projects that involve retrofitting already developed areas. For the sake of my research, I concentrated on the section in Chapter 5 that addresses already developed areas. According to the report, such retrofitting is often prohibitively expensive for cities to consider adding them to the list of engineering projects as ways to manage erosion and sediment due to stormwater runoff. According to the Statewide Urban Design and Specifications Manual, or SUDAS, there are six main objectives addressed by structural BMPs: flow control, erosion control, sediment control, runoff reduction, and flow diversion.[viii] The SUDAS manual is a guidebook based on both EPA data and developing research for structural BMPs developed in Iowa.

Flow control refers to controlling the velocity of flowing stormwater. By reducing velocity, sediment erosion and transportation is also reduced. Such practices are especially important on long or steep slopes where land has been disturbed. Without flow control measures, a high velocity flow can cause severe erosion in a very short amount of time.

Erosion control is the ability to stabilize the ground surface and prevent soil displacement after the area has been disturbed. In theory, all disturbed sites should have some sort of erosion controls in place. Such practices are the simplest, most cost-effective method for keeping sediment in place.

If erosion has not been controlled, sediment control is the next step to consider. Sediment control refers to the removal of suspended soil particles from runoff after erosion. Sediment control is considered the “last line of protection” against releasing stormwater runoff containing a high level of soil particles.

Runoff volume can also be reduced from a specific site. By reducing the volume of the flow, the potential for erosion and sediment transportation is also reduced. The objective is to encourage absorption and increase the potential for stormwater infiltration, rather than sending the water further down the stream.

If water must leave the site, flow diversion may be used to reduce the amount of water flowing over a disturbed area. With less water, the soil is more likely to stay in place, rather than erode away.

Structural BMPs are a physical way to implement these erosion and sediment control practices. Examples include porous pavement systems, , constructed wetlands, and vegetative systems, also known as biofilters such as swales, filter strips and bioretention cells. Structural BMPs are divided into two categories: detention/retention and absorption/infiltration. The terms “detention” and “retention” are sometimes used interchangeably, although they do have distinct meanings.[ix] While detention is usually defined as providing “temporary storage” of runoff for discharge later on, retention is generally defined as providing storage *without* subsequent surface discharge.

Detention basins, underground vaults, tanks, pipes, deep tunnels, and temporary stormwater detention in parking lots can be considered examples of detention practices. Detention systems do not retain a significant permanent pool of water between runoff events.[x] Examples of retention systems include practices that retain a runoff volume until it is displaced “in part or in total” by the runoff event of the next storm. This definition implies a permanent pool of water in a retention system of some sort. Specific retention examples include retention ponds, tanks, tunnels, and wetland basins. Constructed wetland systems differ from traditional retention systems in that they contain wetland vegetation which also absorbs water for nourishment.

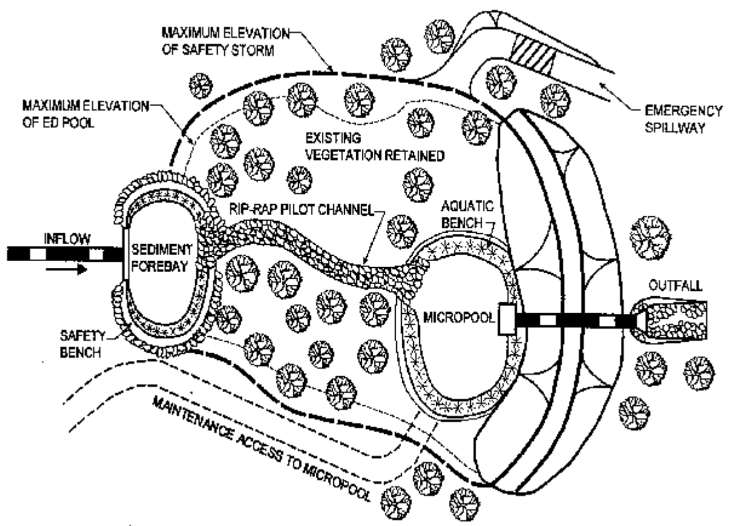
BMPs that include vegetation, whether preexisting or planted and constructed, can be considered infiltration-based BMPs. An infiltration BMP is designed to capture a volume of stormwater runoff, retain it and infiltrate that volume into the ground.[xi] The infiltration reduces, and possibly eliminates, the volume of water discharged to receiving streams and thereby reducing erosion and sediment impact, as well as impact from contaminants within the runoff. Infiltration systems can be designed to capture stormwater and infiltrate over a series of hours or days, if necessary.

A secondary benefit from infiltration systems is the possibility for groundwater recharge from filtered surface water. Pollutant removal can occur as water percolates through the various soil layers.[xii] Microorganisms and structural design elements may increase pollutant removal, and water leaving the infiltration system may be cleaner than when it entered.

