


# National Management Measures to Control Nonpoint Source Pollution from Urban Areas

## Management Measure 1: Program Framework and Objectives

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# MANAGEMENT MEASURE 1
# PROGRAM FRAMEWORK AND OBJECTIVES

## 1.1 Management Measure

Develop, implement, and enhance a runoff management program framework that

- Has adequate legal authority to implement the program effectively;
- Has an effective institutional structure;
- Has adequate funding and staffing;
- Incorporates comprehensive watershed planning, including watershed/subwatershed goals and objectives; and
- Fosters input from citizens, stakeholders, and technical experts, and coordinates with other agencies.

## 1.2 Management Measure Description and Selection

### 1.2.1 Description

The goal of this management measure is to ensure that urban runoff management programs are developed and implemented with a solid institutional foundation. Federal, state, regional, and local governments all play important roles in establishing and maintaining programs. Consequently, a team approach must be taken to avoid overlap of key responsibilities and authorities, and to ensure that the appropriate levels of government function cooperatively.

#### 1.2.1.1 Role of federal government

Because nonpoint source runoff management programs are within the purview of state and local governments, the federal government's primary role in nonpoint source runoff management programs is to develop broad urban runoff control guidance with participation of state, regional, and local governments, and to provide technical and financial assistance to support the implementation of effective programs and practices.

#### 1.2.1.2 Role of state government

State programs play an especially important role in establishing the team approach to runoff management. State officials interpret and coordinate federal mandates for implementation at the local level, establish state performance standards, and design criteria for runoff control. States also typically take the lead in conducting research, providing technical assistance, developing public education programs, running training and certification programs for practitioners of runoff management, and implementing monitoring programs to help evaluate the effectiveness of management practices (WMI, 1997a).

Many states allow runoff management programs to be delegated to local jurisdictions while the states retain important oversight and enforcement responsibilities to ensure statewide

consistency. States should maintain the authority to intervene if necessary. The following is a list of regulatory elements that might be included in a state's runoff legislation, or in rules and regulations to help guide local program implementation (WMI, 1997b):

- Criteria for local program implementation or delegation
- Types of activities that require runoff control
- Waivers, exemptions, and variances
- Plan approval and inspection fees, including construction or maintenance performance bonds
- Authority for a local storm water utility
- Specific design criteria
- Permit application and approval process
- Operation permit requirements and time frames
- Development and implementation of mandated educational programs related to site inspection of active and completed storm water management systems
- Requirements for any other educational programs
- Inspection requirements, including certification of inspectors
- Maintenance requirements for postconstruction runoff control facilities
- Penalty provisions in the event of noncompliance with requirements for the design, construction, or operation of storm water management systems

#### 1.2.1.3 Role of regional authorities

Regional authorities often share some of the duties of state agencies but customize their services to fit the needs and attributes of the region. They provide a link between local communities and the state, and often work with state officials to establish region-based performance standards and design criteria for runoff controls. They also serve as a focal point for coordinating issues and interests among communities in the region, especially in terms of implementing the watershed approach, developing watershed plans, ensuring consistency of storm water runoff master planning, and resolving situations that affect downstream communities.

#### 1.2.1.4 Role of local government

Counties and municipalities integrate local runoff management planning with land use and regional watershed management plans, floodplain management, wastewater planning, and other programs that affect the management of urban runoff. They are involved with the day-to-day administrative, operational, and technical aspects of runoff management and are responsible for performing inspections, enforcing compliance, performing operation and maintenance, identifying and removing illicit connections, and coordinating program funding.

**Wisconsin DNR Revisits their Approach to Watershed Programs**

The Wisconsin Department of Natural Resources (WDNR) recognized a need for a more holistic approach to watershed programs (Nemke, 1997). They recognized the following problems associated with planning, coordination, cooperation, funding, and implementation of watershed initiatives:

- Although money is available for implementing watershed initiatives, no formal mechanisms exist to raise and allocate money needed to carry plans forward.
- There is no single agency or organization that has regulatory authority over all of the resources that are involved in watershed initiatives, which sometimes results in conflicting priorities.
- Groups that plan and implement watershed initiatives typically are made up of a diverse group of stakeholders with different leadership abilities, motivations and priorities, and technical backgrounds. This diversity makes it difficult to keep the group moving in a consistent direction and becomes problematic when a consensus is needed to allocate funding for implementation.
- Rules and guidance documents often dictate inflexible solutions for dischargers and discourage more creative, innovative, or cost-effective solutions that could be equally or more beneficial to the watershed initiative.

WDNR presented the following recommendations for watershed districts to help overcome logistical problems associated with watershed programs:

- Staff should stay current on watershed issues and initiatives by attending conferences and keeping abreast of relevant journal articles and reports to get a better idea of what practices and policies work best.
- Staff should take a leadership role on technical issues relating to evaluation of watershed problems and solutions.
- The district should avoid taking an expanded role in solving watershed problems unless this role is clearly defined in their statutory authority and other government bodies agree that this role is appropriate and prudent.
- The district should only commit funds to initiatives that are clearly tied to potential benefits for the district's users.
- The district should encourage and participate in evaluations of legislative initiatives that will provide adequate authority to implement watershed-based solutions.
- The district should critically evaluate proposed solutions to watershed problems to ensure they will adequately and sensibly address these problems.

All runoff management programs share common needs, including the legal authority to create, adopt, and enforce ordinances; an institutional structure designed to carry out the goals and objectives of the program; and adequate funding for staff and program activities. Planning serves as the foundation for runoff programs; it establishes management measures and determines how and where management practices will be applied. The program framework should also include the input of citizens and other stakeholders, technical experts, and other agencies in the program

planning and implementation. Communities will need to balance stakeholder concerns for the environment and the economy. Community groups must work together as they develop their own sustainable development concepts to contribute to the betterment of the environment and the residents of the watershed. Finally, ongoing program evaluation and feedback are critical (see Management Measure 12: Evaluate Program Effectiveness).

### 1.2.2 Management Measure Selection

This management measure was selected because successful runoff management programs require an established program framework and objectives. The measure is intended to provide general guidance on the common aspects of a program framework that should be considered and addressed when developing a runoff management program. Examples are provided to illustrate how the practices can be used to implement the management measure.

## 1.3 Management Practices

### 1.3.1 Establish Legal Authority

A successful urban runoff program must have the legal authority to accomplish its goals and objectives. State-level programs derive their legal authority from various laws, codes, and regulations enacted by the state legislature. Only a few states have passed comprehensive statewide runoff management legislation. States whose laws often serve as models include Delaware, Florida, Maryland, New Jersey, and Washington.

The language in state runoff legislation is usually general and might include the runoff program's goals, procedures, and general requirements for maintenance. Details concerning design, construction, operation, and maintenance of runoff management practices are established by the program's implementing regulations and guidance materials (runoff management manual).

If authorized by state law, the state can delegate program implementation authority to local entities. Delegation is usually beneficial to local governments because they have a direct interest in seeing that practices are installed, operated, and maintained correctly. Delegation also provides them the flexibility to implement the program based on the needs of the community. To aid local communities in this endeavor and to ensure statewide consistency in runoff management, state program officials typically develop a state manual that presents design criteria and guidance for implementing specific management practices. State and local regulation writers typically adopt the state manual by reference into their regulations wherever appropriate to ensure that the information contained in the document is used and applied correctly.

EPA's Office of Wetlands, Oceans, and Watersheds has developed a Web site that has examples of model ordinances that address issues such as aquatic buffers, erosion and sediment control, open space development, storm water control operation and maintenance, illicit discharges, and postconstruction controls (USEPA, 1999b). The Web site, http://www.epa.gov/owow/nps/ordinance, also has materials that support particular ordinances, such as maintenance agreements and inspection checklists. Additionally, the Center for Watershed Protection's Stormwater Manager's Resource Center Web site has a collection of model ordinances, which can be accessed at http://www.stormwatercenter.net/.

The primary focus of the management practices discussed below is on how local governments can increase their ability to manage runoff by developing new ordinances or regulations, or modifying existing ones. It should be noted that many of these practices could also be adopted at the state level to ensure statewide consistency of runoff management practices.

#### 1.3.1.1 Examine existing laws and regulations

The first step in crafting ordinances to improve runoff management controls at the local level is to examine all the existing mandates, authorities, laws, regulations, codes, ordinances, review processes, and so forth that pertain to environmental review in the community. By comparing current rules and practices with the rules needed to achieve the goals and objectives of the runoff management program, a community can identify gaps and weaknesses that need to be addressed.

**Frederick County, Maryland, Site Planning Roundtable**

The Frederick County Department of Planning and Zoning and the Center for Watershed Protection facilitated a local site planning roundtable in Frederick County, Maryland. The roundtable worked to review the county's current subdivision and zoning codes, define the local hurdles that impede the implementation of more innovative site planning techniques, and hammer out changes to local codes and ordinances that would foster more environmentally friendly development. By January 2000 the diverse group of planners, developers, watershed planners, and other community professionals arrived at a consensus on the modifications necessary to achieve widespread implementation for more environmentally sensitive site designs. The changes the group recommended are designed to guide future site development in the county toward the goals of reducing impervious cover, conserving natural areas, and minimizing storm water pollution.

The resulting document, Frede*rick County Roundtable Recommendations: A Consensus Agreement*, was presented to the Frederick County Commissioners in February 2000. While certainly fostering better site design in Frederick County, the successful Frederick County roundtable also is an important example for other communities interested in implementing similar projects. In addition, this project complements other ongoing regional, state, and local growth management efforts occurring throughout Maryland.

For more information on the Frederick County Site Planning Roundtable's recommendations, contact the Center for Watershed Protection, 8391 Main Street, Ellicott City, Maryland 21043; phone 410-461-8323; fax 410-461-8324; e-mail: mailto:center@cwp.org.

**Revision of Development Rules for the City of High Point, North Carolina**

The state of North Carolina plans to build a reservoir, called Randleman Lake, to meet the growing need for water in North Carolina's Piedmont Triad region (Brewer et al., 2000). Recognizing that the watershed has one of the highest rates of urbanization in the region, the state has developed a set of rules, called the Randleman Lake Water Supply Watershed Protection Rules, to establish requirements for wastewater dischargers, protect and maintain riparian areas, and provide for urban runoff management in areas draining to Randleman Lake. The City of High Point was charged with developing a watershed protection ordinance to comply with the Randleman Lake Rules, which require strict development limitations for areas within the watershed (Table 1.1).

