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OFFICE OF
RESEARCH AND DEVELOPMENT

February 10, 1998

MEMORANDUM

SUBJECT: Guidance Manual for Implementing Municipal Storm Water Management Programs - Volume I - Planning and Administration

FROM: Diana L. Meola, Secretary
Urban Watershed Management Branch

THRU: Daniel Sullivan, P.E., Chief
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TO: Gary W. Hudiburgh, Jr., Chief
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Office of Wastewater Management

Enclosed please find three copies of the Guidance Manual for Implementing Municipal Storm Water Management Programs, Volume I - Planning and Administration which were requested.

Please contact me at (732) 321-6635 if I could be of further assistance to you.

Enclosures

EPA/xxx-x/97-xxx
September 10, 1997
[DRAFT]

GUIDANCE MANUAL FOR IMPLEMENTING MUNICIPAL STORM WATER MANAGEMENT PROGRAMS

Volume I - Planning and Administration

U.S. Environmental Protection Agency
Office of Wastewater Management
Municipal Support Division
Municipal Technology Branch
Washington, D.C. 20460

and

Office of Research and Development
National Risk Management Research Laboratory
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CHAPTER 1

INTRODUCTION

INTRODUCTION

Urbanization and industrial activities around the country have significantly altered the natural landscape of our Nation's watersheds. This, in turn, has adversely affected both the quantity and the quality of storm water runoff and has contributed to the chemical, physical, and biological impairment of receiving waters. Studies, such as the Nationwide Urban Runoff Program (NURP) study (EPA 1983), have shown that storm water from urban and industrial areas is commonly contaminated by heavy metals, synthetic organics, pesticides, fuels, waste oils, and pathogens.

Congress, recognizing the importance of controlling these discharges, passed amendments to the Clean Water Act (CWA) in 1987 requiring that the U.S. Environmental Protection Agency (EPA) issue regulations addressing storm water discharges under the National Pollutant Discharge Elimination System (NPDES) program. Promulgated on November 16, 1990, the NPDES regulations establish permit application requirements for operators of certain municipal separate storm sewer systems (MS4), as well as of storm water discharges "associated with certain industrial activity." Regulated municipalities include those cities and counties operating medium and large MS4s (serving a population of 100,000 or greater) and other MS4s specifically designated by the permitting authority.

According to CWA mandate, municipalities regulated under the NPDES program must, at a minimum, achieve technology-based requirements (i.e., must reduce pollutant loadings in MS4s to the "maximum extent practicable" [MEP] and must effectively prohibit non-storm water discharges through their MS4s) as a first step toward achieving loading reductions consistent with applicable water quality standards. While MEP was not explicitly defined by Congress, EPA interpreted it to mean that municipalities will develop and implement comprehensive storm water management programs. These programs, proposed by the regulated municipalities under Part 2 of the permit application, are required to address a number of storm water control measures, including methods to detect and remove illicit discharges entering municipal storm sewer systems, as well as appropriate best management practices (BMPs) to address discharges from industrial, commercial, and development activities.

At this time, all regulated Phase I[1] municipalities should have submitted both Parts 1 and 2 of the municipal storm water permit application and will soon begin implementing the storm water management programs they have proposed.

PURPOSE OF THIS MANUAL

The purpose of this manual is to provide practical guidance for municipalities on how to best implement their storm water management programs. As mentioned above, most municipalities have already proposed these programs under Part 2 of the application. Upon approval by the permitting authority, these programs will then be incorporated into the municipality's permit and will serve as the blueprint for the municipality's storm water management activities. Permit conditions, however, cannot specify all the procedures necessary to put storm water management programs into effect. It is suggested that municipalities may need to take steps to ensure that storm water management programs are implemented in a practical, cost-effective manner. As noted throughout this manual, the storm water program is a watershed-based stream protection program. Storm water sources include a host of source categories, many of them associated with residential, commercial, and industrial land uses. This, a host of controls is available for this diverse set of sources. An effective Storm Water Management Program (SWMP) will consider all sources and will provide a framework for establishing control priorities on a holistic, watershed basis.

This manual is intended to help municipalities through this implementation process for their storm water management program. A basic seven-step planning process described in this chapter provides a framework for effective decision-making and long-term planning. Municipalities are encourages to revisit decisions made during Parts 1 and 2 of the permit application process to reassess their overall planning strategies, selected controls, policies, and programmatic measures. In addition, this manual is intended to help municipalities transform their storm water management program elements from words into action. For example, many municipalities pledged to develop "public outreach programs" to promote awareness about the effects of storm water runoff. But how should such programs be structured? What are the most cost-effective methods for educating community members? What are the advantages of pursuing a public outreach program versus a public participation event? This manual will help municipalities answer such questions and provide guidance on implementing storm water management program activities into the future.

Finally, this manual emphasizes a watershed protection approach, an integrated, holistic strategy for more effectively restoring and protecting aquatic ecosystems and protecting human health. This approach represents a renewed effort by EPA to focus on hydrologically defined drainage basins—watersheds—rather than on areas defined solely by political boundaries. For a given watershed, regulated municipalities are encouraged to consider not only the water resource (e.g., stream, lake, estuary, or aquafer) but all the land from which water drains to that resource. As water drains off the land, it carries with it the effects of human activities throughout the watershed.

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[1]Pursuant to Section 402(p)(2) of the Clean Water Act, Phase I of the storm water program covers the following: A) a discharge with respect to which a permit has been issued under Section 402 before February 4, 1987. B) a discharge associated with industrial activity, C) a discharge from a municipal separate storm sewer system serving a population of 100,000 or more, and D) a storm water discharge that the administrator or State determines may be contributing to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States. Phase II of the storm water program potentially could cover any sources not covered under Phase I. A request for public comment on Phase II targeting and control options appeared in the *Federal Register* on September 9, 1992.

Consequently, to protect water resources, it is important to address the condition of land areas within the watershed. By concentrating on natural resources and systems, it is possible to detect and take remedial action for such problems as declines in living resources and habitat loss, as well as to identify the more commonly recognized problems associated with elevated pollutant concentrations. This manual provides guidance for municipalities to implement their storm water management programs within a watershed protection framework.

INTENDED AUDIENCE

This manual is intended to provide guidance for regulated municipalities as they begin implementing their storm water management programs. Regulated municipalities include cities and counties operating municipal separate storm sewer systems that serve populations of 100,000 or more, as well as certain municipalities specifically designated by the permitting authority. Individuals from a variety of different municipal departments could potentially be involved with program development and implementation and will benefit from reading this manual. Table 1-1 identifies the municipal agencies and personnel who may be involved in implementing the storm water management program. This manual is also intended for use by State and Federal employees assisting municipalities to meet their NPDES storm water program objectives.

TABLE 1-1. AGENCIES AND PERSONNEL INVOLVED IN Storm water MANAGEMENT PROGRAM DEVELOPMENT/IMPLEMENTATION

Municipal Agencies	City/County Personnel	Other Members of Community
Building Department City/County Attorney's Office Department of Environmental Management Engineering Department Fire Department Health Department Planning Department Police Department Public Works Department Site Plan Review Department Water and Sewer Department Zoning Department	Council members or other elected officials Emergency response teams Engineers and environmental planners Financial officers Inspectors Public health officers Public outreach personnel Public works directors Site/building inspectors Site plan reviewers Treatment works operators Zoning board members	Community representatives Educators Environmental advocates

ORGANIZATION OF THIS MANUAL

This manual, organized in a two-volume set, provides specific guidance on how to implement particular aspects of the storm water management program. The manual does not track all requirements of the two-part permit application; rather, it addresses certain elements of the storm water management program (developed under Part 2 of the application) that could be problematic for municipalities to implement, such as illicit detection and removal procedures, public education efforts, and ongoing monitoring programs. Case studies from municipalities around the country have been provided at the end of each chapter. Wherever possible, worksheets, pictures, maps, and charts have been included to help illustrate a particular process.

Chapters, in each volume, are organized as follows:

Volume I: (Planning and Administration)

- **Chapter 1:** Provides an overview of the NPDES storm water program, reviews the topics addressed by the manual, outlines the storm water management program planning process, and examines the relationship between the NPDES program and other urban runoff management programs.

- **Chapter 2:** Helps municipalities establish priorities for storm water management activities to ensure the greatest return on their investment. The chapter also provides methods for ranking problems (i.e., pollutant sources and receiving waters) and appropriate controls.

- **Chapter 3:** Offers hands-on guidance for fulfilling certain administrative requirements, including procedures for developing effective public outreach/public participation programs, financing the storm water management program, and completing required annual reports.

- **Chapter 4:** Provides specific policy guidance on how municipalities may develop effective programs to detect and remove illicit discharges into their MS4s.

Volume II: (Technical Approach)

- **Chapter 5:** Updates guidance on developing sampling and monitoring programs/procedures for the detection of illicit entries into storm water drainage systems;

- **Chapter 6:** Updates information on storage and/or treatment facilities for urban storm water;

- **Chapter 7:** Provides matrices of source control (or nonstructural) and structural BMPs indicating applicability, effectiveness, advantages, and disadvantages of particular controls;

- **Chapter 8:** Compiles guidance on operation and maintenance required for structural BMPs and residuals management practices;

- **Chapter 9:** Develops methodology for evaluating and designing wetland systems for urban storm water pollution control.

DIFFERENCE BETWEEN THIS MANUAL AND OTHER PUBLICATIONS

A number of guidance materials address municipal storm water permit application requirements and urban runoff management as listed in this chapter references, including the following EPA publications:

- *Guidance Manual for the Preparation of Part 1 of the NPDES Permit Application for Discharges From Municipal Separate Storm Sewer Systems* (April 1991). (EPA 1991a)

- *Guidance Manual for the Preparation of Part 2 of the NPDES Permit Application for Discharges From Municipal Separate Storm Sewer Systems* (November 1992). (EPA 1992a)

This manual differs from most of the other publications because rather than focusing on completing municipal permit application requirements, it provides guidance on how to develop and implement a long-term, cost-effective storm water management program. Specifically, this document will help municipalities to set priorities for successful program implementation. While the manual concentrates on NPDES requirements, it also encourages municipalities to consider a broad range of related storm water/watershed management programs (e.g., nonpoint source programs or coastal zone nonpoint pollution control programs). This holistic approach to storm water management provides a framework that allows a municipality to integrate its storm water program effectively with other watershed protection efforts at the local, State, and Federal levels. This manual is part of a family of literature available from EPA, states, and other sources. Where information is already provided in other publications, the manual will direct the reader to those documents.

OVERVIEW OF PART 1 AND PART 2 PERMIT APPLICATION REQUIREMENTS

Before outlining the seven-step planning process of storm water management program development, it is important to review briefly the municipal permit application requirements at 40 CFR (EPA 1991b) Part 122.26(d). The regulations established a two-part application requirement for municipalities operating large or medium MS4s.

Part 1 of the application required municipalities to gather information about existing watershed conditions and storm water management activities. In addition, they were to examine existing legal authorities to enforce their storm water management programs. Part 1 also required that field screening of major outfalls be conducted to characterize storm water discharges and detect illicit connections in the storm sewer system. The deadlines for submitting Part 1 permit application for large municipal system (>250,000 population) and medium municipal system (100,000 to 250,000 population) were November 18, 1991 and May 18, 1992, respectively.

Part 2 of the application required municipalities to elaborate on information provided in Part 1. Applicants were to establish adequate legal authority, provide additional information on pollutant sources, collect quantitative data from selected sampling points, and analyze fiscal needs versus available resources. Once existing conditions had been assessed and monitoring data collected, municipalities were required to propose a comprehensive storm water management program. The deadlines for submitting Part 2 permit application for large municipal system and medium municipal system were November 16, 1992 and May 17, 1993, respectively. Figure 1-1 summarizes the key elements that required for application of Part 1 and Part 2 storm water permit.

DEVELOPING A WATER MANAGEMENT PROGRAM: THE PLANNING PROCESS

As noted above, this manual delineates a basic seven-step planning process that will help municipalities design cost-effective and sensible storm water management programs. For municipalities that have already completed Parts 1 and 2 of the NPDES municipal permit application, this planning process may suggest ways to improve or enhance the proposed storm water management program. The flow chart appearing in Figure 1-2 has been developed to give municipalities a sense of how each step in the planning process logically leads to the next and ultimately of how the process feeds back into itself, thereby forming a cycle.

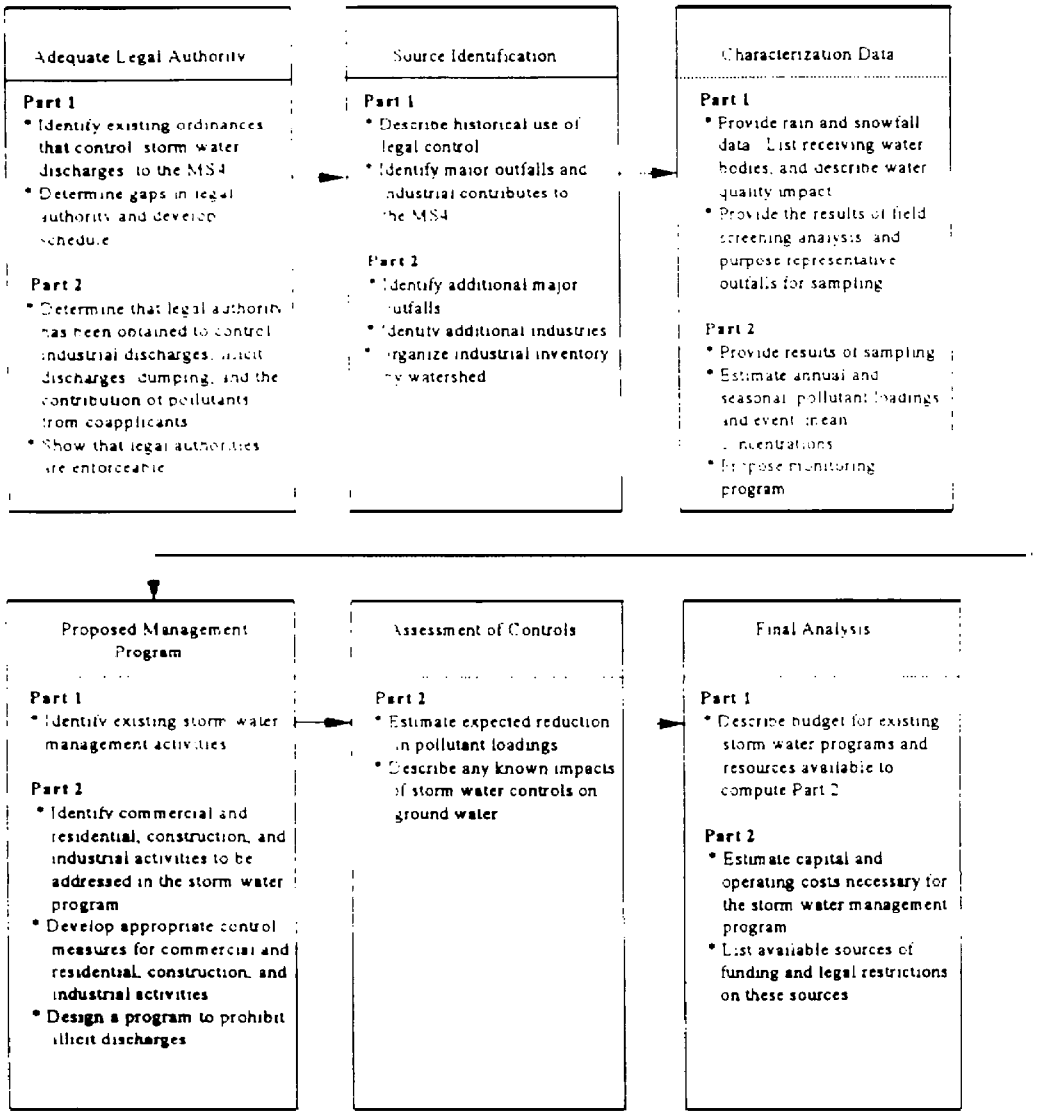


FIGURE 1-1. PART 1 AND PART 2 STORM WATER APPLICATION REQUIREMENTS

After the flow chart, a brief description of each planning step is provided. Other useful guidance materials are listed under the Reference section at the end of this chapter.

- For detailed guidance on Steps 1 and 2 (assessing existing conditions and setting goals), refer to *Guidance Manual for the Preparation of Part 1 of the NPDES Permit Application for Storm water Discharges From Municipal Separate Storm Sewer Systems* (April 1991) and *Guidance Manual for the Preparation of Part 2 of the NPDES Permit Application for Storm water Discharges From Municipal Separate Storm Sewer Systems* (November 1992).

- Steps 3 and 4, which describe methods for ranking pollutants sources and impaired watersheds and for ranking control measures, are addressed in Chapter 2.

- Step 5, which identifies storm water management program administrative requirements, is further discussed in Chapter 3 (guidance for developing public outreach/public participation programs) and Chapter 4 (guidance for developing an illicit detection/removal program).

- Step 6, which addresses data collection programs, is further discussed in Chapter 5.

- Step 7, which addresses evaluating the effectiveness of the program, is elaborated upon at the end of Chapter 3. Other useful guidance materials are listed under the Reference section at the end of this chapter.

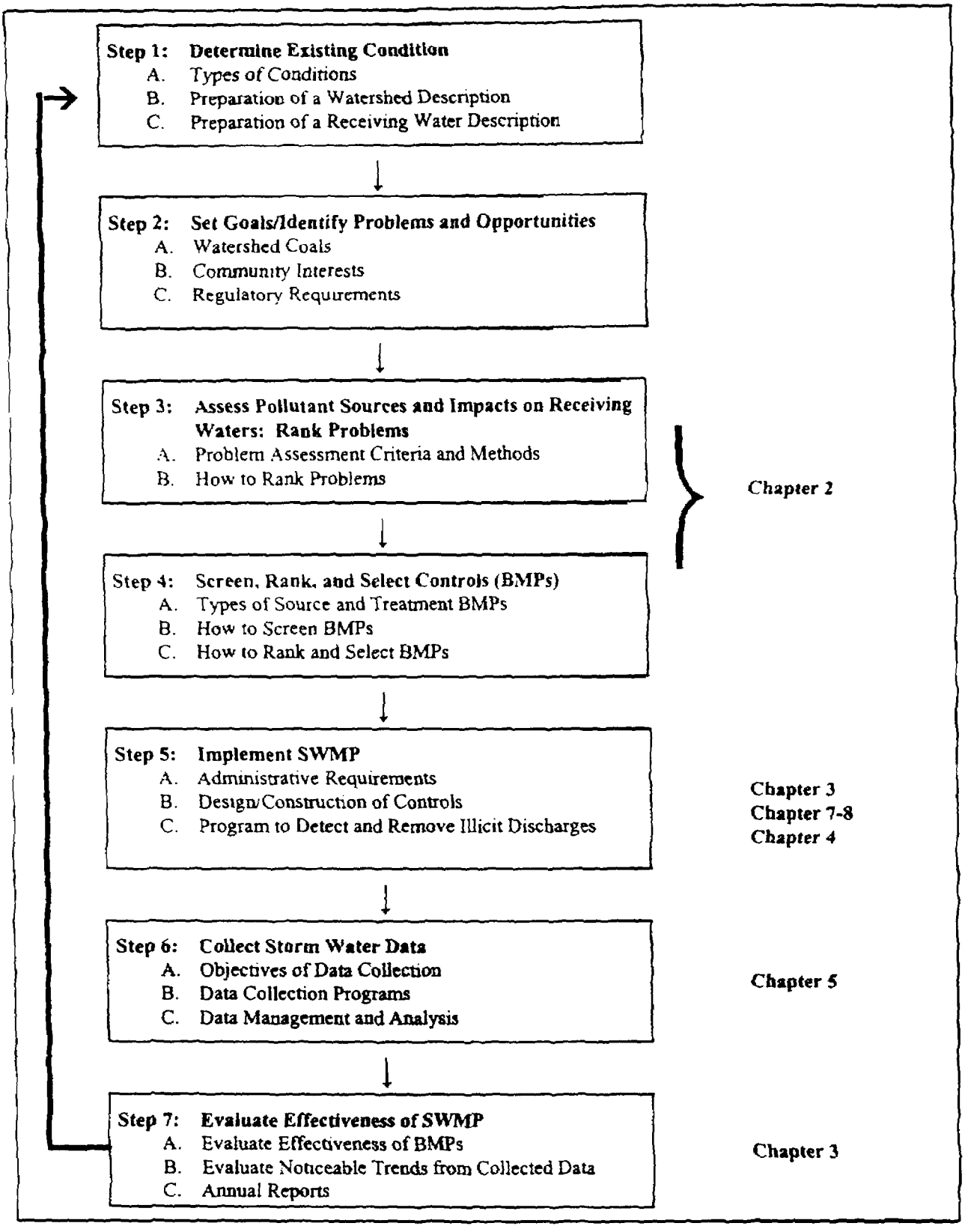


FIGURE 1-2. THE SEVEN STEP STORM WATER MANAGEMENT PROGRAM PLANNING PROCESS

THE SEVEN-STEP STORM WATER MANAGEMENT PROGRAM PLANNING PROCESS

Step 1: Define Existing Conditions

Types of Conditions

The municipality must assess existing water resource conditions to set its initial progran goals. Much of this information was collected during Parts 1 and 2 of the municipal permit application. Guidance on how to begin to assess existing conditions may be found in the *Guidance Manual for the Preparation of Part 2 of the NPDES Permit Applications for Discharges from Municipal Separate Storm Sewer System*. Existing conditions that should be assessed for the SWMP include those identified below.

Pollutant Sources

Municipalities must identify areas or sources known or suspected to contain significant concentrations of pollutants, including industrial sites (those required to obtain permits under the NPDES program), commercial areas, residential areas, and construction activities. In some cases, these areas of concern may be defined on a categorical basis (e.g., all service stations), while in other cases, the area of concern may be more site-specific (e.g., a particular service station). A significant nonpollutant source of concern is excessively high flow, which results in bank erosion, channel scouring, and sediment deposition.

Receiving Waters

Understanding the characteristics of receiving waters is essential for storm water management program development. Municipalities should evaluate available data on the physical, chemical, and biological conditions of receiving waters—and examine existing uses versus designated uses for particular resources—to determine which waterbodies and which specific areas demand highest priority. A wide range of information should be available from State and Federal agencies and local universities. Similarly, the planning and public works department should have relevant information on receiving waters in its possession.

Watershed Characteristics

In addition to identifying pollutants sources and their impacts on receiving waters, municipalities should assess other aspects of the watershed, such as land use and development patterns (e.g., general program, zoning, subdivision requirements), physical characteristics (e.g., soils, slope, subsurface conditions, climate), and characteristics of the drainage system (e.g., physical storm drain characteristics, base flow characteristics, and water quality objectives). Again, such information should be available from existing sources, including local, State, and Federal agencies.

Institutional Considerations

In Phase I, municipalities have assessed their institutional issues for developing and implementing a storm water management program. However, the items to consider in this phase are funding mechanisms, available staffing, legal authority to carry out storm water management program activities, and the institutional ability in marshalling joint efforts for storm water management among different municipal agencies. Municipalities should consider existing municipal programs that either affect storm water quality (e.g., road maintenance) or that may be expanded to address storm water concerns (e.g., pretreatment, fire inspections).

Community Character

To ensure the political and financial support of SWMP activities, municipalities must work in conjunction with community members to determine what issues are important to them and which programs they would be likely to support. The factors to consider include municipal demographics; types of community organizations; environmental, land use, and aesthetic issues; and the local business climate.

Existing Programs and Controls

Many cities and counties already have programs that, to one degree or another, address storm water management. The SWMP will be more cost-effective if municipalities can incorporate these existing programmatic measures or controls into those now envisioned for an expanded comprehensive SWMP. The existing programs to consider include those that currently manage pollutant sources and those that currently manage other activities of parties responsible for pollutant sources.

Preparation of a Watershed Description

Once municipalities have gathered together available data about sources of pollution and the status of receiving waters, these data need to be organized to facilitate decisionmaking for storm water management activities. As discussed in EPA's Part 2 guidance manual, municipalities are required to prepare a map-based watershed description to obtain a visual sense of the topography in their city drainage areas, locations of industries, and existing control measures and to pinpoint major sources of pollution. Much of the data listed in Table 1-2, which municipalities are required to collect under Parts 1 and 2 of the permit application can be plotted on a base map to form a watershed description

TABLE 1-2. TYPES OF DATA TYPICALLY INCLUDED IN A WATERSHED PROFILE

Environmental	Potential Sources/Existing Structural Controls
• Topography • Land use • Recreational areas (beaches, boating areas) • Designated water uses • Soils and surface/bedrock geology • Vegetation • Natural resources • Temperature • Precipitation • Hydrology	• Landfills • Illicit connections • Waste handling areas • Salt storage facilities • Underground tanks • NPDES industrial activities • Pollution control facilities • Retention/detention ponds • Flood control structures
Infrastructure	**Municipal**
• Roads and highways • Storm drainage systems • Sanitary sewer systems • Treatment facilities • Other utilities (water, electric, gas)	• Population density and projected growth • Zoning • Land ownership • Regulations • Ordinances • Municipal source controls (e.g., street sweeping, catch basin cleaning)

For more information about the sources of watershed mapping and data, as well as methods for analyzing watershed data, refer to *Urban Runoff Pollution Prevention and Control Planning*, EPA 1993a.

Preparation of a Receiving Water Description

In addition to preparing a watershed description, municipalities are encouraged to assess receiving water conditions. Effective identification and use of existing water resources data will reduce the schedule program and cost, in some cases by reducing the need for additional sampling and analysis. Municipalities should work closely with States and Regional EPA offices to obtain available data on receiving waters in various States. States must collect receiving water data as required by CWA § 304(1), 305(b), § 314, and § 319 reports. Data should be available from various local departments (e.g., planning, public works, parks and recreation) as well as State and Federal departments (U.S. EPA, United States Geological Survey [USGS], Fish and Wildlife Service, U.S. Department of Agriculture). In some cases, State and Federal agencies may have conducted intensive surveys of a particular watershed or sub-watershed. Municipalities should contact these agencies prior to initiating any data collection efforts on their own or use field data as an initial screening purpose. In addition, volunteer stream monitoring and survey for field vericication of stream conditions will be very valuable to the program. Table 1-3 identifies the data that should be collected to prepare a receiving water description.

TABLE 1-3. TYPES OF DATA TYPICALLY INCLUDED IN A RECEIVING WATER PROFILE

Source Input	Chemical
• CSO data • storm water data • Other NPS data	• Water quality data • Sediment data • Bioconcentration
Physical/Hydrologic	**Biological**
• Physiographic and bathymetric data • Flow characteristics • Tidal elevation in coastal areas • Sediment data	• Fisheries • Benthos data • Biomonitoring data
	Water Quality Standards
	• State water quality standards

For more information about the sources of watershed mapping and data, as well as methods for analyzing watershed data, refer to *Urban Runoff Pollution Prevention and Control Planning*, EPA 1993a.

Step 2: Set Goals and Identify Problems and Oppertunities:

The primary goal of the Clean Water Act and the NPDES permitting program is to protect the physical, chemical, and biological integrity of our Nation's waters. Toward this end, municipalities are required to develop storm water management programs that will control discharges through their storm sewer systems to the "maximum extent practicable" and to prohibit non-storm water discharges through their MS4s. Within this statutory and regulatory framework, regulated municipalities will define their own set of goals that address all aspects of water quality, including chemical water quality (e.g., toxic substances and conventional pollutants), physical water quality (e.g., temperature, flow, and circulation), habitat quality (e.g., channel morphology, composition, and biotic communities), and biodiversity (e.g, species number and range). Table 1-4 identifies sample goals for a municipal storm water management program.

TABLE 1-4. EXAMPLES OF SPECIFIC WATER QUALITY, ECOLOGICAL, AND RESOURCE MANAGEMENT GOALS

Examples of Water Quality Goals		
Parameter	**Goal**	**Reference**
Dissolved Oxygen	At least 1 mg/l at all times throughout the Chesapeake Bay Dissolved oxygen monthly means concentrations of at least 5 mg/l at all times throughout the Chesapeake Bay, with the exception of subpycnocline waters	Part of quantitative criteria established for dissolved oxygen by the Chesapeake Bay Program
Dissolved Oxygen	3.0 mg/l minimum (for other than early life stages) 4.0 mg/l weekly average minimum 5.0 mg/l minimum for early life stages 4.0 mg/l minimum 5.0 mg/l daily average minimum 5.0 mg/l minimum	EPA water quality criteria Virginia standard Pennsylvania criterion District of Columbia standard Maryland standard
Nutrients	Low enough to prevent nuisance growth of algae, weeds, and slimes	Specific objective under the Great Lakes Water Agreement
Solids (settleable and suspended) and Turbidity	Settleable and suspended solids should not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life	EPA Water Quality Criteria
Mercury	Less than 2.1 ppb/0.025 ppb	Quantitative water quality acute criteria/chronic criteria for priority metal (EPA criteria under development)
Polynuclear Aromatic Hydrocarbons (PAH)	Less than 300 ppb/ND	Preliminary marine water quality criteria under development by EPA
Examples of Living Resource Goals		
Wetlands	No overall net loss	Federal Policy
Wetlands	" diking, filling, or dredging in existing estuaries and wetlands shall maintain or enhance the functional capacity of the wetland or estuary. Any alteration of coastal wetlands . shall be limited to very incidental public facilities, restorative measures, nature study, commercial fishing facilities in Bodega Bay, and development in already developed parts of south San Diego Bay..."	Specific objectives set forth in the California Coastal Act
Waterfowl Habitat	Regional land acquisition targets set to meet goals of the Migratory Bird Conservation Act	U.S. Fish and Wildlife Service priority list for land acquisition
Examples of Quality of Life Goals		
Shoreline Access	Substantially expand recreational beach access	So. Carolina's State Comprehensive Outdoor Recreation Program
Park/Recreation Area	Increase urban wildlife programs and public use of opportunities, particularly watchable wildlife programs	U.S. Fish and Wildlife Service "Vision for the Future"

Step 3: Assess Poll... S...rces and Their Impacts on Receiving Water; Rank Problems:

Once municipa...ed data to determine existing conditions within their jurisdictions, they must determine the mos...ms. During this step, municipalities should consider the following issues: (1) the types of storm ...llution (and their sources) in the watershed, (2) the extent to which these pollution sources affec...g water resources, (3) institutional needs and constraints in solving problems, and (4) the deg...ogram goals are being met. Finally, municipalities should take steps to rank their problems using ...aking and analysis methods presented in Chapter 2, which provides additional information on this ...