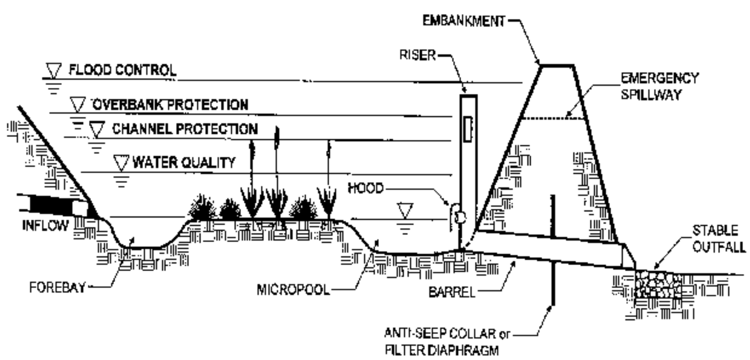
For all the benefits of infiltration systems, not all are suited for every type of location. Infiltration systems are not recommended for installation near large-scale groundwater recharge systems, due to potential for contamination. This is especially true if the runoff is from a commercial or industrial area with potential for organic or metal water contamination exists.[xiii] If runoff contains a high level of sediments, the infiltration system may run the risk of clogging or require frequent maintenance to remove sediment and ensure proper functionality.

A basin is considered a typical infiltration system. Infiltration basins capture surface water, transform it into groundwater, and “remove pollutants through mechanisms such as filtration, adsorption and biological conversion as the water percolates through the underlying soil.[xiv] Over the course of 72 hours, standing water should be completely absorbed; otherwise basins run the risk of becoming mosquito breeding grounds and susceptible to algae blooms or other serious problems.

Wet ponds, also considered retention systems, tend to be commonly used to retain a permanent pool of water. Wet ponds are designed to intercept stormwater, store it, and treat it. While “extremely effective,” according to the EPA, physical appearance and emphasis on volume storage only (versus water quality) of wet ponds, as well as retention basins cause many cities to consider other ways to manage stormwater.



PLAN VIEW



PROFILE

Figure 1: EPA Spec Diagram of a Detention Pond

Infiltration systems such as porous pavement systems, and filtration systems such as constructed wetlands and bioretention systems are being considered as alternatives to digging wet or dry ponds as a physical means of addressing stormwater volume and water quality concerns. Porous pavement is an infiltration system where water runs through a stabilized, permeable surface, such as porous asphalt, concrete, modular perforated concrete block, cobble pavers with porous joints or gaps or reinforced/stabilized turf.[xv]

Figure 2: A bioretention cell located in a Williamsburg, Virgina parking lot. Photo included in a workshop flyer developed by Virginia PRIDE Water Quality Education Program.

While not yet an option for major highway systems or heavy traffic parking lots, permeable pavement systems can be installed along the perimeter of new or existing parking lots to capture residual runoff. They can be used in residential driveways and low-volume parking lots. While some may choose porous pavement due to aesthetic elements, it does come with an added responsibility. Porous pavements require maintenance including periodic vacuuming or jet-washing to remove sediment from the pores.[xvi] Also, heavy equipment and high volumes of traffic can damage the pavement, also causing it to malfunction and wear out more quickly. To date, there is sporadic, inconclusive data on the life cycle and maintenance requirements of porous pavement and concrete systems. This is an area where more research is currently underway and needed for conclusive results.

Figure 3: Porous pavement design options and maintenance suggestions from the Low Impact Development Center. Graphic adapted from The Bioretention Manual, Prince George's County Department of Environmental Resources Programs and Planning Division, Maryland, 2001.

As proven water quality improvement systems, constructed wetlands can serve as a stormwater management system that also creates habitat for wildlife. Constructed wetlands are particularly appropriate where groundwater levels are close to the surface because groundwater can supply additional water necessary to sustain the wetland system without running the risk of contamination. Pollutant removal can occur through "a number of mechanisms, including sedimentation, filtration, adsorption, absorption, microbial decomposition and plant uptake."[xvii] While storing a large volume of stormwater, a constructed wetland also serves as a natural, yet constructed, way to improve water quality.