**Table 1.1: Summary of the Randleman Lake water supply watershed protection rules.**

| Development Option | 1.1.1.1.1 Description |
|---|---|
| Critical area low density | – 6% impervious surface limit or 1 dwelling unit per 2 acres.<br>– 50-foot stream buffers around perennial and intermittent streams. |
| Critical area high density | – 30 percent impervious surface limit.<br>– 100-ft and 50-ft buffers for perennial and intermittent streams, respectively.<br>– Structural controls required for developments with 6 to 30% imperviousness. |
| General watershed area—low density | – 12% impervious surface limit or 1 dwelling unit per acre.<br>– 50-foot stream buffers around perennial and intermittent streams. |
| General watershed area—high density | – 50% impervious surface limit.<br>– 100-ft and 50-ft buffers for perennial and intermittent streams, respectively.<br>– Structural controls required for developments with 12 to 50% imperviousness. |

The city undertook a two-part study to facilitate development of an ordinance that protects water quality while providing flexibility to accommodate projected growth. The first part of the study involved a committee of stakeholders charged with identifying and evaluating different strategies for watershed protection. The city used an iterative approach to involve the stakeholder groups with an important "feedback loop" and key checkpoints throughout the process to gauge and document each stakeholder group's buy-in and formal approval. The second part of the study involved a comparative analysis of impacts of different protection strategies for the watershed. The comparative analysis focused on phosphorus as an indicator of water quality impacts on Randleman Lake. The analysis involved establishing a baseline of phosphorus loading that is not to be exceeded by alternative strategies for new development. It also involved identifying and estimating additional loadings from areas that are expected to be developed more intensely and are expected to exceed the baseline phosphorus loading. Strategies for offsetting these loadings elsewhere in the watershed or mitigating them with more protective on-site management practices were then developed and evaluated.

The plan (see Figure 1.1) and ordinance adopted as a result of this study were based on a phosphorus banking principle and included the following elements:

- Maintenance of a 6.4-square-mile critical area, which is larger and more restrictive than that required in the Randleman Lake Rules and yields a phosphorus loading reduction/offset of approximately 800 lb/yr.
- Use of 440 lb/yr, or approximately 55 percent of the phosphorus offset, to allow increased imperviousness for planned higher-density nonresidential development.
- Use of the remaining offset as a phosphorus reduction reserve.
- Revision of ordinance(s) and engineering specifications to encourage low-impact design and alternatives to traditional storm water ponds.

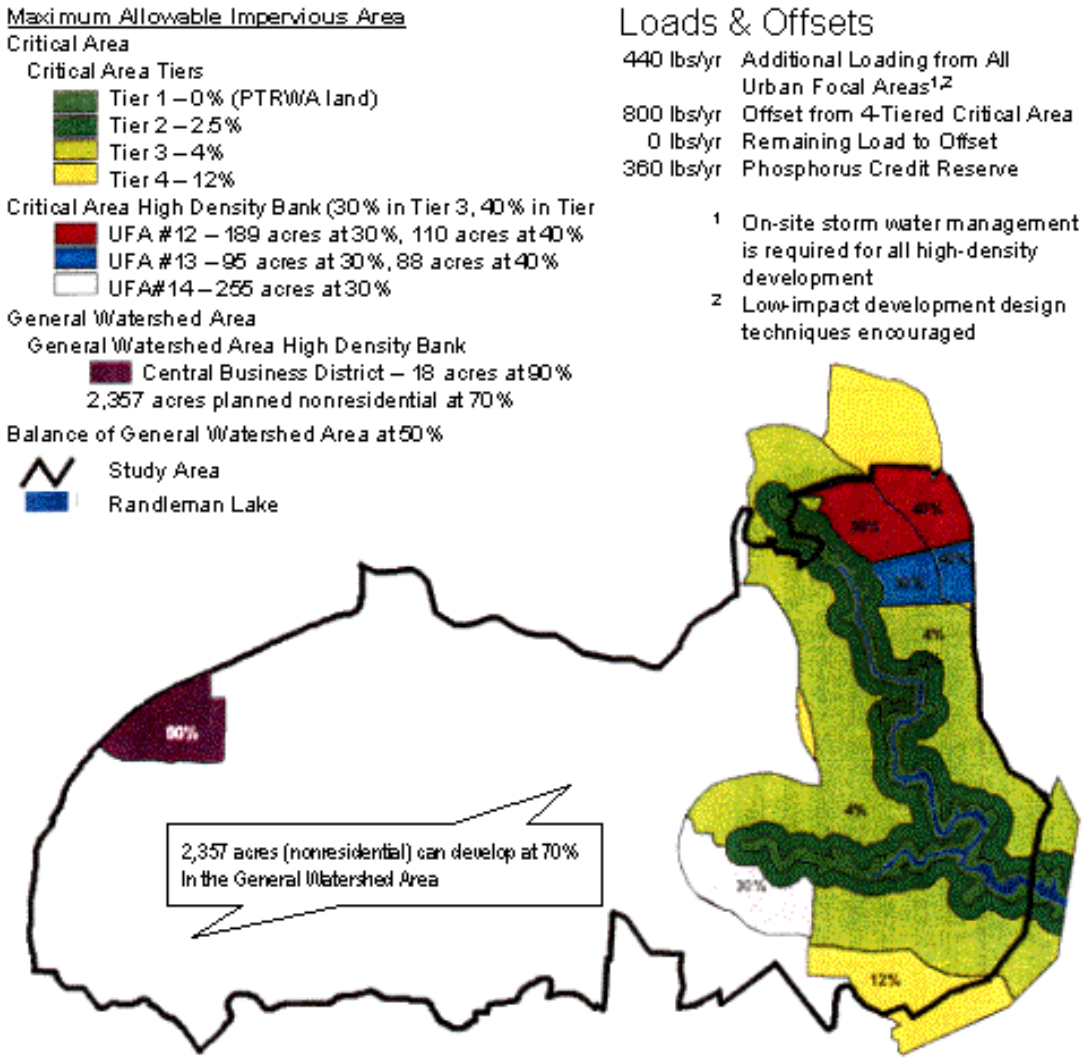


**Figure 1.1: Adopted watershed protection plan for the City of High Point, North Carolina.**

The city has adopted a watershed protection ordinance for the Deep River 1 watershed that incorporates the strategies listed above and has modified its engineering specifications to allow bioretention facilities and to provide guidance for their design. In the coming year, the city will work to:

- Review local monitoring data and recommend additional monitoring protocols that can track the effectiveness of best management practices used, including new low-impact development design techniques. Possible funding sources for monitoring will be identified.
- Review and revise the city's development ordinance and engineering specifications to further allow and encourage low-impact design techniques.
- Plan and host a spring 2000 low-impact development design workshop for city staff, local contractors, and engineers.

### 1.3.1.2 Develop or improve ordinances for water quality enhancement

(1) *Aquatic buffer ordinance*. Aquatic buffers serve as natural boundaries between local waterways and existing development. They help protect water quality by filtering pollutants, sediment, and nutrients from runoff. Some other benefits of buffers are flood control, streambank stabilization, controlling stream temperature, and providing room for lateral movement of the stream channel. Good aquatic buffer ordinances specify the size and management of the stream buffer and are a specific planning tool to protect stream quality and aquatic habitat.

Effective buffer ordinances provide guidelines for buffer creation and maintenance and should require:

- Buffer boundaries that are clearly marked on local planning maps;
- Maintenance language that restricts vegetation and soil disturbance;
- Tables that illustrate buffer width adjustment by percent slope and type of stream; and
- Direction on allowable uses and public education.

(2) *Erosion and sediment control ordinance*. A basic goal of erosion and sediment control programs should be to minimize off-site impacts by first preventing erosion and then maximizing control of sedimentation on-site (WMI, 1997a). A key tool for accomplishing this goal is an effective erosion and sediment control (ESC) ordinance.

An ESC ordinance typically requires developers to submit an ESC plan to a state or local regulatory agency for approval prior to initiating construction activities. This plan contains specific practices to prevent erosion and control sediment, as well as information concerning phasing of clearing and grading activities. Once the plan is approved by the regulatory agency, the developer and contractor are responsible for following the plan and implementing the management practices. If follow-up inspection reveals a lack of

**Residents' Willingness to Pay for Riparian Buffers**

In St. Charles County, Missouri, rapid growth has resulted in serious threats to the environment such as flooding, water pollution, and habitat loss for aquatic organisms and wildlife. To combat these problems, the St. Charles "Natural Watercourse Protection Ordinance" was passed, and requires 50-foot riparian buffer along major streams and a 25-foot buffer along tributaries when adjacent land is being developed for residential or other non-agricultural uses. In anticipation of potential increases in development costs and home prices resulting from the ordinance, a study was conducted in the Dardenne Creek watershed to evaluate the residents' willingness to pay for adopting buffers in newly developed residential communities. Survey respondents identified wildlife, environmental benefits, and natural appearance and sounds as the primary values of Dardenne Creek. Respondents were concerned about the damaging impacts of flooding, erosion, and safety of children on property values. 43.7 percent of the respondents were willing to pay a median value of $1000 for community-owned and open accessible buffers. The study indicates that residents generally recognize the potential environmental benefits of the buffer ordinance, but outreach efforts should focus on informing homeowners that the ordinance may result in increased construction costs and higher home prices. The study's author concludes that the residents' willingness to pay indicates that the real estate market can absorb the possible increases in the construction costs due to implementing the ordinance (Qiu, 2003).

compliance, the inspector may issue a permit violation, stop-work order, or fine, or take other steps to compel action.

Whether program authority is implemented at the state level or delegated to a local government, the ordinance should include goals, performance standards, and design criteria for both erosion prevention and sedimentation control. At a minimum, the ordinance should define the following erosion prevention design criteria:

- The threshold for disturbed areas at which regulatory action/compliance is required; and
- The maximum time frame for permanent site stabilization after final grading or temporary stabilization if construction ceases and the site is left dormant.

(3) *Open space ordinance*. Open space development, also known as "cluster development," is a planning technique that concentrates dwelling units in a compact area and leaves the balance of the site as natural, open space. Lot sizes, setbacks, and frontage distances are minimized, thereby reducing the amount of impervious cover on-site. Open space development reduces the need for clearing and grading by 35 to 60 percent, and increases opportunities for using the reserved land for a variety of purposes such as conservation, recreation, habitat preserves, and storm water management. Table 1.2 shows a summary of studies that contrasted conventional and open space designs in terms of impervious cover and storm water runoff (CWP, 1998a). Specific recommendations on how to limit imperviousness and maximize pervious areas can be found in Management Measure 4: Site Development.

**Table 1.2: Redesign analyses comparing impervious cover and storm water runoff from conventional and open space subdivisions (CWP, adapted 1998a).**

| Residential Subdivisions | Conventional Zoning for Subdivision | Impervious Cover at the Site | | | Percent Reduction in Runoff |
|---|---|---|---|---|---|
| | | Conventional Design | Open Space Design | Net Change | |
| Remlik Hall | 5-acre lots | 5.4% | 3.7% | -31% | 20% |
| Duck Crossing | 3- to 5-acre lots | 8.3% | 5.4% | -35% | 23% |
| Tharpe Knoll | 1-acre lots | 13% | 7% | -46% | 44% |
| Chapel Run | ½-acre lots | 29% | 17% | -41% | 31% |
| Pleasant Hill | ½-acre lots | 26% | 11% | -58% | 54% |
| Prairie Crossing | ½- to ⅓-acre lots | 20% | 18% | -10% | 66% |
| Rapahannock | ⅓-acre lots | 27% | 20% | -24% | 25% |
| Buckingham Greene | ⅛-acre lots | 23% | 21% | -7% | 8% |
| Belle-Hall | High density | 35% | 20% | -43% | 31% |

For open space development to be successful, the ordinance needs to be crafted to foster development that is both marketable and environmentally sensitive. The ordinance also needs to effectively address issues such as maintenance, liability, and access by emergency vehicles. In addition, the community needs to be prepared to manage the space or to dedicate open space to a responsible organization.