Step 4: Screen, Rank, and Select Controls

After municipalities have ranked and targe...ter runoff problems (i.e., particular areas, sources, and waterbodies of concern), efforts can then be focused t...ng those problems in a cost-effective manner. First, the municipality should compile readily available lists of p...n prevention and treatment practices to assess their relative effectiveness. In most cases, more than one set of BMPs will be identified as feasible to address a particular problem. From the list of feasible alternatives, the municipality will then rank and select its final list of BMPs. Chapter 2 discusses this process of screening, ranking, and finally selecting appropriate BMPs.

Step 5: Implement Storm Water Management Program:

Once priorities have been articulated and a list of BMPs drawn up, the storm water management program team is responsible for moving from planning to implementation as soon as all legal requirements are in place. During this step, near- and long-term program responsibilities must be clearly delineated. All involved persons must be familiar with, and accept their role in, implementing and enforcing the program. Some of the most important aspects of implementing a storm water management program include completing administrative requirements (discussed in Chapter 3), developing a program to detect and remove illicit discharges (discussed in Chapter 4), and knowing exactly when certain BMPs would be effective/appropriate (discussed in Chapter 5).

Step 6: Collect Storm water Quality Data

Although the municipality may ...ly have existing data, additional data will need to be gathered throughout the life of the SWMP. When proposing their monitoring programs under the SWMP, municipalities will have to make important decisions about when, where, and how often to monitor their storm water. Ultimately, the permit writer will establish monitoring conditions for each municipality's permit. Chapter 7 presents detailed guidance for developing municipal in-stream water quality monitoring programs.

Step 7: Evaluate Effectiveness of Storm Water Management Program

The final step, evaluating the effectiveness of the storm water management program, encourages municipalities to reassess decisions previously made and, if necessary, to make alterations in the program plan. As part of this process, the NPDES regulations require that municipalities complete an annual report outlining the effectiveness of their programs on an yearly basis (discussed in Chapter 3).

DISCUSSION OF RELATED REGULATIONS/STATUTES AND PROGRAMS THAT ADDRESS MUNICIPAL STORM WATER RUNOFF

While this manual focuses on providing guidance for NPDES storm water program implementation, municipalities should carefully consider other related watershed protection programs. By integrating these programs into the storm water programs, municipalities will enhance the overall effectiveness of the SWMP. A knowledge of such programs can save startup costs (e.g., by minimizing the need to collect data that may have previously been collected for other purposes) and long-term costs (e.g., by piggybacking BMP planning and implementation activities with other watershed protection efforts). Furthermore, by working in conjunction with other runoff management programs, municipalities can more efficiently address a broad range of watersheds problems concurrently. Listed below (Table 1-5) and identified in the following paragraphs are related Federal statutes, regulations, and programs that address municipal storm water runoff, pollution prevention, and control.

TABLE 1-5. RELATED FEDERAL STATUTES, REGULATIONS, AND PROGRAMS ADDRESSING MUNICIPAL Storm water RUNOFF

- Combined Sewer Overflow Policy
- Nonpoint Source Program (CWA § 319)
- Coastal Zone Nonpoint Source Pollution Control (CZARA § 6217)
- Safe Drinking Water Act
- Clean Lakes Program (CWA § 314)
- 404 Regulations/Wetlands Program
- National Estuary Program
- Federal Emergency Management Agency Regulations
- Pollution Prevention Act of 1990

Combined Sewer Overflow Policy

Combined sewer systems are designed to carry both storm water and sanitary sewage. When wet weather flows exceed the carrying capacity of the system, these combined systems discharge the excess flow through designated overflow points. This event is known as a combined sewer overflow (CSO). Such combined sewer discharges, if not treated before overflowing into receiving waters, can cause significant water resource effects and threaten human health. NPDES permits for CSOs include prohibition of CSOs during dry-weather flow conditions, compliance of all wet-weather CSOs with the technology-based requirements of the CWA and applicable State water quality standards, and minimization of water quality impacts from wet-weather generated overflows.

Relationship to SWMP Implementation

Municipalities that own/operate both storm sewer systems and combined sanitary/storm sewer systems are required to comply with many of the same NPDES permit program requirements, including the following:

- Receiving water quality assessment
- Monitoring
- Public education programs
- Enforcement

(EPA 1994)

Nonpoint Source (NPS) Program (CWA §319)

Under § 319 states perform nonpoint source assessments of navigable waters of the United States. They must identify impaired and threatened waters, the activities causing impairment, and controls and programs necessary to address impairments. In addition, States must develop Nonpoint Source Assessment Reports and Nonpoint Source Management Programs that include an inventory of BMPs, a schedule containing annual milestones for program implementation and certification of adequate legal authority to be eligible for Federal funding. Under this program, many States have also developed State Priority Ranking Systems and undertaken monitoring programs to track progress

Relationship to SWMP Implementation

Program information may be used by municipalities completing their storm water management programs for the following purposes:

- Assessing wetland boundaries
- Assessing the water quality of receiving waters
- Identifying major sources of impairment of receiving waters
- Identifying and implementing effective controls
- Prioritizing implementation of SWMP components
- Identify Total Maximum Daily Loads (TMDLs).

(EPA 1989a and 1990a)

Coastal Zone Nonpoint Source Pollution Control (CZARA § 6217, EPA 1993b)

The Coastal Zone Act Reauthorization Amendments of 1990 require States with existing coastal zone management programs to establish coastal NPS programs that must be approved by the National Oceanic and Atmospheric Administration (NOAA) and U.S. EPA. This program is limited to NPS pollution control in coastal areas and the contribution of inland sources of pollution to degraded coastal water quality. To secure an approved coastal nonpoint program, States are required to do the following:

- Coordinate existing State programs, including State and local water quality plans and programs under § 208, § 303, § 319, and § 320 of the CWA

- Submit State coastal zone boundaries and § 6217 management areas to NOAA for review and modification, if necessary

- Implement State NPS control programs in conformance with management measures defined under CZARA § 6217(g) (referenced below) and additional measures where coastal water quality remains impaired.

- Provide technical and other assistance to local governments and the public for implementing additional management measures

- Provide opportunities for public participation in all aspects of the programs and ensure that there will be administrative coordination among various State, regional, and local agencies

- Develop enforceable policies and mechanisms to implement the Coastal Nonpoint Pollution Control Program.

Relationship to SWMP Implementation

There are many similarities between nonpoint source program goals (under § 319 and CZARA § 6217) and NPDES program goals. Both programs address storm water runoff from areas of industrial activity, as well as new development, pollution prevention, and watershed management. However, these programs target different classes and sources of discharges. For example, municipalities subject to NPDES permit application requirements are not subject to requirements under nonpoint source control programs, including CZARA § 6217; small municipalities (under population 100,000) without NPDES storm water permits are currently covered under CZARA § 6217 and § 314.

The distinction between point and nonpoint source programs becomes more problematic in relationship to industrial activities. While certain industrial activities are covered under the NPDES program (40 CFR 122.26(b)(14), many other activities fall under the purview of CZARA § 6217. For example, construction activity that disturbs five or more acres or that is part of a larger common program of development or sale is covered under the NPDES program, whereas construction disturbing fewer than five acres is covered under CZARA.

Safe Drinking Water Act

The Surface Water Treatment Rule (SWTR) of the Safe Drinking Water Act (SDWA) outlines requirements for watershed protection of surface drinking water supplies from urban runoff and nonpoint source pollutants. Municipalities using surface waters for drinking water supplies are required by U.S. EPA or the approved State agency to develop a watershed protection program for such surface waters that includes the following: a watershed description, identification of physical watershed characteristics and a description of activities potentially affecting water quality, a program to control pollutant sources (including implementation of appropriate BMPs), and an ongoing program to conduct monitoring.

Relationship to SWMP Implementation

The NPDES storm water management program and the Safe Drinking Water Act have many overlapping requirements, and municipalities are urged to share information between these two programs. Activities common to both include:

- Identifying critical areas and watersheds
- Determining watershed characteristics

- Identifying activities detrimental to surface water quality
- Implementation of control practices to address pollution sources.

(EPA 1986 and 1990b)

Clean Lakes Program

The Clean Lakes Program sets goals for defining the cause and extent of pollution problems in the lakes of each State. Emphasis is placed on developing watershed assessments and effective technology that considers all point and nonpoint sources that affect lake quality

Relationship to SWMP Implementation

Information developed under this program that may be useful to municipalities implementing SWMPs include:

- Identification of environmental conditions
- Description of the lake's sources of pollution and abatement actions to reduce the pollution caused by these sources
- Monitoring data on receiving waters
- Alternative BMPs for pollution control.

(EPA 1993c)

404 Regulations/Wetlands Program

The Army Corps of Engineers and EPA jointly implement section 404 of the Clean Water Act, which regulates the discharge of dredged and fill material into waters of the United States, including most wetlands, and establishes a permit program to ensure that such discharges comply with environmental requirements.

Relationship to SWMP Implementation

Information available through this regulation may assist the municipality by helping to:

- Identify wetlands and delineate boundaries. (Corps of Engineers Delineation Manual 1987)
- Enforce SWMP restrictions on discharging fill materials
- Develop water quality standards specifically for wetlands.

(EPA 1989b, 1993c, and 1995)

National Estuary Program (NEP)

The National Estuary Program (NEP) focuses on point and nonpoint pollution in geographically targeted, high-priority, estuarine watersheds. Under this program, EPA assists State, regional, and local governments in developing estuary-specific comprehensive conservation and management programs that recommend corrective actions to restore and maintain estuarine water quality and to protect fish populations and other designated uses of these targeted waters.

Relationship to SWMP Implementation

Information obtained under the NEP may be helpful to the municipalities in their efforts to:

- Assess pollutant sources/loadings in particular watersheds
- Monitor trends in receiving water quality
- Implement public outreach elements of the program.

(EPA 1992b)

Federal Emergency Management Agency Regulations (FEMA)

FEMA works closely with local communities to identify flood hazard areas and flooding risks. Flood plain maps are also available through the agency.

Relationship to SWMP Implementation

Municipalities developing storm water management programs may use this information to

- Effectively place structural controls
- Determine floodplains boundaries.

(FEMA 1992 and 1993)

Pollution Prevention Act of 1990

The Pollution Prevention Act of 1990 established a national policy specifying that pollution prevention should be emphasized over pollution control or treatment. With this policy, Congress defined a pollution prevention hierarchy to be followed by all pollution reduction programs:

- Prevent or reduce at the source whenever feasible
- Where prevention is unfeasible, recycle in an environmentally safe manner
- Where prevention or recycling is not feasible, treat in an environmentally safe manner
- As a last resort, dispose of (or otherwise release to the environment) materials in an environmentally safe manner.

Relationship to SWMP Implementation

Management practices set forth in EPA's pollution prevention policy include public education, household hazardous waste collection, location and elimination of illicit connections to separate storm systems, reduction of roadway sanding and salting, and reduction of pesticide, herbicide, and fertilizer use. Many of these measures are required or suggested elements of the storm water management program and can, therefore, be implemented in conjunction with one another.

SUMMARY

Chapter 1 provided an overview of the NPDES storm water program and briefly summarized the remaining chapters. In particular, this chapter introduced the storm water management program planning, a seven-step process that involves establishing goals, collecting data, establishing priorities, and implementing the program. This planning process incorporates the requirements of Parts 1 and 2 of the NPDES municipal storm water permit application. Finally, this chapter examined the relationship between the NPDES program and programs addressing urban runoff management.

Chapter 2 will provide guidance for municipalities as they attempt to establish priorities for storm water management activities. The chapter will describe methods for ranking "problems" (i.e., pollutant sources and receiving waters) and ranking appropriate controls

REFERENCES

Corps of Engineers. 1987 Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1.

Federal Emergency Management Agency (FEMA) 1992. Answers to Questions About The National Flood Insurance Program. FIA-2/March.

Federal Emergency Management Agency (FEMA) 1993. Disaster Assistance Programs - A Guide to Federal Aid in Disasters, DAP 19/March.

U S Bureau of National Affairs. 1987. Clean Water Act Amendments of 1987. OCLC Number: 16658043.

U S Congress. 1990. Public Law 101-508, 104 Stat. 1388-321, OCLC Number 25738515.

U S. Environmental Protection Agency (EPA). 1983. Results of the Nationwide Urban Runoff Program, Volume 1, Final Report. Water Planning Division, Washington, DC. 1983, PB 84-185552.

U S. Environmental Protection Agency (EPA). 1986. Safe Drinking Water Act 1986 Amendments, EPA 570/9-86-002.

U.S. Environmental Protection Agency (EPA). 1989a. Selecting Priority Nonpoint Source Projects, Office of Water Regulations and Standards, Office of Wetland Protection.EPA 506/2-89/003, pp. vi, 1.

U.S. Environmental Protection Agency (EPA). 1989b. Highlights of Section 404, Federal Regulatory Program to Protect Waters of the United States, EPA Office of Wetland Protection, PB 95-194809.

U.S. Environmental Protection Agency (EPA). 1990a. NATIONAL GUIDANCE, Wetlands and Nonpoint Source Control Programs, 24916286.

U.S. Environmental Protection Agency (EPA). 1990b. Surface Water Treatment Rule-Implementation Manual, EPA Office of the Assistant Administrator for Water, PB 93-186641.

U.S. Environmental Protection Agency (EPA). 1991a. Guidance Manual for the Preparation of Part 1 of the NPDES Permit Applications for Discharges from Municipal Separate Storm Sewer Systems, EPA 505/8-91-003A.

U.S. Environmental Protection Agency (EPA). 1991b. Part 2, 40 CFR Part 122, NPDES General Permits and Reporting Requirements for Stormwater Discharges Associated with Industrial Activity; Proposed Rule, Federal Register Vol. 56, No. 159, PB 94-152337.

U.S. Environmental Protection Agency (EPA). 1992a. Guidance Manual for the Preparation of Part 2 of the NPDES Permit Applications for Discharges from Municipal Separate Storm Sewer Systems, EPA 833/B-92-002.

U.S. Environmental Protection Agency (EPA). 1992b. The National Estuary Program After Four Years, A Report to Congress. EPA 503/9-92-007.

U.S. Environmental Protection Agency (EPA). 1993a. Office of Research and Development. Urban Runoff Pollution Prevention and Control Planning Hanbook. 1993. EPA 625/R-93-004.

U.S. Environmental Protection Agency (EPA). 1993b. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. EPA 840/B-92-002.

U.S. Environmental Protection Agency (EPA). 1993c. A Commitment to Watershed Protection., A Review of the Clean Lake Program.. EPA 841-R-93-001.

U.S. Environmental Protection Agency (EPA). 1994. Combined Sewer Overflow Control Policy. 59 FR 18688. April 19.

U.S. Environmental Protection Agency (EPA). 1995. EPA Wetlands Fact Sheets. Wetlands Fact Sheet [illegible] - Clean Water Act §404. EPA-843-F-95-001.

U.S. Environmental Protection Agency (EPA). 1996. Safe Drinking Water Act 1996 Amendments. EPA570/9-96-002.

CHAPTER 2

ASSESSING STORM WATER RUNOFF PROBLEMS AND DEVELOPING SOLUTIONS: HOW TO SET PRIORITIES

Step 3: Assess Pollutant Sources and Impacts on Receiving Waters: Rank Problems

A. Problem Assessment Criteria and Methods
B. How to Rank Problems

Step 4: Screen, Rank, and Select Controls (BMPs)

A. How to Screen BMPs
B. How to Rank and Select BMPs

INTRODUCTION

The MPDES regulations require that municipalities develop storm water management programs to control storm sewer system discharges to the maximum extent practicable. In order to develop an effective storm water implementation program, the municipalities should know what their biggest storm water runoff problems are and which solutions are most cost effective.

This chapter[1] is designed to help municipalities answer these questions by identifying sources of information to recognize the existing conditions of a watershed, suggesting ways to identify and prioritize sources of water quality problems, and evaluating the effectiveness of potential control measures. Municipalities have already complied some of this information as part of the application requirements. However, other watershed information was not included in the applications and will involve additional data collection activities. Using information available on watershed conditions will enable municipalities to set priorities for conducting storm water management activities. As information is gathered and analyzed, a municipality may find it will need to modify SWMP planning and implementation activities. This chapter also emphasizes the use of water quality models to determine this information. However, there are non-computer based methods for determining the benefits and impact of different pollution prevention alternatives.

[1]Chapter 2 has been adapted in part from U.S. EPA, Office of Research and Development. *Urban Runoff Pollution Prevention and Control Planning.* September 1993a.

This chapter consists of 3 primary sections. The first section addresses methods for assessing problems and ranking them in order of importance. The second section of the chapter offers methods for evaluating and selecting controls to solve these problems. The criteria used to assess problems (e.g., consideration of public opinion, costs, goals) will often be similar, if not identical, to those used for selecting control measures. The third section includes case studies of municipalities assessing storm water runoff problems and evaluating/selecting and evaluating/selecting appropriate BMPs.

As mentioned in Chapter 1, Steps 1 and 2 (setting goals and assessing existing conditions) are not extensively discussed in this manual because they were covered in the application guidance manuals; *Guidance Manual for the Preparation of Part I of the NPDES Permit Application for Discharges from Municipal Separate Storm Sewer Systems* (April 1991) and *Guidance Manual for the Preparation of Part 2 of the NPDES Permit Applications for Discharges from Municipal Separate Storm Sewer Systems* (November 1992a). Readers should refer to these manuals for detail on Steps 1 and 2. This chapter addresses Steps 3 and 4. Step 3, assessing receiving waters and sources of any impaired conditions, is described below. Step 4 is discussed later in this chapter. Step 6, which addresses data collection programs, is discussed in Chapter 5.

STEP 3: ASSESS POLLUTANT SOURCES AND IMPACTS ON RECEIVING WATERS: RANK PROBLEMS

To determine the need for, and appropriate level of, pollution prevention and control measures under their SWMPs, municipalities need to assess and rank existing watershed conditions. To assess watershed conditions, a municipality must gather information concerning the physical, chemical, and biological integrity of the water bodies in its jurisdiction. This type of information can be accessed through numerous sources, including Federal, State, and local sources. Some of these sources are a biennial report (known as the Clean Water Act § 305(b) report) on water quality conditions; the State's listing of impaired water bodies (known as Clean Water Act § 304(1) listings) prepared by the State for submittal to EPA; State Nonpoint Source Assessments (known as Clean Water Act § 319 listings); State Water Quality Assessment (known as Clean Water Act § 314 listings) Fish and Wildlife Service biological surveys; United States Geological Survey (USGS) sources, including maps, water quality and quantity data, and aerial photographs; water quality data compiled by State environmental agencies; Geographic Information System (GIS) data compiled by State or Federal agencies (e.g., EPA, Department of Agriculture, and Department of the Interior); as well as information available by local park departments, health departments, public works departments, and local universities.

Information concerning watershed conditions that may have been collected as part of the application requirements includes the following.

Part 1

- Major outfalls and industrial contributions to the MS4
- Topographic map
- Rain and snowfall data
- List of receiving water bodies, with a description of water quality impacts
- Results of field screening analysis
- Existing storm water management activities.

Part 2

- Runoff sampling results
- Estimate of annual and seasonal pollutant loadings and event mean concentrations
- Estimate of expected reduction in pollutant loadings.

Using the information collected from the sources listed above, a municipality must identify the watershed conditions in its jurisdiction. When identifying the problems, a municipality must consider the chemical, physical, and biological conditions of a water body and determine the degree to which flow volumes and/or associated pollutants led to impaired conditions. For example, when eutrophication occurs in a lake, excess nutrients are of concern. The municipality, in turn, needs to assess the problem, which in this case may be too much fertilizer reaching the water body through runoff. Another example may involve storm water flow resulting in bank erosion and/or changing the strata of the streambed. In large part, the traditional water quality program has focused on chemical impairments. However, in developing a storm water program, municipalities will also need to consider physical and biological impairments.

Once the problems have been identified, they need to be assessed. While many different types of problem assessments may be conducted as part of the storm water management program, to simplify the process this chapter focuses on four major types:

- Resource Assessments: Evaluating the extent to which these pollution sources adversely affect water resources
- Pollutant Source Assessments: Assessing the sources of urban runoff pollution in the watershed
- Institutional Assessments: Assessing existing BMPs, costs, public opinion, and technical feasibility
- Goals and Objectives Assessments: Evaluating whether program goals and objectives are being met.

Municipalities may establish criteria (such as those presented in Table 2-1) for assessing problems. Methods for assessing the problems can also be explored. A discussion of the most commonly used methods of problem assessment is presented under each of the four headings. Finally, methods for ranking problems using both quantitative and qualitative measures are explained.

Once storm ... runoff problems have been fully assessed and ordered, municipalities will begin to screen and select BMPs (dis... ... second section of this chapter).

Resource Assess.

The critical element fo... rm water runoff problems is assessing storm water effects on receiving water physical, chemical, and t... ...rity and determining locations where preventive and corrective measures are needed.

Criteria To Consider

In assessing receiving waters, mu... onsider the importance or value of a resource (with respect to such issues as aquatic habitat, rec... lic water supplies), the current and desired uses of a resource, and the degree to which a resource ... esource values are reflected in a State's water quality standards.

TABLE 2-1. CRITERIA FOR ASSESSING POLLUTION PROBLEMS

Resource
• Existing use of the affected resource (type, status, and level of use)
• Designated use of receiving water
• Type and severity of impairment
• Relative value of resource affected
Pollutant Source
• Type of pollutant
• Pollutants typically associated with the source
• Source magnitude/pollutant loading
• Transport mechanisms to water resource (direct pipe, overland flow, or ground water)
Institutional
• Available resources and technologies
• Problems and opportunities
• Potential for solving identified problems
• Implementability of controls
• Applicable and adequate regulations
• Multi-agency responsibilities
• Costs of controls and program implementation
• Funding sources and limitations
• Public perception
Goals and Objectives
• Water resource goals (water use objectives)
• Technology-based goals
• Land use objectives

Adapted in part from U.S. EPA, 1987a.

Municipalities should consider the following when evaluating which receiving waters need to be addressed by storm water control activities:

- Extent to which the waterbody is meeting its designated use
- Level of waterbody impairment due to pollution (chemical integrity), loss of aquatic habitat, or riparian or terrestrial area modification (physical integrity)
- Relative value of resource from functional perspective, for instance, for aquatic habitat (biological integrity), recreation, and water supply
- Threat of waterbody impairment, habitat destruction, or terrestrial area destruction if no action is taken (i.e., new impairments are anticipated)
- Feasibility of implementing corrective or protective (e.g., pollution preventative) measures and achieving demonstrable results in the watershed

- Availability of information necessary to target waterbodies and watersheds and to develop and implement effective management strategies.

Methods for Assessing Water Resources and Receiving Waters

Water resource assessments address the effect of storm water flow and associated pollutants on the water bodies of interest. Water resource assessments frequently involve taking the results of the pollutant source assessments described in the following part of this chapter and determining the effect of these pollutant sources on water resources. Water resource assessments may include chemical water quality assessments, as well as aquatic life assessments, sediment quality evaluations, and assessments of any other relevant conditions, such as streambed strata. The methods to perform water quality assessments can range from simple evaluations, involving the comparison of measured concentrations to water quality standards, to detection modeling, to more complex, mathematically based computer models. It is more than likely that sufficient State and local data exist to assess the chemical quality of the waters. It is less likely that local, State, and Federal agencies have data on the physical and biological integrity of the water body of concern. Nonetheless, the municipality should work with the permit writer to access any available information. If necessary, municipal staff, perhaps with the assistance of local universities, can conduct biological assessments. EPA (1989) has issued a valuable guide to biological assessments entitled, *Rapid Bioassessment Protocols for Use in Streams and Rivers* (EPA/444/4-89-001)

Some municipalities may choose to use receiving water models to assess existing water quality conditions and to simulate future conditions of the water resource under various pollution prevention and control scenarios. These models can also be used to differentiate the impacts of sources from one another, thereby enabling the decision maker to make decisions concerning control options. Receiving water models can also be used to assess the impacts of alternative BMPs. These models receive input from runoff model results, field-measured parameters, and the values of parameters found in the literature. The level of complexity of the receiving water model chosen should parallel that of the model used to assess urban runoff flows and loads. Some commonly used receiving water models include the following:

- The Enhanced Stream Water Quality Model (QUAL2E)
- The Water Quality Analysis Simulation Program (WASP4)
- The Exposure Analysis Modeling System II (EXAMSII).

These models are available from U.S. EPA's Center for Exposure Assessment Modeling, Environmental Research Laboratory, in Athens, Georgia. For further information, refer to *Urban Runoff Pollution Prevention and Control Planning*, EPA, 1993a.

Pollutant Source Assessments

Using the Federal, Regional, State, or local sources discussed above, it can be determined which physical and chemical conditions are threatening the water bodies and/or their designated uses. Previous studies on water quality have indicated that certain pollutants are associated with a discrete number of sources. Some of these sources are more easily controlled at a local level than others. For example, controlling runoff from gas stations can be more practically controlled at the local level than can atmospheric deposition.

This section presupposes that municipalities are already aware, or can gain ready access to, information identifying the pollutants of concern. In still other cases, municipalities may be able to anticipate pollutants that may be of concern in the years ahead based on, for example, a knowledge of growth patterns. The purpose of this section is to help municipalities determine which sources they want to control based on impacts to water bodies. In heavily industrialized watersheds, for example, municipalities may want to control industrial sources by using detention ponds to filter runoff. In residential areas, municipalities may want to focus on non-structural measures, such as public education campaigns encouraging used oil recycling. In choosing a source to focus on, municipalities need to consider pollutant loading estimates for storm water runoff and to calculate such estimates on a sub-watershed basis.

Criteria To Consider

To evaluate which sources should be addressed first, municipalities will want to consider the range of pollutant characteristics and sources, the size of each source, the distance between the source and the receiving water, and the mode of pollutant transport. In keeping with the watershed approach, impacts should not be confined to exceedances of chemical criteria. Rather, flow impacts on the physical regime and biological community structure need also be considered. "High-tech" tools useful in evaluating criteria for assessing pollutant sources include GIS and urban runoff models. However, high-tech technologies are not essential to step 3. Hand-drawn maps and desk top calculators can be just as effective in problem assessment and solution identification. The criteria a municipality would consider when determining which sources to address include an estimate of pollutant loadings from the source and an estimated impact of that source on water quality conditions. Sources can be identified in an incremental fashion by targeting areas of the watershed first, then by further focusing on individual sources or source categories (e.g., large parking lots, service stations) within the sub-watershed. Other important criteria to consider include the use of environmental indicators. The discussion below relates the goals of storm water management programs to the use of environmental indicators to meet the goals.

Environmental Goals and Indicators for Storm Water Management Programs

The "seven-step" planning process for storm water management programs must identify both the overall and project-specific environmental goals for the program. Overall environmental goals include those identified in local watershed strategies, basin-wide plans, local ordinances, community local master plans, and State water quality standards, especially the narrative statements. Project-specific goals include specific actions that will be taken to ensure that the environmental goals will be met. Such specific actions can involve pollutant loadings reductions, bank stabilization, elimination of hydraulic disturbances, increasing the effectiveness of buffers, and other common activities. Environmental indicators are used to measure the progress in meeting the overall environmental goals. Tracking of the completion of the project-specific goals must also be done.

EPA has identified four overall environmental goals and specific objectives for the nation's surface and ground waters (Table 2-2). The two ultimate overall environmental goals are to (1) Protect and Enhance Human Health, and (2) Conserve and Enhance Ecosystems. These goals will be achieved by Improving Ambient Conditions and Reducing Pollutant Loadings (Table 2-2). There are a variety of types of indicators to consider which apply to all water management programs, including storm water, traditional point sources, CSOs, and nonpoint sources. A source to assist municipalities in targeting the use of indicators for specific management actions is the *Guidance for Specifying Management Measures for Sources of Non Point Pollution in Coastal Waters* (EPA 1993b). Despite its title, this document broadly addresses specific actions for all types of storm water management in freshwater.

The following discussion provides a summary of the types of indicators available to meet the overall environmental goals and the specific objectives. We are not suggesting that all of these indicators must be measured. Indicators should be selected based upon the overall and specific goals of the project. For example, if contaminated sediment is not suspected to be a problem, then there is no need to routinely sample for sediment toxicity or chemistry. However, sediment toxicity and chemistry may need to be sampled in the future to help diagnose a problem. The Intergovernmental Task Force for Monitoring Water Quality (1995) recommended a core set of parameters be measured in all water management programs followed by more detailed parameters to meet specific needs. Among those core parameters include basic water chemistry and physical measurements (temperature, pH, nutrients, solids), biological community measurements (benthic macro invertebrates, fish, and/or algae), and physical habitat.

TABLE 2-2. EPA's ENVIRONMENTAL GOALS, OBJECTIVES, AND INDICATORS

Environmental Goal	Objective	Indicator Type
Protect and Enhance Public Health	Safe Drinking Water	Meet Public Water Supply Designated Use
	Safe Aquatic Recreation	Beach Closures
		Meet Swimming and Secondary Contact Designated Uses
	Safe Fish and Shellfish Consumption	Tissue Concentrations
		Fish Advisories
Conserve and Enhance Ecosystems	Biologically Healthy Water Resources	Biological Diversity
		Biological Criteria
Improve Ambient Conditions	Ground Water Protection	Ground Water Quality
	Improved Ambient Pollutant Concentrations	Water Quality Standards
		Selected Parameters
	Reduce Contaminated Sediments	Extent of Contaminated Sediment
	No Net Loss of Wetlands	Loss or Gain of Wetland Acreage
Reduce Pollutant Loadings	Reduce Conventional Pollutant Loadings	Water/Effluent Chemistry
	Reduce Toxic Pollutant Loadings	Water/Effluent Chemistry

Human Health Indicators

Indicators for human health protection are fairly straightforward. These would include the measures used by the State to determine whether the designated use for public water supplies are met, as well as the designated uses for swimming and secondary contact use. These would typically include beach closures, if applicable.