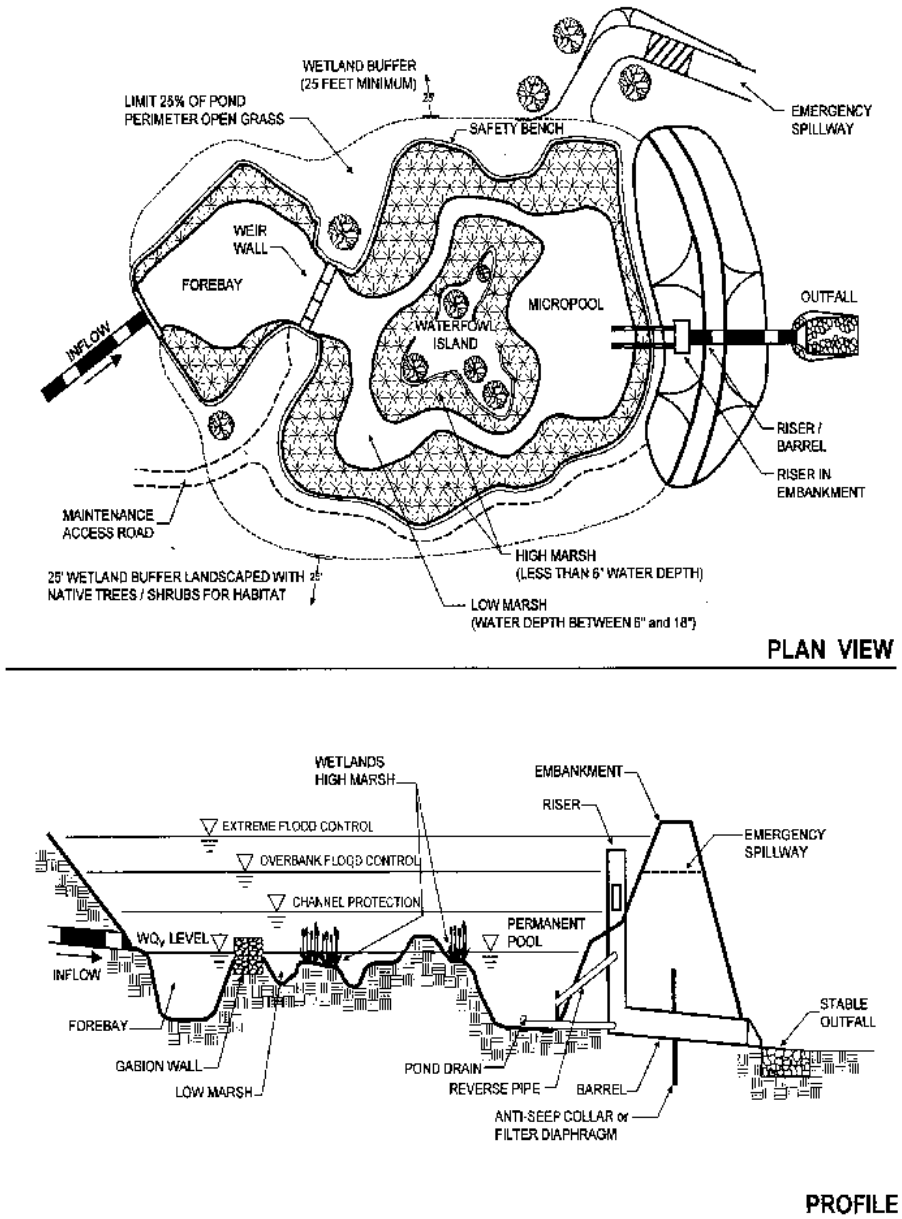


Figure 4: EPA spec diagram for a constructed wetland.

Like constructed wetlands, bioretention systems mimic a natural ecosystem while treating stormwater runoff. Bioretention is a fairly new practice, where the area mimics a forest floor. A combination of filtration, retention, detention, and filtration systems are implemented. An example would be a parking lot “island,” where stormwater is captured, retained, filtered, and released. Bioretention systems operate through a sand filter/soil bed system where stormwater flows into the area, pools on the surface, and gradually infiltrates into the soil bed. Treated water is allowed to infiltrate into the surrounding soil, or is collected by an under-drain system and discharged to the storm sewer system or directly to receiving waters.[xviii] In areas where infiltration is possible, but a constructed wetland would not be appropriate, bioretention cells may be an alternative. Parking lot runoff may be treated with a bioretention cell, for example. When the lot is constructed, there may be opportunities to install a filtration system within green space between stalls. Curbs may be cut and surfaces may be graded to manipulate runoff flow directions, sending stormwater directly to the bioretention system for treatment.

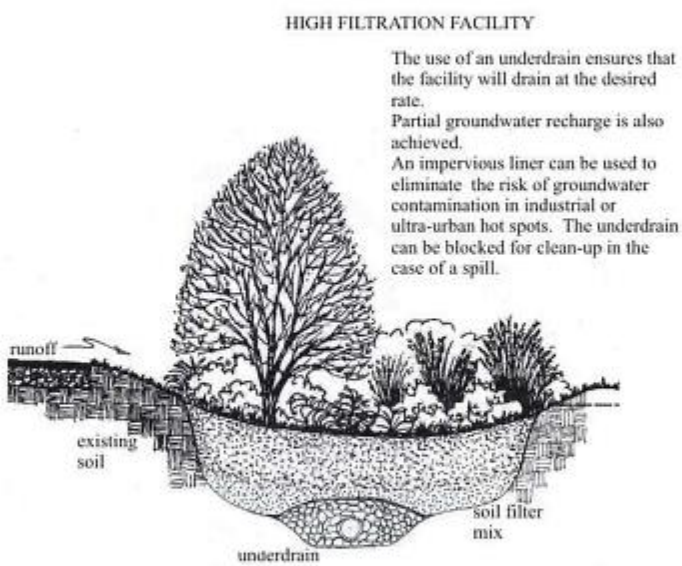


Figure 5: Graphic adapted from The Bioretention Manual, Prince George's County Department of Environmental Resources Programs and Planning Division, Maryland, 2001.

Structural BMPs come at a significant cost[xix]. Evaluated costs refer primarily to the cost of constructing the BMP, including costs related to erosion and sediment control during construction. Factors such as design, geotechnical testing, legal fees, land costs, and other unexpected or additional costs are not included in estimates used in this report. Construction costs outlined range from $.50 to $6.00 per cubic foot. With inflation rates increasing overall prices since 1997, the recent increases in fuel costs, changes in raw materials costs, and other factors, new price estimates are necessary. This report shows existing data and recommendations from the EPA. Based on the data, it is likely to assume a higher construction cost at the present time for each BMP.