**The Center for Watershed Protection and EPA Present Model Ordinances on the Web**

Communities can strengthen the language of their regulations and ordinances to better protect environmental resources by referring to examples of exemplary ordinances from across the country. The following is a list of ordinances available for download from http://www.epa.gov/owow/nps/ordinance.

**Aquatic Buffers**
- Language from Baltimore County, MD
- Coastal Zone Program, RI (an example of a buffer ordinance in a coastal region)
- Ordinance on Riparian Habitat Areas, Napa, CA
- Portland Metro Floodplain Preservation Ordinance
- Model Land Trust Agreement from the Natural Lands Trust

**Erosion and Sediment Control**
- Erosion and Sediment Control Ordinance from Minneapolis, MN
- Clearing and Grading Ordinance from Olympia, WA
- Erosion and Sediment Control Inspection Checklist from the Lower Platte South Natural Resources District, NE
- Small Site Design Guideline from the Indiana Department of Natural Resources
- Preconstruction Meeting Notice from Montgomery County, MD

**Open Space Development**
- Open Space Development Ordinance from Calvert County, MD
- Land Preservation District Model Zoning from Montgomery County, PA
- Open Space Ordinance from Hamburg Township, MI

**Storm Water Operation and Maintenance**
- Ordinance Language from Grand Traverse County, MI
- Example Maintenance Agreement from Albemarle County, VA
- Easement and Right-of-Way Agreement from Montgomery County, MD
- Inspection Checklist from Anne Arundel County, MD
- Performance Bond from Colorado

**Illicit Discharges**
- Fort Worth, TX, Environmental Code: Storm Water Protection
- Washentaw County, MI, Regulation for Inspection of Residential Onsite Disposal Systems at Property Transfer
- Metro. St. Louis Sewer District Sewer Use
- City of Monterey, CA, Storm Water Ordinance
- Montgomery County, MD, Illicit Discharge Ordinance

**Postconstruction Controls**
- Maryland Department of the Environment Proposed Storm Water Management Regulations
- Grand Traverse County, MI, Soil Erosion and Storm Water Runoff Control Ordinance
- City of Seattle Storm Water, Grading, and Drainage Control Code
- St. Johns River Water Management District, FL: Environmental Resource Permits
- City of Santa Monica, CA, Municipal Code of Ordinances: Urban Runoff Pollution

**Source Water Protection: Ground Water Ordinances**
- Aquifer Protection District Ordinance from Stratham, NH
- Ground Water Protection and Siting Ordinance from Hernando County, FL
- Ground Water Source Protection Overlay District Ordinance from Salt Lake City, UT
- Sinkhole Ordinance from Lexington, KY
- Wellhead Protection District Ordinance from Weston, WI

**Source Water Protection: Surface Water Ordinances**
- Tahoe Regional Planning Agency Source Water Protection Ordinance
- Shoreland Management Overlay District Ordinance from Buffalo, MN
- Water Supply Watershed District Overlay Ordinance from Greensboro, NC
- Watershed Management and Protection Area Overlay District Ordinance from County of York, VA
- Town of Skaneateles Lake Watershed District Ordinance, NY

**Miscellaneous Ordinances**
- Lake Travis Nonpoint Source Ordinance
- Storm Water Utility Ordinance from Takoma Park, MD
- Transfer of Development Rights Ordinance from Sarasota, FL
- Golf Course Management Guidelines from Baltimore County, MD
- Wetlands and Watercourses Ordinance from Croton-on-Hudson, NY
- Forest Conservation Ordinance from Frederick County, MD

(4) *Storm water operation and maintenance ordinance*. The expense of maintaining most storm water management practices is relatively small compared to the original construction cost. Too frequently, however, maintenance is not completed, particularly when the practice is privately owned. Improper maintenance decreases the efficiency of management practices and can also detract from the aesthetics of the practices. The operation and maintenance language within a storm water ordinance can ensure that designs facilitate easy maintenance and that regular maintenance activities are completed.

(5) *Illicit discharge ordinance*. An illicit discharge is defined as any discharge to the municipal separate storm sewer system that is not composed entirely of storm water, except for discharges allowed under an National Pollutant Discharge Elimination System permit or waters used for firefighting operations. These non-storm water discharges occur because of illegal connections to the storm drain system from residential, business, or commercial establishments. As a result of these illicit connections, contaminated wastewater enters storm drains or directly enters local waters before it receives treatment at a wastewater treatment plant. Illicit connections might be intentional or can be unknown to the business owner; often they are the result of connection of floor drains to the storm sewer system. Additional sources of illicit discharges include improperly connected sanitary sewer lines, failing septic systems, illegal dumping practices, and the improper disposal of sewage from recreational activities like boating and camping.

Illicit discharge detection and elimination programs are designed to prevent contamination of ground and surface waters by monitoring, inspection, and removal of these illegal non-storm water discharges. An essential element of these programs is an ordinance granting the authority to inspect properties suspected of releasing contaminated discharges into storm drain systems. Another important factor is the establishment of enforcement actions for those properties that are found to be in noncompliance or refuse to allow access to their facilities.

(6) *Postconstruction runoff control*. The management of runoff from sites after the construction phase is vital to controlling the adverse effects of development on urban water quality. The increase in impervious surfaces such as rooftops, roads, parking lots, and sidewalks due to land development can have a detrimental effect on aquatic systems. High amounts of impervious cover have been associated with stream warming, habitat alteration, and decreased aquatic integrity in urban areas (Karr, 1991; May et al., 1997; Schueler, 1995; Shaver et al., 1994). Runoff from impervious areas can also contain a variety of pollutants that are detrimental to water quality, such as sediment, nutrients, road deicers, heavy metals, pathogenic bacteria, and petroleum hydrocarbons.

The main goal of a runoff management ordinance for existing development is to limit surface runoff volumes and reduce runoff pollutant loadings. For example, the ordinance could specify which nonstructural and structural storm water practices are allowed in the community. Communities might also wish to add language pertaining to on-site runoff requirements, and should identify whether off-site treatment is an option. Example ordinances can be found on EPA's Model Ordinances to Protect Local Resources Web site at http://www.epa.gov/owow/nps/ordinance/index.htm.

(7) *Source water protection ordinances*. Source water protection involves preventing the pollution of the ground water, lakes, rivers, and streams that serve as sources of drinking water for local communities. Source water protection ordinances help safeguard community health and reduce the risk of water supply contamination. When drafting an ordinance aimed at protecting these sources, drinking water supplies can be divided into two general sources: ground water (aquifers and wells) and surface water (lakes and reservoirs). Wellhead Protection Zones and Aquifer Protection Areas are two examples of source water protection ordinances that seek to protect ground water sources. Water Supply Watershed Districts and Lake Watershed Overlay Districts are examples of local management tools that provide protection of surface water supplies by restricting land uses around a reservoir used for drinking water.

(8) *Runoff management ordinances/regulations*. The primary purpose of runoff regulations is to ensure that runoff management systems (within the area of jurisdiction) are properly designed, constructed, inspected, operated, and maintained. A comprehensive ordinance should incorporate the issues addressed below (WMI, 1997b).

(a) *Design and review requirements*. Runoff management systems must be properly designed and constructed to function efficiently. A design manual tailored to local topographic, geologic, and climatic conditions and local regulations should be developed to accompany a runoff management ordinance. National and regional guidance is available to assist local governments in developing technical guidance. For example, the National Association of Homebuilders (NAHB, 1995) has produced a guidance manual entitled *Storm Water Runoff and Nonpoint Source Pollution Control Guide for Builders and Developers* that can be used to develop a technical design manual. The design manual is typically referenced in the ordinance to direct users to technical support for their runoff management projects.

(b) *Construction requirements*. Runoff management facilities can fail prematurely if they are poorly constructed or if sediments and other pollutants are not carefully managed during the construction phase. Techniques for protecting structural practices from construction-related pollution are usually addressed in the state runoff management manual and incorporated by reference into the ordinance. Specific practices to mitigate construction site erosion and control sediment are discussed in Chapter 5 under the construction site erosion and sediment control management measure (8).

To ensure that a facility is constructed properly, a runoff management ordinance should include the following:

- *Financial assurances*. A guarantee, usually in the form of a surety or cash bond, should be made that the completed runoff management facility functions properly. The amount typically should not be less than 50 percent of the estimated construction cost of the system (WMI, 1997b).
- *Inspections*. Inspectors should maintain a presence throughout the construction phase and conduct inspections at specified stages of construction, not at assigned time intervals (WMI, 1997b).

- *As-built certifications and record drawings*. Completed facilities should have official documentation prepared and sealed by a professional engineer or other qualified design professional (WMI, 1997b).
- *Allowances for damage to temporary practices*. Funds should be set aside specifically to repair damage to erosion and sediment controls (e.g., silt fences) at temporary construction sites caused by severe storm flows, high winds, or fallen trees. Funds may be used only if documented inspections show erosion and sediment controls are installed and maintained as required. This allowance helps to ensure 100 percent compliance by contractors (Deering, 1999).

(c) *Operation and maintenance requirements*. Ensuring that runoff management facilities are properly operated and maintained, both in the short term and the long term, is another critical element that should be addressed in the design phase. For the short term, the ordinance should stipulate a warranty period (perhaps one or two years) during which the original developer must retain all operation and maintenance responsibilities. The developer should be required to post a bond or other security to ensure that costs will be covered if any design defects or construction failures are discovered during the warranty period.

Several techniques can be used to ensure longevity of management practices, including warranties, operating permits, and maintenance bonds. Specific requirements for operation and maintenance to be set forth in an ordinance might include the following:

- An easement that provides an access road for maintenance equipment
- Ownership of the system and maintenance access road by those who use the system
- Inspection by a certified site inspector at defined intervals
- Land set aside for disposal of sediments removed during maintenance
- Clear documentation of maintenance responsibilities and maintenance schedule
- A written maintenance agreement

When the initial warranty period is over, long-term operation and maintenance responsibilities typically revert to a property owners' association. Unfortunately, in many instances these types of groups do not perform important operation and maintenance tasks because they lack the financial, legal, and/or administrative capability. Very often, this neglect results in failed systems and problems for downstream property owners. The ordinance needs to incorporate specific elements to ensure that a system is in place for collecting fees, contracting for services, and establishing rules and regulations before a property owners' association is granted authority for long-term maintenance. In some cases, it is more prudent for an alternative entity such as local government, special taxing district, or public utility to be responsible for long-term operation and maintenance functions.

(d) *Maintenance inspection requirements*. Periodic inspections and certifications are necessary to ensure that the legal operation and maintenance entity is keeping the storm water system in good working order and making all necessary repairs. An ordinance needs to include language that identifies the inspectors and specifies how often the inspections are to be conducted. Depending on the framework, inspections could be done by the permitting authority or some other public agency. Alternatively, private inspectors might be used. In

either case, inspectors should be required to complete a state-sponsored course and receive certification.