Ecosystem Health Indicators

Determining the biological health, or integrity, of the communities inhabiting the surface waters requires more than just chemical and physical sampling. Even toxicological measures usually only account for a portion of the community effects due to other potential impacts such as habitat degradation, cumulative and synergistic effects of toxicants, and the conventional and other non-toxic pollutants. Two categories of indicators should be examined to measure progress towards meeting this goal: biological diversity and biological criteria or condition. Biological diversity measures usually are limited to determining the presence of threatened/endangered or rare species that may appear on State or Federal lists. Consultation with the State regulatory and natural resource agencies, The Nature Conservancy, and the National Biological Survey should reveal whether any "special status" species have been encountered in the area. Correction of storm water impacts could bridge important gaps in the natural range of special status species and reintroduce them into the management area.

Biological criteria, or condition, is monitored and assessed by most State regulatory, or natural resource, agencies. This process requires the collection of at least two assemblages, such as fish and benthic macro invertebrates (and/or algae) and the results are compared with reference conditions developed by sampling least-impacted conditions within specific ecoregions, or by other means available to State biologists. States are working towards adoption of numeric biological criteria into their State water quality standard similar to that done by the State of Ohio, so measurements of the biological health of the waters should be a standard part of the program.

Ambient Condition Indicators

Improvement of ambient conditions can be measured in a number of ways. Table 2-2 shows the types of pollutants that could be monitored associated with various types of storm water management activities. This table summarizes the information in EPA's coastal zone guidance (EPA 1993b), but for more detailed information not in this text, we encourage you to refer to the original document. The traditional approach for determining the improvement in ambient conditions is to compare the receiving water chemistry with State water quality standards or national criteria. However, this does not provide much information for determining the reduction in the extent of contaminated sediments. Conducting sediment toxicity testing is an effective screening tool for determining whether additional sampling and measurement of sediment chemistry is needed.

Pollutant Loading Indicators

This chapter addresses methods for assessing pollutant sources. It is important to document the reductions in pollutant loadings due to management activities to be sure that these activities resulted in measurable progress towards meeting the ultimate environmental goals. The success or failure of these activities can help us learn more about the effectiveness of best management practices.

Methods for Assessing Pollutant Sources

Once criteria have been developed to evaluate pollutant sources—including consideration of the type, magnitude, and transport mode of the pollutants (existing or potential)—the municipality can assess these sources. Pollutant assessments are frequently aimed at quantifying the source flows and pollutant loads under various conditions. Many municipalities may have already completed this step under their municipal permit application. Described below is one widely used assessment method for pollutants source.

Source Determination and Data Evaluation

Urban runoff pollution sources can be defined by completing a comprehensive watershed description that includes the following: the type(s) of pollution affecting a water resource, the pollutant transport mechanisms, the characteristics of drainage patterns and drainage structures, and the land uses in the program area. (Refer to Chapter 1 and the EPA Part 2 NPDES Guidance Manual.)

Those activities or land uses within a watershed that are causing pollution problems need to be identified. Both point source and nonpoint source discharges should be considered. Pollutant types found in the watershed can provide some clues regarding the source(s) of the problems. To isolate sources of pollution, it is helpful to divide the watershed into smaller areas so that individual pollution sources can be identified. Depending on the size of the watershed, a drainage basin can first be divided into subbasins. If necessary, subbasins can then be divided into individual tributaries, pipe systems, or drainage channels. Table 2-3 lists pollutant types typically associated with certain activities or land uses. This information can be used to identify potential sources. Problem sources can also be identified according to water resource conditions, such as eutrophication of a water body resulting from excessive nutrients, or closures of shellfish beds because of high concentrations of bacteria. In addition, sediments from aquatic systems and storm sewers can provide useful information for tracing and identifying potential sources.

Computer modeling is valuable in estimation the flows and loads of pollutant sources needed for pollution source assessments. Available models range from simple screening tools to numerical models with varying levels of complexity based on the number of processes incorporated and the level of detail provided. The level of application of a given model may also vary depending on the objectives of the analysis and available resources. Municipalities must keep in mind that modeling can be quite expensive and should only be used when the potential benefits justify their use.

In addition to the magnitude of a pollutant load and the location of a pollution source with respect to its receiving waters, the mode of transport to the receiving water and the degradation of the pollutant should also be considered. Sources with a clear path to a waterway, such as pipes, ditches, and gullies, often cause more adverse effects in a receiving water than similar sources that must travel through natural filters, such as forested or grassy areas, before entering a surface water body. Changes in loads, from the initial source discharge to the point where they affect the receptor, occur because of such factors as travel time, dilution, pollutant availability, and decay. The fate and transport of pollutants can be modeled using hydrologic and pollutant buildup-washoff models that account for these factors. The more simple modeling methods (i.e., unit load or statistical) can only empirically estimate these factors, and, thus, the level of uncertainty and error is likely to be higher.

TABLE 2-3. TYPES OF ACTIVITIES AND ASSOCIATED POLLUTANTS

Categories and Subcategories	Nutrients	pH	Sediment	Organic Enrichment	Bacteria	Toxic Organics	Toxic Metals	Oil and Grease	Salts (TDS)	Hydrologic Alterations	Thermal Alterations	Pesticides
Agriculture												
Cropland	✓		✓		✓							✓
Pasture Land Animal Holding Areas Animal Waste Storage Areas	✓		✓	✓	✓							
Hayland	✓			✓	✓							✓
Wash & Processing Water	✓	✓	✓	✓	✓			✓				✓
Waste Application Areas	✓		✓	✓	✓		✓					
Construction												
Highways, Bridges, Roads	✓		✓		✓	✓		✓	✓	✓	✓	✓
Land Development	✓		✓		✓			✓		✓	✓	
Urban Land												
Storm Water Sewers, Combined Sewers, Surface Runoff-Pavement	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
Surface Runoff Turf Areas	✓		✓		✓					✓		✓
Infiltration Wells & Basins	✓				✓	✓	✓	✓	✓	✓		
Land Disposal												
Wastes-Sludge-Septage	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
Landfills	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
In-Situ Wastewater System	✓				✓	✓	✓	✓				✓
Hazardous Waste Areas	✓	✓			✓	✓	✓	✓	✓			✓

TABLE 2-3. TYPES ‹ ‹IVITIES AND ASSOCIATED POLLUTANTS (Continued)

Categories and Subcategories	Nutrients	pH	Sediment	Organic Enrichment	Bacteria	Toxic Organics	Toxic Metals	Oil and Grease	Salts (TDS)	Hydrologic Alterations	Thermal Alterations	Pesticides
Hydrologic Modifications												
Earth Fills, Channelization			✓							✓	✓	
Dam Construction/ Reconstruction	✓	✓	✓	✓						✓	✓	
Other Sources												
Atmospheric Deposition	✓	✓				✓	✓					✓
Underground Storage Tank Leaks						✓	✓	✓				✓
Illegal Disposals/ Dumping Release of Contaminants from in-place deposits	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
Highway/Bridge Maintenance	✓		✓			✓	✓	✓	✓			✓
Auto Salvage			✓			✓	✓	✓				
Washing & Processing Areas	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Snow Dumping Areas	✓		✓	✓	✓	✓	✓	✓	✓			
Utility R O W S			✓							✓	✓	✓
Surface Runoff from Gasoline Station						✓	✓	✓				
In-place sediments	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
Sewer System Leaks, Domestic	✓			✓	✓	✓	✓					
Wild Birds and Mammals	✓			✓	✓	✓	✓					
Natural Vegetation (Leaves, Fallen Trees)	✓	✓	✓	✓						✓		
Marinas & Boat Moorings, Boat Maintenance & Boat Washing	✓		✓	✓	✓	✓	✓	✓				

Source Morehouse 1988

Models available for urban runoff assessments vary widely in their levels of complexity, ranging from simple estimation techniques to sophisticated and expensive computer models. Simple methods are compilations of expert judgement and empirical relationships between physiological characteristics of the watershed and pollutant export that can be solved by a spreadsheet program or hand-held calculator. These methods are often used when data limitations, budget, and time constraints preclude the use of more detailed models. Simple models frequently include information on land use, percent impervious factors, runoff coefficients, size of the drainage area, pollutant loading values, and rainfall data. The Federal Highway Administration (FHWA) has made great strides in researching pollutant loadings from highway storm water discharges. FHWA has a number of models and statistical methods that municipalities may find useful in determining the benefits and impacts of various pollution prevention alternatives.

Mid-range models, on the other hand, attempt to compromise between the empiricism of the simpler methods and the complexity of detailed models. Detailed models use storm event or continuous simulation to develop historic time series of storm water runoff and pollutant loadings and concentrations. These models often consider, among other factors, soil type and percent imperviousness factors. To select the model that will best achieve the project objectives, analysts need to consider the available required input data, watershed pollutant characteristics, and time and resources available (*Compendium of Watershed-Scale Models for TMDL Development*, June 1992b).

Several models are available from EPA's Center for Exposure Assessment Modeling in Athens, GA. For more detailed information on urban and nonurban models, refer to the following publications:

- U.S. EPA, Office of Water. *Compendium of Watershed-Scale Models for TMDL Development*. EPA841-R-92-002. June 1992.
- U.S. EPA, Office of Research and Development. *Urban Runoff Pollution Prevention Planning and Development*. EPA/625/R-93/004. March 1993.
- U.S. EPA. *Guide to Nonpoint Source Pollution Control*. 1987b.

Example Models

The following discussion highlights a number of commonly used methods and focuses on models used to predict pollution characteristics in an urban environment. The methods include constant concentration or unit load estimates, preliminary screening procedure, statistical method, rating curve or regression approaches, and hydrologic and pollutant buildup-washoff models.

Constant Event Mean Concentration or Unit Load Estimates

Constant event mean concentrations or unit pollutant loads can be used to estimate pollutant source loads. They can be obtained from available data or estimated according to the types and sizes of land uses in the watershed. Constant event mean concentrations can be coupled with runoff volume estimates to calculate runoff loads or can be used in hydrologic models to calculate time variable flows and loads. Freeman (1995), for example, estimated pollutant loads by using rating curve relationships (including runoff volume), event mean concentrations, and loading/washoff parameters for specific watersheds, land uses, and time of the years. The constant event mean concentration or unit load method is easy to use and can be helpful in identifying which areas within a watershed contribute the largest pollutant loads. Constant event mean concentrations or unit loads can also be estimated using a spreadsheet. Where local resources allow, these calculations can be facilitated using a GIS to keep track of such information as pollutant concentrations from different sources, land use or source boundaries, and quantities of flow produced in individual

Where actual measurements are not available, input data can be taken from the literature. For example, the U.S. EPA's Nationwide Urban Runoff Program provides a comprehensive study of storm water runoff from residential, commercial, and light industrial areas throughout the United States and contains a large data base of pollutant concentrations and loads measured during various storm events from 1978 through 1983 (U.S. EPA, *Results of the Nationwide Urban Runoff Program*, 1983). The Metropolitan Washington Council of Governments has published a manual entitled *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs* (1987). It recommends a simple method for calculating pollutant export from urban development sites. Included in this manual are recommended concentration values for phosphorus, nitrogen, COD, BOD_5, lead, zinc, and copper from new suburban sites, older urban areas, and a central business district.

Other data bases of storm water pollutant concentrations and loads include Driver and Tasker (1990), Tasker and Driver (1988). These data can be used as inputs to source load estimation techniques, such as the constant concentration or unit load method.

Preliminary Screening Procedure

Simple equations can be used to estimate annual average loading contributions of urban runoff for BOD, suspended solids, volatile solids, total phosphate phosphorus, and total nitrogen. Pollutant loadings can be estimated based on the relative contribution of pollutants from each land use; however, the equations are not location-specific and are only useful for screening purposes.

Statistical Method

The statistical method of modeling urban runoff assumes that event mean concentrations (EMC) are distributed log-normally and characterizes EMCs by their median values and their coefficients of variation. The U.S. EPA's statistical method (Driscoll et al., 1989) includes statistical properties of rainfall, area, runoff coefficients, median EMCs, and coefficients of variation of EMCs of various pollutants. The FHWA has implemented U.S. EPA's statistical method at various locations in the United States (Driscoll et al., 1989, and Woodward-Clyde Consultants, 1990)

Regression-Rating Curve Approaches

Rating curve or regression models, such as the 31 storm-runoff-load models developed by the USGS for metropolitan areas throughout the United States (Driver and Tasker, 1990, and Tasker and Driver, 1988), use site-specific rainfall, runoff, and water quality data, such as the data collected for U.S. EPA's Nationwide Urban Runoff Program and similar studies, to relate concentrations and loads of pollutants to flow rates and volumes (see Driver and Tasker, 1990).

Hydrologic and Pollutant Buildup-Washoff Models

Hydrologic and pollutant buildup-washoff models address the accumulation of pollutants during dry-weather periods and runoff of these pollutants during rainfall events. Of the many models available, some of the more widely used models that use a buildup-washoff mechanism include:

- Hydrological Simulation Program-Fortran (HSPF) (U.S. EPA, 1982); also described in (U.S. EPA 1991)

- Storm Water Management Model (SWMM) (U.S. EPA, 1988); also described in (U.S. EPA 1993)
- Source Loading and Management Model (SLAMM) (Pitt, 1989).

Institutional Assessments

In ranking urban runoff related problems, it is also essential to assess institutional constraints/capabilities for the regulators, owners, and the public.

Criteria To Consider

To assess institutional constraints/capabilities, municipalities may want to consider the following: applicable regulations, preferences of the local authorities and regulatory agencies, funding sources and limitations, multi-agency responsibilities and overlaps, and public acceptance of the program. The criteria a municipality would consider when considering which sources to target or which receiving waters to address include:

- Potential for solving the identified problem
- Degree to which existing resources, technology, or (municipal, State, Federal) programs could be used
- Potential for adverse effects due to a particular action
- Willingness of municipal agencies to take steps (use their tools and resources) to help address this problem
- Potential for combined action (involving government agencies, citizens, interest groups, or nongovernmental organizations) in conducting storm water management activities
- Extent to which there are existing programs/activities to support measures required under the SWMP
- Implementability of controls in a particular area
- Level of public support for a) protecting a given resource, b) developing a particular program measure, or c) funding recommended controls
- Availability of funds to undertake a particular project
- Extent to which regulatory/permit requirements are satisfied.

Methods for Assessing Institutional Constraints/Capabilities

The institutional issues of a program are assessed by evaluating the program's potential and limitations and by reviewing the requirements of involved agencies and the public. One major institutional issue that must be addressed by an urban runoff program is determining the responsibilities of each involved party. This is especially true for programs involving *multiple* agencies. Interviews and meetings with all interested parties can be conducted to help

develop institutional criteria. Questionnaires can be prepared and distributed to help identify concerns. Complaints, either filed with local authorities or available through public interaction programs, can help develop urban runoff pollution prevention and control programs to be implemented later.

Issues related to the control of the program, such as enforcement, permitting, maintenance, and funding, can affect the program's emphasis and the selection of its corrective measures. For permitting and enforcement, the storm water permit program is a two-phase program under section 402 (p) of CWA,1987 Under Phase I of the National Pollutant Discharge Elimination System (NPDES) program, EPA published a permit application regulation on November 16, 1990, establishing permit application requirements for municipal separate sewers serving large or medium-sized populations (greater than 250000 or 100000 people, respectively) and for storm water discharges associated with industrial activity. Under Phase II, EPA prepared two reports to assess remaining storm water discharges; determine the nature and extent of pollutants in such discharges; and establish procedures and methods to control the storm water discharges. Then, EPA issued regulations that designated storm water discharges, in addition to those described in Phase I, to be regulated to protect water quality and established a program to regulate those designated sources.

Maintenance of storm water management facilities is an important part of storm water management programs. Effective long term performance of a storm water management practice relies heavily on its routine inspection and adequate maintenance. For examples, greater 50 % of infiltration trenches fail after five years due to poor maintenance and clogging of the trenches, and dry detentions lose their flood control and removal abilities due to excessive weed growth and debris accumulation (Yu 1993 and Botts et al. 1996). These BMPs will perform better if pretreatment devices and routine cleaning are conducted.

Financing a storm water management plan is a challenge for local governments. The U.S. EPA's Environment Financial Advisory Board (EFAB) and Environmental Financial Network (EFIN) are available sources for creating a financing strategy for implementing comprehensive conservation and management plans (Henkin and Mayer 1996). The U.S. EPA State Resolving Fund provides loans to local governments for financing surface water related infrastructure projects with 0 % interest rate and could cover 100 % of eligible costs (Singelis 1996). In New Jersey, funding for CSO projects is provided through a grants and low-interest construction loan program jointly administered by the New Jersey Department of Environmental Protection and the New Jersey Wastewater Treatment Trust (Binder 1996).

Another institutional issue involves the limitations of available technology. Implementability of controls may also be considered, particularly in areas involving limited access to private properties. In addition, the potential for eliminating or reducing an urban runoff problem or improving affected water resources can be considered. Public questions and concerns can be influential during the decision-making processes. Applicable regulations and permit conditions may force the sequencing of corrective measures so that those addressing compliance with the regulations or permit conditions are implemented first.

Goals and Objectives Assessments

Finally, municipalities should evaluate storm water runoff problems with respect to current and future goals.

Criteria To Consider

Municipalities will generally want to focus on those problems where preventive or corrective measures would provide the greatest benefit. One goal, for example, might be to increase the use of public beaches by decreasing bacteria counts and aesthetic nuisances associated with storm water events. Application of goals and objectives criteria could identify where corrective measures would provide the greatest benefit, perhaps at beaches only slightly degraded and needing only minimal cleanup before they are restored, or at beaches in heavily populated areas where many people could benefit from restoration of the water body. Criteria a municipality may consider when considering which sources to target or which receiving waters to address include:

- Potential for achieving water resource goals as described in the water quality standard
- Potential for realizing short-term benefits, thereby building good will and commitment to long-term objectives
- Consistency with other land use objectives
- Consistency with programmatic goals of SWMP
- Opportunity to maximize efforts by coordinating activities with other agencies

Methods for Assessing Attainment of Goals and Objectives

The relative importance of an urban runoff problem may be assessed by comparing that problem to the program's water resource and technology-based goals and objectives. By considering pollution problems in connection with the program's goals and objectives, the program team can identify and focus on the urban runoff problems most important in attaining the overall aims of the program. The assessments conducted on pollutant sources, water resources, and institutional aspects provide input to these determinations.

How to Rank Storm Water Runoff Problems

Municipal storm water pollution problems can be numerous, and funding to correct these problems is usually limited. It is desirable, therefore, that a priority list of sources or impacts be developed to allow for targeting of limited resources. Ranking is a subjective process that requires the judgement of decision-makers. A ranking methodology can range from simple, descriptive methods (qualitative) to numerically complex (quantitative) methods, depending on the requirements of the urban runoff program objectives and the constraints of program funding. Ranking methods can be applied to a variety of geographic areas, ranging from counties or communities with multiple watersheds or individual water bodies or pollution sources.

A ranking methodology is developed for a specific study area to encourage a phased approach and to ensure the optimal allocation of available resources. Several methodologies can be used to rank pollution problems for control, depending on the complexity of the watershed, water resources, and their problems.

Criteria such as those presented in Table 2-1 can be used in problem ranking. Ranking should be conducted following consultation with involved parties, including local, State, and Federal agencies, local environmental groups, and concerned citizens.

Qualitative Rankings

The simplest approach is to use qualitative rankings, such as high, moderate, or low, to prioritize pollution problems. Table 2-4 provides an example of such a ranking system. The assigned ratings must then be interpreted to determine which areas should receive the highest priority as appropriate controls are developed. The use of rating points or categories can allow all the criteria to be evaluated on an equivalent basis. For each problem, the ranking criteria can be assigned relative ratings of 1 to 10, with a higher rating indicating a higher priority. In Table 2-4, the criteria used to gauge which area should receive highest priority for storm water management include imperviousness of the site, land use, runoff coefficient, annual runoff volume.

Quantitative Rankings

To perform numerical ranking, a rating is assigned to each ranking criterion for each problem. The assigned ranking for a criterion can then be multiplied by its relative weight for each pollution problem. All of the products (Criterion Ranking × Relative Weight) should be summed for a given problem. This procedure is then repeated for all problems being evaluated. The sums thus assigned should be compared, and the problems with the highest sums should receive the highest priority during implementation of urban runoff controls. An example of numerical ranking is given on page 2-23.

An important point for municipalities to consider when using the rankings is that the ultimate goal is to address their specific water quality problems. For example, in a given municipality, stream bank erosion from high intermittent flows may be a more serious problem than eutrophication from high nutrient input. In this case, the municipality would weigh runoff volume control heavier than nutrient removal in runoff.

STEP 4: SCREEN, RANK, AND SELECT CONTROLS

Once particular waterbodies and sources have been targeted for action (based on the criteria discussed in Step 3), the municipality's task is to determine the most cost-effective solutions to solve the identified problems. In addition, local communities can also respond to individual symptoms of deterioration in urban watersheds and waterbodies by the increased impervious areas of new development. A report from Metropolitan Washington Council of Governments (Schueler 1994), which summarized a twelve-step process to design, implement, and maintain the best system of practices and land uses for stream protection, could be a good reference for development review on effective local stream protection. The following section discusses the tools needed to prioritize and rank solutions or control measures in relationship to program goals.

TABLE 2-4. ESTIMATED NONPOINT SOURCE LOADINGS USING CONSTANT CONCENTRATIONS

Source Area	Description and Location	Area (acres)	% Impervious	Land Use	Runoff Coeff.	Annual Runoff Volume (MG)	Annual FCOL Loading org x 10^{12} (rank)	Annual NO_3-N Loading lbs (rank)	Qualitative Ranking
A	Main St and Freeport Outlet Stores	3 3	85	Commercial[a]	0 73	2 7	1 7 (12)	14 (11)	Low
B	Commercial development at I-95 Interchange, Main St, and Pine St	30 6	50	Commercial	0 45	15 7	9 8 (1)	82 (1)	High
C	A portion of Freeport Crossing Outlets, Main St, Varney Rd, and Kar Klean	13 9	60	Commercial	0 61	9 7	6 0 (3)	51 (4)	High
D	Main St, Varney Rd, a portion of Linwood Rd, and adjacent residential development	21 0	10	Multifamily Residential	0 13	3 1	2 0 (10)	24 (8)	Low
E1	South LL Bean parking lot	6 5	85	Industrial	0 73	5 4	2 8 (7)	28 (7)	Medium
E2	Northern LL Bean parking lot	5 5	80	Industrial	0 69	4 3	2 2 (8)	23 (9)	Medium
F	Independence Way, Eastland Shoe warehouse, Horsefeathers Restaurant, and Main St	14 1	20	Commercial	0 21	3 4	2 1 (9)	18 (10)	Low
G	Somerset Condominiums, Summer St, Upper West St, and Freeport Place Condominiums	38.0	20	Single[b] and Multifamily Residential	0 21	9 1	5.9 (4)	73 (3)	High
H	Municipal Garage, Main St, and town office parking lot	15.0	60	Industrial Commercial	0 53	9 1	4.7 (5)	48 (5)	High
I	Downtown Village area along Main St, between Morse and West St, including Oak	19.2	75	Commercial	0 65	14 2	8.8 (2)	75 (2)	High

Source: Metcalf & Eddy, 1992

[a] FCOL Conc. = 16,000 org/100 ml, NO_3-N Conc. = 0.63 mg/l
[b] FCOL Conc. = 17,000 org/100 ml, NO_3-N Conc. = 0.96 mg/l
[c] FCOL Conc. = 14,000 org/100 ml, NO_3-N Conc. = 0.63 mg/l
[d] FCOL Conc. = 37,000 org/100 ml, NO_3-N Conc. = 0.96 mg/l

EXAMPLE: NUMERICAL RANKING SYSTEM

The following is an example of a numerical ranking system for prioritizing pollution sources. A hypothetical application of this weighted ranking methodology uses the following criteria: water body importance (as reflected by stream or lake size), type of use (ranging from urban drainage to recreational contact), status of use (impaired versus denied), level of use (low, moderate, or high), pollutant loads (not actual loads but estimates for comparative purposes), and implementability of controls (based on institutional factors, existing ordinances, or technical considerations). The criteria used for this example are similar to those identified in Table 2-1. Other criteria may be just as valid. The relative importance of the ranking criteria is designated by assigning each criterion a weight appropriate for the site-specific conditions of the watershed under consideration. The sum of all weights used to rank the problems equal 100. Next, for each problem, the criteria are ranked using a suggested range of 1 to 9, with a higher numerical ranking indicating a higher need for corrective action. This listing allows relative comparisons to be made among problems with respect to a single criterion.

This numerical ranking method for prioritizing pollution problems is illustrated in the hypothetical urban watershed (below) which consists of three streams and several types of land use (Figure 2-1). Information describing the system is presented in Tables 2-5 and 2-6. Typical sources for these data include site-specific pollutant loading data, model results, and literature values from such projects as the NURP study. For this example, the three "use" criteria are clustered together as subcriteria of a "beneficial use" criterion. There are, thus, four prioritization criteria of equal weight: stream size, beneficial use, pollutant load, and ability to implement (Table 2-7).

Ranking for "stream size" is determined according to the total drainage area of each of the three streams. Consistent with the goals for the hypothetical watershed, Stream C is ranked highest with respect to "type of use" because of its recreational uses in the city park, Stream B receives the lowest ranking because it is used mainly as an urban drain, and Stream A is ranked between the other two streams because it is used to support aquatic life. With respect to "status of use," Stream A ranks highest because although somewhat impaired, it has the potential to be improved by control of pollution sources. Stream B receives a low ranking for use status because its water quality is poor and its function as part of an urban drainage system has long been accepted. Stream C also receives a low ranking for use status since the water is of high quality. Rankings for "level of use" reflect the number of people using or affected by each stream.

Mass pollutant loadings are calculated based on runoff coefficients (functions of the amount of impervious area), runoff concentrations of pollutants, and the amount of land use type in each stream's drainage area. Each stream is ranked based on the proportion of pollutant load from its watershed (in this example, total suspended solids is used). The watershed of Stream B is judged to be easiest to implement controls because it is predominantly industrial. Based on the method presented in this example, the watershed of Stream C should receive priority during implementation of controls, followed by the watershed of Stream A and then that of Stream B.

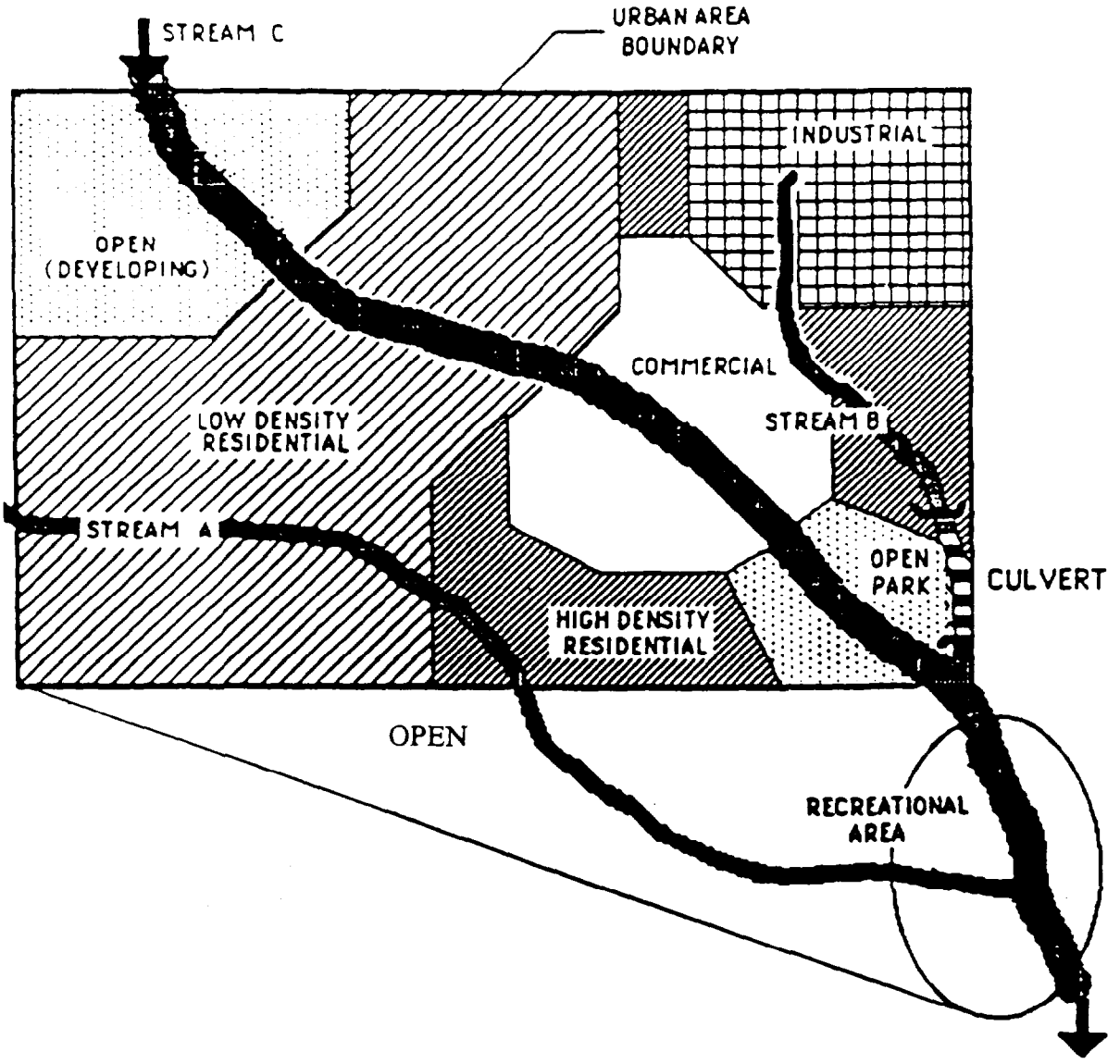


Figure 2-1. SCHEMATIC REPRESENTATION OF WATERSHED

TABLE 2-5. CHARACTERISTICS OF THE TARGETED AREAS AND ESTIMATED CONCENTRATION LOADS

Land Use Category	Runoff Coefficient	Average Concentration in Runoff (mg/l)				Drainage Area (acres)			
		Total Suspended Solids	Oil and Grease	Total Phosphorus	Copper	Stream A	Stream B	Stream C	Urban Total
Industrial	0.6	120	20	0.20	0.05	0	150	0	150
Commercial	0.8	80	15	0.20	0.05	10	80	110	200
Residential (High Density)	0.4	90	10	0.40	0.04	100	100	50	250
Residential (Low Density)	0.2	100	5	0.60	0.03	200	0	200	400
Open - Developing	0.1	150	0	0.80	0.01	0	0	150	150
Open - Urban Park	0.1	50	0	0.80	0.01	0	0	50	50
Total Urban Area						310	330	580	1,200
Upstream Drainage Area						600	0	20,000	20,600
Total Drainage Area						910	330	20,560	21,800

Source Woodward & Clyde, 1990

TABLE 2-6. ESTIMATED TOTAL SUSPENDED SOLID LOADS FOR TARGETED AREAS

Land Use Category	Total Suspended Solids Load (lbs per inch of rain)			
	Stream A	Stream B	Stream C	Urban Total
Industrial	0	150	0	2,452
Commercial	10	80	1,598	2,906
Residential (High Density)	100	100	409	2,043
Residential (Low Density)	200	0	908	1,816
Open - Developing	0	0	511	511
Open - Urban Park	0	0	57	57
Watershed Total	1,870	4,431	3,482	9,784
Watershed Rank Value	1.7	4.1	3.2	9.0

Source Woodward & Clyde, 1990

TABLE 2-7. PRIORITIZATION ANALYSIS FOR URBAN AREA TARGETING

Urban Watershed	Stream Size	Beneficial Use			Pollutant Load (TSS)	Ability to Implement	Target Score
		Type	Status	Level			
Weights	25	10	10	5	25	25	100
Watershed A	4	5	7	4	1.7	5	4.08
Watershed B	2	2	2	1	4.1	7	3.73
Watershed C	8	8	2	6	3.2	3	4.85
Total Urban Watershed	8	8	5	8	9.0	2	6.45

Target Score = Weighted Average of Rank Points = Sum(Rank Score * Weight)/Sum(Weights)
TSS: Total Suspended Solids

Source: Woodward & Clyde, 1990

Selecting BMPs for preventing and controlling storm water runoff pollution is a two-step process. First, a comprehensive list of BMPs should be compiled and screened to eliminate those that are inappropriate for the program. The appropriate BMPs are then assessed to select those that will ultimately be implemented in the SWMP.