Structural BMP Details*

BMP Type	Typical Cost* ($/cf)	Notes
Retention and Detention Basins	0.50-1.00	Cost range reflects economies of scale in designing this BMP. The lowest unit cost represents approx. 150,000 cubic feet of storage, while the highest is approx. 15,000 cubic feet. Typically, dry detention basins are the least expensive design options among retention and detention practices.
Constructed Wetland	0.60-1.25	Although little data are available to assess the cost of wetlands, it is assumed that they are approx. 25% more expensive (because of plant selection and sediment forebay requirements) than retention basins.
Bioretention	5.3	Bioretention is relatively constant in cost, because it is usually designed as a constant fraction of the total drainage area.

1. Base costs do not include land costs.
2. Total capital costs can typically be determined by increasing the costs by approximately 30&.
3. A range is given to account for design variations.

* Base year for all cost data: 1997

Long-term costs are also evaluated for a five-acre commercial development for infiltration systems and 50-acre retention/detention systems. The figures are based on a construction cost equation for each project, the actual cost, typical design, contingency and other capital costs (figured to be 30 percent of total construction costs), annual maintenance costs, and basic notes to help describe the project. [xx] Based on 1997 EPA data, prices for each project range from $60,000 for bioretention systems to more than $100,000 for retention/detention systems.

Structural BMP Costs

BMP Type	Typical Cost* ($/BMP)	Notes
Retention Basin	$100,000	50-Acre Residential Site (Impervious Cover = 35%)
Constructed Wetland	$125,000	50-Acre Residential Site (Impervious Cover = 35%)
Bioretention	$60,000	5-Acre Commercial Site (Impervious Cover = 65%)

1. Base costs do not include land costs.
2. Total capital costs can typically be determined by increasing the costs by approximately 30&.
3. A range is given to account for design variations.

* Base year for all cost data: 1997

Non-structural BMPs include a range of pollution prevention, education, institutional management and development practices designed to limit the conversion of rainfall to stormwater surface runoff and to prevent pollutants from entering runoff at its source.

Unit program costs recommended by the EPA for public education programs include supplies for volunteers, communications strategizing, environmental education, education services and field trips, teacher training, equipment, staffing for a water interpretation specialist, equipment for this staff person, and funds for Youth Conservation Corps (YCC) clean up activities. [xxi] Costs may range from $3,400 for teacher training to $210,900 for YCC cleanup efforts.

Unit program costs are defined as a public attitude survey, flyers, a soil test kit, paint, and safety vests for volunteers as part of a public education program. Such prices range from $.10-.25 per flyer to, $1,250-$1,750 per 1,000 households to process a public attitude survey.

Upon full, nationwide implementation, the EPA estimates the total annual compliance cost to be approximately $512 million. This estimate was made under the assumption that 109,652 construction projects were started in 1998. The agency expects municipal programs to achieve at least 80 percent effectiveness, resulting in annual benefits from freshwater use and passive use in the range of $67.2 to $241.2 million. At the time of the report, potential value of improvements in marine waters and human health benefits had not been quantified.

Total compliance costs of the rule are estimated at $807.2 million, with the $512 million in erosion and sediment controls making up the largest portion. A partial monetary estimate of benefits currently range from $700 to $865 million, assuming 80 percent effectiveness nationwide. The largest portion of funding, $624 million is associated with the same erosion and sediment controls for construction sites.

Funding a Stormwater Management Program

Merrill considers the meaning of a “mid-altitude” perspective related to possible funding sources for stormwater projects[xxii]. Traditional sources of funding for stormwater management have been from the local municipal coffers. These funds are typically generated through sales and property taxes. Due to tax cuts, credits and the lack of incentive to levy higher or new taxes, such sources are becoming harder and harder to secure.

According to Merrill, 60 percent or more of a city’s general fund dollars are typically committed to emergency services, such as police, fire and ambulance. Stormwater projects are usually funded through public works and or maintenance accounts. [xxiii] These typically receive 5 to 7 percent of the typical jurisdiction’s general fund.

Merrill defines six possible funding sources: enterprise funds, special districts, development fees, bond financing, grants, and other programs as possible funding sources. Enterprise funds are often used for municipal water service, sewer maintenance, and other designated services. Water and stormwater services are well suited for such a system, according to the author, because there is a unit of measurable service resulting from usage by the property owner. Because such “services” are not always as apparent to the land owner, establishing a stormwater utility may not be easily done, and may often lead to controversy. [xxiv] Often a flat rate is the result for residential, and a graduated rate for commercial land use.

Special districts, or assessment districts, are defined by well described physical boundaries. All property within the district is assessed a fee for the service, based on those services delivered and their relative costs. Unlike enterprise funds, the cost is based on property ownership, not the actual use of a service. In other words, a vacant property might be assessed the same unit cost as a house next door; thus raising equity issues.

Development fees are one-time charges based on action taken by the property owner, relating to use of the property. While possibly a short-term option, development fees are not likely to serve as a sustainable funding mechanism for a stormwater management program. Development fees are limited in scope, as they are one-time only payments, and therefore cannot be used for ongoing system maintenance and expansion of existing programs.