The frequency of inspection depends on the type of management practices employed at the site. Some types of facilities (e.g., a wet pond) might need to be inspected only annually. A sand filter, in contrast, might need to be inspected once a month or even more frequently during the wet season. The entity responsible for maintenance inspections should maintain inspection and maintenance records on file. In addition, procedures need to be established to ensure that problems identified during the inspection process are fixed in a timely manner and that reinspection occurs as soon as practicable.

(9) *Wetlands protection ordinance*. Local governments can protect wetlands by adopting a wetland protection ordinance that supplements the permitting program established under Section 404 of the Clean Water Act (for more information on Section 404, see the Introduction (section 1.2.2 Regulatory Context) or http://www.epa.gov/owow/wetlands/facts/fact10.html). Section 404 does not cover all wetlands, nor does it cover all activities that may infringe on a wetland. A local regulatory program can be used to provide additional protection. A local ordinance should, however, be compatible with, supplement, and/or streamline the Section 404 program while tailoring wetland protection plans to meet local conditions and circumstances (Patton et al., 2000).

Following are some of the important components of a wetlands ordinance (Cowles et al., 1991).

- The applicant should be required to submit a detailed wetland analysis, performed by a trained wetland ecologist, of the subject property, including a professional survey of the wetland edge.
- A wetland should be protected by an adequate undisturbed buffer and placed within a permanent open space or protective easement tract to preclude future subdivision of the wetland.
- Wetlands should not be used as surrogate runoff detention structures. Any runoff directed into a wetland should be pretreated.
- Construction near wetland areas should utilize management practices, including proper placement and installation of sedimentation control and clearly marked limits of construction to avoid inadvertent wetland impacts.
- Non-wetland field staff such as building inspectors, grading inspectors, or any other appropriate staff should be trained to recognize wetlands and to ensure management practices are used and enforced during the construction process.

(9) *Miscellaneous ordinances*. Other ordinances capture issues that are important for protection of water resources but do not fall into a single category. The following are examples of miscellaneous ordinances:

- The Nonpoint Source Ordinance for Lake Travis, which is located along the lower Colorado River near Austin, Texas, addresses techniques required to control nonpoint source pollution from permitted and unpermitted activities.
- The Transfer of Development Rights Ordinance of Sarasota, Florida, allows for the transfer of development rights to protect environmentally sensitive areas from impacts caused by new development by directing new development to less-sensitive areas.

#### 1.3.1.3 Explore market-based regulatory approaches

Water quality trading is a market-based approach to improving and preserving water quality. Trading allows one pollution source to meet its regulatory obligation by purchasing pollutant reductions created by another source that reduces pollution below levels required by federal and state regulations. Trading is a cost-effective solution because pollution control is achieved where the cost is lowest.

EPA is currently targeting water quality trading and providing guidance and procedures. Trading is a possibility in all watersheds, even where water quality is not impaired, but the focus is on watersheds with approved TMDLs. Water quality trading is encouraged for nutrients and sediments. For pollutants other than nutrients or sediment, a higher level of scrutiny would be applied. EPA does not support the trading of persistent bioaccumlative toxic pollutants, or trading where water quality standards would be exceeded.

Water quality programs should include the following provisions for trading:

- Permits under Sections 402 and 404.
- For NPDES permits, information on how trading baselines and conditions have been established and how they are consistent with water quality standards.
- Standard methods for measuring compliance.
- Designated uses to be protected (e.g. the antidegradation policy will be upheld).

Credible trading programs generally include:

- Legal authority and mechanisms
- Clearly defined units of trade
- Creation and duration of credits
- Protocols for quantifying credits and addressing uncertainty
- Provisions for compliance and enforcement
- Public participation and access to information
- Periodic program evaluations

This box is intentionally left empty.

EPA's trading Web site (http://www.epa.gov/owow/watershed/trading.htm) provides a number of resources related to the current policy, new developments, case studies, and links to other trading programs.

### 1.3.2 Develop an Institutional Structure

The following practices follow the approach presented by the Center for Watershed Protection in the *Rapid Watershed Planning Handbook* (CWP, 1998c). This approach applies mainly to local efforts in small watersheds. State and regional agencies might need to conduct their efforts on a larger scale. Other resources that address establishing a watershed planning framework on a larger scales include *Framework for a Watershed Management Program* (Clements et al., 1996) and *Know Your Watershed* (CTIC, 2000).

#### 1.3.2.1 Establish a watershed baseline

The first step in a watershed assessment process is to gather basic background information about the watershed and subwatersheds. This process can be used as a foundation for developing the rest of the watershed plan.

(1) *Define watershed and subwatershed boundaries*. Watershed and subwatershed boundaries need to be mapped on a good topographic map such as those produced by the U.S. Geological Survey. These maps, an example of which is shown in Figure 1.2, can help in identifying the political jurisdictions and citizens that should participate in the watershed planning effort, and the land use patterns in the watershed and each subwatershed (CWP, 1998c).

(2) *Identify "embedded" agricultural areas*. Livestock waste management is typically not considered an issue in urban areas. However, the urban/suburban landscape can build up around an existing agricultural area, or property owners can board animals on residential property, making animal waste management an important component of maintaining water

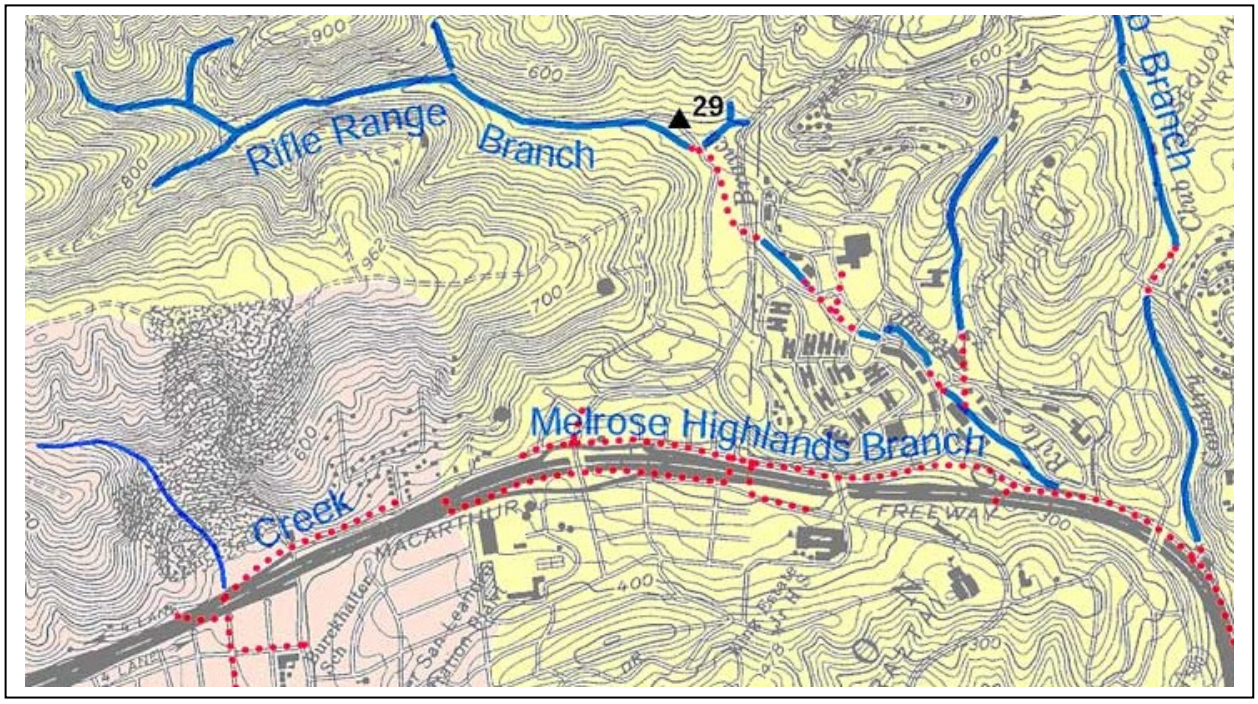


**Figure 1.2: Example of part of a subwatershed base map (Oakland Museum of California, No date).**

quality in urban areas. Animal wastes from stables or backyard pens contribute nutrients and pathogens to runoff and ground water. Manure can also be a nuisance because of odors and flies, and animals can contribute to the destruction of vegetation through trampling and overgrazing.

Water quality problems can be associated with stables and backyard livestock pens. Management techniques to address these agricultural nonpoint sources include (Terrene Institute, 1994):

- Siting animal areas to drain away from water bodies
- Planting or maintaining as much vegetation as possible between animal areas and water bodies
- Establishing diversions upslope from a high-use area to divert clean water away from bare soils and manure
- Establishing berms or diversions downslope of high-use areas to collect contaminated runoff for treatment
- Establishing fenced areas for animal use to protect vegetation
- Collecting manure and bedding regularly and protecting stored manure from rainfall and runoff

**Good Horse Keeping**

Horse owners in Massachusetts and the Patriot Resource Conservation and Development (RC & D) Council have launched the Horse Manure Management Initiative (HMMI). The Initiative involves collaboration between horse owners, the Massachusetts Farm Bureau, the Massachusetts Stable Owners, and the Operators and Instructors Association to improve and protect water quality in Essex, Middlesex, Norfolk, and Suffolk counties. The HMMI is focused on education, outreach, and policy initiatives to promote good horse keeping practices and manure management. The Patriot RC&D Council plans to release a *Good Horse Keeping* video and a *Horse Owner Directory and Resource Guidebook* in 2003. For more information, visit http://patriotrcd.org/horse_manure_management.html.

- Applying animal wastes as fertilizer for pastures, croplands, lawns, gardens, nurseries, and greenhouses at rates dictated by soil analyses
- Composting raw manure to reduce bulk, odors, and bacteria

Sources of information for managing pollution from livestock areas include local cooperative extension service offices, soil and water conservation district offices, and U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) offices. NRCS published the *Agricultural Waste Management Field Handbook*, which is a comprehensive guide for livestock operators that provides detailed technical information about practices to properly manage animal wastes (USDA NRCS, 1992). This document can be accessed online at http://www.wcc.nrcs.usda.gov/awm/awmfh.html. Additionally, EPA published *National Management Measures to Control Nonpoint Source Pollution from Agriculture*. This document is available for download from the Office of Wetlands, Oceans, and Watersheds' Web site at http://www.epa.gov/owow.

(3) *Identify possible stakeholders*. Stakeholder participation in planning for watershed management is crucial. Stakeholders have power and a variety of insights that will play a large role in whether the plan succeeds or fails. Stakeholders are affected by the outcome of the watershed plan, have a responsibility for implementing the plan, or have the ability to impede or assist the plan's implementation. See below for a list of organizations and people that might be stakeholders. This group is not limited to people living or working in the watershed or subwatershed delineated on the watershed map. Because several local management units can be encompassed by a single watershed**,** state, tribal, interstate, and federal officials often are considered stakeholders in a local watershed initiative. In addition to identifying the stakeholders, the planning process should include developing a technical advisory team or committee to assist with the scientific aspects of the watershed program.