The construction of facilities to collect and treat urban runoff may be prohibitively expensive. Therefore, the emphasis of storm water pollution control should be on developing a cost-effective approach that includes nonstructural controls and low-cost structural controls. Nonstructural controls include both regulatory controls (e.g., pollution prevention measures and land use controls) and source controls (e.g., controls that reduce pollutant buildup or lessen its availability for wash-off during rainfall). Low-cost structural controls include the use of facilities that reduce the kinetic energy associated with storm water, control hydraulic and flow distribution over the system, and remove coarse particulates. Dissolved pollutants and colloids then are further reduced by filtration, infiltration, plant uptake, a biotic function, or biodegradation. Given below is a list of the types of controls and BMPs available to municipalities for managing their storm water runoff (discussed in detail in Chapter 7).

EXAMPLES OF SOURCE CONTROL AND TREATMENT BMPs
Regulatory Controls • Land use regulations • Comprehensive runoff control regulations • Land acquisition
Source Controls • New development controls • Illicit discharge controls • Materials management controls (fertilizers, chemical storage and use) Street storm sewer maintenance controls pill prevention and cleanup iblic education/pollution prevention
Treatment Controls • Detention facilities • Infiltration practices • Vegetative practices • Filtration practices • Water quality inlets • Retrofitting existing flood control facilities

How to Screen BMPs

The goal of the BMP screening process is to reduce the list of BMPs to a more manageable number to be considered for implementation. Because this is an initial step, the methods used are generally qualitative and require that good engineering judgement be exercised.

For the purposes of screening, BMPs are divided into two general categories: structural and nonstructural. Structural BMPs, such as detention ponds and infiltration practices, are designed to address specific pollutants from known sources. In contrast, nonstructural BMPs, which include regulatory practices (such as those that limit impervious areas or protect natural resources) and source controls (such as street sweeping or solid waste management) are typically implemented throughout an entire community, watershed, or special area to be protected. Municipal storm water management programs will in most cases, rely on a combination of both structural and nonstructural practices. Methods for screening these two types of BMPs are outlined below. Chapters 5 and 6 present detailed guidance on implementing structural and nonstructural BMPs.

Nonstructural Practices

Nonstructural BMPs are a good solution when limited funds are available. In addition, these BMPs can perform an auxiliary role to a structural BMP. Many low-cost techniques can lead to significant improvements in water quality. Urban storm water management programs typically include a number of nonstructural BMPs. For example, an urban runoff management plan for the Santa Clara Valley identified more than 100 separate potential nonstructural BMPs used throughout the county (Woodward-Clyde, 1990-1992). To reduce the large number of available BMPs, municipalities must screen these regulatory and source control BMPs for their appropriateness to the watershed. The case study at the end of Chapter 2 discusses the Santa Clara Valley program and the BMP screening and selection method.

One screening method involves applying screening criteria to each nonstructural practice to determine its applicability to the conditions in the watershed. The screening criteria will be specific to the watershed and will depend on the goals of the program. Typical criteria include:

- Pollutant Removal: Different regulations and source control practices are designed to address different pollutants and, therefore, the program team should ensure that the screened list of controls includes those practices designed to address the pollutants of primary concern. Certain source control measures (e.g., development of a public information program) may not be measured in terms of reduction in pollutants loads. Therefore, municipalities may want to use alternate measures, such as the level of public participation in recycling programs or the number of community outreach activities completed.

- Existing Government Structure: Some practices implemented throughout the country require a specific government structure. For example, a strong county government may be important for implementing a specific regulatory control. However, the role of county governments can vary from one section of the country to another. Practices requiring specific government structures that do not exist in the area of concern could, therefore, be eliminated from the list.

- Legal Authority: For regulatory controls to be effective, municipalities must have the legal authority to implement and enforce regulations. Municipal boards and officials may lack this authority and may be required to obtain it through local action.

- Public or Municipal Acceptance: It may be difficult to implement some practices because of resistance from the public or an involved municipal agency. An improved communications strategy or other appropriate measures may improve the perception of these practices.

- Technical Feasibility: Some of the municipal BMPs described may require large expenditures, extensive efforts, and long-term operation and maintenance costs. Therefore, they may not be suitable for implementation in small municipalities that lack the required resources.

Additional screening criteria may also be used, as shown in the Santa Clara Valley case study at the end of Chapter 2. Another method of screening involves the use of a comparative summary matrix, an example of which is presented in Figure 2-2 (EPA 1993b). This matrix was developed for screening nonstructural control practices in coastal areas; however, it is at least in part applicable to inland areas as well. In this matrix, various regulatory and source control practices are listed and compared for their ability to meet various criteria. The criteria listed generally include ability to remove specific pollutants, such as nutrients and sediments, maintenance requirement, longevity, community acceptance, secondary environmental impacts, costs, and site requirements. Other criteria are also listed, and some of these are only applicable in coastal areas. For each practice and criterion, an assessment of effectiveness is indicated,

with the solid circle indicating high effectiveness and the open circles indicating low effectiveness. This type of matrix may provide a basis for making an initial assessment of practices and their applicability to the program.

Structural Practices

Because structural practices generally are more site-specific and have more restrictions on their use than nonstructural practices, the initial screening step for these practices can be more precise than the initial screening step for nonstructural practices. Table 2-8 outlines some of the more important criteria for screening structural BMPs, including their pollutant removal efficiencies, land requirements, the drainage area that each BMP can effectively treat, the desired soil conditions (e.g., soils favorable for infiltration), ground water elevation, and costs. By using these criteria and the information obtained in the data collection and analysis and problem identification and ranking steps, the program team can narrow the choice of BMPs to a list that can be further assessed in the BMP selection step.

The initial screening criteria for structural practices include the following:

- Pollutant Removal: It is important for the municipality to ensure that the BMPs selected address the primary pollutants of concern to the level of removal desired.

- Land Requirements: Large land requirements for some of the above-ground structural BMPs can often restrict their use in highly developed urban areas.

- Soil Characteristics: Structural BMPs have differing requirements for soil conditions. Infiltration facilities generally require permeable soils, while detention BMPs generally require impermeable soils. The municipality must become familiar with soil conditions in the watershed. A good source of information on local soil information is the United States Department of Agriculture (USDA-NCRS).

- Ground Water Elevation: The ground water elevation in the watershed can be a limiting factor in siting and implementing structural BMPs. Generally, high ground water elevation can restrict the use of infiltration facilities.

- Public Acceptance: It may be difficult for a municipality to implement a structural BMP that meets with general public approval. Public acceptance of the BMP is an important consideration in the screening step.

- Technical Feasibility: Some of the municipal BMPs described may require large expenditures, extensive efforts, and long-term operation and maintenance costs. Therefore, they may not be suitable for implementation in small municipalities that lack the required resources.

Of the screening criteria listed, the pollutant removal, land requirements, and drainage area served are usually absolute restrictions. Soil condition and ground water elevation, on the other hand, impose restrictions that can potentially be overcome by importing needed soil or constructing facilities with clay liners to restrict ground water inflow. These modifications, however, can add significantly to BMP costs.

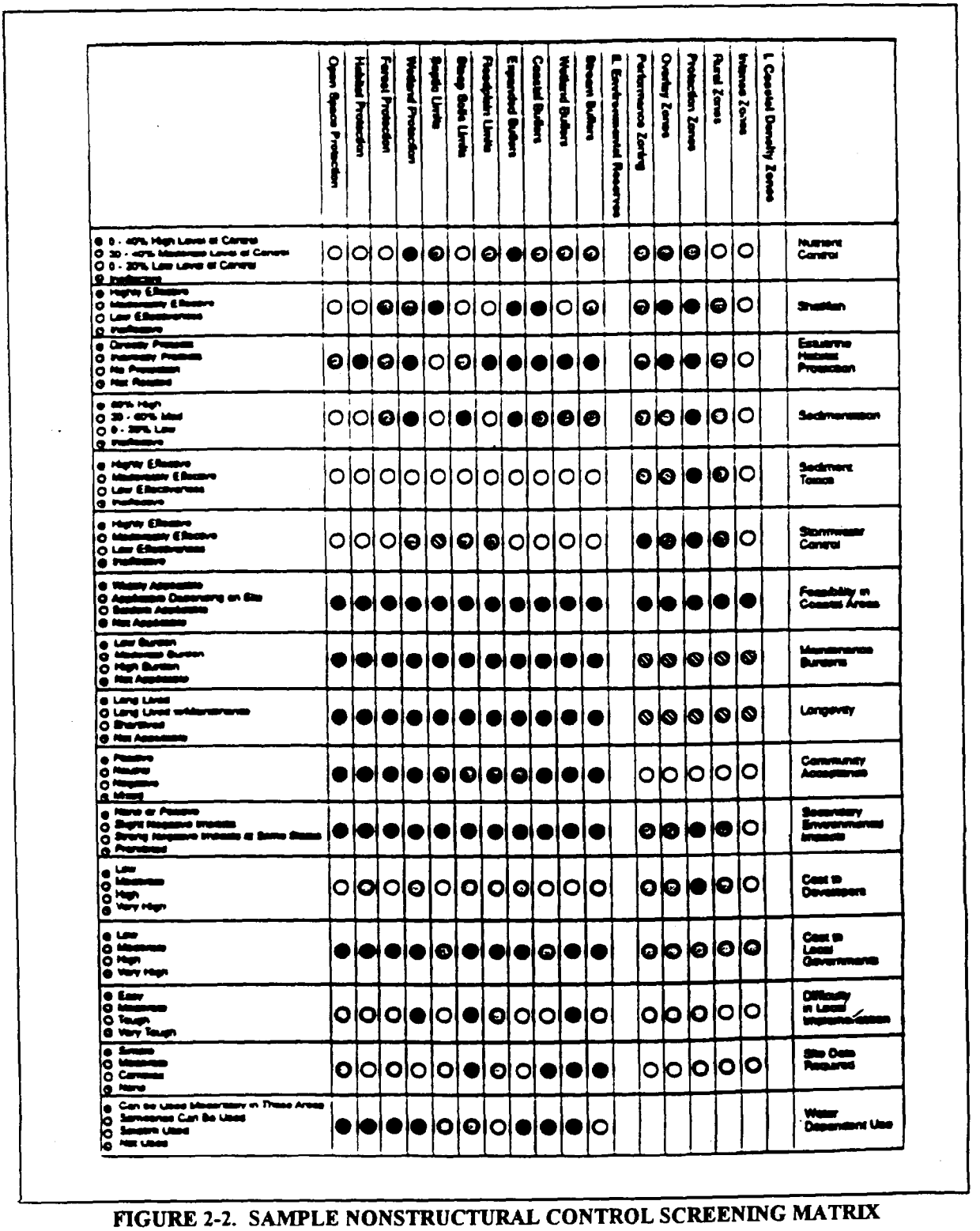


FIGURE 2-2. SAMPLE NONSTRUCTURAL CONTROL SCREENING MATRIX

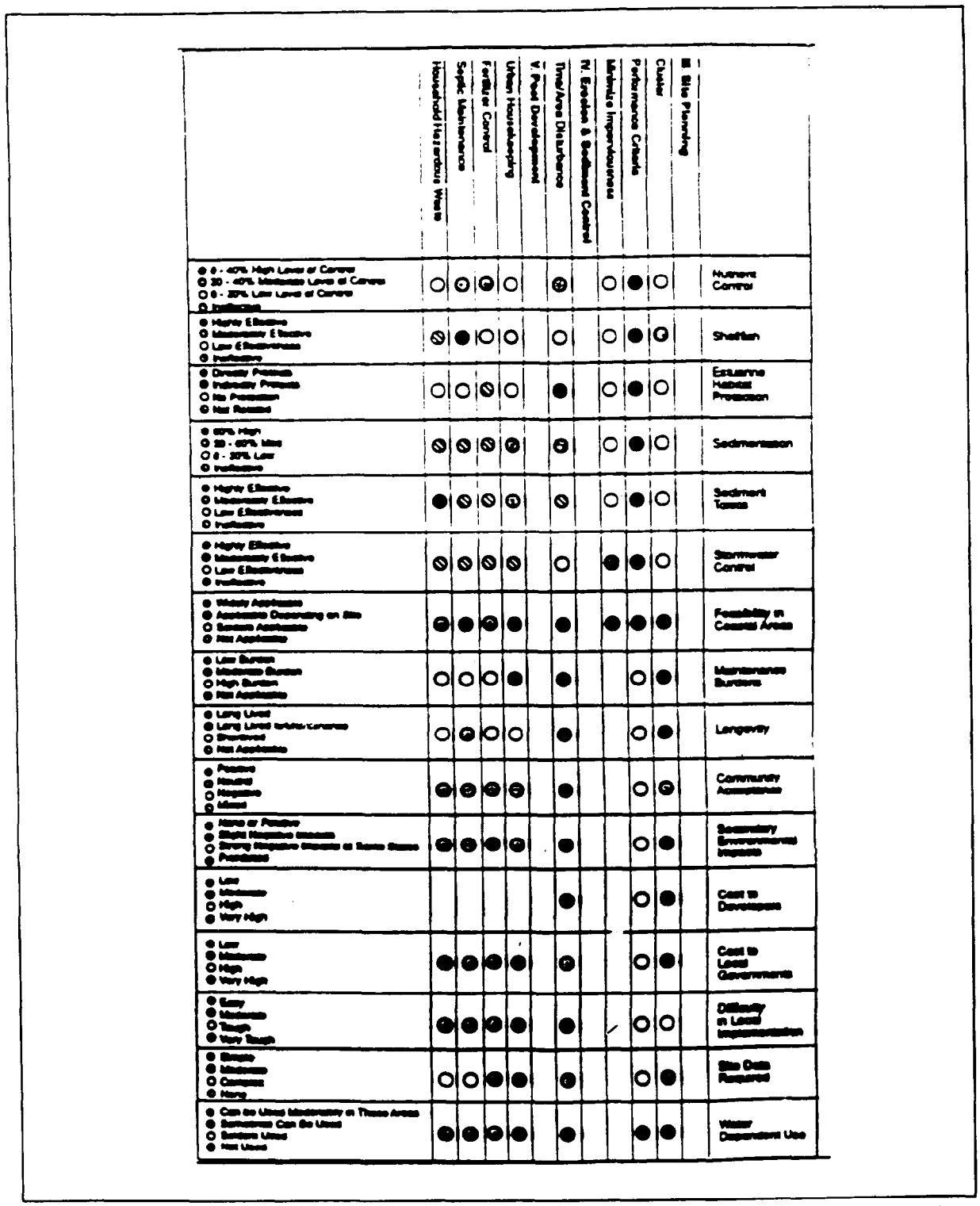


FIGURE 2-2. SAMPLE NONSTRUCTURAL CONTROL SCREENING MATRIX (Continued)

TABLE 2-8. STRUCTURAL BMP INITIAL SCREENING CRITERIA

Structural BMPs	Pollutant Removal (1)					Land Requirements	Drainage Area (2)	Desired Soil Conditions	Ground Water Elevation
	Suspended Solids	Nitrogen	Phosphorus	Pathogens	Metals				
Detention Facilities									
Extended Detention Basins	Medium-High	Low-Medium	Low-Medium	--	Low-Medium	Large	Medium-Large	Permeable	Below Facility
Wet Ponds	Medium-High	Low-Medium	Low-Medium	--	Low-Medium	Large	Medium-Large	Impermeable	Near Surface
Constructed Wetlands	Medium-High	Low	Low-Medium	--	Medium-High	Large	Large	Impermeable	Near Surface
Infiltration Facilities									
Infiltration Basins*	Medium-High	Medium-High	Medium-High	High	Medium-High	Large	Small-Medium	Permeable	Below Facility
Infiltration Trenches/ Dry Wells*	Medium-High	Medium-High	Low-Medium	High	Medium-High	Small	Small	Permeable	Below Facility
Porous Pavement	High	High	Medium	High	High	N/A	Small-Medium	Permeable	Below Facility
Vegetative Practices									
Grassed Swales	Medium	Low	Low	--	Low-Medium	Small	Small	N/A	N/A
Filter Strips	Medium-High	Medium-High	Medium-High	--	Medium	Varies	Small	N/A	N/A
Filtration Practices									
Filtration Basins	Medium-High	Low	Medium	--	Medium-High	Large	Medium-Large	Permeable	Below Facility
Sand Filters	High	Low	--	--	Medium-High	N/A	Small-Medium	N/A	N/A
Water Quality Inlets	Low-Medium	Low	Low	--	Low	N/A	Small	N/A	N/A

(1) Low = 0-30%; Medium = 30-65%; High = 65-100%
(2) Small = 0-10 acres; Medium = 10-40 acres; Large = >40 acres
N/A = Not applicable
* Potential for failure high, especially when not designed and installed properly

Sources: Schueler, 1987; Woodward-Clyde, 1991.

BMP Selection Process

Having screened the initial list of BMPs, municipalities can now rank and select a final set of BMPs using the decision-making process (Figure 2-3) described below. This process evaluates the relative merits of each BMP or group of BMPs. Because of the complexity of urban runoff control problems, a number of factors must be taken into account in assessing alternative plans. These are presented in Figure 2-3 as inputs to the decision process and include analysis tools and decision factors. The analysis tools are those used to assess and rank the existing pollution problems (see beginning of Chapter 2). The decision factors are the criteria used to compare the alternatives. All of these inputs are then used to evaluate the alternatives using one or more decision analysis methods. The following discussion discusses each input to the decision analysis, then describes the various decision analysis methodologies that may be used to select BMPs for ultimate inclusion in the SWMP.

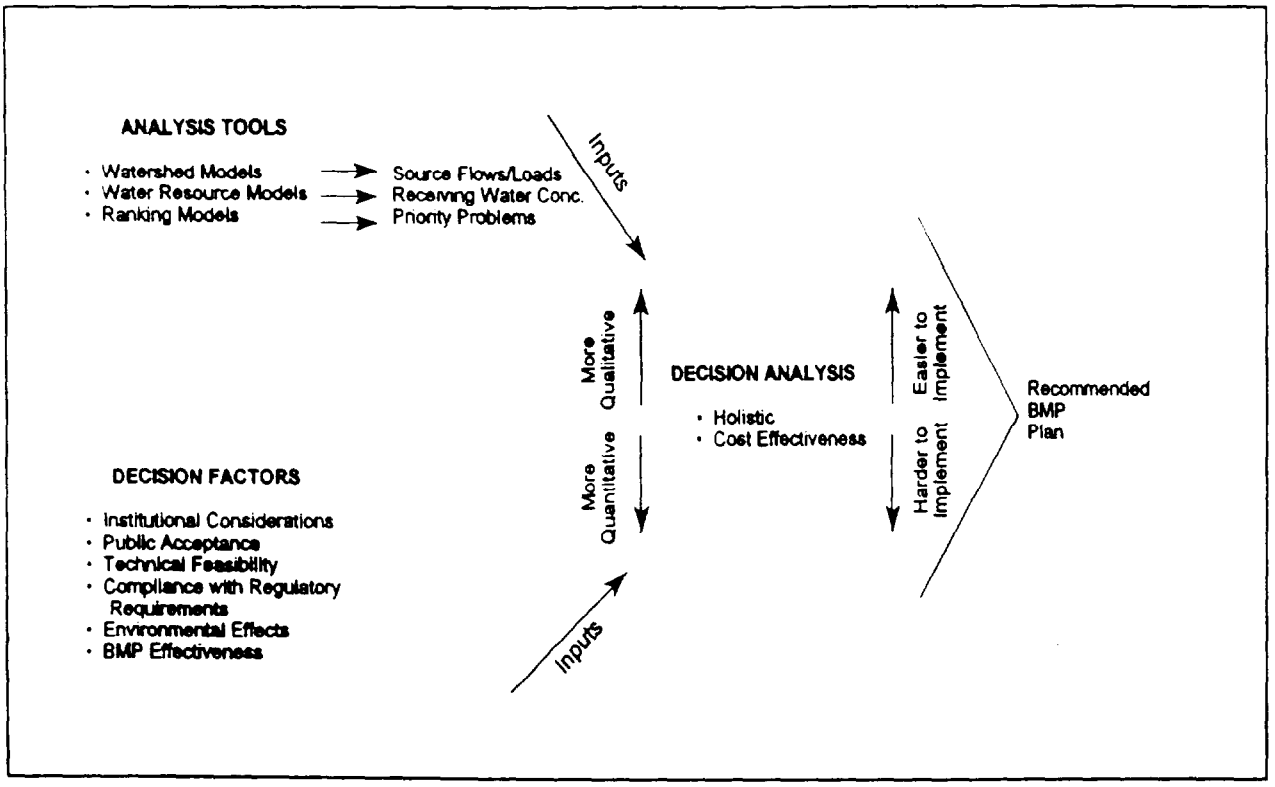


FIGURE 2-3. CONCEPTUAL DIAGRAM OF BMP SELECTION METHOD

Analysis Tools

These tools were described in detail during the discussion of Step 3. They can consist of watershed models, receiving water models, and ranking models. The analysis tools are used to project future conditions, given the alternatives being investigated. For example, the total pollutant loads for each alternative may be calculated (whether using a unit load method or complex models, such as SWMM). This will serve as one item of input information as the alternatives are

being compared. Similarly, the impacts to receiving waters may be assessed using these tools, so that the impacts can be compared when making a decision.

Criteria for Decision-making

An important step in BMP plan selection is to determine the decision factors of importance. The selection of these criteria is site-specific and needs to be determined by the program team based on the characteristics of the watershed and the financial and personnel resources available. Typical decision-making criteria are discussed below. Note that they are similar to the problem assessment criteria use in Step 3.

Institutional Considerations

To evaluate and select appropriate BMPs, municipalities may want to consider a number of institutional factors, including existing governmental structures, legal authority, and implementation responsibilities. If the proper legal authority does not exist, an analysis for attaining this authority must be undertaken (as required under Part 2 of the application). In addition to these considerations, the team should investigate existing urban runoff programs in the community, region, or State. Often, cost savings are realized and total program efforts reduced by taking advantage of material and data compiled from existing programs. It should be noted that these decision factors are similar to the assessment criteria used to rank pollution problems. Factors to consider when ranking BMPs are:

- Degree to which existing technologies or programs (municipal, State, Federal) could be used
- Availability of tools (technical methods and measures) to address adverse side effects of a particular action
- Extent to which legal authority exists to implement the BMP

Public Acceptance

In many instances, the public will be responsible for at least a portion of the funding required to implement the recommended plan. Public reaction to aspects of the storm water management program should, therefore, be assessed through the use of public meetings. Measuring public acceptance can be difficult, but is often important to the overall success of a program. The main factors to consider are:

- Level of public support to address problems
- Level of public support for implementing a particular BMP
- Public perception of the value of the resource.

Technical Feasibility

Cost is one of the most important factors to consider when selecting BMPs. Municipalities should consider the costs associated with both the development and implementation of nonstructural BMPs and the construction and operation of structural BMPs. Total costs should be reflected in addition to capital and operation and maintenance costs for each alternative. The benefits associated with the implementation of a control plan are usually more difficult to determine. For example, if an urban runoff control plan is designed to reduce the discharge of fecal coliform to a closed shellfish area, there will be monetary benefits when these beds are reopened. These benefits are difficult to quantify but should not be neglected when selecting BMPs. The factors to consider are:

- Relative costs for a particular BMP
- Availability of funds (capital) to initiate the project
- Availability of funds to operate and maintain BMPs over time.

Construction Issues

In evaluating and selecting BMPs (particularly structural BMPs), municipalities should consider various aspects of construction, including site requirements, the extent of disruption, and the degree of construction difficulty. When relying on complex structural controls, there are difficulties inherent in construction and future maintenance that need to be overcome. Construction issues are not as important when assessing source control and regulatory control practices. However, for structural controls, they can often be very important. The factors to consider include:

- Land requirements
- Soil requirements
- Ground water elevation
- Slope.

Compliance With Regulatory Requirements of the SWMP

BMPs should also be assessed on their capacity to meet the regulatory requirements of the SWMP. For example, as part of the SWMP, municipalities must prevent illicit discharges from entering the storm sewer system. In addition, they must control discharges into their storm sewer systems from industries. BMPs that work toward achieving these programmatic requirements would be assigned higher priority than those that do not. Priority considerations and pollution sources should be the focus of the selected alternative. The factors to consider are:

- Extent to which regulatory requirements are satisfied
- Extent to which specific programmatic measures of the SWMP are satisfied.

Environmental Effects

The implementation of pollution control measures for storm water runoff can affect the environment in a number of ways. When evaluating various BMPs, municipalities should consider the potential effects—both positive and negative—that may result from their implementation. The many resources that can be positively affected include water resources, aquatic animal and plant life, wildlife, and wetlands. The negative environmental effects, which can include aesthetic problems, cross-media contamination, the loss of useable land, and wetlands impacts, may also be considered.

The importance of considering BMP side effects is becoming more widely recognized. Indeed, there is a shift away from viewing BMPs simply in terms of their pollution control ability. Incorporating structures into new developments or retrofitting them in existing areas can gain wider acceptance if aesthetic qualities are considered. For example, unvegetated above-ground infiltration basins or extended detention basins are generally not attractive elements of the environment and may serve as insect breeding grounds. However, natural-looking wet ponds or vegetated wetlands can be incorporated into the environment and even improve aesthetics. These are issues that can greatly affect public acceptance. The main factors to consider are:

Potential for positive effects of BMPs on the community (e.g., property value, aesthetics), water resources, aquatic animal and plant life, wildlife, or wetlands

- Potential for negative effects due to BMP, such as aesthetic problems, cross-media contamination, the loss of useable land, wetlands impacts, operation and maintenance costs to the community (taxes).

Secondary environmental impacts from municipal BMPs most often affect wetlands because of the role they play in storm water management. Constructed wetlands are used in the treatment of urban storm water discharges within a storm water management program. The impacts of urban storm water discharges on wetlands include degradation of wetland hydrology, wetland water quality, wetland soils, and wetland plants and animals. As a result of urbanization, wetland hydrology is affected by the increased quantity and poor quality of the storm water discharges. The impacts to wetland hydrology include lower wetland response time, change in water levels in the wetland, and a change in the wetland's detention time. The changes in wetland water quality that result from urban storm water runoff are physical and chemical. The physical changes occur in temperature, conductivity, and the level of suspended solids. The chemical changes result from the increased levels of toxic substances, metals, and nutrients contained in the storm water runoff. Impacts to wetland soils include changes in the pH and redox potential. The combined results of the above impacts negatively affect plants and animals in the wetland. The increased levels of storm water runoff can flood plants and the feeding and breeding grounds of many animals. Also, the toxicity levels in storm water runoff may kill plants and other food for animals within the wetland habitat.

BMP Effectiveness

Estimating the effectiveness of a BMP is one of the most important factors a municipality will consider as part of the BMP selection process. In most cases, determining BMP effectiveness for structural controls is easier than for nonstructural controls. Structural controls (e.g., detention facilities and infiltration basins) may be assessed in terms of their demonstrated capacities to remove pollutants (see Chapter 7), whereas nonstructural controls (e.g., street sweeping, land use regulations, and solid waste management) may be evaluated according to indirect measures, such as the degree to which public awareness is heightened or the number of community outreach programs that are implemented.