Bond financing is contingent on a local government's current bond rating. If debts are high, the rating is low; the city may not have the option of a bond issue to fund a stormwater management program. Also, Merrill strongly suggests a well-planned public education program to help push through the bond vote. [xxv] There should also be a strong coalition between the regulated community, regulators, and the environmental activist community in order for the bond issue to pass.

Grants usually provide some portion of funding, but rarely fund entire stormwater programs. [xxvi] Projects may be bootstrapped with grant money, but qualified proposals are usually accepted with the plan for future funding to come from another source. The author states that grants are typically not to fund "cutting edge" projects, they are highly competitive, and mostly seek to benefit disadvantaged communities. If a municipality is looking to serve as a progressive model, grants may serve as source of funding. Due to the competitive nature and short-term cycles of most grant funding, cities often use them for specific, short-term projects related to stormwater management. Grants may be used for large system upgrades or retrofitting projects, but grants are not necessarily steady, reliable funding sources for ongoing resource needs.

Other programs generate specific property fees as a way to fund stormwater programs. San Mateo, California, included a motor vehicle license fee as a way to fund stormwater projects related to streets and curb-and-gutter maintenance. [xxvii] Justification is due to parking lot runoff and motor vehicle emissions and leakage of petrochemicals as potentially harmful substances in area waters. The fee generates a supplemental amount of income for the city, but not nearly enough to fund the entire stormwater management program. While some cities consider unique approaches like motor vehicle fees, many are turning to stormwater utilities as a way to fund such programs. Throughout the United States there are several examples of cities, municipalities, and counties who have successfully implemented stormwater utilities as financing mechanisms for NPDES compliance. In this report I include detailed information on Fort Wayne, Indiana, Union, Ohio, Valparaiso, Indiana, and Griffin, Georgia as national examples of successful stormwater utility systems. Bettendorf, Iowa is included as a positive example within Iowa, and Davenport, Iowa is described as a city who failed to properly communicate the objectives of its stormwater management program and reason behind implementation of a stormwater utility.

Case Studies

The inception of the stormwater utility began during Phase I compliance with the NPDES statute. The city of Fort Wayne, Indiana created a stormwater utility to fund efforts related to NPDES compliance[xxviii]. As part of the EPA mandate, cities over 100,000 were included in Phase I, requiring large cities and municipalities to improve conditions related to discharge into sewer systems and local water bodies, ultimately improving the conditions of local rivers, lakes, and streams.

The sewer system within Fort Wayne serves more than 60,000 residential and commercial users. The system contains 600 or more sewer lines, ditches, open channels and drains spanning 68 square miles throughout the city. Given such a large coverage area, the city estimated $3.5 million would be required annually to begin compliance with NPDES standards and requirements.

In 1991, the city enacted an ordinance that gave the Public Works department responsibility for maintaining and operating the city’s stormwater system. City staff and the city council worked on both costs and funding sources, respectively. Based on a five-year cash flow analysis, rates were set for $1.94 per month as a residential fee, and $52.47 per month for commercial and industrial customers.

No credit system was allowed for residential customers, but commercial and residential customers could use BMPs to qualify for credits and a lower stormwater utility fee. Publicly owned streets and roads were not included in the billing structure.

The project was initially implemented with four phases: data assessment and evaluation, strategic issue assessment, and financial analyses, which were split into cost-of-service rates and billing system studies.

Methods of collecting data included interviewing "key city and county sources," which were never specifically identified in the report. Existing city sanitary and sewer billing systems were taken into consideration, as possible models for a new billing system for stormwater billing. Also used for research purposes were land use maps, GIS data, county assessors' records and the county auditor's database.

Issue papers were also used to aid policy decisions. Paper topics included rate methodology, water quality, organization and legal framework. As a result, stormwater charges were included on a consolidated utility bill. First came solid waste, then stormwater charges, followed by water and sewer charges – all on the same bill each month.

As a result, Fort Wayne has a framework for meeting NPDES requirements, and the financial resources to address any existing or future issues related to stormwater management.

Case Studies, Continued: EPA Follow Up and Interviews

In 2000, EPA published case studies on three city stormwater utility systems. The cities listed were Union, Ohio; Valparaiso, Indiana; and Griffin Georgia. I was able to follow up the initial case studies with interviews with city staff from Valparaiso, Indiana and Griffin, Georgia. The interview consisted of the following questions:

1. What was the impetus for your city's stormwater utility?
2. How has the program evolved since the original ordinance passed?
3. Does your program offer a credit system for utility fees? If so, how is it structured?
4. How has NPDES impacted your stormwater utility?
5. What kinds of information and education programs are included in your stormwater program?
6. Do you involve schools or other opportunities for youth education and involvement?
7. Are there any planned changes to your current stormwater system? If so, when are they set to take place?

Valparaiso, Indiana[xxix]

Matt Kras is the stormwater engineer for the city of Valparaiso, Indiana. The city's stormwater utility was generated in response to citizen complaints regarding drainage problems. With no existing funding source specific to stormwater management, the city was including stormwater projects when funding road, sanitary, and other projects as a way to address concerns. Larger projects required more funding than such projects would allow, so the utility was considered. A bond issue was passed after the utility was established as a means for larger capital improvement projects, but no tax levy was attempted.