Federal Agencies
- Environmental Protection Agency
- Army Corps of Engineers
- Fish and Wildlife Service (Department of the Interior)
- Federal Emergency Management Agency

Nonprofit Organizations
- Greenways coalitions
- "Friends of …" groups
- Watershed coalitions or foundations
- Anglers' groups
- Volunteer organizations
- Recreation/hiking groups

State/Local Agencies
- Environmental or wildlife agency
- Flood control district
- Water rights agency (primarily in the southwestern United States)
- Public works department
- Planning/zoning department or board
- State department of transportation
- Local conservation commissions
- Extension services from land grant universities

Private Sector
- Consulting engineers
- Local businesses
- Real estate companies
- Builders/developers
- Trade associations

Other Citizens
- Local residents
- Schools/teachers
- "Downstream" users (i.e., drinking water consumers)

(4) *Measure existing impervious cover*. The amount of impervious cover is a key attribute of watersheds. The impervious cover model (CWP, 1998a) directly links imperviousness levels to the quality of water resources at the subwatershed scale. Crucial to the use of the model is an estimation of the percentage of the subwatershed covered by impervious surfaces. A number of practices can be used to make this estimate, ranging from measuring cover directly using aerial photographs to predicting cover based on the relationship between imperviousness and population or road density statistics.

(5) *Assemble historical monitoring data*. Most water resources in urban and suburban areas have been monitored at one time or another. The challenge is to identify who has collected data and whether the data are in an accessible and usable form. Often the people that collect data in a particular watershed are also stakeholders or members of the technical committee. Whatever the source, watershed data need to be assessed in terms of quality and usefulness. The technical advisory team plays an important role in this endeavor. Once organized, historical data provide the background knowledge necessary for guiding the other steps of the local watershed planning process.

(6) *Assess existing mapping resources*. Resource maps are used to present many aspects of the watershed management plan in a clear, reader-friendly format. Natural and cultural features that can be included on a resource map are:

- Floodplain boundaries
- Stream corridors
- Soils and geologic features
- Current and future land use
- Transportation routes
- Buffers
- Wetlands
- Detention/retention ponds
- Direction of drainage

(7) *Conduct an audit of local watershed protection capabilities*. A sometimes overlooked but very important task associated with baseline assessment is a critical evaluation of local capabilities to implement watershed practices. The audit should be as complete as possible and should include examination of local programs, regulations, ordinances, master plans, staff resources, and funding. If deficiencies or potential problems are found, the audit can be used as a basis for making changes.

**Watershed Assessment, Tracking, and Environmental Results**

EPA has developed an integrated information system for the nation's surface waters that combines data from various EPA Office of Water programs into one large framework. Data from the information system, Watershed Assessment, Tracking and Environmental Results (WATERS), is available online through interactive Web-based applications and mapping tools. The following is a list of programs that are incorporated or scheduled to be incorporated into the database:

- *Water Quality Standards*: The Water Quality Standards Database contains information on designated uses for waterbodies
- *Water Quality Inventory 305(b) Report*: The National Assessment Database includes information on the attainment of water quality standards. Waterbodies are classified as Fully Supported, Threatened or Not Supporting these designated uses.
- *Total Maximum Daily Load 303(d) List*: The TMDL Tracking System provides information on waterbodies that are designated as Not Supporting. These waterbodies are required by law to have TMDLs developed, and the database tracks the status of those TMDLs.
- *Water Quality Monitoring*: The STORET database contains water quality, biological and physical data.
- *NPDES Permits*: The Permit Compliance System stores data on NPDES facilities, permits, compliance status, and enforcement activities for up to six years.
- *Safe Drinking Water*: The Safe Drinking Water Information System contains information on public water systems and drinking water standard violations.
- *Fish Consumption Advisories*: The National Listing of Fish and Wildlife Advisories database includes information on fish consumption advisories issued by states, tribes, and the federal government.
- *Nonpoint Source Pollution*: The Section 319 Grants Reporting and Tracking System is a compilation of information on projects and activities funded by CWA Section 319(h) funds.
- *Nutrient Criteria*: The Nutrient Criteria Database stores and analyzes nutrient water quality data.
- *The BEACH Program*: The Beaches Environmental Assessment, Closure & Health (BEACH) Watch database provides information on whether a specific beach is being monitored for water quality, the party responsible for the monitoring, the pollutants that are being monitored, and advisories or closures that have been issued.
- *Vessel Sewage Discharge*: Vessel sewage discharge is regulated under Clean Water Act Section 312, which mandates the use of marine sanitation devices (on-board equipment for treating and discharging or storing sewage) on all commercial and recreational vessels that are equipped with installed toilets. Under Section 312 States may request a No-Discharge Zone designation that prohibits the discharge of sewage from all vessels into defined waters.

The WATERS database can be accessed online at http://www.epa.gov/waters.

#### 1.3.2.2 Set up an institutional structure

A successful runoff management program requires a strong institutional structure (CWP, 1998c). A typical institution carries out many functions, including:

- Setting goals for the watershed and subwatersheds
- Identifying gaps in monitoring data and taking steps to acquire needed information
- Operating as a forum for stakeholder input
- Reviewing and prioritizing management strategies to achieve maximum watershed protection
- Establishing links with other groups and agencies
- Encouraging cooperative exchanges of information
- Providing funding for planning actions and exploring funding options for management practice implementation
- Ensuring long-term implementation of the runoff management plan

Key attributes needed to perform these functions are:

- Adequate permanent staff to perform facilitation and administrative duties
- A consistent, long-term funding source to ensure a sustainable organization
- Inclusion of all stakeholders in planning efforts
- A core group of dedicated people that have the support of local governmental agencies
- Local ownership of the runoff management plan throughout the process
- A process for monitoring and evaluating implementation strategies
- Open communication channels to increase cooperation among organization members

There are three types of runoff management institution models:

- Government-directed model
- Citizen-directed model
- Hybrid model

The primary difference among the three management options is the authority that is ultimately responsible for directing the watershed plan. In the government-directed model, local or regional agencies assume responsibility for making decisions about how the watershed is managed. The citizen-directed model is driven by citizen activists or grassroots organizations, and the hybrid model combines the best of both models and is recommended for most watersheds. Each paradigm has particular strengths and weaknesses, but whatever form the model takes, the framers of the institution must define its goals and carefully lay out the responsibilities and contributions that will be made by each element. Table 1.3 compares the typical components of the three models, lists advantages and disadvantages associated with each model, and specifies conditions where each model might best be applied.

**Table 1.3: Elements of three watershed management structures (CWP, 1998c).**

| Element | Government-Directed Model | Citizen-Directed Model | Hybrid Model |
|---|---|---|---|
| Formation | Created by legislative authority. | Created at grassroots level by citizens or other interested parties. | Created with some governmental authority and support from citizens. |
| Membership | Organization membership appointed by governmental authority. | Stakeholder participation is voluntary. | Some members are required to participate, but many are volunteers. |
| Authority | Structure has regulatory authority over land use and other permits. | Advisory capacity with no regulatory authority over land use or permits. | Some members of the structure have regulatory authority; others act in a volunteer or advisory capacity. |
| Funding | Funding is through taxes or levied fees. | Funding is by grant, donations, or sometimes local government contributions. | Much of the funding is through a steady source, such as an agreement with a local government, but grants might also compose a significant portion of the budget. |
| Implementa-tion | Government agencies at the state, local, and federal levels implement the plan. | Local governments implement the plan. | Local governments implement the plan with some assistance from state and federal agencies. |
| Advantages | Has legal authority to influence development. Has a secure funding source. Consistent staff are available. | Local community has ownership in the plan. No stakeholders are forced to participate. Residents are less intimidated by other citizens than by the government. | Has some authority to implement the plan. Incorporates stakeholders from the public and the government. Usually has some stable funding source and permanent staff. Technical expertise from many sectors can be used to formulate the plan. |
| Disadvan-tages | Might not incorporate all interests. Citizens and local governments might not have a sense of ownership in the process. | Might be difficult to secure a stable funding source. Implementation might be difficult without legal authority. Because most members are volunteers, it might be difficult to complete the plan quickly. The most vocal groups might be over-represented. | Demands significant input from citizens and government. |
| Where best applied | Where the plan will require extensive regulations and land use rules to implement. Where the local community cannot raise the funds to develop and implement a plan. Where the community is not strongly mobilized to take the initiative. | Where the local community has a very strong interest in the water resource. Where the local government has an excellent relationship with local citizens' groups and developers. Where some external funding source, or a steady supply from local governments, can support the citizen groups. Where disagreements between different interests are not expected to slow the group's progress. | Most watersheds. |

(1) *Government-directed model*. In this model, an agency of government takes on the responsibility for determining the goals of the runoff management program and directing the means by which those goals are met. Such a structure can consist of one agency vested with regulatory responsibility or a coalition of agencies from the local, state, and federal levels.

The program framework under the government model is strong because of its legal authority and consistent funding, whether required by legislation or instituted as a reflection of an administrative priority. Government involvement ensures that the management process draws on broad public goals and balances the utility of various courses of action. However, government-directed programs often do little to raise public awareness of the need for resource protection, and if a government-led watershed management plan makes inadequate provisions for public input, feelings of disenfranchisement can result. In addition, interagency rivalry can hamper the effectiveness of a government-led management structure.

The government-directed model is frequently employed when a government agency is best positioned to address a particular problem, or when public interest and awareness are not sufficient to motivate citizen participation in the runoff management process.

(2) *Citizen-directed model*. This type of framework is highly legitimate in the public eye because it concentrates heavily on co-opting public involvement throughout the management process and gives the public a strong sense of ownership of the plan. Management recommendations coming solely from the community have no legal authority, however, and community leaders must rely on their ability to engage and motivate governmental entities to accomplish their goals. For that reason, the citizen model usually is effective only where there is a healthy relationship between community leaders and local government.

(3) *Hybrid model*. A quasi-governmental structure, a hybrid runoff management institution is designed to combine legislative authority with technical advice, allowing additionally for stakeholder and citizen input. By representing both government and citizen interests, the model usually provides the most effective means of incorporating public opinion and activity into the needs of the locality and watershed. The specific form that a hybrid management structure takes depends on a variety of factors, but it will usually concentrate heavily on incorporating as many stakeholders as possible into the watershed planning process. Hybrid structures are not vested with regulatory authority but use one of several structures to recommend courses of action to the governing body and plan and implement runoff management practices.

#### 1.3.2.3 Determine budgetary resources available for watershed planning

One of the most important challenges confronting a watershed manager is how to develop watershed and subwatershed plans within existing budget constraints. The manager needs to identify what sources of funding are available and develop budgets for the subwatershed and watershed plans. The cost of a watershed plan varies depending on choices the watershed manager makes regarding mapping, monitoring, modeling, and ongoing management. The budget also depends on the area and complexity of the watershed and its subwatersheds.