Some municipalities may choose quantitative, decision analysis techniques to assess BMPs, whereas others may prefer to use more basic qualitative assessments backed by basic statistics, such as cost-effective data. While qualitative factors may be subjective by their very nature, the need for more quantitative, decision analysis models may be unnecessary during the early steps of BMP selection.

One type of qualitative analysis involves a holistic approach, which relies on the use of certain basic facts, intuition, and professional judgment. One key deciding factor (cost, for example) can guide the process. Given the inherent complexity of assessing alternative urban runoff control plans and the large number of available inputs to the decision, this approach is usually over-simplified. The selection of an appropriate plan from the developed alternatives will generally require an assessment of multiple factors and should be done in as quantitative a manner as is reasonably possible.

Quantitative approaches include such measures as cost-effectiveness analyses. A cost-effectiveness analysis helps the municipality attain a predetermined goal with the least expensive method possible.

SUMMARY

The process of targeting storm water runoff problems and selecting BMPs to control those problems is difficult and can best be performed by undertaking a systematic assessment process. Because of the qualitative nature of some inputs to these assessments and decisions, subjective comparisons among the alternative plans will likely be necessary. Where

cost-benefit issues need to be addressed, or where technically complex cases are encountered, more quantitatively based, analytical tools may be necessary. The process outlined in this chapter acts as a guide for decision making and cannot account for all of the circumstances that might be encountered. Professional judgment and care is needed at each step along the way. Once these choices have been made and BMPs have been selected, the storm water management program is ready to be implemented.

WORKSHEETS

The next two pages contain worksheets developed for the *State of California Storm Water Best Management Practice Handbook (Municipal)*. These worksheets may be useful in setting priorities for selecting municipal source and treatment controls.

WORKSHEET 1
SOURCE CONTROL BMP

PROGRAM ACTIVITIES:

PROGRAM ELEMENTS:

BMPs	Meets Regulatory Requirements (1 - 5)	Effectiveness of Pollutant Removal (1 - 5)	Public Acceptance (1 - 5)	Implementable (1 - 5)	Institutional Constraints (1 - 5)	Costs (1 - 5)	Total (30 MAX)

WORKSHEET 2
MENT CONTROL BMP

Polluta of Concern	MPs	Are Applic (Ac)	nnual ollutants Removed (Lb/Yr)	Annual Capital Costs[1] ($/Yr)	Annual O&M Cost[2] ($/Yr)	Annual Admin. Costs ($/Yr)	Total Annua l Costs ($/Yr)	Removal Cost[3] ($/Lb)

[1] Annual capital costs based on a 20-year design period.
[2] Annual administration costs are best determined by a given community once a city-wide program is established.
[3] Removal costs are in units ($/Yr)/(Lb/Yr) = $/Lb.

CASE STUDIES

The following case studies provide examples of methods for both assessing storm water runoff problems and evaluating/selecting appropriate BMPs to address those problems.

VIRGINIA BEACH, VIRGINIA, PART 2 APPLICATION, SETTING PRIORITIES

This section summarizes the Virginia Beach, Virginia, Part 2 Storm Water permit application. The example illustrates the overall program priorities considered by Virginia Beach for the initial implementation of its storm water management program.

Program priorities were developed based on a qualitative approach rather than a rigorous quantitative approach using specific evaluation criteria that are assigned values and weights. Priorities, however, were considered by evaluating each activity listed in Table 2-9 using the following guidelines:

- Level of pollution load reduction (if high, then higher priority)
- Cost (if low, then higher priority)
- Public acceptance (if high, then higher priority)
- Type of program (if ongoing program, then higher priority than enhanced ongoing program; if new program, then lower priority than existing program; if program designed to meet a minimum requirement not presently undertaken by city, then a higher priority)
- Type of development (if program for new development, then higher priority than for program for existing development)

Using these guidelines, the first priority programs and the second priority programs were selected and are presented in Table 2-9 under the heading Priorities with either a "1st" priority or a "2nd" priority indication.

Schedule

Figure 2-4 shows an overall schedule for the program activities listed in Table 2-9. Many of the ongoing programs (e.g., BMP Reinspection Program) and some of the new programs (e.g., implementation and enforcement of new storm sewer system ordinance) will be fully implemented during each year of the term of the permit. Other programs will require phased implementation (e.g., development of a slide show for reporting illicit discharges), and still others will be developed during the middle years of the program (e.g., evaluation of any existing major flood control structures for water quality benefits). For some programs, the schedule indicates the number of ponds, structures, and sites to be considered (e.g., ongoing field screening for up to 25 new sites a year) for each year of the permit. The frequency (e.g., once a year) of monitoring and specific inspection programs are also indicated on the schedule.

Program Evaluation

During the term of the permit, the city, principally through the Department of Public Works, will monitor the progress of implementing the components of the comprehensive management program and the representative monitoring program. As part of this process, the city will evaluate the pollution removal/control effectiveness of the various program activities. For commercial and residential areas, the comprehensive storm water management program will be tracked and evaluated in light of the new and existing ordinances related to storm water quality. The expanded BMP data base will be monitored to assure that new data on structural BMPs are being used by the BMP reinspection program to assist in the maintenance schedule for structural controls, including major sediment removal.

TABLE 2-9. PROPOSED MANAGEMENT PROGRAM ACTIVITIES*

Activities	Priorities
Program for Commercial and Residential Areas	
• Master Plan for New Development	
- Maintenance of Comprehensive Plan	1st
- Existing Ordinances	1st
- Owl Creek Watershed Protection Program	1st
- Design Guidelines	2nd
• Maintenance of Structural Controls	
- Maintenance of Structures	
-- Retention/Detention Ponds	1st
-- Ditches/Canals/Waterways	1st
-- Oil/Water Separators	1st
-- Volume Control BMPs	1st
-- Culverts/Structures	1st
- BMP Reinspection Program	1st
- BMP Data Base Expansion	2nd
- Major Sediment Removal	2nd
• Practices for O&M for Streets, Roads, and Highways	
- Erosion and Sediment Control	1st
- Catch Basin and Ditch Cleaning	1st
- Snow and Ice Control	1st
- Litter Control	1st
- Other Programs	1st
• Flood Management Procedures Assessment	1st
• Pesticide, Herbicide, and Fertilizer Application	
- Certification and Licensing	1st
- Training	1st
- Public Education	2nd
• Storm Water Master Plan Continuation	
- Plan Maintenance	1st
- Storm Sewer System Inventory	2nd
Program for Illicit Discharges and Improper Disposal	
• Implementation and Enforcement of Ordinance	1st
• Ongoing Field Screening	
- Sites from Part 1 Investigation	1st
- New sites each year	2nd

TABLE 2-9. PROPOSED MANAGEMENT PROGRAM ACTIVITIES (Continued)

Activities	Priorities
Program for Illicit Discharges and Improper Disposal (Continued)	
• Storm Sewer Investigations	
- Mapping and Evaluation	
-- Part 1 sites	1st
-- New sites	2nd
- Field surveys	
-- Part 1 sites	1st
-- New sites	2nd
- Source Identification	
-- Part 1 sites	1st
-- New sites	2nd
• Spill Response and Inspection Program	1st
• Reporting of Illicit Discharges	
- Brochures, Cityline Message and Slide Show	1st
- Hotline and main-in programs	2nd
• Controls to Limit Infiltration	1st
Program for Industrial Facilities	
• Mount Trashmore (Closed Landfill)	
- Inspection/Maintenance of Park	1st
- Monitoring Program for Two Lakes	1st
• Landfill No. 2	
- Inspection	1st
- Monitoring at One Site	2nd
• Other Facilities Data Evaluations	2nd
Program for Construction Sites	
• Site Plan Review	1st
• Inspection/Enforcement	1st
• Training Site Operators	2nd

*Taken verbatim from the Part 2 NPDES Storm Water Permit Application prepared by the City of Virginia Beach, Virginia (1992)

ACTIVITIES	YEAR OF PERMIT				
	1	2	3	4	5
COMMERCIAL AND RESIDENTIAL AREAS					
Master Plan for New Development					
Comprehensive Plan					
Existing Ordinances					
Owl Creek Watershed Protection Program					
Design Guidelines					
Maintenance Plan for New Development					
Maintenance of Structures					
BMP Reinspection Program					
Data Base Expansion					
Major Sediment Removal	2 ponds	2 ponds	2 ponds	2 ponds	2 ponds
Practices for O&M for Streets, Roads, and Highways					
Flood Management Procedure Assessment					
Pesticides, Herbicides, and Fertilizer					
Certification/Licensing					
Training (O = developed)	O				
Public Education (O = developed)	O				
Storm Water Master Plan					
Water Quality Model					
Plan Maintenance					
Storm Sewer System Inventory (continuing after 5 years)					
ILLICIT DISCHARGES AND IMPROPER DISPOSAL					
Implementation and Enforcement of Ordinance					
Ongoing Field Screening					
Sites from Part 1 Investigation	30 sites				
New Sites Each Year	25 sites	25 sites	25 sites	25 sites	25 sites
Storm Sewer System Investigations					
Mapping and Evaluation					
Part 1 Sites	30 sites				
New Sites	25 sites	25 sites	25 sites	25 sites	25 sites
Field Surveys					
Part 1 Sites		30 sites	25 sites	25 sites	25 sites
New Sites		25 sites	25 sites	25 sites	25 sites

FIGURE 2-4. CITY OF VIRGINIA BEACH, VIRGINIA PROPOSED STORM WATER MANAGEMENT PROGRAM SCHEDULE*

ACTIVITIES	YEAR OF PERMIT 1	2	3	4	5
Source Identification					
Part 1 Sites		30 Sites			
New Sites		25 Sites	25 Sites	25 Sites	25 Sites
Spill response and Inspection Program					
Reporting of Illicit Discharges					
hure, Cityline Message, and Slide Shows (O = Developed)	O				
Call-in and Mail-in (O = Developed)	O				
Proper Management and Disposal of Toxic Materials					
Support for Ongoing Programs					
Brochure, Cityline Message, and Slide Shows (O = Developed)	O				
Controls to Limit Infiltration					
INDUSTRIAL FACILITIES					
Mount Trashmore					
Inspection/Maintenance of Park					
Monitoring Program for Two Lakes	Twice	Twice	Twice	Twice	Twice
Landfill No. 2	O				
Inspection	4 Times	4 Times	4 Times	4 Times	4 Times
Monitoring at a Site	Once	Once	Once	Once	Once
Oth s Evaluations					
ite Data					
Site Inspection of Each Site	Once	Once	Once	Once	Once
STRUCTION SITES					
Site Plan Review					
Inspection/Enforcement					
Training Site C O = Developed)	O	Once	Once	Once	Once

IGURE 2-4. CITY OF VIRGINIA BEACH, VIRGINIA
OPOSED STORM WATER MANAGEMENT PROGRAM SCHEDULE (Continued)

KING COUNTY'S BASIN PLANNING PROGRAM ESTABLISHING WATERSHED PRIORITIES

Criteria for Prioritizing Basins

The primary objective of King County's watershed approach is to protect and maintain the integrity of County stream systems and to prevent their degradation to the degree possible.

King County's philosophy is that stream protection must be accomplished through the evaluation and management of land and water within the entire watershed; that erosion cannot be managed without controlling the high flows that cause erosion; that water pollution cannot be adequately reduced without controlling the runoff and sediment, by which pollutants are transported; and that aquatic habitat cannot be managed without considering all of the chemical, physical, and hydrological elements that define each habitat.

Accordingly, criteria for prioritizing watersheds were developed to give planning urgency to those basins where hazardous conditions, such as landslides and flooding, were most frequent/severe and where water quality and habitat have not been severely affected (and could yet be preserved through proactive planning).

The initial basin planning prioritization was based on a significant body of knowledge gained from the 1987 Basin Reconnaissance program, a field inventory of problems and potential solutions conducted during the rainy seasons of 1985-1986 and 1986-1987. Multidisciplinary teams noted existing problems and features in portions of 29 service area basins. These data were used directly to determine ratings for each basin in four major categories: Existing Problems, Future Problems, Existing Resources, and Urgency/Timeliness. Rating criteria were associated with each major category, as listed in Table 2-10 below.

Table 2-10. BASIN PLANNING PRIORITIZATION CATEGORIES AND CRITERIA*

Category	Criteria
Existing Problems	- Landslides - Erosion/Sediment - Flooding
Future Problems	- Land in Unincorporated King County - Subdivision/Plat Activity - Population Growth - Permitted Residential Units
Existing Resources	- Stream Habitat - In-Stream Resources - Wetland Value - Wetland Storage Potential - Water Quality Potential
Urgency/Timeliness	- Other Agency Interest - Opportunity to Integrate with Other Programs

* Taken verbatim from the Part 2 NPDES Storm Water Permit Application prepared by the King County Surface Water Management Division (1992)

Problem counts for each category were generated from the Technical Appendix of each Basin Reconnaissance report (included with the Part 1 permit application). For example, for the Landslides, Erosion/Sedimentation, and Flooding categories, the following ratings were applied: "0" - low (few problems), "1" - moderate (some problems), and "2" - high (many problems). For other criteria, such as Water Quality and Stream Habitat, opposite scores were assigned: "0" - low quality (many problems), "1" - moderate (some problems), and "2" - high quality (few problems).

Tables 2-11 through 2-14 show the final scores of each basin for each major category. Table 2-15 shows the ranking of basins according to total scores. These rankings form the basis of the proposed basin planning schedule shown in Table 2-16.

By the end of 1992, the County will have completed, or will be substantially underway, with basin plans for 12 of the 37 basins in the surface water management service area. As expected from the ranking criteria, the first basins selected for planning services were predominately rural watersheds. More recently, the Surface Water Management Division has begun the basin planning process in urban or urbanizing basins, such as Miller Creek, Seola Creek, and Salmon Creek. The planning process for these basins will incorporate many of the same management strategies applied to rural basins and will be complemented with new programs being developed and implemented as part of the NPDES program (e.g., drainage mapping, illicit discharge surveys, and source control best management practices).

TABLE 2-11. BASIN PRIORITIZATION*

I. Existing Problems (from Basin Reconnaissance)				
	Criteria			
Drainage Basin	Landslide	Erosion/ Sediment	Flooding	Sheet 1 Total
McAleer	1	1	2	4
Lyons	0	1	2	3
Swamp	0	1	2	3
Sammamish	2	2	1	5
North	0	0	0	0
Little Bear	0	1	1	2
Big Bear	0	2	1	3
Thornton	0	0	1	1
Lk Washington	0	2	1	3
Juanita	1	2	2	5
Forbes	0	1	1	2
Evans	1	2	1	4
W Lk Sammamish	1	2	1	4
E Lk Sammamish	1	2	1	4
Coal	1	1	1	3
Tibbetts	2	1	1	4
May	1	2	2	5
N Fk Issaquah	0	1	1	2
E Fk Issaquah	0	1	1	2
Issaquah	1	2	0	3
Lower Cedar	2	2	2	6
Duwamish	0	1	2	3
Black	1	2	0	3
Mill	0	2	2	4
Lower Green	1	2	1	4
Soos	0	1	2	3
Jenkins	0	1	2	3
Covington	0	0	0	0
Middle Green	2	1	1	4
Boeing	2	2	1	5
Middle Puget	1	1	1	3
Lower Puget	2	2	1	5
Salmon	1	1	1	3
Miller	0	1	1	2

TABLE 2-12. BASIN PRIORITIZATION*

II. Future Problems					
	Criteria				
Drainage Basin	Land in Unincorp. King Co.	1982-1987 Subdivision/ Plat Activ.	Population Growth	Permitted Residential Units	Sheet 2 Total
McAleer	1	1	0	1	3
Lyons	0	1	0	2	3
Swamp	0	1	1	2	4
Sammamish	1	2	2	1	6
North	0	2	1	2	5
Little Bear	0	1	2	0	3
Big Bear	1	1	2	2	6
Thornton	1	0	0	0	1
Lk Washington	0	2	1	1	4
Juanita	2	2	2	2	8
Forbes	1	2	1	2	6
Evans	2	2	2	1	7
W Lk Sammamish	0	2	1	2	5
E Lk Sammamish	2	2	2	2	8
Coal	1	1	2	0	4
Tibbetts	1	1	1	0	3
May	1	0	1	1	3
N Fk Issaquah	2	0	1	0	3
E Fk Issaquah	1	0	0	0	1
Issaquah	2	0	0	0	2
Lower Cedar	0	1	1	1	3
Duwamish	0	0	0	1	1
Black	0	1	1	2	4
Mill	1	0	1	0	2
Lower Green	1	2	1	2	6
Soos	2	2	2	1	7
Jenkins	2	1	1	1	5
Covington	1	0	0	0	1
Middle Green	0	0	0	1	1
Boeing	2	1	0	2	5
Middle Puget	0	0	0	0	0
Lower Puget	1	2	2	2	7
Salmon	2	0	0	2	4

TABLE 2-13. BASIN PRIORITIZATION*

III. Existing Resources						
	Criteria					
Drainage Basin	Stream Habitat	In-Stream Resources	Wetland Value	Wetland Strg. Pot.	Water Quality	Sheet 3 Total
McAleer	0	0	0	0	1	1
Lyons	0	0	0	0	0	0
Swamp	1	1	1	0	1	4
Sammamish	0	2	1	1	1	5
North	1	2	0	0	2	5
Little Bear	1	2	0	0	2	5
Big Bear	1	2	2	2	2	9
Thornton	0	0	0	0	0	0
Lk Washington	0	0	1	1	0	2
Juanita	1	1	1	0	1	4
Forbes	1	1	1	1	1	5
Evans	1	1	2	2	1	7
W Lk Sammamish	0	1	0	0	1	2
E Lk Sammamish	1	1	2	2	1	7
Coal	0	1	1	0	1	3
Tibbetts	1	2	0	0	1	4
May	1	1	2	1	1	6
N Fk Issaquah	1	1	1	1	1	5
E Fk Issaquah	1	1	1	1	1	5
Issaquah	2	2	2	1	2	9
Lower Cedar	1	1	2	2	1	7
Duwamish	1	1	0	0	0	2
Black	0	2	1	0	0	3
Mill	0	1	1	0	0	2
Lower Green	0	1	2	1	1	5
Soos	1	2	2	2	1	8
Jenkins	2	2	2	2	2	10
Covington	2	2	2	2	1	9
Middle Green	1	2	2	1	1	7
Boeing	0	0	0	0	0	0
Middle Puget	0	0	0	0	0	0
Lower Puget	0	0	2	1	0	3

TABLE 2-14. BASIN PRIORITIZATION*

IV. Urgency/Timeliness			
	Criteria		
Drainage Basin	Other Agency Interest	Opp. to Integrate with Other Programs	Sheet 4 Total
McAleer	1	0	1
Lyons	1	1	2
Swamp	1	0	1
Sammamish	0	1	1
North	0	0	0
Little Bear	0	0	0
Big Bear	2	2	4
Thornton	1	0	1
Lk Washington	0	0	0
Juanita	0	0	0
Forbes	0	0	0
Evans	2	1	3
W Lk Sammamish	1	1	2
E Lk Sammamish	1	1	2
Coal	1	0	1
Tibbetts	2	1	3
May	0	0	0
N Fk Issaquah	2	2	4
E Fk Issaquah	2	2	4
Issaquah	2	2	4
Lower Cedar	0	1	1
Duwamish	2	1	3
Black	0	1	1
Mill	2	2	4
Lower Green	0	2	2
Soos	2	2	4
Jenkins	2	2	4
Covington	2	2	4
Middle Green	0	2	2
Boeing	0	0	0
Middle Puget	0	0	0

TABLE 2-15. BASIN PRIORITIZATION*

Summation Sheet Ranked According to Total Score					
Drainage Basin	**Existing Problems**	**Future Problems**	**Existing Resources**	**Urgency/ Timeliness**	**Total Sum**
Big Bear	3	6	9	4	22
Jenkins	3	5	10	4	22
Soos	3	7	8	4	22
E Lk Sammamish	4	8	7	2	21
Evans	4	7	7	3	21
Hylebos	4	6	7	2	19
Issaquah	3	2	9	4	18
Juanita	5	8	4	0	17
Lower Cedar	6	3	7	1	17
Lower Green	4	6	5	2	17
Lower Puget	5	7	3	2	17
Sammamish	5	6	5	1	17
Covington	0	1	9	4	14
May	5	3	6	0	14
Middle Green	4	1	7	2	14
N Fk Issaquah	2	3	5	4	14
Tibbetts	4	3	4	3	14
Forbes	2	6	5	0	13
W Lk Sammamish	4	5	2	2	13
E Fk Issaquah	2	1	5	4	12
Mill	4	2	2	4	12
Swamp	3	4	4	1	12
Black	3	4	3	1	11
Coal	3	4	3	1	11
Salmon	3	4	4	0	11
White	2	1	7	1	11
Boeing	5	5	0	0	10
Des Moines	3	2	2	3	10
Little Bear	2	3	5	0	10
North	0	5	5	0	10
Duwamish	3	1	2	3	9
Lk Washington	3	4	2	0	9

TABLE 2-16. PROPOSED BASIN PLANNING SCHEDULE 1992 - 1997*

Basin/Start Year	Current and Future Conditions Report	Draft Basin Plan	WMC Proposed Basin Plan	WMC-approved or Executive Proposed	Expected Adoption
Soos/87	—	Nov 89		July 90	*Jan 92*
Bear/87	—	*Dec 89*		May 91	Oct 92
Hylebos-LPS/88	*July 90*	*Feb 91*		July 91	Jan 93
ELS/88	*Sept 90*	*May 92*	Nov 92	June 93	Sept 93
Issaquah/89	*Oct 91*	Nov 92	Apr 93	Sept 93	Jan 94
Cedar/91	Jan 93	July 93	Jan 94	Sept 94	Jan 95
May 2/92	Aug 93	April 94		Nov 94	May 95
Miller-Salmon-Seola/92	Oct 93	July 94		Feb 95	Aug 95
Green/94	May 95	Feb 96		Dec 96	Jun 97
Duwamish-Black-Mill/94	Feb 95	Oct 95		May 96	Nov 96
Sammamish 94	Dec 95	Sept 96		Apr 97	Oct 97
Boeing-McAleer-Lyon-Thornton/95	Feb 96	Oct 96		May 97	Dec 97
Juanita, E LK Wa. 96	Apr 97	Dec 97		Jul 98	Dec 98
W. Lk. WA, W. Lk. Samm 96	May 97	Dec 97		Jul 98	Dec 98

*Taken verbatim from the Part 2 NPDES Storm Water Permit Application prepared by the King County Surface Water Management Division (1992)

THE EIGHT-STEP BMP PLANNING PROCESS DEVELOPED BY CHARLOTTE, NORTH CAROLINA

This section summarizes the Part 2 storm water permit application prepared by Charlotte, North Carolina. The discussion does not mirror the planning process described in this manual, but rather presents a variation for municipalities to consider.

Step 1 — Develop Criteria to Evaluate Objective Attainment and Planning

The table below, taken verbatim from the Charlotte, North Carolina, Part 2 storm water permit application, summarizes the factors considered in each of the Charlotte Storm Water Quality Management Program (SWQMP) elements. The purpose of the table was to force full consideration of both the pros and cons of each program element and to assist the city in determining the practicability of each measure in formulation of its MEP.

TABLE 2-17. BEST MANAGEMENT PRACTICE SCREENING CRITERIA*

BMP					
	Criteria Description	**+**	**0**	**-**	**Comments**
1.	Human Risk, Public Safety and Potential Liability				
2.	Environmental Risk and Implications				
3.	Ability to Control Key Targeted Pollutants				
4.	Costs to Implement and Continuing Costs				
5.	Acceptability to the Public, Stakeholders, Staff and Political Leadership				
6.	Equitability to Impacted Persons				
7.	Reliability and Consistency Over Time				
8.	Sustainability in Terms of Maintenance or Program Management				
9	Ability to be Applied Universally Throughout the Jurisdiction or, on a Specific Watershed Basis				
10.	"Fit with other Charlotte Operations and Programs				
11.	Relationship to other Federal, State, or Local Regulatory Requirements				
12.	Amenity or Multi-use Value				
Totals					

*Excerpted verbatim from the Part 2 Storm Water Permit Application prepared by Charlotte, North Carolina (1992)

Step 2 — Develop List of Possible Control Measures (BMP's)

There are almost an infinite number of variations on programmatic, structural, and nonstructural BMPs. A candidate set of nearly 100 control measures, program elements, and other activities was developed through brainstorming sessions. A preliminary screening was done of these based on engineering judgement and knowledge of what measures

were not remotely feasible. Candidate control measures and programs surviving this initial screen were subjected to a more formal consideration using the table in step 1.

Step 3 — Apply the Criteria to Screen the Measures

The criteria were generally applied (along with engineering judgement) to spotlight potential problems with the application of program elements. It was considered too premature to require the use of certain structural BMPs, though a more formal technical consideration of specific design standards and incorporation into Charlotte design criteria was adopted as a program element.

Step 4 — Preliminarily Analyze a Practical Set of Control Measures

This shortened list was organized and analyzed to determine how each measure will function singularly and in conjunction with other program elements and how and by whom these elements will be implemented. Another part of this analysis is to determine ranges of BMP application to allow for development of alternative programs and to get a feel for cost sensitivity where appropriate.

Step 5 — Estimate Overall Program Costs and Pollution Reduction Effectiveness

In most cases, particularly for nonstructural BMPs, it was very difficult to assign pollution reduction numbers without better data and information. In many cases it was inappropriate. Great care and engineering judgment must then be exercised. The steps generally were to:

- Define such factors as the control measures, phases of implementation, ranges of implementation, equipment, and locations as necessary to define the program as fully as possible; consider pilot applications and data monitoring feedback loops
- Make first order estimates of program costs in each implementation stage or phase.
- Realistically allocate budgets to these programs over the first 5-year permit period and at ultimate development as appropriate.
- Make first order estimates of the program's effectiveness by relying on the experience of other cities.

Step 6 — Obtain Feedback and Revise Program Scope to Maximize Program Cost Effectiveness

There is a need in any comprehensive program development to go back and look at the whole assembled puzzle after suitable examination of each of ces and after preliminary coordination with the permit writer. Adjustments were made to the program scope dule.

Step 7 — Describe R Responsibilities to Implement the Program

After a preliminary S wQMP strategy was formulated, preliminary roles or responsibilities for each program element were identified. The local organizational structure and current program responsibilities were considered.

Step 8 — Develop Schedule for Implementation Control Program Including Management and Feedback Loops

The end result of this step is the schedule and budget for program implementation. It was considered important to evaluate the success of the programs at every step and build into each program ways to measure that success. This may be through specially designed feedback from the persons implementing the program, through data collection and monitoring, public awareness polls, or other means.

EXAMPLE METHOD FOR SELECTING SOURCE CONTROL BMPs

This section summarizes the *State of California Storm Water Best Management Practice Handbook (Municipal)*, Storm Water Quality Task Force, March 1993. The discussion provides a step-by-step planning example on how to select potential source control BMPs for inclusion in a municipal Storm Water Management Program. It assumes that program goals and priorities and existing conditions (Steps 1-3) have been identified. This example illustrates how source control BMPs may be selected using the Source Control Worksheet #1.

Selection Process

The selection criteria and the scoring system below are similar to other selection processes developed around California. It is recommended, however, that the criteria and/or the scoring be modified to suit the particular community. Modification of the following selection process attributes may be considered:

- **Criteria** — Redefine some of the criteria or add/subtract criteria.
- **Scores** — Modify the scoring to a simple +,0, and -, or 1, 2, and 3.
- **Weighting** — Group the criteria into tiers reflecting their relative importance to specific SWMP goals. By multiplying the scores of the highest tier by some factor (e.g., x2), the first tier scores could be weighted more heavily than the others to reflect this importance.
- **Fatal flaw** — Provide for some fatal flaw in scoring the BMPs (e.g., the BMP is illegal or its implementation is completely unacceptable to the public) that would make implementation impossible. Scoring a fatal flaw as a 0 is one way of highlighting the flaw. Any BMP scoring a 0 against a criterion would be eliminated from consideration, regardless of its overall ranking.

Example

In the following example, municipality Anytown, California, is developing a Storm Water Management Program that includes an element for Residential/Commercial Activities. By following the steps below, the community uses Worksheet 1 to rank the BMPs according to their ability to meet the selection criteria. The worksheet shows the initial results of this hypothetical ranking.

1. The selection process involves consideration of following:
   - Table 2-18, Application of BMPs to SWMP Program Elements
   - Discussion of selection criteria
   - Worksheet 1
   - Source Control BMPs.

2. A review of Table 2-18 shows that for Residential/Commercial Activities, the storm water regulations require the SWMP to have an element addressing Roadway and Drainage Facility Maintenance. The program activity and element are listed at the top of Worksheet 1.

3. Looking across the Roadway and Drainage Facility Maintenance row in Table 2-18, two categories of source control BMPs apply, Material Use Control and Street/Storm Drain Maintenance.

4. The Material Use Control category includes two types of BMPs, Housekeeping Practices and Safer Alternative Products. These are listed on Worksheet 1.

5. Several BMPs are described within each fact sheet. These are also listed on Worksheet 1.

6. Using the discussion of selection criteria, the BMPs are ranked against the selection criteria using the scale of 1-5.

7. For the first BMP, Distribute Public Education Materials, the following scores are recorded:
Meets Regulatory Requirements = 3. Public education meets the intent of the storm water regulations.
Effectiveness of Pollutant Removal = 2. Effectiveness of source control is high; however, insufficient data exist to support this claim.
Public Acceptance = 5. Anytown believes that the public education materials are available from other municipalities and agencies to serve as models or to purchase for use as is.
Implementable = 5. The existing department and staff may be used, and public education materials are available from other municipalities and agencies to serve as models or to purchase for use as is.
Institutional Constraints = 4. To provide a consistent message to the public, Anytown must coordinate its public education program with the county, which already has in place a hazardous waste disposal program. The county has indicated that it will cooperate fully with Anytown to ensure that the public education material is consistent with the county's program.
Costs = 5. Given the availability of materials to serve as models or to use directly, production should be relatively inexpensive.