Since the passage of the stormwater utility in 1996, the program has been led by a three-person stormwater management board. The board consisted of the same members for ten years: a citizen who had first-hand experience with local flooding, a geology professor from a nearby university, and one person with financial expertise. In 2006, the board was restructured with a more technical focus. Members now include one professor, a business professional with both an MBA and financial background, and a representative from the Indiana Department of Environmental Management (IDEM) with grant writing expertise.

The Valparaiso stormwater utility currently does not offer a credit option for reduced stormwater utility fees. Kras stated the city is in pre-planning stages of establishing a credit system at a future date.

Discussion of a stormwater management system began in Valparaiso in 1996, and concentrated primarily on stormwater volume, or water quantity management. NPDES regulations have brought water quality issues to the fore as well. The stormwater management board has approved municipal water quality improvement projects and future plans include both quantity and quality as part of a comprehensive stormwater management system.

Information and education practices are managed by a tri-county commission known as the Northwestern Indiana Regional Planning Commission, or NIRPC. Porter, Lake, and LaPorte Counties have combined efforts toward consistent messaging, signage, and overall awareness campaigns for the community. The commission has produced PSA announcements for radio and television, brochures, and a website dedicated to an MS4 stormwater system: www.nirpc.org/MS4%20Home.html

Valparaiso has sponsored teacher workshops, incorporating the Water Education for Teachers curriculum development program known as Project WET. The city has also hosted workshops for builders, developers, and contractors to inform and educate on the construction and post-construction requirements within Phase II compliance.

The city has not changed the stormwater utility rate in ten years. The city follows a graduated rate system ranging from $2.25 per month paid by renters and mobile home dwellers to $96 per month for greater than 160 square feet of impervious surface on a property.

Griffin, Georgia[xxx]

Griffin, Georgia has also maintained its stormwater utility system since 1998, virtually unchanged. Milton McCartheny is the deputy director of stormwater for the city and provided me with information regarding the city's system. The only change to the utility was an increase in fees from $2.50 to $3.50. The increase occurred four years after initial implementation. The fee is based on equivalent residential units, or ERU. Each residential property pays one unit, while non-residential properties pay additional units based on amounts of impervious surfaces on the properties.

Flooding was the primary issue addressed by the Griffin stormwater utility. The city was also replacing infrastructure older than 100 years, in addition to a response to local rivers and streams listed on the Georgia 303(d) list if impaired water bodies. Again, volume control was the initial focus of the stormwater management system. NPDES requirements have caused the city to also include water quality practices.

Youth education is the primary focus of the Griffin, Georgia stormwater education and information program. An education credit allows public schools a 50% discount on stormwater utility fees if the school incorporates a national Water Wise™ program in fifth grade curriculum. Kits are distributed to all fifth graders in the city, and Enviroscape® Watershed/Nonpoint Source model displays are distributed to all public schools, two per year, until all schools are supplied. The EnviroScape model demonstrates how different land uses affect water quality.

While residential property is charged a flat fee with no credit incentives, non-residential properties are eligible for credits. Incentives range from 20 to 50 percent discounts for structural BMPs incorporating both water quantity and quality improvements prior to the stormwater leaving the property.

Stormwater in Iowa

Iowa cities are also implementing stormwater utilities as a way to finance water quality and quantity management practices at a municipal level. The same interview questions were asked of Wally Mook, public works director for the city of Bettendorf, Iowa, which implemented its stormwater utility in 2003.[xxxi] The city's Phase II permit was the driving force behind what has now become a comprehensive stormwater management system. While the city has no current credit system for either residential or non-residential properties, there may be a credit system implemented in the future. The utility has generated revenue for capital improvements related to stormwater management and has also created new staff positions dedicated entirely to stormwater management.

The city has included a brochure in sanitary sewer billings and mailings as a way to educate residents on the utility and its purposes. Bettendorf has also established an outreach program with both Bettendorf and Pleasant Valley community schools. City officials have met with school administrators and also provide the Water Wise curriculum to teachers interested in incorporating water quality in annual curriculum. While the 2003 stormwater utility ordinance has operated with no changes, the city plans to revise other stormwater ordinances to incorporate water quality as well as water quantity management. Particularly, Mook would like to see a reduction in the discharge rate from detention basins. Current requirements allow for detention of 100-year flood waters in a detention basin, later discharged at a rate no faster than a 5 year flood would discharge.

According to Mook, the 5-year flood rate is still high enough to cause hydrological problems, as the flow is still higher than normal rates within certain creeks. The city may consider reducing the flow rate to a release no more than a one-year flood discharge rate as a way to protect existing streambanks and prevent further erosion.

Bettendorf began a city-wide initiative to educate citizens on stormwater issues and justified the case for a stormwater utility prior to its implementation. On February 6, 2003, Mook presented an "informational overview," containing 43 slides of information to give the public as much information as possible regarding goals and objectives of the project[xxxii]. Slides included images of grass clippings tossed into the street; runoff from bare ground on construction sites; and streams that have left their banks during thunderstorms. Each served as examples of what the NPDES program is meant to address.