### 1.3.2.4 Project future land use change in the watershed/subwatershed

Land use in a watershed and individual subwatersheds has a strong influence on aquatic ecosystems. Current impervious cover should have been measured as a part of the watershed baseline analysis. The watershed manager needs to forecast the future impervious cover based on available land use planning information, such as existing zoning or master plans.

Impervious cover projection helps watershed managers determine if aquatic resources will degrade from current conditions (see Section 6 of the Introduction for more information about impervious cover). If the analysis indicates that impervious cover will increase to such an extent that it will cause subwatershed quality to decline, a watershed manager should consider shifting impervious cover to another watershed or limiting development.

**Southeastern Delaware Whole Basin Management**

The Delaware Department of Natural Resources and Environmental Control (DNREC) and Sussex County officials developed a phased process to manage the Inland Bays Basin that combines an assessment program with an implementation plan to solve water quality problems affecting Rehoboth, Indian River, and Little Assawoman Bays (Delaware DNREC, 2000). They identified excessive nitrogen and phosphorus as the most pressing water quality problems in the basin. They attributed the elevated nutrient levels to both urban and agricultural sources, including

- Failing or inadequate septic systems.
- Sewage treatment plant effluent.
- Fertilizer application for residential and commercial landscaping.
- Construction site sediment export.
- Exhaust emissions.
- Open burning.
- Field application of manure to crops.

They also assessed biological populations and identified priority communities and species that warrant special protection.

To begin implementing a whole basin management program, the Delaware legislature established the Center for the Inland Bays in 1994. In 1998 the Center initiated a Tributary Strategy Program that organized stakeholders into three Tributary Action Teams, which assist the Center in reducing nutrient inputs to the bays and restoring habitat. They are also assisting DNREC in developing pollution control strategies to meet TMDLs for nutrients. In 1999 the Delaware House of Representatives passed Resolution 32, which established a multijurisdictional committee to

- Assess progress toward implementation of the Land-Use Action Plan of the Inland Bays Comprehensive Conservation and Management Plan.
- To identify areas where implementation has not been achieved.
- To recommend changes to Sussex County's Comprehensive Plan and implement zoning and subdivision ordinances.

Finally, in 1999 the Delaware Legislature passed the Delaware Nutrient Management Law, which established the Delaware Nutrient Management Commission. The purpose of the Commission is to develop a program to address nutrient inputs from both agricultural sources and urban sources such as golf course landscape operations, residential inputs, and residential and commercial fertilizers.

Regardless of the forecasting option chosen to estimate future impervious cover, it is important to verify and adjust the estimate periodically. This adjustment helps ensure that land use planning tools for the watershed result in the desired level of impervious cover needed to maintain the management strategy of each subwatershed.

#### 1.3.2.5 Develop subwatershed plan

Based on the information obtained in the preceding steps, the watershed manager should determine what goals and objectives are appropriate in the watershed and its individual subwatersheds. Goal-setting is among the most important steps in watershed planning, and the management structure should ensure full involvement from stakeholders at this stage.

A subwatershed plan is a detailed blueprint to achieve the established subwatershed objectives. A typical plan may include revised zoning, management practice regulations, proposed management practice locations, description of proposed new programs, estimates of budget and staff needed to implement the plan, stream buffer widths, or monitoring protocols.

The plan should target the subwatershed objectives with the combination of management practices that is most economical, effective, and feasible. Implementing management practices by planning on the subwatershed scale can increase cost-effectiveness and water quality benefits. A combination of nonstructural, on-site, regional, and channel stabilization practices specifically tailored to the subwatershed will help to maximize these benefits. Pollution prevention and nonstructural practices are key, as they can reduce the generation of pollution and its exposure to rainfall and runoff. In addition, implementing site-dispersed, low-impact development practices can help to control both runoff quality and quantity at the site level. Ensuring that drainage channels and floodplains are stable will provide protection against flooding and serve to buffer receiving waters. Finally, regional runoff control and treatment practices are a last line of defense to control flooding and reduce pollution. The following are descriptions of each type of practice and how they can meet water quality objectives in a subwatershed:

- *Nonstructural practices*. Pollution prevention and nonstructural practices are effective in reducing the generation of pollution and its exposure to rainfall and runoff. These practices help to increase public awareness, and can reduce the need for pollutant removal capacity in runoff treatment controls and the burden of maintaining those controls. Used alone, however, nonstructural practices do not provide a comprehensive solution for runoff management. While various techniques have been developed to qualitatively measure the effectiveness of nonstructural practices, it is difficult to gauge their direct water quality benefits.
- *Site-dispersed (on-site) practices*. Site-dispersed, low-impact development practices control runoff quality and quantity at the site level and reduce the flow volume and pollutant load that reaches drainage channels. In addition to these benefits, infiltration practices can be a source of ground water recharge and reduce the frequency of combined sewer overflows (CSOs). They require less land area and can provide aesthetic benefits. These practices can also provide cost savings from both reduced construction costs and lower maintenance requirements. On the other hand, responsibility might fall on the property owner to inspect and maintain the practices. In addition, on-site treatment

practices only treat the first ½ inch to 1 inch of runoff, and the rest is bypassed. They are, however, good first practices in a system of storm water management practices.

- *Regional (off-site) practices*. Regional runoff control and treatment practices act as a last line of defense to control flooding and reduce pollution. The advantages of regional controls are that they are easier to maintain and do not require the actions of the property owner; they can provide aesthetic and recreational benefits; and they can be cost-effective due to the economy of scale. However, a regional pond offers no protection to upstream tributaries, and placement in low-lying areas may hurt natural wetlands. Communities may also have to address safety and liability considerations.
- *Stable drainage channels*. Stable drainage channels and floodplains are important for protection against flooding and as buffers for receiving waters by filtering pollutants and preventing erosion. Riparian areas can provide aesthetic and recreational benefits as well as wildlife habitat. Restoring stream channels and riparian areas can, however, be expensive, and is not feasible when development exists along drainage channels or restoration conflicts with landowner use of streamside property.

**Regional vs. On-Site Development Regulations**

In anticipation of dramatic growth in the next decade or two, the city of Seattle, Washington is considering the development of an integrated drainage plan to address storm water at the subwatershed level rather than on a project-by-project basis. One of the options being considered is the establishment of off-site mitigation programs in urban jurisdictions. These programs allow developers to meet on-site development requirements relating to storm water by compensating the municipality to provide equivalent mitigation in an off-site public facility. In a case study, Maupin and Wagner (2003) explore the costs and benefits of regional and onsite management practices. The authors determine that an offsite mitigation program might be beneficial if the municipality has storm water management obligations, has the authority to regulate development, requires on-site storm water management on new development or redevelopment projects, and cost, water quality, or community benefits may result from off-site treatment. Because it shifts the maintenance burden to the municipality, it may not be appropriate in all cases (Maupin and Wagner, 2003).

**Targeting Runoff Treatment Practices for Temperature Control**

In the Token Creek Watershed in Dane County Wisconsin, a proposed 492-acre development for single-family homes posed concern for regulators regarding Token Creek, a cold water stream that is a major tributary to Lake Mendota. Managers identified three major goals for the watershed: reduce overall sediment and nutrient flows to Lake Mendota; protect the water quality in Token Creek, primarily regarding sediment and water temperature; and implement practices that will be aesthetically pleasing and increase property values. Managers recognized that traditional treatment practices such as storm water ponds and wetlands (for more information, see Management Measure 5) would not protect the stream from the potential thermal impacts of runoff from a highly developed area. Instead, the channel was lined with rock to provide infiltration, heat dissipation, and erosion control, and rock-filled gabion dams were installed. The Temperature Urban Runoff Model (TURM) was used to estimate water quality benefits. Modeling results predicted a 10.7 degree Fahrenheit increase in water temperature with the practices installed, as opposed to a predicted 21.6 degree increase without the practices (Dorava et al., 2003).

#### 1.3.2.6 Adopt and implement the watershed plan

The best way to ensure that a plan is implemented is to incorporate the right stakeholders, realistically assess budgetary resources, develop a scientifically and economically sound plan, and mandate the plan's use and implementation. During and after plan development, watershed managers need to ensure that local governments have both the regulatory authority and the resources to implement the plan.

Watershed managers need to identify funding sources to support plan implementation. One of the greatest costs of watershed implementation is the staff resources needed to continue monitoring in the watershed, design and build retrofits and new management practices, and enforce the ordinance and laws called for in the plan.

#### 1.3.2.7 Revisit and update the watershed and subwatershed plan

A one-time watershed study only identifies the problems that exist in a watershed. Many local governments, for one reason or another, take on watershed planning without realizing that it is a process rather than a report. Watershed and subwatershed plans should continue to be updated and revised as the watershed management process evolves and problems are identified.

### 1.3.3 Provide Adequate Funding and Staffing

Implementing an urban runoff control program requires funding to support programs and provide staff. Local and state governments can provide revenue from the tax base, but environmental programs often come up short when they compete with other municipally funded projects. Alternative borrowing and fundraising techniques can be used to provide additional money for water quality projects.

A variety of resources for financing information are available. The Environmental Finance Center, sponsored by EPA and the University of Maryland Sea Grant College, was created to assist local communities in finding creative ways to pay for environmental projects. The Center promotes alternative and innovative ways to manage the cost of environmental activities, provides training and development opportunities in environmental management, and works to increase awareness of the benefits associated with sound environmental management policies. In addition, the Center serves as a national repository and clearinghouse for environmental finance-related information, including information from EPA, the Environmental Financial Advisory Board (EFAB), and the Environmental Financing Information Network (EFIN), as well as other Environmental Finance Centers (EFCs) across the nation. More information about the technical assistance and support the Center provides, such as workshop and conference sessions, problem-solving roundtables for communities, watershed management training sessions, and utility rate design assistance, is provided at http://www.mdsg.umd.edu/EFC (EFC, 2000).

Another source of financing information is the Florida Stormwater Association (FSA), which was formed to assist professionals in both the public and private sectors who work in the storm water management and finance areas. FSA provides online services to its members, including a newsletter, storm water utility survey, access to local ordinances, and the FSA membership directory. For more information about FSA, refer to http://www.florida-stormwater.org/ (FSA, 2000).

**City of Lenexa, Kansas, Sales Tax Increase**

The City of Lenexa, Kansas, passed a 1/8-cent sales tax to help fund a new storm water program. The initiative includes the construction of multipurpose lakes and other storm water facilities to reduce flooding, improve water quality, and provide recreation for the citizens of Lenexa. The program differs from conventional storm water programs in that it also focuses on water quality and recreational opportunities. Most storm water programs focus only on preventing flooding. Revenue from the sales tax will be used to

- Construct lakes, detention basins, and sport fields.
- Acquire land in key locations before development occurs.
- Address existing problems in developed areas.

Other sources of revenue for the program include an annual $30 per home utility charge, a new development charge, and existing revenue sources such as a mill levy and Johnson County storm water funds.