8. Addition of the criteria scores across each row produces a total score, which may be compared to the other totals.

9. The process is continued for each of the source control BMP categories checked in Table 2-18.

As a result of this evaluation, Anytown, California, implemented all the BMPs in the Housekeeping Practices and Safer Alternative Products categories, as well as the maintenance BMPs in the Street/Storm Drain Maintenance category. However, the scores for the other Street/Storm Drain Maintenance BMPs indicated that further study was necessary before their implementation could be proposed. Anytown, California, also found that storm drain flushing was not allowed by the local sewer agency, so this fatal flaw removed this BMP from further consideration.

A Few Points to Remember

- Have several people or one of the storm water committees conduct the selection independently to get a broad perspective on the relative merits of each BMP and to help reach a consensus.
- Keep the selection system as simple as possible and use best professional judgment to interpret and to conduct a reality check on the total scores.
- Remember that differences of a few points in the total score are probably not significant.
- Use the final rankings to plan and prioritize the SWMP. For example, those BMPs with the highest scores may be implemented in the first year of the NPDES permit, while low scoring BMPs may need more time to develop, relegating their implementation to the fifth year or to further study.
- Use the exercise of working through this selection to provide the necessary data to promote the program to other departments, political leaders, regulatory agencies, and the public.

WORKSHEET 1* SOURCE CONTROL BMP							
PROGRAM ACTIVITIES: *Residential/Commercial*							
PROGRAM ELEMENTS: *Roadway and Drainable Facility Maintenance*							
BMPs	Meets Regulatory Requirements (1 - 5)	Effectiveness of Pollutant Removal (1 - 5)	Public Acceptance (1 - 5)	Implementable (1 - 5)	Institutional Constraints (1 - 5)	Costs (1 - 5)	Total (30 MAX)
MATERIAL USE CONTROL:							
Housekeeping Practices							
• Distribute Public Education Material	3	2	5	5	4	5	24
• Train City Employees Regarding Chemical Use	3	3	5	4	4	5	24
Safer Alternative Products							
• Use Organic Soil Amendments	3	5	5	3	5	2	23
• Train City Employees Regarding IPM	3	3	5	4	4	5	24
• Substitute IPM for Pesticides	3	5	5	2	5	5	25
STREET/STORM DRAIN MAINTENANCE:							
Street Cleaning							
• Replace Mechanical Sweepers with Vacuum	3	3	5	3	3	1	18
• Increase Frequency Two Times a Week	3	2	5	3	4	2	19
• Maintain Equipment	3	2	5	5	5	4	24
• Maintain Operation Log	3	1	5	5	5	5	24
Storm Drain Flushing							
• Flushing	3	4	4	2	0	4	17*

*Taken verbatim from the *State of California Storm Water Best Management Practice Handbook*, Storm Water Quality Task Force, March 1993.

TABLE 2-18. APPLICATION OF BMPs TO SWMP PROGRAM ELEMENTS*

Required Elements of SWMP	Source Control BMPs Chapter 4							
	Planning Management	Material Use Control	Material Exposure Controls	Material Disposal & Recycling	Spill Prevention & Cleanup	Illegal Dumping Controls	Illicit Connection Controls	Street/Storm Drain Maintenance
FOR RESIDENTIAL/COMMERCIAL ACTIVITIES:								
Roadway and drainage facility maintenance		✓						✓
BMP planning for new development and redevelopment projects	✓							✓
Retrofitting existing or proposed flood control projects with BMPs	(See Page 3-9 Chapter 3)							
Municipal waste handling and disposal operations		✓	✓	✓	✓	✓		
Pesticide, herbicide, and fertilizer use controls		✓	✓	✓	✓	✓		
FOR IMPROPER DISCHARGE ACTIVITIES:								
Prevention, detection, and removal of illegal connection to storm drains							✓	
Spill prevention, containment, and response		✓	✓	✓	✓	✓		
Promote proper use and disposal of toxic materials		✓	✓	✓	✓	✓		
Reduce storm water contamination by leaking/overflowing separate sanitary sewers					✓	✓		
FOR INDUSTRIAL ACTIVITIES:								
Inspection and control prioritization and procedures		✓	✓	✓	✓	✓	✓	✓
Monitoring of significant industrial discharges						✓	✓	
FOR CONSTRUCTION AND LAND DEVELOPMENT ACTIVITIES:								
Water quality and BMP assessments during planning	✓	✓	✓	✓	✓	✓		✓
Site inspection and enforcement procedures	✓	✓	✓	✓	✓	✓		✓
Training for developers and contractors	✓							

*Taken verbatim from the *State of California Storm Water Best Management Practice Handbook (Municipal)*, Storm Water Quality Task Force

MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION BMP SELECTION MATRIX

To address storm water and nonpoint source pollution control in areas of new development, the Maine Department of Environmental Protection (ME DEP) has developed a method to select BMPs. The method is based on the following information:

- Development land use type and size
- Receiving water type (e.g., estuary, wetland, river, or stream)
- Watershed priority (either priority or nonpriority)
- Erosion and sediment control target or "level to achieve"
- Storm water quality control target or "level to achieve"
- Erosion and sediment control options and "treatment level codes"
- Storm water quality control target or "treatment level codes."

To implement the BMP selection method, ME DEP has developed a series of eight matrices. There are two matrices for each receiving water type (estuary, wetland, river, and stream). One matrix is applied to development in designated priority watersheds, and the other is applied to development in nonpriority watersheds. A priority watershed list has been developed by ME DEP based on environmental sensitivity, local support for water quality, and importance of the watershed to the State. Example matrices for priority and nonpriority estuary watersheds are shown in Tables 2-19 and 2-20.

TABLE 2-19. PRIORITY ESTUARY STORM WATER CONTROL MATRIX*

Land Use Category	Erosion and Sediment Level to Achieve	Erosion and Sediment Controls	Water Quality Level to Achieve	Storm Water Controls
Low Density Residential >2 acres per lot	1	Erosion and Sediment 1	1	Buffer 1
High Density Residential <2 acres per lot	2	Erosion and Sediment 2	3	Buffer 1 or 2 Wet Pond 2 Infiltration 1 or 2 Created Wetland 2
Commercial <1 acre distributed	1	Erosion and Sediment 1	1	Buffer 1
Commercial 1-3 acres distributed	1	Erosion and Sediment 1	2	Buffer 1 or 2 Infiltration 1 Swale 1
Commercial >3 acres disturbed	2	Erosion and Sediment 2	4	Buffer 1 or 2 Infiltration 1 or 2 Created Wetland 2 Wet Pond 2 or 3 Fertilizer Control 1 Shallow Impoundment 1
Intensive Use Open Space (e.g., golf courses, nurseries)	2	Erosion and Sediment 2	5	Buffer 1 or 2 Fertilizer Control 1 Pesticide Control 1 Created Wetland 2 or 3 Wet Pond 2 or 3
Multi-housing Units	2	Erosion and Sediment 2	3	Buffer 1 or 2 Fertilizer Control 1 Pesticide Control 1 Created Wetland 2 Wet Pond 2 Infiltration 1 or 2
Industrial <1 acre disturbed	1	Erosion and Sediment 1	1	Buffer 1 Swale 1
Industrial 1-3 acres disturbed	1	Erosion and Sediment 1	2	Buffer 1 or 2 Swale 1
Industrial >3 acres disturbed	2	Erosion and Sediment 2	5	Buffer 1 or 2 Swale 1 Created Wetland 2 or 3 Wet Pond 2 or 3

*Taken verbatim from *Storm Water Best Management Practices—Second Draft*, prepared by the Maine Department of Environmental Protection (1990)

TABLE 2-20. NONPRIORITY ESTUARY STORM WATER CONTROL MATRIX*

Land Use Category	Erosion and Sediment Level to Achieve	Erosion and Sediment Controls	Water Quality Level to Achieve	Storm Water Controls
Low Density Residential >2 acres per lot	1	Erosion and Sediment 1	1	Buffer 1
High Density Residential <2 acres per lot	2	Erosion and Sediment 2	2	Buffer 1 or 2 Infiltration 1
Commercial <1 acre distributed	1	Erosion and Sediment 1	1	Buffer 1
Commercial 1-3 acres distributed	1	Erosion and Sediment 1	1	Buffer 1
Commercial >3 acres disturbed	2	Erosion and Sediment 2	2	Buffer 1 or 2 Infiltration 1 Swale 1 Shallow Impoundment 1
Intensive Use Open Space (e.g., golf courses, nurseries)	2	Erosion and Sediment 2	3	Buffer 1 or 2 Infiltration 1 or 2 Fertilizer Control 1 Created Wetland 2 Wet Pond 2
Multi-housing Units	2	Erosion and Sediment 2	2	Buffer 1 or 2 Infiltration 1
Industrial <1 acre disturbed	1	Erosion and Sediment 1	1	Buffer 1 Swale 1
Industrial 1-3 acres disturbed	1	Erosion and Sediment 1	2	Buffer 1 or 2 Swale 1
Industrial >3 acres disturbed	2	Erosion and Sediment 2	4	Buffer 1 or 2 Swale 1 or 2 Created Wetland 2 or 3 Wet Pond 2 or 3

- Taken verbatim from *Storm Water Best Management Practices—Second Draft*, prepared by the Maine Department of Environmental Protection (1990)

Each matrix has two major components, which are broken down by land use type. The first is an erosion and sediment control "level to achieve," and the second is a storm water quality "level to achieve." The "level to achieve" for a given combination of land use and receiving water category is a relative, qualitative measure of the impact of storm runoff pollution. It ranges from 1 to 5, with 1 being the lowest impact and 5 being the greatest impact. For example, a multi-housing development proposed for a priority estuary watershed is given an erosion and sediment "level to achieve" of 2 and a water quality "level to achieve" of 3. By comparison, a small residential development in the same priority watershed is given an erosion control "level to achieve" of 1 and a water quality "level to achieve" of 1. In all cases, the " levels to achieve" for priority watersheds are greater than or equal to those for nonpriority watersheds.

TABLE 2-21. BMPs AND TREATMENT LEVEL CODES*

BMPs	Level of Treatment
Erosion and Sediment Control	
• One line of erosion control	1
• Two lines of erosion control	2
[illegible] Buffers	
[illegible]	1
• [illegible]	2
• 200 feet	3
Swales	1
Shallow Impoundments	1
Infiltration Systems	
• Single system	1
• Multiple systems	2
Wet Ponds	
• Single pond system holding 2.5 inches of runoff	2
• Double pond system each pond holding 2.5 inches of runoff	3
Created Wetlands	
• Single created wetland	2
• Two created wetlands	3
Street Cleaning	1
Fertilizer Application Control	1
Pesticide Use Control	1
[illegible]les with Level Spreaders	1
[illegible]llowing land that is currently impervious to become a vegetative buffer)	1

*[illegible]ken verbatim from *Storm Water Best Management Practices—Second Draft*, prepared by the Maine Department of Environmental Protection (1990)

Each matrix also addresses the types of BMPs that can be implemented for pollution control. ME DEP selected a number of BMPs and assigned each a "treatment level code" based on the expected level of pollutant removal. The "treatment level code" is a relative, qualitative measure assigned to indicate the relative pollutant removal expected from various BMPs. "Treatment level codes" range from 1 to 3, with 1 providing the lowest level of control and 3 providing the greatest level of control. The BMPs and their treatment level codes are shown in Table 2-21. As indicated, various designs for each BMP are given different treatment level codes. For example, a 50-foot buffer is given a treatment level code of 1, a 125-foot buffer is given a treatment level code of 2, and a 200-foot buffer is given a treatment level code of 3.

For a proposed development to be approved, the sum of treatment level codes for the proposed BMPs must be greater than or equal to the "level to achieve." For example, if a multi-housing unit development is proposed for a priority estuary

(erosion "level to achieve" of 2 and water quality "level to achieve" of 3, the developer could implement erosion and sediment controls (treatment level 2) and a combination of a swale (treatment level 1) and an infiltration system (treatment level 2). Additional combinations also could be implemented as long as the total "treatment level" provided is greater than or equal to the total "level to achieve." ME DEP has also recommended that at least one vegetative BMP be implemented unless the site is already 100 percent impervious. The specified vegetative BMPs are buffers, grassed swales with level spreaders, and swales.

This BMP selection system is in its early stages of implementation. Its success will depend on the ability to establish "levels to achieve" that will adequately protect the water bodies in new developments. It will also depend on the ability of treatment level codes to quantify the effectiveness of the identified control measures. Thus, the system is a technology-based approach for erosion and sediment control, as well as for storm water pollution control.

Currently, this method is outlined in a state-wide guidance document and is not a regulatory requirement. Municipal officials can incorporate this process at their discretion in subdivision regulations. This method of BMP selection requires extensive up-front work to develop the matrices and BMP levels of treatment. Once these are developed, however, this method provides a simple and direct technology-based approach to BMP selection. It has flexibility in terms of the range of BMPs that can be selected for given types of proposed development and given site constraints.

SANTA CLARA VALLEY, CALIFORNIA, NONPOINT SOURCE CONTROL PROGRAM BMP SCREENING AND SELECTION PROCEDURE

Background

In 1986, the San Francisco Regional Water Quality Control Board developed a Basin Plan for San Francisco Bay that involved regulatory activities to control point and nonpoint source discharges. This was the driving force behind initiating Santa Clara Valley Nonpoint Source Control Program. This program involves a number of local governments and county and is designed to address water quality problems in Lower South San Francisco Bay. In conducting this project, a process that closely follows the process outlined in this manual was used. The 12 steps are as follows:

- Program
- Existing Conditions
- Conduct Field Monitoring
- Define Program Objectives
- Develop Evaluation and Planning Criteria
- Inventory of Candidate Controls
- Apply Criteria to Screen Candidate Controls
- Apply Professional Judgment to Select a Practical set of Controls
- Estimate Overall Program Cost and Effectiveness
- Revise the Previously Defined Control Programs to Balance Cost, Effectiveness, and Other Factors
- Describe the Roles of Various Agencies
- Develop an Implementation Schedule.

Development of the Nonpoint Source Control Plan began in 1986 and has continued through various stages to initial implementation and preliminary assessment of effectiveness.

Watershed Description

Santa Clara County, which incorporates the entire study area, is located at the southern end of San Francisco Bay (see Figure 2-5). The watershed is approximately 690 square miles and consists primarily of the relatively flat Santa Clara Valley. Land use in the watershed is approximately 30 percent residential, 5 percent industrial (predominantly light industry associated with high technology manufacturing), and 62 percent open space. Large cities, San Jose, Sunnyvale, and Santa Clara, account for the majority of urban areas in the watershed.

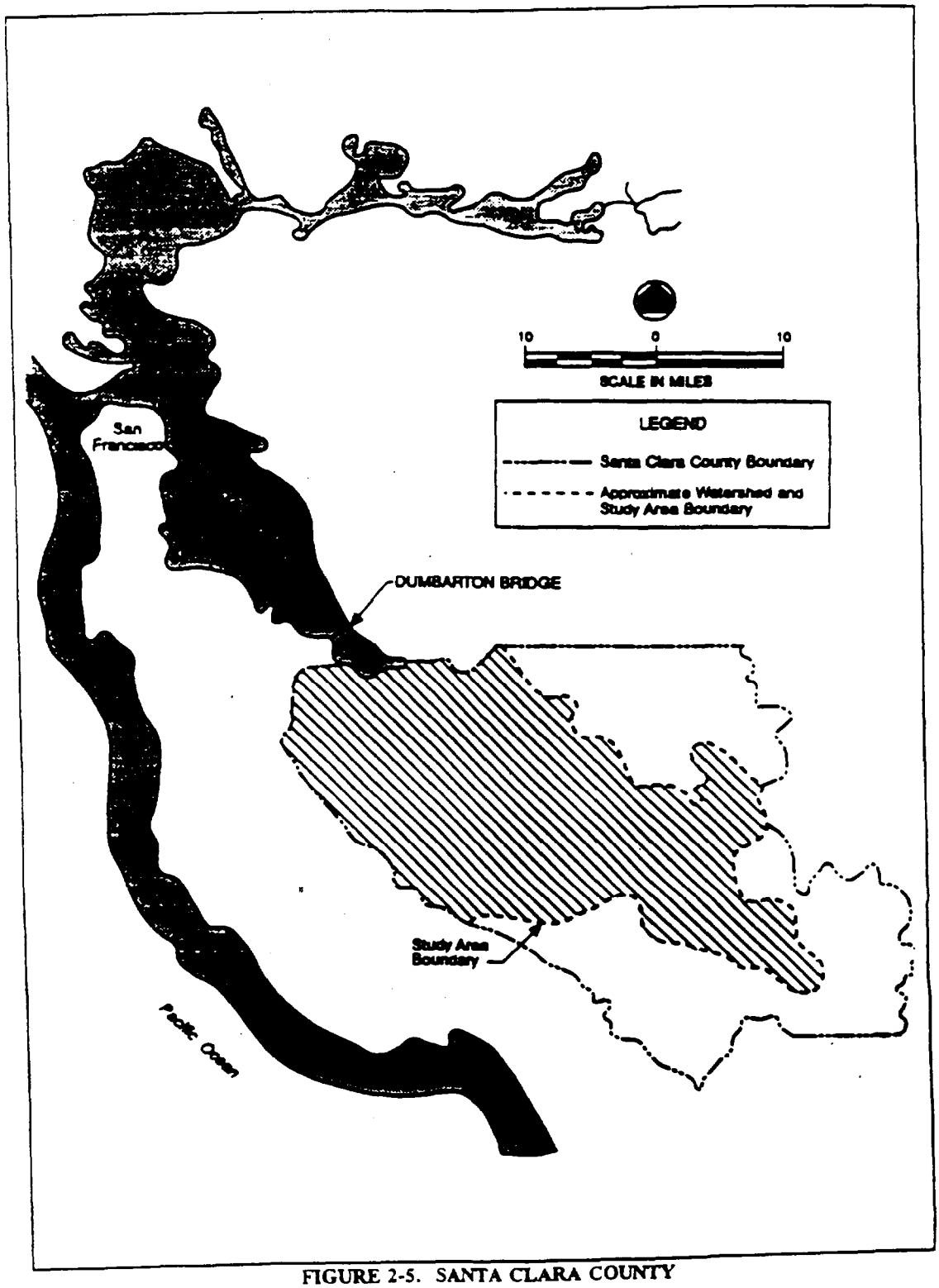


FIGURE 2-5. SANTA CLARA COUNTY

Overview of Water Quality

To characterize existing water quality in Lower South San Francisco Bay, a comprehensive monitoring program was undertaken. This program included hydrologic monitoring, wet and dry weather water quality monitoring, sediment monitoring, and biological monitoring. The monitoring was conducted primarily to determine the levels of toxic pollutants, such as heavy metals and pesticides, as well as nutrients and bacteria. Data obtained through this monitoring program were incorporated into data bases and used for developing computer models. Watershed loads were estimated using the Storm Water Management Model (SWMM), which was calibrated to the observed data gathered in the monitoring program. The data were also used to compare the relative contributions of point (e.g., waste water treatment plants) and nonpoint source pollution to the bay.

Water quality monitoring results indicated that heavy metal concentrations in receiving waters increase during wet weather due to contaminated runoff as well as resuspension of contaminated sediments. The metals primarily detected were cadmium, chromium, copper, lead, nickel, and zinc. However, copper was the primary metal regularly detected at levels greater than the EPA aquatic life toxic criterion during wet weather. The criteria were only occasionally exceeded for cadmium, lead, and zinc. Also, during wet weather, hydrocarbons and pesticides were detected in approximately 25 percent of the samples collected, while none was detected during dry weather. The limited bacteria data gathered indicated increased levels (by a factor of about 10) of fecal coliform bacteria during wet weather as compared to dry weather conditions.

int and nonpoint source contributions to water quality problems in Lower South San Francisco Bay, the showed that point sources account for approximately 98 percent of the nutrient load. However, nonpoint ource 60 to 80 percent of the load for metals and about 98 percent of the total suspended solids on a long-term basis.

Management Practice Screening

Because of the large size of the watershed and the variety of pollutants entering the Lower South San Francisco Bay, the emphasis of the nonpoint source pollution control program was on pollution prevention measures and nonstructural controls that could be implemented across municipal boundaries. Selection of appropriate pollution controls was accomplished through a process consisting of preliminary screening followed by final control measure selection (see Figure 2-6).

To screen the extensive list of potential pollution control practices, the program team first developed a list of important criteria for the selected control measures. The criteria developed for this project were:

- **Pollutants Controlled:** Emphasis is placed on controls for metals, pesticides, oil and grease, bacteria, and sediments.
- **Effectiveness:** Each control measure should contribute enough toward the overall program pollution control to warrant its inclusion.
- **Reliability/Sustain-ability:** Control measures should be effective over an extended period of time and be able to be properly implemented over time.
- **Implementation Cost:** Emphasis was placed on control measures with low planning, design, land acquisition, construction, and equipment acquisition costs.
- **Continuing Costs:** Emphasis was placed on control measures with low operation, maintenance, repair, support service, and equipment replacement costs.

- **Equatability:** Controls were evaluated regarding the degree to which costs and benefits would be considered to be equitably distributed.
- **Universality:** Controls were evaluated in terms of how universally they would have to be applied to be effective.
- **Public Acceptability:** Control measures were assessed on the expected response of agencies responsible for implementation.
- **Relationship to Regulatory Requirements:** Control measures were evaluated on their consistency with existing and anticipated regulatory requirements.
- **Risk/Liability:** Control measures were evaluated in terms of the risks or liabilities that may occur in implementation.
- **Environmental Implications:** Control measures were evaluated regarding the positive and negative environmental impacts resulting from their use.

Once the control measure criteria were listed and agreed upon, the project team developed a comprehensive list of potential control measures for implementation. The inventory of potential control measures was developed through a review of technical literature and other nonpoint source control programs. In addition, technical and managerial personnel from other State agencies, county agencies, and city public works and planning agencies were interviewed. This review resulted in a list of more than 120 separate control measures to be screened. This initial list was developed to be comprehensive, and no consideration was given to the applicability of the measures. However, once the list had been developed, obviously inappropriate control measures were eliminated. The control measures eliminated from the list at this step were primarily those designed to address specific situations that did not exist in the watershed. This initial screening reduced the list of potential pollution controls to 92.

This list of 92 control measures was then assessed qualitatively using the criteria developed earlier in the program. This was conducted by assigning each of the control measures a letter "grade" (A through F) for its ability to meet the criteria. Those measures receiving an "A" were viewed to meet all or a large number of the assessment criteria, while those receiving an "F" were viewed to meet none or very few of the assessment criteria. In this way, each of the potential control measures was assigned to a category. The control measures that fell into the category of "F" were immediately eliminated from further consideration in the Santa Clara Valley watershed.

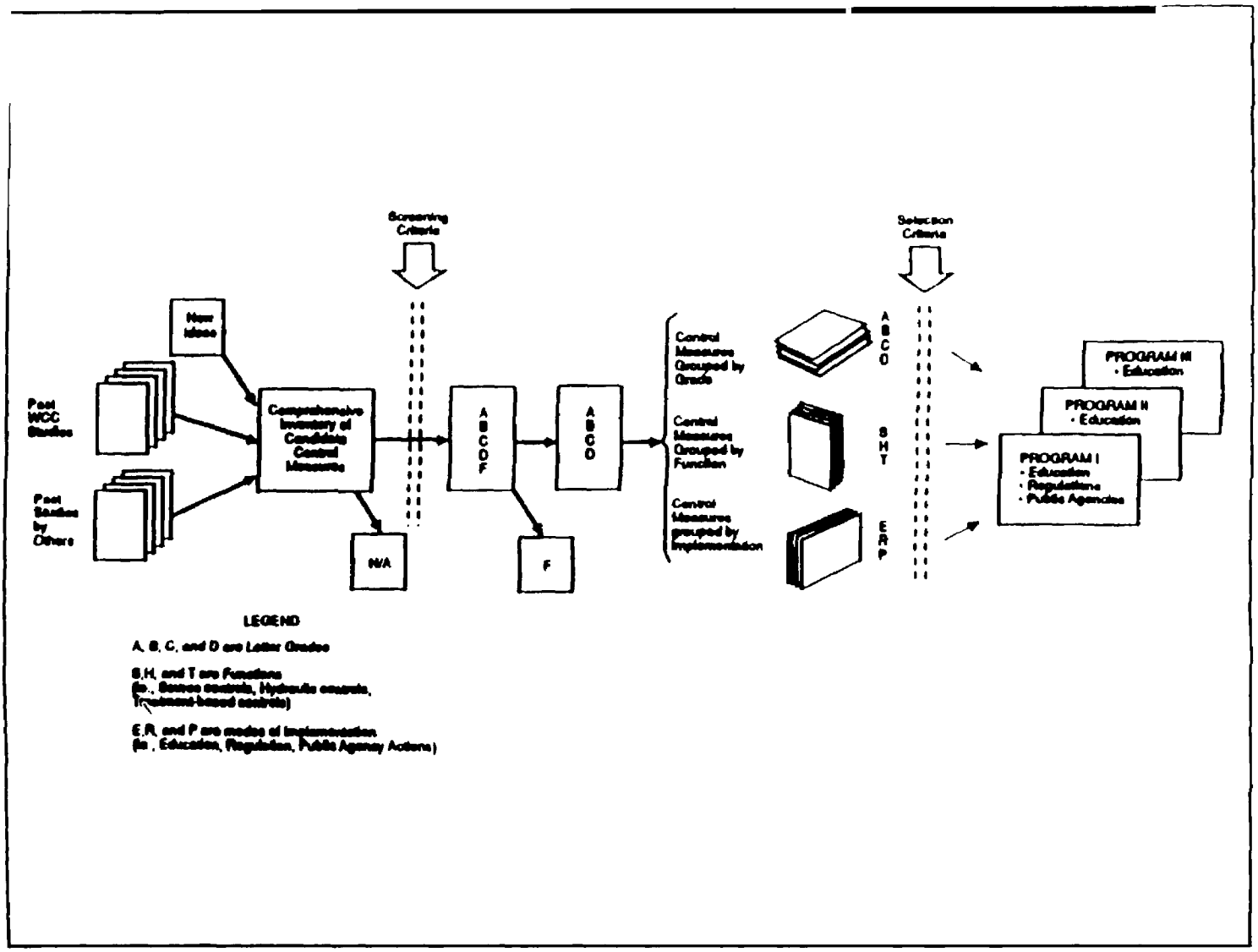


FIGURE 2-6. SELECTION OF APPROPRIATE POLLUTION CONTROLS

WAUKEGAN RIVER RESTORATION, LAKE COUNTY, ILLINOIS

The Waukegan River/Ravine system is the primary drainage for the urban areas of Waukegan. Significant point and nonpoint source discharges of storm water runoff create considerable water quality problems. Directly related to these water quality concerns are significant erosion and siltation problems occurring in various areas of the river/ravine system.

The Waukegan River/Ravine main channel and tributaries are approximately 12.5 miles. The watershed, primarily in Waukegan, is approximately 7,640 acres and receives storm water runoff from point and nonpoint discharges from an urban area with 80,000 residents. The river/ravine system has the highest population density (8.0 people per acre) of any river in Lake County. The Waukegan River discharges into Lake Michigan just east of the downtown area at a point 6,000 feet from the city's fresh water intake.

The water quality problems identified are siltation, suspended sediments, pesticides, petroleum products, and solid waste. In addition, unstable stream channels result in severe bank erosion, and damaged sewer lines along the stream channel. Stream channel instability has already broken up small sewer lines that enter the main sewer (buried in the floodplain along the stream).

In response to these problems, a number of implementation activities have occurred. The Lake County Storm Water Management Commission developed a model environmental storm water strategy and is implementing a nonpoint source pollution awareness project. This strategy is a watershed-based, multiobjective approach that considers all the environmental values associated with surface water. This comprehensive strategy includes a complete coordinated system addressing program operations, planning design, construction, finance, maintenance, and regulations. In addition, the strategy addresses prevention, remediation, and maintenance.

A specific program to restore this area includes the restoration of urban streambanks through the development of technical and legal procedures for urban stream management and training of local government employees in the bioengineering techniques of vegetative stream stabilization. Also, to improve water quality in the Waukegan River, an aerator was installed and an illicit connection program is proposed.

The purpose of the storm water pollution prevention awareness project is to increase the awareness of urban storm water pollution problems in Lake County, Illinois, through pollution prevention advertisements (e.g., messages, graphics, and photographs) on billboards, buses, and bus stops. The advertisements will address such urban runoff issues as gasoline spills on pavements, storm drains clogged by debris, sediment runoff from construction sites, erosion of urban stream banks, and runoff of phosphate detergents into storm drains. Preventive actions will include storm drain stenciling programs and recycling of motor oil.

An intensive 10-year monitoring and evaluation program has been implemented to demonstrate and evaluate the effectiveness of the storm water best management practices (BMPs) implemented in the Waukegan River watershed. This monitoring effort focuses on the impacts of the storm water pollution control program on urban fisheries and stream habitat.

Identification of Water Quality Problems

Physical Setting

Lincoln Creek is a 9 mile high gradient warm water stream in the Milwaukee River South Watershed. The Milwaukee River drains into Lake Michigan. The creek's drainage area, the City of Milwaukee, is mostly urbanized.

Land Use

Lincoln Creek is the largest urban subwatershed in the Milwaukee River South Watershed, draining 12,600 acres. This subwatershed is entirely urban, although there are large areas of recreational and open space land, including a U.S. Army tract, the State's Havenwoods Forest Preserve and Nature Center, the Milwaukee County Lincoln Creek Parkway, and golf courses and municipal parks.

Residential lands dominate the subwatershed. High density residential areas cover 35 percent of the subwatershed and multifamily residential areas cover an additional 15 percent. Industrial areas cover 12 percent and commercial areas 7 percent of the subwatershed. Most of the subwatershed is contained within the city of Milwaukee. However, a small portion is contained within the city of Glendale and includes primarily industrial and multifamily land uses.