His presentation continued with descriptions of the six NPDES objectives, and how the city of Bettendorf could best address each. One key factor in his presentation was the focus on public involvement. He had information on dates and locations of public meetings, volunteer opportunities, and guidelines to be considered when drafting the city's stormwater ordinance.

In contrast to the Bettendorf stormwater management system, Davenport, Iowa, population 100,000 and also located on the west bank of the Mississippi River, immediately south of Bettendorf, has not had as much success implementing its stormwater utility. The city council passed an ordinance to implement a stormwater utility, but in November of 2005, candidates for both the council and the mayoral race were adamant upon reviewing, and possibly revoking the ordinance entirely. The issue became a lightning rod for the local election.

Woolson interviewed the safety and training supervisor for the city's Public Works Department in 2005[xxxiii]. According to the official, the city's elected and appointed officials invited citizens and the business community into the process early and encouraged them to help design a system to address current stormwater concerns and prepare the community for future development. What has since developed is swift and fierce opposition. The October 8, 2005 election resulted in the defeat of aldermen who voted in March 2005 to create a stormwater utility. Days after the 6-4 vote, city officials received angry calls, stating "we're going to vote you out" theme. A local veterans' organization was reportedly distributing materials identifying elected officials and city staff members who should be fired and faith-based groups have threatened to sue the city for not being exempt from the stormwater utility.

The interview serves as advice for other communities looking to implement a stormwater utility. The Davenport officials did not include enough people from the beginning, and admit now they failed at communicating information, and getting strong, vocal support from major stakeholders. The safety supervisor thinks the concept of stormwater management is too complicated for regular citizens to understand. This may be part of the problem. Rather than resolve not to explain something seen so complicated, the city should have worked to make the stormwater utility concept a bit more understandable. If citizens understood what it funded and why it was necessary, they may not have an entirely new city council after the October 2005 election.

Stormwater Utility Details by City

City	Pop.	Administrator	Year	Rev.	Residential Credits	Non-Residential Credits	Education/Information
Griffin, GA	25,000	Deputy Director of Stormwater	1998	$1,200,000.00	No	20, 30, 50%	Schools/Water Wise Program, Enviroscape
Valparaiso, IN	25,500	Stormwater Engineer	1996	$520,000.00	No	No	Tri-County Planning Commission
Bettendorf, IA	31,275	Director of Public Works	2003	$1,238,078	No	No	Schools/Water Wise Program

Cedar Falls, Iowa

The city of Cedar Falls is required to submit an annual report to the Iowa Department of Natural Resources (IDNR) to ensure compliance with the city's stormwater management permit. The permit was approved by the DNR in May 2004 by Joseph Griffin of the DNR Wastewater Section, Environmental Protection Division. This agency approves all NPDES permits for the state of Iowa.[†]

The annual report includes a variety of information that describes the basic composition of the city as it relates to stormwater management.[xxxiv] Specifically, it addresses the six requirements within the NPDES statute:

1. **Public Education and Outreach:** the city reported on various brochures, website data and other means of communicating NPDES information with citizens.
2. **Public Participation/Involvement:** reports included agendas from two public hearings in 2004 and 2005.
3. **Illicit Discharge Detection and Elimination:** details included the city' status on this project. A draft ordinance has been created and will be subject to city council approval in coming months.
4. **Construction Site Runoff Control:** this is one of two sections that the city is still working to complete.
5. **Post-Construction Site Runoff Control**: this is the second of the two sections the city is working to complete.
6. **Pollution Prevention and Good Housekeeping:** more information on website data and current city BMPs are included in this section.

Both sections 5 and 6 of the report will include more details in the Year 2 annual report, including ordinances the city plans to pass regarding construction and post-construction requirements. The report also includes a city map that identifies all city MS4s, which are municipal separate stormwater sewer systems. MS4s are defined as drainage systems that may include municipal streets, catch basins, curbs, gutters, channels, or storm drains that are owned or operated by the city.

On December 29, 2005, the city of Cedar Falls began the process of implementing a stormwater utility. The city council passed an ordinance to establish a stormwater management program. The December 29 ordinance was the first of four planned

[†] A Year Two Report was submitted to the Iowa DNR in April 2006. Contents were intended to accompany the original report and were significantly smaller in content and details. Most information was to update on progress outlined in the Year One Report.

ordinances to establish the program for the city. As the initial ordinance, it serves as the foundation for the remaining three. In brief, the ordinance simply formalizes the process, and allows city officials to formally work with the local utility to establish a rate and billing system, as well as determine what revenues would fund in terms of structural and non-structural BMPs.

At the time of its passage, the city had no formal plans for either structural or non-structural BMPs.[xxxv] The final stormwater utility ordinance passed May 22, 2005. At the time of the ordinance vote, the city had no well-defined stormwater management program from which public information and communications could be based. Rather than outlining objectives at its inception, the city worked with the municipal utility to outline a fee structure and billing system and outline a skeletal budget with no specific details regarding allocation and intended fixed costs or perceived expenses.