The city's watershed management program will be implemented by constructing new facilities, improving the management of existing facilities, establishing development policies and processes, and implementing activities to ensure compliance with new regulations associated with the Clean Water Act. Lenexa has recently inventoried critical natural areas in the city to provide guidance for conserving, protecting, and restoring natural resources. Stream restoration opportunities in developed areas of the city will be identified, along with measures to address flooding. Lenexa encourages citizens to participate in the Watershed Management Program and offers tips for improving the quality of urban storm water runoff.

For more information about the Lenexa Storm Water Management Plan, contact Lenexa Public Works at 913-477-7680 or refer to http://www.ci.lenexa.ks.us/Stormwater/intro.html (Lenexa, No date).

Finally, the Center for Urban Policy and the Environment at Indiana University–Purdue University Indianapolis (2001) developed *An Internet Guide to Financing Stormwater Management*. This guide, located at http://stormwaterfinance.urbancenter.iupui.edu, is designed to help communities find ways to pay for storm water management projects. The site includes an annotated bibliography of existing storm water finance materials, an archive that contains selected previously published materials concerning storm water finance, a manual that discusses the financing options available to communities for storm water management programs, a set of case studies that describe successful finance mechanisms that have been used in seven communities around the country, and a group of links to other useful Web sites about storm water management.

Several mechanisms that watershed managers can use to secure funding for their storm water programs are described below.

#### 1.3.3.1 Taxes and fees

Municipalities often use taxes to fund environmental programs, but the taxes are not dedicated for a specific purpose and may be allocated to other, non-environmental programs. Fees are another method that can generate money for environmental programs. Table 1.4 outlines several kinds of taxes and fees that are appropriate for financing storm water management programs.

**Table 1.4: Types of taxes and fees that can be used to raise money for storm water management programs (adapted from USEPA, 1994).**

| Tax or Fee | Description |
|---|---|
| Property and sales taxes | Charged as a percentage of property value or gross sales. |
| Real estate transfer taxes | Assessed as a percentage of property values when property is sold. |
| Commodity taxes | Charged on specific items such as gasoline and hunting and fishing equipment. |
| Tax surcharges | Added to established tax rates. |
| Tax incentives | Offer tax reductions as state tax credits, deductions, or rebates. |
| Tax disincentives | Fees, taxes, or price increases to discourage the use of an inefficient product. |
| Tax differentiation | Tax charged on an inefficient product to encourage the use of an efficient substitute. |
| Selective sales tax | In the form of a retail tax or an inspection fee. |
| Tax increment | Financing incremental increases in real estate taxes to repay the original investment in improved public facilities that resulted in increased real estate values. |
| Plan review fees | Collected to conduct development plan reviews to ensure they meet requirements. |
| Storm water utility fees | Imposed on property owners based on amount of runoff generated, impervious area on the property, or the assessed value of the property. |
| Impact fees | The cost of infrastructure services is paid up-front by fees collected from developers or property owners. |
| Inspection fees | Collected to ensure that development plans are properly implemented. |
| User fees | Directly tied to the use of a resource or facility and especially useful at the local level where user groups are easily identified. |
| Capacity credits | Private interests guarantee future capacity in a public facility and provide additional funding to local governments for project completion. |
| Effluent discharge fees | Levied on an industrial facility based on the volume of pollutants discharged. Can be used to meet water quality objectives, to cover costs of pollution abatement, or to meet effluent standards. Provides economic incentive to reduce pollution output and is an equitable method for funding pollution control projects. |

#### 1.3.3.2 Bonds

Several kinds of bonds can be used to fund projects over the long or short term. Long-term bonds provide funding for the duration or life expectancy of the project and can be paid back all at once at the end of the project or little by little until the end of the project. Short-term bonds provide interim funding for long-term projects that have not yet been financed. There are also general obligation bonds, which are issued by state or local governments and are repaid using taxes and other revenues. Revenue bonds are also issued by state or local governments, but they are repaid using income or funds generated by the project itself. Finally, state revolving funds, which are long-term, low-interest loans to local governments or individuals for capital investments, can be used to fund storm water projects. Repayment allows the fund to revolve its lending ability continuously. The fund is intended to provide a permanent source of financing for state and local water quality projects and can be used for many different projects, including:

- Construction of wastewater treatment plants
- Implementation of approved state nonpoint source management programs and ground water protection strategies under section 319 of the Clean Water Act

- Development and implementation of estuary comprehensive conservation and management plans under section 320 of the Clean Water Act

#### 1.3.3.3 Leases

A municipal lease grants the lessee the option of applying lease payments to the purchase of the facility. The lessee is responsible for paying taxes on the property. Leases can be used to finance the purchase of environmentally sensitive areas, land for wetland restoration, or other projects. A sale/lease-back arrangement allows the owner of a facility to sell it to another entity and subsequently lease it back from the new owner. This arrangement can provide alternative financing for a facility and may limit a government's liability.

#### 1.3.3.4 Intergovernmental transfers and assistance

Grants are awarded to state or local governments for assistance in meeting national environmental quality goals. EPA establishes the criteria that must be met before receiving funds, while section 319 of the Clean Water Act allocates federal funds to states for implementing approved nonpoint source management programs. The grant money can also be used for postimplementation monitoring and groundwater assessment as part of an approved NPS pollution control program.

The conservation districts in Delaware have a conservation cost-share program that is funded by the state. Each of the three districts currently receives approximately $300,000, plus an additional $175,000 for nutrient management program practices. Most of the urban management practices involve backyard drainage projects, streambank erosion control, rehabilitation of storm water management ponds, urban flood control projects, tree plantings in community open space, conservation windbreaks, and debris pit remediation, and they can include assisting a community with an engineering study to determine solutions for a problem. Each conservation district determines the priority areas for the conservation funding, with the most urban BMPs implemented in New Castle County. Depending on the practice, the landowner pays 25 to 50 percent of the costs (Mickowski, 2004).

**Using Clean Water Act Funds for Water Quality Improvements**

The Delaware Department of Natural Resources and Environmental Control (DNREC) is using the Clean Water State Revolving Fund to effect water quality improvements. Practices implemented with the funds include wastewater collection to eliminate 300 failing onsite wastewater treatment systems and prevent 594 new systems; replacement of failing onsite wastewater treatment systems; sediment and storm water management practices; water body restoration practices such as stream bank stabilization, wetland restoration, and riparian buffer installations; land purchases and conservation easements for water quality protection; and implementation of Comprehensive Conservation and Management Plans for the Delaware Estuary and Delaware Inland Bays. For more information on the Clean Water State Revolving Fund, see http://www.epa.gov/owmitnet/cwfinance/cwsrf.

#### 1.3.3.5 Public-private partnerships

The private sector can invest in public-sector facilities. This approach reduces the financial burden for the public sector through cost sharing and is especially appropriate when neither the public nor private entities can fund the projects themselves. However, there might be political opposition from government workers or negative public opinion due to private ownership and operation of a public facility, even though private operations are often more cost-efficient, provide a higher level of service, and require less implementation time than public operations.

### 1.3.4 Foster Input from Technical Experts, Citizens, and Stakeholders

Most runoff management institutions require input from three groups of people—technical experts, citizens, and stakeholders—to plan and implement successful runoff management practices. Technical committees are often set up to provide expertise on scientific issues, while citizen advisory and stakeholder committees afford the public a chance to include their opinions in the management process.

#### 1.3.4.1 Technical committees

The central principle of technical committees is that proactive involvement of all stakeholders will result in greater watershed improvements because actions will have the approval of all interests. Ideally, members of the technical committee are also agency representatives in the larger management institution. Members may include representatives from the state and county natural resources, environment, planning, health, and water resources management entities. In addition, federal agency representatives and individual citizens with expertise in scientific fields or engineering may participate. The technical committee evaluates monitoring data and identifies data gaps, coordinates monitoring efforts within the watershed to obtain missing data, evaluates proposed regulatory or land use changes with respect to their potential impact on the watershed resource, interprets scientific data for the watershed management institution, and assesses and coordinates currently approved implementation projects.

#### 1.3.4.2 Citizen committees

A citizen committee is open to all citizens and provides direct feedback to the management institution on public sentiments regarding the planning process. The review of citizen concerns in a comprehensive process is critical in gaining community support. Some of the possible functions of a citizen committee include organizing public outreach and community awareness projects, such as tree planting days, stream cleanups, storm drain system stenciling, watershed awareness days, and volunteer activities, and exploring funding sources and grant-writing. In addition, such a committee might organize media relations and publicity programs such as press releases, informational flyers, and watershed awareness campaigns; act as a liaison between citizen groups and government agencies; and establish early stakeholder and public involvement.

**Creating Quality Places Program, Kansas City, Missouri**

The "Creating Quality Places: Successful Communities by Design" is a program of the Mid-America Regional Council (MARC), which represents city and county governments in the bistate Kansas City metropolitan area. The program, which is partially supported with resources from EPA's Sustainable Communities Challenge Grant Program, is aimed at developing a better quality of life in neighborhoods throughout the Kansas City region. Creating Quality Places is divided into two phases. In the first phase, 20 quality principles were identified to guide future development. These principles offer the best means for the region to grow, while also preserving and enhancing the quality of life enjoyed by residents. The second phase of the program focuses on the means for implementing these principles.

Creating Quality Places was a coordinated effort between multiple stakeholders. In the first phase, a steering committee and three advisory committees were convened by MARC to ensure broad stakeholder representation. The steering committee, which included elected officials, developers, civic leaders, citizens, planners, and representatives of other stakeholder groups, provided input and direction throughout the proceedings. The three advisory committees provided specific and technical input during deliberations. These committees each represented a specific sector of the development arena and included mayors, city council members, county commissioners, planning commissioners, city managers, planning directors, park professionals, public works professionals, developers, builders, architects, and engineers.

The initial quality principles were developed by merging the principles devised by each of the four committees. At a joint session of the four committees, the combined principles were reviewed, strengths and weaknesses of each were identified, and the principles were edited. The edited principles were then reviewed through a questionnaire, which was administered at public forums conducted for each topic area. The steering committee and advisory committees conducted a final review, and the quality principles were finalized. This development and review process allowed stakeholders to be involved throughout the entire process.

MARC also ensured stakeholder involvement by organizing public forums to establish dialogue on quality development issues and to raise awareness about land use and development practices. The forums consisted of two parts. The first part was a session at which national speakers and local panels discussed issues, and the second was a workshop that provided steering and advisory committee members with an opportunity to ask questions and discuss concerns.

For more information about the quality principles, including specifics of the final 20 quality principles, resources for implementing the principles, and case studies of how other communities are using the principles, refer to *www.qualityplaces.marc.org* (MARC, 2000).

### 1.3.4.3 Stakeholder committees

Stakeholder committees address the goals and opinions of the agencies, organizations, or individuals directly affected by management activities in the watershed. The incorporation of stakeholder views into the development of the watershed plan is crucial to building consensus and gaining support for future implementation. Typical stakeholders involved in the watershed planning process include:

- Conservation groups (e.g., Trout Unlimited, Save our Streams, Bass Masters)
- Developers
- Homeowners
- Citizen associations

- Farmers
- Industrial and commercial business interests
- Utility companies

Other groups, such as trade associations, research and academic institutions, sporting groups, and individual citizens, might also wish to be involved in the process. When planning occurs at the watershed level or higher, local and regional offices of federal agencies will also often decide to become involved. By placing the emphasis for watershed management on the subwatershed level, the number of stakeholders guiding plan development will be much more manageable.