Project Area Size

The Lincoln Creek drainage area is about 20 square miles (12,600 acres), and the entire area is urbanized. The breakdown for some of the land uses is high density residential (35%), multifamily residential (15%), industrial (15%), and commercial (7%).

Critical Areas

Critical land uses were identified using the Source Loading and Management Model (SLAMM). Critical areas were those that had the highest annual loads of sediment and lead. Lead was considered an indicator for other toxic pollutants. High density residential, industrial, multifamily residential, and commercial land uses contributed most of the sediment and lead loads. The Lincoln Creek drainage area was the most important source of toxic pollutants in the Milwaukee South Watershed. There are 24,000 feet of eroding streambank, which produces about 430 tons of sediment each year. Construction sites are another critical source of sediments.

Water Resource Condition

The lower portion of Lincoln Creek has the potential to support a warm water sport fishery, while the upper portions have the potential to support a warm water forage fishery. All sections of the creek have the potential to support partial body contact water recreation.

However, none of the potential uses of the creek are being attained. Recent surveys of the creek have found it to be highly degraded. Only two fish species (fathead minnow and sunfish) were found in the middle portions of the creek in 1992 and both species are pollutant tolerant. Lincoln Creek should support a diverse fish community of at least 15 fish species.

Lincoln Creek is almost entirely channelized, with the channel alternating between concrete and earthen sections. Channel modifications and frequent high storm water flows contribute to the low biological activity observed in the creek.

Levels of petroleum aromatic hydrocarbons (PAHs), heavy metals, fecal coliform and suspended solids, and other pollutants increase significantly during runoff events. Some pollutants, like PAHs, reach levels high enough to exceed water quality standards. Based on EPA criteria, the bottom sediments are moderately or heavily polluted with heavy metals and PAHs.

Crayfish tissue is highly contaminated with PAHs. Mortality was observed in fathead minnows exposed to Lincoln Creek water for more than 15 days. Traditional acute and chronic bioassays did not indicate any toxicity.

Problems in the creek are caused by poor habitat, increased flows, and high levels of pollutant loading.

BMPs, such as wet detention basins, are proposed in the priority watershed plan to address these problems.

Storm water pollution control objectives for Lincoln Creek include:

1. Restore the forage and sport fish communities by improving the habitat and water quality.
2. Improve the recreational uses.
3. Reduce the loadings of pollutants to the Milwaukee River and Lake Michigan.

Watershed Plan

The implementation plan for Lincoln Creek is part of the Milwaukee River South Priority Watershed Plan, which was implemented in 1991.

One of the recommendations in the watershed plan has been implemented—the preparation of a storm water management plan. The storm water management plan provides detailed information about the management alternatives for Lincoln Creek. Critical land uses are identified by sewershed instead of the whole drainage area. A major effort is put into determining the feasibility of installing the structural practices recommended in the watershed plan and locating sites for installing the wet detention basins.

Inventory Results

Existing urban land uses, future urban land use, construction sites, and eroding streambanks were the urban sources of pollutants evaluated during the preparation of the priority watershed plan. The inventory of the urban land uses was designed to quantify the acres and the development characteristics of each land use. Existing land use categories were delineated on 1" = 400' scale, aerial photographs were digitized, quantified, and mapped by the Southeastern Wisconsin Regional Planning Commission.

Annual pollutant loadings of sediment, phosphorus, and lead were calculated for existing and planned land uses by running SLAMM. Input parameters for SLAMM included the acres of each land use and the development characteristics, such as the percent connectedness. SLAMM was also used to evaluate the effectiveness of different BMPs on the existing and future urban areas.

Lincoln Creek receives an annual lead loading of about 8,000 pounds. Major land uses contributing to the elevated lead levels are: high density residential (33%), industrial (32%), multifamily residential (14%), and commercial (14%). Future development could increase lead loads by 21 percent. These same land uses also contribute relatively large amounts of other toxicants, such as PAHs and heavy metals.

Runoff from construction sites and streambank erosion annually contribute about 6,500 tons of sediment to the stream. Sediment loads are expected to decrease as the remaining planned areas are developed.

Storm water flows have adverse effects on the creek. High flows cause flooding, bottom scour, and streambank erosion. The Milwaukee Metropolitan Sewage District is evaluating alternative measures for reducing flows in the creek.

Pollutant Reduction Goals

Pollutant reduction goals were based on the needs of the stream. A different approach was taken to establish the reduction goals for each type of problem.

Sediment and Phosphorus

An overall 50 percent reduction in the existing sediment loading is needed to improve the habitat in the creek. Implementation of the storm water pollution control program should reduce the sediment load from construction sites by about 75 percent.

A high reduction of phosphorus (50% to 70%) is needed to reduce the excessive aquatic plant growth in the Milwaukee River and reduce the threat to Lake Michigan.

Storm Water Pollutants

Lead is being used as an indicator pollutant for the other toxic pollutants. Although the State of Wisconsin does not currently use numeric effluent limits to regulate storm water, the pollutant reduction goals for lead were based on meeting the chronic toxicity standards in the Wisconsin Administrative Code. The average annual concentration of total lead in the Milwaukee River exceeds the chronic toxicity standard by 50 percent for surface waters. The proposed pollutant load reduction goal for lead in Lincoln Creek is 50 percent.

By combining the output of SLAMM with a Probabilistic Dilution Model for the creek, the frequency with which the chronic toxicity standard for a number of pollutants is exceeded in Lincoln Creek. The models will assist in determining the amount of reduction needed to significantly lower the probability of exceeding the chronic toxicity standards. The Probabilistic Dilution Model was developed by the EPA and is a good technique for estimating the amount of pollutant reduction needed.

Stream Flow

Specific goals will be established by the Milwaukee Sewage District; however, there are three basic hydrologic goals that must be considered.

1. Maintain baseflow in the creek as much as possible.

2. Reduce stream flows to prevent streambank erosion and bottom scour.

3. Maintain peak flow discharge for 2-year 24-hour storm at predevelopment conditions.

Bottom Sediments

Bottom sediments are heavily polluted. Although a specific reduction goal has not been determined for the bottom sediments, the watershed project has a goal of reducing the levels of pollutant in the bottom sediments.

Management Practices

BMPs are those practices identified in the Wisconsin Administrative Code and are referenced in the Milwaukee River South Watershed Plan to be the most cost-effective controls for storm water pollutants. SLAMM was used to evaluate the effectiveness of wet detention basins, infiltration devices, street sweeping, and roof top disconnection for both existing and future urban areas. Pollution prevention measures were also suggested for controlling construction site erosion and streambank erosion.

Following is a list of BMPs proposed in the storm water management plan.

Best Management Practice	State Cost-Share Rate
Critical Area Stabilization	70%
Grade Stabilization Structure	70%
Shoreline and Streambank Stabilization	70%
Shoreline Buffers	70%
Wetland Restoration	70%
Structural Urban Practice	70%
Street Sweeping	50%

A high level of control is needed to achieve the pollutant reduction goal for lead. All of the critical land uses in established areas would have to be controlled with structural practices, such as wet detention basins or other structural practices.

About 90 one-acre wet detention basins will be needed to treat all the critical land uses in Lincoln Creak. Street sweeping could be used as an interim practice before all the structural practices are built. About 14,000 curb miles of streets would need accelerated sweeping schedules. Twelve one-acre ponds would be needed to treat all the land uses in the planned areas.

Using structural practices in the existing and planned areas would also achieve the pollutant reduction goal for sediment. However, the watershed plan also recommends the implementation of construction site erosion and streambank protection practices. These practices will provide greater than 50 percent reduction before the structural practices are completed.

The watershed plan assumes that an effective construction erosion program will be in place for the cities to obtain cost-share dollars. Erosion control practices standards and applicability criteria should be consistent with those set forth in the *Wisconsin Construction Site Best Management Practice Handbook* (DNR, 1989). Cities in the Lincoln Creek drainage area are required to effectively administer and enforce their existing ordinances.

Control of streambank erosion will require a combination of streambank protection practices. The Cities of Milwaukee and Glendale plan to control peak flows to help protect their streambanks. The Milwaukee Metropolitan Sewage District is preparing a comprehensive stream corridor management approach for Lincoln Creek. The approach will consider flow reduction, alternative approaches for stabilizing eroding streambanks, and rehabilitation of the concrete stream sections.

Construction on the stream corridor will have the most impact on the quality of Lincoln Creek in the near future. Monitoring the proposed project will document the effectiveness of improving the stream corridor. The changes should occur over the

next 3 years, while other practices will take longer to bring about significant changes in the water quality of the creek. Urban education is also a practice recommended in the watershed plan.

Institutional Roles and Responsibilities

Wisconsin Department of Natural Resources

The Wisconsin Department of Natural Resources (WDNR) will have both administrative and monitoring responsibilities for the Lincoln Creek Evaluation Monitoring Project. The administrative role is defined as part of the Department's role in the Wisconsin Water Pollution Abatement Program.

Administration

Administration of the project began by following a selection process. After the project was selected, WDNR worked with Wisconsin Department of Agriculture Trade and Consumer Protection, the cities, and counties to prepare a watershed plan. Implementation of the plan is based on the guidance in the plan.

The Department is working with the Cities of Milwaukee and Glendale to develop cost-share agreements for the practices recommended in the plan. Grant requests will be reviewed by the Department. Interpretation of the State statutes, administrative rules, and watershed plans is provided by the Department.

Financial Support

Financial support for implementation of watershed projects is provided by local assistance agreements and a nonpoint source grant agreement. The cost of implementing all rural and urban practices in the Milwaukee River South Watershed Project is between $89,000,000 and $159,000,000. The State share is about $18,000,000. Installation of the structural practices in existing and future areas in Lincoln Creek will cost between $36,000,000 and $74,000,000. The State share of this cost is about $5,000,000. Total cost of street sweeping each year would be about $350,000. Development of storm water management plans for Lincoln Creek cost about $1,000,000. Most of the cost for the implementation of the watershed plan is for the structural practices. State funds are available to cover the State's share of the cost.

Project Evaluation

Project evaluation will involve the collection, analysis, and reporting of information needed to track the progress of the project. The categories of evaluation include administrative accomplishments, pollutant reduction, and water quality improvements. The local units of government will report annually on the progress of core and segmented program activities. Information will also be provided on financial expenditures and time spent on project activities.

Technical Assistance

The WDNR will provide technical assistance to the local units of government on the design and application of BMPs.

Monitoring Responsibilities

Fish, habitat, and macroinvertebrate sampling will be the responsibility of the Department. Field work will be done by crews supervised by the Department's Bureau of Research.

Stakeholders

Local Units of Government

Each local unit of government will have a number of responsibilities for the core and segmented programs.

University of Wisconsin Extension

Area extension agents will provide support in developing and conducting a public information and education program.

Milwaukee Metropolitan Sewage District

Sewage districts have all the privileges and responsibilities of cities, villages, and counties when participating in the program.

Landowners and Land Operators

In some situations, private landowners will install practices on their property.

United States Geological Survey

All of the chemical and physical monitoring will be the responsibility of the U.S. Geological Survey (USGS). Peter Hughes will be the project manager for the USGS.

REFERENCES

Binder, N.G. 1996. *New Jersey Funding Status*. Proc. Wet Weather Flow Control Semin., New Jersey Water Environ. Assoc., Newark, NJ.

Botts, J., Allard, L., and Wheeler, J. 1996. *Structural Best Management Practices for Storm water Pollution Control at Industrial Facilities* Proc. WATERSHED 1996 MOVING AHEAD TOGETHER: Tech. Conf. Expo., Baltimore, MD, Water Environ. Fed., 501

Camp, Dresser & McKee et al. 1993. *California Storm Water Best Management Practice Handbook (Municipal).* California State Water Quality Board.

City of Charlotte, North Carolina. 1992. *Part 2 NPDES Storm Water Permit Application.*

City of Seattle, Washington. 1992. *Part 2 NPDES Storm Water Permit Application.*

City of Virginia Beach, Virginia. 1992. *Part 2 NPDES Storm Water Permit Application.*

Driscoll, E.D., P.E Shelley, and E.W Strecker. 1989. *Pollutant Loadings and Impacts from Highway Storm Water Runoff.* McLean, VA: Federal Highway Administration, Office of Engineering and Highway Operations Research and Development.

Driver, N.E., and G.D. Tasker. 1990. *Techniques for Estimation of Storm-Runoff Loads, Volumes, and Selected Constituent Concentrations in Urban Watersheds in the United States.* Denver, CO: U.S. Geological Survey. Open-File Report 88-191, Water Supply Paper #2363.

Freeman, W and Fox, J. 1995. *ALAWAT: A Spatially Allocated Watershed Model for Approximating Stream, Sediment, and Pollutant Flows in Hawaii, USA* Environmental Management, Volume 19, No. 4, pp. 567-577.

Henkin, T. and Mayer, J. 1996. *Financing National Estuary Program Comprehensive Conservation and Management Plan: How to Identify and Implement Alternative and Financing.* Proc. WATERSHED 1996 MOVING AHEAD TOGETHER: Tech. Conf. Expo., Baltimore, MD, Water Environ. Fed., 501

King County Surface Water Management Division. 1992. *Part 2 NPDES Storm Water Permit Application.*

Intergovernmental Task Force on Monitoring Water Quality. 1995. *The Strategy for Improving Water-Quality Monitoring in the United States.*

Lincoln Creek Subwatershed, Milwaukee, Wisconsin—A Case Study.

Maine Department of Environmental Protection, 1990. *Storm Water Best Management Practices—Second Draft.* December

Pitt, Robert. 1989. *SLAMM 5—Source Loading and Management Model: An Urban Nonpoint Source Water Quality Model, Volume I: Model Development and Summary.* University of Alabama at Birmingham.

Prince George's County, Maryland. 1992. *Part 2 NPDES Storm Water Permit Application.*

Schueler, T. 1987. *Controlling Urban Runoff: A Manual for Planning and Designing Urban BMPs.* Metropolitan Washington Council of Governments.

Schueler, T. 1994. *The Stream Protection Approach.* Metropolitan Washington Council of Governments.

Singelis, N.D. 1996. *Financing Priority Watershed Projects with the State Revolving Fund.* Proc. WATERSHED 1996 MOVING AHEAD TOGETHER: Tech. Conf. Expo., Baltimore, MD, Water Environ. Fed., 501

Tasker, G.D., and N.E. Driver. 1988. *Nationwide Regression Models for Predicting Urban Runoff Water Quality at Unmonitored Sites.* Water Res. Bull. 24(5):1091-1101.

Terrene Institute. 1992. *Decisionmaker's Storm Water Handbook.*

U.S. EPA. 1982. *Hydrological Simulation Program—Fortran (HSPF).* EPA 600-3-82-046.

U.S. EPA. 1983. *Results of the Nationwide Urban Runoff Program,* Volume 1, Final Report. Water Planning Division, Washington, DC. OCLC 16766955.

U.S. EPA. 1987a., Office of Water Regulations and Standards. *Setting Priorities: The Key to Nonpoint Source Control.* PB 88-243951

U.S. EPA. 1987b. Office of Water. *Controlling Nonpoint Source Pollution: A Guide.* PB 93-234292.

U.S. EPA. 1988. *Storm Water Management Model (SWMM) Version 4, Part A: User's Manual.* EPA 600-3881-001A.

U.S. EPA. 1989. *Rapid Bioassessment Protocols for Use in Streams and Rivers.* EPA 440-4-89-001.

U.S. EPA. 1991. *Guidance Manual for the Preparation of Part 1 of the NPDES Permit Applications for Discharges from Municipal Separate Storm Sewer Systems.* EPA 505-9-91-003A.

U.S. EPA. 1992a. *Guidance Manual for the Preparation of Part 2 of the NPDES Permit Applications for Discharges from Municipal Separate Storm Sewer Systems.* EPA 833-B-92-002.

U.S. EPA. 1992b., Office of Water. *Compendium of Watershed-Scale Models for TMDL Development.* EPA841-R-92-002.

U.S. EPA. 1993a. Office of Research and Development. *Urban Runoff Pollution Prevention and Control Planning.* EPA 625-R-93-004.

U.S. EPA. 1993b. *Guidance for Specifying Management Measures for Sources of Non Point Pollution in Coastal Waters.* EPA 840-B-92-002

U.S. EPA. 1993c. *Storm Water Management Model (SWMM) for Microcomputer.* PB 95-504577.

Waukegan River Restoration, Lake County, Illinois—A Case Study.

Weart, Thomas. *Developing the Watershed Plan.* U.S. Department of Agriculture/Soil Conservation Service.

REFERENCES

Western Aquatics, Inc., and North Carolina Division of Environmental Management. *North Carolina's Whole Basin Approach to Water Quality Management: Program Description (Draft).*

Wisconsin Department of Natural Resources. 1989. *Wisconsin Construction Site Best Management Practice Handbook.*

Woodward-Clyde Consultants. 1992. *Santa Clara Valley Nonpoint Source Control Program: Annual Report.*

Woodward-Clyde Consultants. 1991. *Santa Clara Valley Nonpoint Source Control Program: Storm Water Management Plan (Draft).*

Woodward-Clyde Consultants. 1990. *Urban Targeting and BMP Selection, an Information and Guidance Manual for State NPS Program Staff Engineers and Managers*, Final Report.

Yu, S.L. 1993. *Storm Water Management for Transportation Facilities*, National Cooperative Highway Research Program Synthesis of Highway Practice 174, Transportation Research Board, National Research Council.

CHAPTER 3

GUIDANCE ON COMPLETING ADMINISTRATIVE REQUIREMENTS

INTRODUCTION

Chapters 1 and 2 summarized the municipal storm water management program regulatory requirements and guidance for municipal officials to rank storm water management activities for maximum cost effectiveness. This chapter discusses the administrative requirements of a municipal storm water management program. These requirements include public information and participation campaigns, fiscal resources, and annual assessment reports.

Public information and public participation programs are essential to the implementation of an effective municipal storm water management program. The key points to consider in developing this component of the program include creating appropriate goals and objectives, targeting the proper audience, explaining and selling the program to the audience, and having the necessary equipment and staff for proper program implementation. The availability of fiscal resources is another essential component of municipal storm water management programs. Several funding options are available to municipalities: local funding mechanisms, matching fund programs, and grant programs. In addition, to implement an effective program, an assessment of the program must be developed annually and submitted to the permitting authority. This assessment allows the permitting authority and municipality to critique the effectiveness of the program and to make any necessary changes.

PUBLIC INFORMATION CAMPAIGNS

Developing Goals and Objectives

The program's goals and objectives will form the framework for developing public information and participation efforts. Program goals are usually general and should include the essence of a program's purpose. They should also include some measure of the expected outcome. An example goal might be "to protect our watershed by linking and supporting citizens and organizations that are working locally for protection of wetlands and water quality."

Objectives are more specific and should identify actions or activities to be taken at the program-operations level. They focus the broad vision of the goal to something that can be accomplished through organizational resources. An example of an objective is "to publish and distribute four 12 to 16-page wetland journals by June 1, 1994."

To accomplish these goals and objectives, everyone involved in the program must be given the opportunity to participate and contribute and agree on the ideas. To ensure cooperation, the benefits should be explained. Otherwise, goals and objectives will not be important to the staff and will not be considered seriously when implementing the program. Also, because people may interpret goals differently, it is essential to develop the goals and objectives jointly

with the staff through a meeting or other forum that is appropriate in your organization and to make sure that everyone understands them.

Identifying the Target Audience

When developing a public education campaign, it is critical to identify the target audiences and develop materials accordingly. Target audiences are groups that have common characteristics, such as age, culture, socioeconomic background, language, and the educational level of the community or watershed. Learning more about the target audience will assist the staff in developing an effective outreach program. To reach the target audience, you must know specifically who it comprises and what common traits they share. This involves breaking groups down into subgroups that exhibit similar characteristics or traits. For example, construction contractors who are likely to have projects within your municipality or residents who change their own oil can be targeted. Some likely target audiences include:

- Members of industrial categories (e.g., landfills)
- Developers
- Construction contractors
- Auto repair shop owners
- Environmental groups (e.g., Adopt-a-Stream, local chapters of Sierra Club, Audubon Society)
- Community groups (e.g., churches, Boy and Girl Scouts, Jaycees)
- Non-English speaking residents
- Outdoor recreation groups (fishermen, garden clubs)
- Homeowners
- Students
- Legislators, other programs and agencies.

Identifying and learning about target audiences allows messages and programs to be developed in a way that will reach and influence these subgroups. The following contacts can provide more information about the target audiences in your community:

- Chamber of Commerce for information on the interests of local business people and what types of materials are most useful to them

- Other government agencies that interact with groups similar to those you will target (e.g., planning department for a list of construction contractors who have received building permits or an economic development department to learn about certain industries)

- Tax records or zoning records to find industrial and commercial facilities

- Wastewater treatment plants for a list of industry types, facility sizes, and potential pollutant sources

- Board of Education to identify ongoing school programs and methods for contributing to school programs and curricula

- Libraries to find local and State magazines and newsletters directed at specific audiences (e.g., environmental and outdoor recreation topics)

- Agency public information and professional associations.

"Selling" the Storm Water Program

Educating the public about a new regulatory program and getting them involved with its implementation are among the most important factors for ensuring program success. Issues such as regulatory deadlines and implementation procedures all depend on educating both the regulated community and the public at large. A key element of the municipal storm water management program is to help communities understand the importance of the storm water program and citizens' participation in improving water quality.

When creating public outreach materials, the storm water management program goals must be clearly communicated and the importance of accomplishing these goals explained. This is especially true in cases where municipalities intend to impose a utility fee for the storm water program. Municipalities may encounter opposition to a new fee if the benefits of the program are not understood. In such cases, it is important to obtain public and political support for the program through education.

One of the biggest political obstacles that municipalities face is that the impacts of polluted storm water runoff may not be obvious. For example, a water body that has been overloaded with sediment from an upstream construction activity may look fine to the casual observer when, in fact, the fish and plant life has been harmed significantly. Once an awareness of both the sources and impacts of water pollution is created, educational programs can be developed to motivate the public to effect positive changes in their daily activities, thereby reducing the addition of pollutants to receiving waters.

Information intended to educate the target audience should include solutions as well as explanations of the issues. Simply providing people with information may not make them change their attitudes and rarely makes them change their behavior. People need to know more about the solutions and action that they can take. Education efforts, therefore, should present the reasons why the program is important and focus on actions that citizens and businesses can take to prevent increases in pollution of storm water. Examples of successful outreach materials that provide information and solutions are included at the end of this chapter.

Developing Outreach Materials

Specific education activities can include disseminating information through flyers included in residential utility bills; interactive methods, such as workshops; open houses at industrial facilities; school curricula materials; or talks or slide shows for schools and community groups. Whichever activities you use, communication should strive to be interactive and allow for feedback to those implementing the program. For example, written materials become interactive when a telephone number to receive further information is provided. Keeping track of the number of callers and the questions they have also provides a way to judge the effectiveness of the materials. Some examples of communication methods that can be used to publicize public involvement are given in the following list:

- TV public service announcement
- TV news story
- Radio public service announcement
- "Freebies (i.e., bumper stickers, magnets)
- T-shirts, hats, etc.
- Workshops

- Radio news story
- Newspaper advertisement
- Newsletter
- Fact sheet
- Pamphlet
- Storm drain stencils (e.g., "Dump No Waste, Drains To Lake")
- Magazines
- Magazine advertisement
- Magazine article
- Billboard
- Community meetings
- Church meetings
- School meetings
- One-on-one personal contact
- "Event" days
- Opinion leaders (i.e., community leaders, parents, teachers)
- Fairs
- Libraries
- Books
- Transit cards (i.e., in buses)

Table 3-1 presents positive and negative characteristics of several outreach options.

Many outreach materials already exist that you may borrow ideas from or incorporate directly into your storm water management program. One particularly good source of public education materials is a guidance manual entitled, *Urban Runoff Management Information Education Products*, developed by EPA Region 5, Water Division, and EPA Office of Wastewater Enforcement and Compliance, February, 1993. This document describes specific materials (booklets, books, bumper stickers, catalogs, citizen action guides, computer software, fact sheets, handbooks, newsletters, pamphlets, posters, slide shows, student activities, and videos) and how to obtain them. It is available from the EPA Office of Water Resources Center, (202) 260-7186.

Outreach materials should use clear, concrete language and, where possible, incorporate graphics. The goal is to design effective materials that people pay attention to, remember, and use. Effective materials should persuade people to behave in a more environmentally friendly manner and to influence others to do the same. The ideas discussed below should help you create interesting materials that will attract public attention, encourage community action, and ultimately make a positive impact on environmental conditions in your area.

When crafting outreach materials, remember to use concrete language that helps people to understand, visualize, and remember information. Here are some tips:

- Do not use jargon or technical, scientific language.
- Use anecdotes and examples. Tell a story to draw you reader in and to add more "human interest."
- Use analogies.
- Use descriptive adjectives and adverbs.
- Use active verbs.

- Try to visualize what you are saying.
- Use graphics to illustrate and highlight what you are saying.
- Describe consequences of action (or no action) in terms of an individual, family, or business rather than using a broader term, such as "the public."

The format and layout of the materials will also influence the readers reaction to the information. Materials should be designed to help the reader find information quickly and easily. An audience that is confused or overwhelmed will be less likely to read and remember the message of the materials. Even though you may have many important points to make, try to avoid crowded pages with small type and little white space. Important information can be highlighted by using bullets, boxes, side-bars, or shading to highlight it. For example, side-bars with the following heads will capture the reader's attention: "Things You Can Do To Help" or "Where to Get More Information." An appealing layout and easy-to-read type will greatly increase the chances that your materials will be read. Special type fonts, bold, italics, or colors can be used for titles, headings, or, occasionally, extra emphasis. A medium-weight type that is large enough, usually 10 point and above, is more easily read. Selected examples of outreach materials that are easy to read are included at the end of this chapter.

Graphics can enhance the program materials by capturing attention and providing a simple visual picture of important information. A good rule of thumb is to keep graphics simple and portray images that the reader shall remember. For example, to influence people to dispose of hazardous waste properly, a person pouring oil down the storm sewer should

TABLE 3-1. CHARACTERISTICS OF SELECTED MEDIA

Media Format	Channel	Pros	Cons
Newsletters	Mail, handout	Can reach a large audience	Printing/mailing is costly
		Can be more technical	Staff time
			Passive, not participatory
Videotape	Workshops	Can reach a large audience	Relatively expensive
	Mail	Visually pleasing	Must be done well
	Cable TV	More participatory	
		Can show behavior	
Public Service Announcements	TV	Free	Sometimes aired at night
	Radio	Can reach a large audience	Competition for air time
		Can target audience	Very passive
			Difficult to evaluate
Mass Media	TV	Can reach a large audience	Constrained by time, space
	Radio	Good for raising awareness	Must be "newsworthy"
	Newspapers	Usually considered credible	Cannot explain complex issues
			Bad for persuasion
Presentations	Workshops	Can be participatory	Reach smaller audience
	Conferences	Good for persuasion	Staff time
	Group meetings	Can show behavior	Can be too technical
		More personal	People may not attend
Exhibits	Libraries	Can reach a large audience	Staff time
	Malls	Visually pleasing	Must be durable
	Fairs		
Freebies (i.e., bumper stickers, buttons, magnets, hats, etc.)	Fairs	Increases awareness	Very short message
	"Event" days	Inexpensive	Weak on persuasion
	Easy to produce		

not be used (even if the text is talking about the hazards of doing so). A picture of a person taking the waste to a proper collection site would be more effective. The following list provides further tips on using graphics effectively:

- Large illustrations are better than small ones.
- Photographs are more effective than sketches.
- If sketches are used, simple, clear, realistic ones are better than cartoons or more abstract drawings.
- A large photo at the beginning of an article draws the reader in.
- Bright colors are useful because they attract our attention.
- Pictures grouped together have greater interest than pictures scattered throughout an article. They can also the be used to "tell a story."
- Graphics are especially useful for showing "how to" type information.

Meeting Staffing and Equipment Needs

Consider the resources allocated to your storm water management program. What kind of budget do you have to spend on production and distribution? How much time do you have? How many staff people are available and what are their skills and expertise? Is it possible to get help from citizen volunteers for development and distribution of materials? Producing your communication materials may be a major cost of your program. Make sure that you have enough resources to produce sufficient quantities of your material and to distribute them in your community.

Consider the number of people that need to be reached as a function of the amount of available money. A "cost-per-person" can be calculated by dividing the total cost of production by the number of people being targeted. This will allow comparison of different communication strategies on a cost basis.

PUBLIC PARTICIPATION PROGRAMS

Public education and participation efforts often go hand-in-hand, but public participation may require additional coordination efforts and can present unique challenges to those implementing the storm water management program. The benefits of involving the public in the implementation of the storm water program are many:

- If the public is encouraged to participate in the decisionmaking process of the program, their support for the program will likely increase.
- Large numbers of community members can watch over more of a watershed or municipality than a handful of regulators.
- The public is often the primary source of reports of illicit connections and illegal dumping to storm drains.

- Only the homeowners and residents can implement pollution prevention practices on their residential properties.

- Public volunteer efforts will save staff resources.

With proper training, citizens (e g , community groups, local colleges, and high schools) can also be included in field screening and sampling portions of the storm water management program. This can possibly reduce the labor required to perform a large-scale dry-weather screening program or at least locate more discharges than could be done by staff alone. In addition, dischargers would be constantly reminded that the public is watching and has access to the system, thereby encouraging compliance with the municipality's management program. To take full advantage of the public participation watchfulness in dry-weather screening programs, municipalities can develop reporting criteria and procedures for the public to follow. The information needs to be clearly stated, public participation should be voluntary, and the city should not be liable if someone is injured in attempting to collect information. The reporting procedures can be similar to crime-watch or fraud-reporting programs and can even include a hotline for the public to report illegal dumping.