Suggestions for Cedar Falls

Without a well defined, citizen-based plan for stormwater management, it would serve the city well to consider work done elsewhere as both good and bad models. For example, Fort Wayne, Indiana implemented a comprehensive stormwater program in three phases: data assessment and evaluation; strategic issue assessment; and financial analyses based on both cost of service and billing system studies. The existing Cedar Falls stormwater management program can follow the same model. Based on current status, the work would need to be reorganized. The city began with costs and billing system studies and has yet to conduct any data assessment or evaluation to determine exactly what problems need to be addressed by a stormwater management system.

Rather than begin major capital improvement projects, it is a recommendation based on the research gathered in this report to concentrate on data assessment and evaluation and also on strategic issue assessment to ensure efficient use of stormwater utility funds, and also to ensure water quality improvement is truly the objective of the overall program.

The city also needs to formulate a comprehensive communications and awareness-building campaign to educate and inform citizens of the stormwater program. Without timely, effective messaging that clearly outlines the objectives of the program and measurable outcomes, the program could generate a negative public image. In

Davenport, Iowa, poor communication and lack of clarification cost not only seats on the city council, but the city also lost an opportunity to build water quality awareness.

As the stormwater utility is implemented, the city should consider amending the current ordinance with a credit manual to outline eligible practices. Rather than offering a full waiver of the fee, the city should offer percentage discounts based on both volume and water quality controls. Volume control only should be awarded the minimum percentage discount. Water quality improvements should be awarded a higher percentage discount, and a combination of both practices should receive the highest percentage discount on the stormwater fee. Cities like Bettendorf, Iowa are revising existing stormwater ordinances to require water quality as well as volume management and rewarding best practices.

Because of monitoring and enforcement difficulties, residential credits may not be a feasible option. Cities that do offer residential stormwater utility credits require an application and fee for a percentage discount. Rather than consider a lot-by-lot credit system, Cedar Falls might consider an option where a “sub-watershed” approach includes residential credits. If neighborhoods, schools, or other entities within close proximity to one another choose to implement a collaborative structural BMP, all parties might possibly receive a percentage discount. In such a case, water quality may be a higher reward than volume storage, yet again. The city might consider offering a cost-share or mini-grant program, generated by stormwater utility funds, as an incentive for such practices.

Monitoring and enforcement will be required for both residential and non-residential BMPs, should the city consider a stormwater utility credit system. EPA officials within Region VII monitor Iowa for NPDES compliance, along with other federal environmental requirements. Local agencies are also available for a more routine enforcement and monitoring system.

Conclusion

The EPA and the state of Iowa may choose to follow Phase II compliance with further legislation, Phase III or IV requirements. Rather than react to the expansion of environmental requirements, the city of Cedar Falls could use Phase II NPDES requirements as an opportunity to both prepare itself for expansion of water quality regulation and also to educate and inform both existing and future residents on how they can help improve water quality and avoid further degradation.

NPDES compliance could prompt the city to consider new ordinances related to development as well. The city might consider drafting a "sensitive areas" ordinance as a way to protect wetlands, streambanks and floodplains from future development that may result in changes in hydrology or degradation in water quality. The city of Okoboji Iowa passed a low-impact development ordinance May 9, 2006 as a way to address such issues.[xxxvi] The ordinance requires low impact development techniques for new subdivisions and will phase in over three years for building permits for existing structures. After a series of seminars held 2004 - 2005 the city's planning and zoning board revised existing ordinances to protect water quality of the Iowa Great Lakes. Cedar Falls' Planning and Zoning Commission could consider similar steps as a way to incorporate stormwater management in a comprehensive water quality and environmental planning program.

Regarding further program establishment and structure, Bettendorf, and possibly county-wide models such as Dickinson County are good programs to emulate. Bettendorf serves as a model example in the state of Iowa. Particularly, the fact that the project was championed by the city engineer, who ambitiously worked to have the program established and functional in one year. He was unsuccessful in his time frame, but such drive led to increased public involvement. The increased participation may have slowed the process down for Mook, but the program may not have been such a success if the public had not been so involved.

If Cedar Falls implements a successful, comprehensive stormwater management program, the model could serve as the basis for both a county-wide stormwater management program and low-impact development model all of Black Hawk County might consider implementing. Given the close proximity of other area towns such as Waterloo, Hudson, Elk Run Heights and Evansdale, it is not unlikely for stormwater management issues to eventually become county-wide, if not regional issues. What passes today in Cedar Falls and neighboring communities may soon be an issue addressed by the county supervisors, regional watershed groups, or possibly even statewide legislation. By planning ahead for such possibilities, Cedar Falls and Black

Hawk County could be well-positioned to serve as a model community for the state of Iowa. Ordinances such as what passed in Dickinson County may also apply.

Some issues with non-compliance may or may not even exist at the moment. If communities like Cedar Falls wait too long to begin the process, the city may not only find itself subject to harsh penalties once the 2009 deadline passes. The city may also be several steps behind a growing national trend. NPDES may simply be a first regulatory step by the EPA. With agricultural stormwater management not part of the statute, there may be other policy to come. If and when such regulation reaches Iowa, those communities already entrenched in comprehensive stormwater management programs may be more likely to absorb the adjustments necessary to comply with any new statutes.

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