Early and frequent involvement of stakeholders is a key ingredient in building support for the subwatershed management process. Stakeholders should be given a meaningful and well-defined role in the formulation of management plans. Sharing data and mapping, establishing goals, setting priorities, developing management criteria, measuring success, and reviewing and approving subwatershed plans will strengthen stakeholder ownership in the plan.

### 1.3.5 Establish Intergovernmental Coordination

The watershed management institution's primary responsibility is to oversee the execution of a watershed management plan. The management institution focuses the diverse stakeholders in a watershed into a viable group capable of guiding implementation. The institution is also responsible for the timely preparation and implementation of the watershed plan and its revision as project goals are achieved or changed. Communities might elect to create a single authority for an entire watershed, or a series of smaller authorities at the subwatershed level. The effectiveness of the management institution is dependent upon its ability to forge all interagency or multi-jurisdictional partnerships and agreements necessary to support the organization over the life of the planning process.

Intergovernmental coordination is essential when establishing a watershed management program, especially when the watershed extends over more than one political jurisdiction. Without the participation of a broad spectrum of local, state, and federal agencies, most watershed planning endeavors will not have the financial or information-gathering resources required to continue beyond initial start-up efforts. Interagency coordination requires sharing of resources and data, joint development and endorsement of a watershed management plan, and continued participation of all agencies. Care must be taken to avoid interagency rivalries or miscommunication.

The first step in fostering interagency coordination is the establishment of a watershed management institution. One instrument that has been used to steer this process is the Memorandum of Understanding (MOU). An MOU is an agreement by government agencies and local stakeholder representatives to work together in the creation of a watershed planning strategy. MOUs are widely used because agencies can enter into these agreements while retaining their jurisdictional and budgetary appropriation authority. MOUs are not legally binding contracts. Instead, the points in an MOU are presented in a broad manner to facilitate consensus. Typically short (one or two pages), these agreements outline the goals and objectives for the watershed management institution. The basic contents of an MOU are:

- Identification of the parties involved in the process
- Vision statement
- Purpose of the MOU (issues to be addressed by the agreement)
- Pact to provide assistance to the partnership for coordination of planning efforts under a central management organization
- Resolution to use the watershed plan as guidance in future land use or water management decisions
- Signatures of all partners involved

**Philadelphia's Office of Watersheds**

In 1998, the Office of Watersheds was created within the Philadelphia Office of Water. The new department is charged with administering a watershed management program that integrates combined sewer overflow, storm water management, and drinking water source protection. The watershed approach focuses on regional and local partnerships and supports watershed initiatives at the local level through innovations and demonstrations, and by facilitating cooperation between stakeholders. The Office of Water's "watershed technology center" is a central repository of technical support such as Geographic Information Systems, information technology, and model development for the various watershed programs. The office is working with local watershed organizations, academic institutions, and other agencies to pursue funding for demonstration projects, streambank restorations, and information collection for regional watersheds (Neukrug, 2003; WERF, 2000).

### 1.3.6 Develop Training and Education Programs and Materials

Training programs and educational materials designed for people directly involved in the design and implementation of a runoff management program are essential. Most states and many local governments have developed guidance manuals, workshops, and other educational opportunities to assist developers, site designers, contractors, plan reviewers, consultants, inspectors, and others in understanding and complying with runoff management goals and objectives.

Most states make education and training voluntary. A few states, however, including Delaware, Florida, Maryland, South Carolina, and Virginia, have made professional educational programs mandatory by law or regulation. Delaware, for example, requires that "all responsible personnel involved in a construction project will have a certificate of attendance at a Department-sponsored or approved training course for the control of sediment and storm water before initiation of land disturbing activity." The state provides personnel training and educational opportunities for contractors to meet this requirement, and has delegated program elements to conservation districts, counties, and other agencies.

In addition to professional audiences, the public can greatly benefit from runoff management education and training. Public awareness of program goals leads to greater support. Awareness can be achieved in many ways, including workshops, brochures, meetings, and media campaigns, as well as hands-on projects like storm drain stenciling and stream clean-ups.

Watershed citizens can and do play an important role in controlling nonpoint source pollution. Consequently, they need to acknowledge and be educated on pollution prevention issues and activities. Management practices concerning this topic are discussed in greater detail under the Management Measure 9: Pollution Prevention.

## 1.4 Information Resources

*An Internet Guide to Financing Stormwater Management* is a Web site presented by the Center for Urban Policy and the Environment (2001) at Indiana University-Purdue University Indianapolis. The site includes an annotated bibliography of existing storm water finance materials, an archive that contains selected previously published materials concerning storm water finance, a manual that discusses the financing options available to communities for storm water management programs, a set of case studies that describe successful finance mechanisms that have been used in seven communities around the country, and a group of links to other useful Web sites about storm water management. The site can be accessed at http://stormwaterfinance.urbancenter.iupui.edu.

The Center for Watershed Protection's *Rapid Watershed Planning Handbook* (CWP, 1998) describes techniques communities can use to more effectively protect and restore water resources. This document is available for purchase from the Center for Watershed Protection's Web site (http://www.cwp.org).

*Framework for a Watershed Management Program* (Clements, 1996) develops a specific watershed management protocol to increase the understanding of the critical components in watershed management programs. The publication is available for purchase from the Water Environment Research Foundation by calling 800-666-0206 and specifying publication order number D53016.

*Building Local Partnerships*, an Internet brochure published by the Conservation Technology Information Center (no date), provides an overview of local partnerships, including the types of partnerships that can be made, a how-to guide for forming partnerships, and caveats, as well as links to other resources pertaining to partnership-building. The publication can be accessed at http://www.ctic.purdue.edu/KYW/Brochures/BuildingLocal.html.

The Environmental Finance Center (2000) was created to assist local communities in finding creative ways to pay for environmental projects. The Center promotes alternative and innovative ways to manage the cost of environmental activities, provides training and development opportunities in environmental management, and works to increase the public and private sector's awareness of the benefits associated with sound environmental management policies. The site includes *Creative Financing Techniques for Establishing Riparian Forest Buffers* (or other land protection efforts), which describes methods such as notification, recognition, and nonbinding agreement programs; management agreements and leases; financing arrangements, such as agreements tied to loans; easements; and land acquisition to encourage conservation and stewardship of ecologically significant properties. The site also includes *Financing Stream Corridor Protection with a Community Quilt*, which describes a method for financing environmental protection and restoration efforts using a "community quilt" of financing techniques that has the potential to cover the variety of activities within the watershed. The Environmental Finance Center is located at http://www.mdsg.umd.edu/EFC.

The Florida Stormwater Association (2000) Web site contains information for storm water managers and stakeholders, including a manual entitled *Establishing a Stormwater Utility in*

*Florida*, storm water utility surveys, articles, news, and activities, and links to storm water management resources. The site can be accessed at http://www.florida-stormwater.org/.

The National Association of Counties (1999) has assembled a comprehensive kit that provides counties a host of tools for beginning and strengthening programs that favor purchase of products that are energy-efficient, contain recycled materials, and are less hazardous to the environment and human health. The kit includes case studies, a model purchasing resolution, a sample press release, and a comprehensive list of resources. It can be ordered (free for members, $10 for nonmembers) from the National Association of Counties' Web site at http://www.naco.org/Template.cfm?Section=Publications&Template=/cffiles/pubs/publications.cfm&PubCat=EPP.

The *State and Local Government Guide to Environmental Program Funding Alternatives* (USEPA, 1994) provides an overview of traditional (nongovernmental) funding mechanisms and innovative approaches for funding environmental programs. The document can be downloaded from http://www.epa.gov/owow/nps/MMGI/funding.html.

The *Catalog of Federal Funding Sources for Watershed Protection* (USEPA, 1999a) provides a guide for watershed practitioners on federal funds that might be available to support a variety of watershed protection projects. The catalog presents information on 69 federal funding sources (grants and loans) that can be used to fund watershed projects. The information on funding sources is organized into categories including coastal waters, conservation, economic development, education and research, environmental justice, forestry, Indian tribes, mining, pollution prevention, and wetlands. The catalog also includes key words that can be used to search for funding programs for particular subject areas. The document is available in HTML format at http://www.epa.gov/owow/watershed/wacademy/fund.html.

*Model Ordinances to Protect Local Resources* (USEPA, 1999b), located at http://www.epa.gov/owow/nps/ordinance, is a Web site of model ordinances that can serve as a template for those charged with making decisions concerning growth and environmental protection. For each model ordinance listed, there are several real-life examples of ordinances used by local and state governments around the nation. The ordinances address matters that are often forgotten in many local codes, including aquatic buffers, erosion and sediment control, open space development, storm water control operation and maintenance, illicit discharges, and postconstruction controls. There is also a miscellaneous category containing ordinances that don't fit into these sections. In addition, this Web site has materials that support particular ordinances, such as maintenance agreements and inspection checklists.

EPA's Office of Wastewater Management (USEPA, 2001) has a financing Web site (http://www.epa.gov/OWM/finan.htm) that provides an overview of the many types of assistance they provide to national, state, and local programs to abate and prevent municipal water pollution. Included is guidance information such as *Paying For Water Quality: Managing Funding Programs to Achieve the Greatest Environmental Benefit* and *Guide to Using EPA's Automated Clearing House For the Drinking Water State Revolving Fund Program* as well as information on programs such as the Clean Water State Revolving Fund (SRF), Construction Grants Programs, Section 106 Water Pollution Control Program Grants, Section 104(b)(3) Water Quality Cooperative Agreements, and Indian Set-Aside Grants.

The Watershed Management Institute, Inc. (1997a) printed a book entitled *Institutional Aspects of Urban Runoff Management: A Guide for Program Development and Implementation*. This book presents a comprehensive review of the institutional frameworks of successful urban runoff management programs. It was developed to assist individuals responsible for developing and implementing urban erosion, sediment control, and storm water management programs. The book is available for purchase ($10 for Storm Water Phase II communities, $27 for others) using an order form that can be downloaded at http://www.naco.org/Template.cfm?Section=Publications&Template=/cffiles/pubs/publications.cfm&PubCat=EPP.

The Southeast Michigan Council of Governments (SEMCOG) is a regional planning partnership that supports local planning efforts through technical support, the facilitation of intergovernmental coordination, and the adoption of region-wide plans and policies. SEMCOG partnered with six local communities to assemble a workbook, *Opportunities for Water Resource Protection in Local Plans, Ordinances, and Programs: A Workbook for Local Governments*, which provides guidance on planning to protect water resources. SEMCOG's approach is not prescriptive, but rather provides various options for planners, outlining key programmatic and regulatory components for a range of watershed protection approaches. The workbook emphasizes the need to address the protection of water resources through planning and prevention, and is meant to serve as a basis for local governments to customize their individual plans based on the needs and resources of the community. The book is available for download at http://www.stormwater.ucf.edu/publications/urban_runoff.pdf.

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