Coordination and Integration

Many water quality programs already exist at the local, State, and Federal levels. It is essential, therefore, that storm water management efforts be coordinated with these existing programs so that you are not repeating efforts. By coordinating with other agencies, non-profit groups, industry associations, chambers of commerce, and other citizen groups, you will not only save resources but will also build a coalition of supporters for the program. It may even be possible for your agency to take the lead in identifying all relevant programs and orchestrating them into an effective, comprehensive program with a focus on water quality improvement.

Resources and existing programs do not need to be strictly environmental in focus. For example, in Prince George's County, Maryland, the Police Community Relations Program will incorporate water pollution control information into their outreach program. In this way, the enforcement of water quality regulations will be enhanced through integration between police and water quality specialists.

Program C[illegible]nents

Public participation efforts contribute to the success of the storm water management program by educating other citizens and promoting responsibility for, and interest in, the preservation of water quality. This, in turn, will help generate public and political support for the storm water program. The municipality staff may save certain resources, but will have the added responsibility of communicating with other groups and programs, coordinating and training volunteers, and organizing public events. The following efforts, among others, have contributed to the success of various public participation programs:

- Partnerships with civic organizations, such as with the Boy Scouts and Girl Scouts to stencil storm drains

- Neighborhood representatives to educate their neighbors about the effects of household chemicals, such as fertilizers, herbicides, and cleaners, and alternatives homeowners can use and proper disposal methods

- Citizen watch and reporting programs

- Citizen advisory groups to help create and establish local ordinances
- Household hazardous waste collection days
- Stream and lake cleanup campaigns.

CASE STUDIES

The following pages present case studies of selected municipalities and their public information and public participation programs.

SANTA CLARA COUNTY, CALIFORNIA

The overall goal of Santa Clara County's public outreach eff is to educate its target audiences about the significance of ster er pollution. The objectives of the program a to elicit public support through volunteer efforts, to enco ges in everyday chemical usage and disposal habits, and to generate political support for the storm water manag gram in general. The target audiences include households, small businesses, large industries, educatio s, private and public waste management programs and facilities, environmental groups, community/ d groups, and local governmental offices. Specific education campaigns address:

- Prope llutants that would otherwise enter storm drains and channels
- Control of leaks and spills from automobiles, trucks, and storage tanks
- The role of atmospheric emissions in generating nonpoint source pollution
- The need to promote better site runoff and sediment control.

Many of the objectives of the Santa Clara County public information and participation program will be achieved through a combination of activities that are designed to address various interest groups. A number of activities and have already been conducted, including the development of a public information participation ent of a public information subcommittee, the development of program logo and stationery, d distribution of a four-color general awareness brochure. Santa Clara County has also developed a storm drain stencil with instructions, a slide show, and poster and convened focus groups to coordinate a nonpoint source educational effort with existing educational programs. Specific action items include:

- Distribution of a storm drain stencil and how-to pamphlet and slide show for use with volunteer groups and general audiences
- Coordination with the Santa Clara County Household Hazardous Waste Program to develop and distribute 1) two pollutant-specific brochures to commercial and industrial audiences and 2) information guidebook for use by the jurisdictions
- tribution a "how-to manual" explaining storm water management requirements and pollution prevention opportunities at industrial facilities
- Development of educational curriculum to teach students about the impacts of urban runoff and ways to prevent pollution
- Development of media support and advertising to promote public awareness of municipal storm water pollution and for the nta Clara County storm water management program.

The city of Seattle has implemented an education and outreach program designed for each watershed to inform and educate the general public, businesses, and students about the fate of pollutants discharged to the storm drain system and what individuals can do to reduce pollution. The following paragraphs briefly describe some of the major components of the education program.

Schools Education Program

Seattle's extensive school education program includes field trips to an aquarium and a trout farm, videos and films, guest speakers, teachers guides, aquarium displays, and training and equipment for raising salmon in classrooms and releasing the fish into local receiving waters. Development of the program was enhanced by obtaining input from both students and teachers about what kinds of materials would be most interesting and educational.

Consumer Education

The city of Seattle has recruited more than three dozen businesses in the Pipers Creek watershed to display information about caring for the watershed and the proper use and disposal of household, yard, and automotive products. Information is presented in a series of brochures that are displayed in a colorful holder depicting a typical house and its connections to the water through the storm drain and sanitary sewer systems. Each business or service that is hosting a display is given a plaque that they in turn can display to the public.

Clean Water Business Partners

Businesses are mailed invitations to become clean water business partners. To qualify, businesses must earn a certain number of points based on their commitment to clean water. Points are earned by following sound management practices to help protect clean water, hosting information displays, and promoting community activities related to water quality. Each qualified business is presented with a plaque suitable for display certifying that they are a Clean Water Business Partner and honoring their commitment to the environment. The city will bring attention to these businesses through other educational promotions.

Storm Drain Stenciling

Volunteer school and community groups have been recruited to paint a pollution prevention message on a number of Seattle's 30,000 storm drain inlets. The message reads "Dump No Waste - Drains to Stream" and other variations depending on where the storm drain discharges. The program has been expanded through incorporation into the school education program and will likely expand further into a new "Adopt-A-Street" program. To date, more than 5,000 storm drain inlets have been stenciled in Seattle.

Motor Oil Recycling

Motor Oil Recycling is a joint project of the Seattle Drainage and Wastewater Utility (DWU) and the Seattle Solid Waste Utility. Waste oil collection tanks have been placed at 12 auto supply stores located throughout Seattle. The program is publicized by the auto store (Shucks) and by the two utilities. Spin-off programs have been initiated by other auto supply establishments in response to this program.

Waterfront Awareness Campaign

Seattle's downtown waterfront is a major tourist and recreation destination. Litter is a major problem along the waterfront, especially within the water itself. An association of waterfront businesses has initiated a cleanup campaign aimed at improving the appearance of the waterfront. The DWU has joined this partnership and has expanded the message to include the impact of litter and pollution on water quality. DWU recruited youth from the recreation centers around Seattle to paint trash receptacles colorfully with clean water and anti-pollution messages. Signs have been designed by Seattle Aquarium artists and placed along the waterfront reminding people about the effect of their actions on aquatic habitat. Posters similar to the signs will be displayed in waterfront businesses.

Bill Inserts and Citywide Direct Mailings

Seattle utilities include education and public awareness information in their bimonthly billings, which are sent to 188,000 customers. DWU's bill is shared with the Seattle Water Department and the Seattle Solid Waste Utility. The information is distributed on a variety of water quality subjects, including household hazardous waste, protection of Elliott Bay and the Duwamish River, and the school education program. A brochure has been distributed to every customer describing the storm water protection program and the role of the drainage and wastewater utility.

Television Public Service Announcements

Seattle has also developed four television public service announcements (PSAs) for broadcast on local television as part of the education video project in the schools program. The PSAs address the importance of watersheds, the difference between storm drains and sanitary sewers, nonpoint pollution, and pet waste.

MITCHELL CREEK WATERSHED, GRAND TRAVERSE COUNTY, MICHIGAN

Grand Traverse County, Michigan, developed a storm water control ordinance in response to the increase in development the county was experiencing. The primary reason for creating a new ordinance, rather than relying on the old system of Drain Commissioner review of drainage programs, was to establish clear, written guidelines for developers to follow for storm water management.

In writing the ordinance, the Grand Traverse County Drain Commissioner formed the Storm Water Management Advisory Committee. The committee comprised of area engineers, concerned citizens, and officials from the township, county, and state. The committee was split into two subcommittees: a technical committee and a policy committee. The technical committee wrote the technical guidelines for the ordinance and then submitted them to the policy committee for approval. The policy committee made all the final decisions on the ordinance and were assisted by a county-funded environmental planner

After the ordinance was approved by the committee, the Drain Commissioner took the ordinance to each Township Planning Commission and Town Board for comments and approval. The county then held public hearings, particularly to communicate with some community members who thought the ordinance was unnecessary. The public hearings allowed the county to hear these skeptic's concerns and, in turn, to educate them about the potential impacts to the lakes and streams from soil erosion and additional storm water runoff. The county is convinced that the majority of people now understand the need for this ordinance. After the public hearings, the County Board of Commissioners approved the ordinance and it went into effect January 1992.

The ordinance went into effect with no major problems and has become acceptable practice throughout the community. Many developers are glad that there are finally written guidelines, which make project planning easier. Neighboring counties have been interested in adopting similar ordinances in their communities.

Grand Traverse County also established a program to educate landowners about pollution control on their property and the availability of conservation easements and tax-deductible land gifts through the Grand Traverse Regional Land Conservancy. A citizen committee and the Conservancy assist landowners in permanently protecting the wetlands, streamside greenbelts, and ground water upland recharge areas on their property. The county programs to contact every land owner within the critical areas of the watershed to discuss the various land protection programs offered by the Conservancy. The Conservancy has put together a Mitchell Creek Watershed Landowner's Handbook which covers creek protection issues, watershed care, land protection regulations, and a Mitchell Creek Watershed Map. There will also be a series of workshops to give property owners the chance to learn best management techniques "hands-on."

The county has also targeted areas with streams running through the property, including an elementary school and two golf courses. The county has worked with the Michigan State University Extension Service to assist the landowners in creating buffer zones around the stream and to reduce the amount of fertilizers and pesticides used. At the elementary school, students will participate in planting a buffer zone along the edge of the creek. Where possible, financial assistance is also provided either through public or private grants to cover the cost of planting additional vegetation. These programs are intended to protect the quality of the streams but they also provide education about storm water runoff and watershed protection.

PRINCE GEORGE'S COUNTY, MARYLAND

The goal of the Prince George's County program is to educate the public about water quality, focusing on steps that people can take to improve water quality. The program will identify specific tasks for public participation in the management of water quality. Tailored to the specific community demographics and types of land use, the program may include an array of educational programs dealing with the following topics: lawn care (proper fertilizer and pesticide application), car care (car washing tips proper disposal of oil and antifreeze), recycling, composting of yard wastes, reporting of pollutant spills, landscaping to improve wildlife habitat and water quality, swimming pool care, septic system overflows, use/storage/disposal of household hazardous wastes and toxic material, and animal waste control.

The county has also proposed a number of public outreach programs to involve citizens and industries in watching over their local water resources. Along with public education programs, public outreach programs will be important in storm water pollution prevention efforts. To the extent possible, community groups will be identified to conduct and organize a number of volunteer activities, including tree planting, stream cleanups, road cleanups, biological monitoring, and environmental watch programs to report and stop illegal dumping activities. Environmental activists in communities, citizen groups and Citizen Advisory Committees, industrial coalitions, and schools will all be targeted for various programs, such as:

- Adopt-A-Stream and Adopt-A-Road projects
- [illegible]ality Hotline
- [illegible]lution contests and projects at area schools
- [illegible]creational opportunities
- Recycling
- Co-op for organic fertilizers
- Wildlife sanctuary delineations
- Wildlife corridors
- Tree planting
- Cleanups
- Award programs
- Household hazardous waste collection.

In addition, communities and public meetings will be held to encourage reporting of illegal dumping into storm drains. The public will also be instructed to watch for industries or other entities that may be contributing unpermitted, non-storm water discharges to the storm sewer. A Water Quality Hotline number is planned that will enable the public to talk to local officials about violations and other water quality problems. This information may then be used in conjunction with local and State investigation and enforcement programs to control illicit discharges to the county's waterways.

Prince George's County has also planned a Community Liaison Service to assist in implementing the storm water management program. The program stresses non-enforcement methods to solve water pollution problems by empowerment and cooperation. County officials will coordinate with various organizations, such as business groups, community associations, environmental groups, Citizen Advisory Groups, schools, to enlist their help in implementing the storm water management program. This coordination will entail notification of programs (stream surveys, watershed surveys, complaints), training of all people interested in any program, and recruitment of volunteers for baseline water quality sampling.

FISCAL RESOURCES

The part 2 municipal permit application requires municipal permittees to demonstrate sufficient financial resources to meet the costs of implementing conditions of the permit. This section provides guidance on some sources of revenue available to permittees.

Selection of one or more revenue sources to fund a storm water management program depends on three factors: (1) type of organization that is operating the storm water management program, (2) amount of money that may be raised by various revenue options, (3) political feasibility of the options, and (4) fiscal needs of the program.

The first consideration when choosing revenue options is to identify options that are legally authorized. This will depend on the type of local government organization used to implement the storm water program. Frequently, storm water programs are set up as storm water utilities and use a variety of revenue options. A storm water utility is a government entity established to design, construct, maintain, and operate a drainage system to control storm and surface water runoff. Utilities handle decisions concerning financing, personnel, and administration. These decisions are not delegated to another governmental department.

Once the legally authorized revenue options have been identified, the second consideration is the amount of money that may be raised and the activities that may be funded by each option. Each revenue source should be examined to determine if the funding is equitable to the consumers. It is critical that the revenue options chosen are able to finance all aspects of the program.

Third, the revenue options must be politically feasible. A successful capital improvement program will select the revenue option, or package of options, that raises the required funding and is most politically feasible.

Revenue may be generated from the sectors of society that will benefit most from the replacement and expansion of the storm water infrastructure. Local governments may levy impact fees on developments for expansion and on redevelopments for upgrading the existing system. Current users should not be responsible for funding the expansion and the replacement of facilities of an existing system. The revenue options chosen should be equitable in meeting the needs for replacement, upgrading, and expansion of the storm water system. Figure 3-1 illustrates the capital and financing process. The figure shows the process by which capital projects are financed in relation to the benefits derived from the projects.

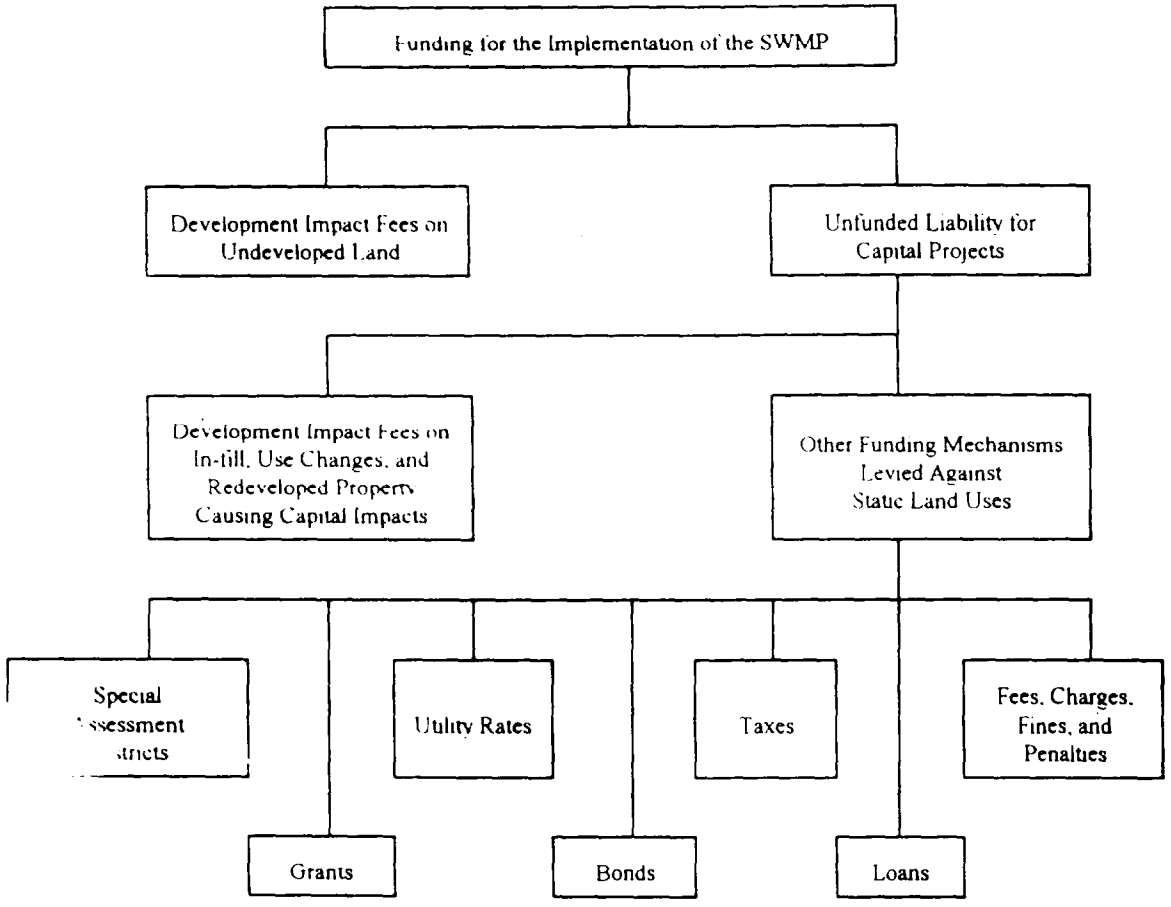


FIGURE 3-1. STORM WATER MANAGEMENT Program—FISCAL RESOURCES

The following discussion provides an overview of the revenue options identified in Figure 3-1. In choosing a series of options to finance a storm water program, the first step is to determine whether funding is needed for replacing, upgrading, or expanding the system. If funds are needed to finance growth and expansion onto previously undeveloped land, then the authority should assess development impact fees. Development impact fees are assessed against private developers in compensation for the new capacity requirements their projects impose on public facilities.

Development Impact Fees on Undeveloped Land

A significant part of the SWMP is dictated by private development of previously undeveloped property. Additional homes and businesses require service that can only be supported by the construction of new infrastructure (including storm water BMPs). Local governments can levy development impact fees to defray the proportionate share of the infrastructure costs caused by and of benefit to the development. The capital improvement plan should contain sufficient detail to validate such fees.

Unfunded Liability for Capital Projects

Development impact fees will help finance the growth of storm water infrastructure in new developments; however, the upgrading and replacement of the system as it ages still needs to be financed. Local governments need a mechanism to finance the unfunded liabilities, other than continually drawing upon the historical funding sources. One way to help upgrade the storm water infrastructure is by including development impact fees on in-fill,[1] use changes, and property redevelopment. The funds collected can be used to help offset the cost of upgrading an existing system.

Development Impact Fees on Developed Land

Levying development impact fees on properties being redeveloped, in-fill developed, or under changed use must be determined to assure current ratepayers that they are not subsidizing development. When levying development impact fees, there should be a distinct division between replacement and expansion of the system. The component of a project apportioned to replacement should be quantified. The component required for system enhancement to service new customers should be attributed to development impact fees. If the division is not made, current customers may pay for both replacing and upgrading the storm water infrastructure.

Funding of Nondevelopment-Related Project Liabilities

Portions of projects that cannot be legally or accurately charged to development should be financed by revenues paid by existing users of the capital projects. These projects may include the replacement of existing facilities or portion of an upgrade or an expanded plant that cannot be properly be apportioned to development. For example, new

[1]In-fill is the cumulative development of single lots scattered throughout the community or the redevelopment of property that results in higher densities or increased demand on public facilities. In terms of storm water management, it includes residential to commercial use changes and an increase in the amount of impervious surface area.

customers should not be expected to pay for replacing a down stream storm sewer line that has deteriorated as a result of age. However, they will be responsible for pipeline enlargement to handle newly increased flows. Methods appropriate for use in financing storm water capital expenditures include fees, charges, fines, and penalties; taxes; utility rates; special assessment districts; debt financing (i.e., bonds and loans); and grants.

Fees, Charges, Fines, and Penalties

Municipal storm sewer operators have discovered that greater revenues may be secured with fewer complaints by separating special services and charges from general services and billing full recovery costs separately for these special operations. In addition, fines and penalties may be used to modify behavior.

Fees

Permit fees may be used to fund the portion of a storm water program that regulates activities of construction and development. Construction permits generate revenue, and they can be used to standardize the construction of new facilities and promote the use of BMPs to limit construction site runoff.

Charges

Special services are those requested and received by a few ratepayers. Utility services for which special fees should be charged include initiation of service, restoration of discontinued service, detection and repair of household leaks, line location, and review of construction plans.

Fines and Penalties

Fines and penalties are an important part of any effective enforcement program. These revenue sources are better suited to modifying behavior than raising revenue. As enforcement improves and the number of violations decrease, revenue from fines and penalties will decline. This is a reflection of an effective program. In some cases, especially in the early years of the program, revenue from fines and penalties are sizeable and may help to finance information/education enforcement and related efforts.

Taxes

Local governments may levy a variety of taxes to fund their programs. The sales tax, property tax, business and occupation tax are the principal sources of revenue for most local governments. While all these tax sources have the potential for financing storm water management programs, in reality, few dollars are available for such programs for two primary reasons: (1) many local governments have utilized all available taxing authority provided by the State and (2) it is difficult to obtain political support to raise taxes in jurisdictions that have not exercised all of their legally authorized taxing power.

Many local governments have used all of their taxing authority and still have difficulty financing their basic programs. In these cases, it is unlikely that local governments will be able to make tax dollars available to fund storm water management programs. In jurisdictions where voters have a strong preference for minimizing local taxes, raising taxes is politically difficult. Thus, while taxing authority may be available, raising taxes to fund storm water management programs may not be a viable alternative.

If taxes are involved, then a tax analysis of the community's ability-to-pay should be performed. In such cases, the jurisdiction that has the power to levy taxes must have a clear understanding of its current and future tax sources. This will help quantify the need in terms of operational, subsidy, fixed-asset replacement, or capital project purposes. With such information, specific tax sources may be identified to finance capital projects, relate benefits to payments, and indicate ability-to-pay.

Utility Rates

Municipalities may choose to form a storm water utility that is funded based upon values of fees charged to users of the storm sewer system. A storm water utility's rate structure should finance the portions of the capital improvement plan that are not the responsibility of new or in-fill development. The portions of utility rates that will fund capital improvements are determined through detailed rate studies. Such studies are conducted to assess the proper payment level for operations and maintenance, fixed asset replacement, and system capital needs that cannot be attributed to development.

Rates are an appropriate mechanism for raising revenue for programs where there is a defined population being serviced. There are two types of rates: (1) unit charges and (2) service charges.

Unit Charges

Unit charges, the traditional types of rates, are calculated monthly and based on the quantity of a product consumed. For example, water and electricity rates are unit rates based on consumption. Utilities have traditionally levied rates in this form. Because it is difficult to measure the amount of storm water discharged by each user, however, storm water management programs do not lend themselves to levying rates based on unit charges. Increasingly, local governments turn to service charges to finance such programs.

Service Charges

Service charges are attractive when users cannot be charged according to their level of use, and services are difficult to price on a unit basis. Most service charges are structured to minimize administrative costs and to ensure that payments approximate the distribution of benefits received. As such, they are viewed as an equitable way to pay for services. Revenue from service charges is predictable and may be substantial.

The storm water service charge is determined through three commonly used methods, each based on the disruption of the natural drainage system. The first is an approximation of the percent impervious surface. Percent impervious surface is a measure of the property that does not allow water to penetrate the ground. This includes roofs, parking lots, and sidewalks. A second method is a flat rate based on the number of residents in a community. The third method assesses a service charge through a combination of percent impervious surface, type of business (SIC classification), and size of the property. Each business type is assigned a runoff factor that reflects the potential discharge of pollutants from the property and a development factor that reflects the percent impervious surface. The product of these two factors is then multiplied by the size of the property in 500 square foot increments. Once the rate is calculated, a fixed fee is added to cover administration costs. A municipality may use a combination of these methods or develop an entirely different method that better suits the characteristics of the community served.

An analysis of the service charge should be conducted annually to update needs, assure continued internal equity, and update cash flows and reserve projections. Computer models may be developed to provide annual rate updates. This

type of operating system deflates potential political and financial problems by small annual rate increases instead of less frequent and more dramatic rate increases.

Special Assessment Districts

For services that cannot be categorized within a utility or fee schedules, a city, county, or utility district with the legal authority may create a special assessment district. Special assessments are levied for infrastructure installation or operations and maintenance. Normally, bonds are issued to finance capital construction that is backed by special assessments levied on district members.

Debt Financing

Financing of capital projects through public utility debt has three major advantages: (1) once the money is borrowed or a bond issued, a fixed interest rate and repayment schedule are established, and the debt is repaid over the years with dollars that are cumulatively deflating in value; (2) individuals who require and will use the facilities being built with the borrowed funds will pay for the facilities as they use them throughout debt repayment; and (3) debt financing provides large sums of money up front to finance the capital expenditures.

Bond issues and loans are the two primary methods to acquire capital through debt financing. It is important to note that because borrowed funds must be repaid, the ultimate source for repayment of bonds and loans is either taxes or rate revenue. Bonds are not suited to fund ongoing routine expenses, such as the operation of a storm water management program.

Bonds

The two types of bonds commonly used to finance capital acquisitions are general obligation and revenue bonds. General obligation bonds are backed by the full faith, credit, and taxing power of the local government issuing the bond. While a particular revenue source may be earmarked for their repayment, guarantee for repayment of the bonds is provided by the entire stream of tax revenues paid to the local government. For this reason, general obligation bonds may be considered stronger guarantees of repayment than revenue bonds.

Revenue bonds are backed by revenue from a dedicated source as a rate revenue. Because revenue bonds have far fewer statutory constraints, they have replaced general obligation bonds as the primary form of municipal financing. In theory, because this form of debt has its own guarantee (the project revenues, if any), it should not affect a locality's credit rating. In practice, however, revenue debt represents an indirect obligation of the issuing government. Because the lender has only the project revenues to depend on for repayment, interest rates are generally higher for revenue bonds than general obligation bonds.

In most cases, established utilities issuing bonds will issue revenue bonds. New utilities may not have enough history to issue revenue bonds. In these cases, general obligation bonds are issued or, alternatively, double-barreled bonds may be issued. These bonds are backed by both a dedicated revenue source and the full faith and credit of the local government.

Many small communities are unable to enter the national bond market because of poor credit ratings, little financial expertise, and relatively small capital needs. When access to the national bond market is available, small communities usually pay very high interest rates. Some States have created bond banks that enable small communities to issue bonds

through the bank. This provides the small communities access to the municipal bond market at lower interest rates and with lower issuance costs.

Loans

A common loan program available within most States is the State Revolving Fund (SRF) for water pollution control planning. SRFs are intended to create a perpetual source of low cost financing. The funds invested in the capitalization of SRFs assist communities in meeting their needs by providing one-time loans or grants. Below market interest rates are the single most important advantage to some communities. This reduced capital cost decreased the level of user fees required to repay the project debt. The CWA requires recipients of SRF assistance to provide a dedicated source of revenue to cover loan payments. However, SRF assistance to storm water management programs is limited more by state laws than federal restriction. To address this concern, EPA has developed a case study guidebook that presents examples of how expanded use activities can be funded under the SRF program. For more information on expanded uses, refer to EPA, Office of Water, *Funding of Expanded Use Activities by State Revolving Fund Programs: Examples and Program Recommendations*, August 1990, (EPA 43/09-90-006).

Most States have issued SRF loans at interest rates of 2 to 5½ percent below market rates. With the current interest rate being relatively low, the difference between State SRF loans and the market rate may be minimal and, therefore, not as attractive to communities. Similar to the construction grants, some States may require communities to provide a "match" prior to granting the loan. However, economically distressed communities have indicated that they would be unable to pay back a loan even at a zero percent interest rate and must rely on grants for funding.

Grants and Matching Programs

In addition to all the financial methods mentioned previously, States provide grants to communities for their wastewater quality needs. Grants can be in many forms, with or without community matches or use restrictions. Some States, for example, may provide grants to communities to be used as the prerequisite SRF match. Grants are neither a constant or consistent revenue source and should not be seen as an integral part of financing the daily operations of the storm water program. Grants are more likely to be issued for large one-time capital expenditures to assist in reducing the financial burden on the local community.

Table 3-2 lists selected Federal grant programs that can assist in the financing of storm water management needs. The list does not include grant programs available at the State level. The *Catalog of Federal Domestic* (GSA, 1991) contains a comprehensive list of Federal assistance programs.

TABLE 3-2. SELECTED FEDERAL GRANT PROGRAMS

Program Name	Economic Development—Grants for Public Works and Development Facilities
1992 Catalog of Federal Domestic Assistance Number	11.300
Administering Office or Agency	Economic Development Administration, U.S. Department of Commerce
Legislative Authority	Public Works and Economic Development Act of 1965, as amended
Objectives	To promote long-term economic development and assist in the construction of public works and development facilities needed to initiate and encourage the creation or retention of permanent jobs in the private sector in areas experiencing severe economic distress.
Types of Assistance	The basic grant rate may be up to 50 percent of the project cost. Severely depressed areas may receive supplementary grants to bring the Federal contribution up to 80 percent of the project cost; designated Native American Reservations may be eligible for up to 100-percent assistance. Additionally, redevelopment areas located within designated Economic Development Districts may, subject to the 80-percent maximum Federal grant limit, be eligible for a 10-percent bonus on grants for public works projects. On average, EDA grants cover 50 percent of project costs.
Uses and Use Restrictions	Grants can be used for public facilities, such as water and sewer systems, and infrastructure improvements. Qualified projects must fulfill a pressing need for the area and must (1) tend to improve the opportunities for the successful establishment or expansion of industrial or commercial plants or facilities, (2) assist in the creation of additional long-term employment opportunities, or (3) benefit the long-term unemployed and members of low-income families. In addition, proposed projects must be consistent with the currently approved Overall Economic Development Program for the area and for the Economic Development District, if any, in which it will be located and must have adequate local share of funds with evidence of firm commitment and availability.
Eligible Applicants	States, cities, counties, and other political subdivisions and private or public nonprofit organizations or associations representing a redevelopment area or a designated Economic Development Center are eligible to receive grants.
Information Contacts	Director, Public Works Division, Economic Development Administration, Room H7236, Herbert C. Hoover Building, Department of Commerce, Washington, DC 20230.

TABLE 3-2. SELECTED FEDERAL GRANT PROGRAMS (Continued)

Program Name	Economic Development—Support for Planning Organizations
1992 Catalog of Federal Domestic Assistance Number	11.302
Administering Office or Agency	Economic Development Administration, U.S. Department of Commerce
Legislative Authority	Public Works and Economic Development Act of 1965, as amended
Objectives	To assist in providing administrative aid to multi-county districts and redevelopment areas economic development planning and implementation capability and thereby promote effective utilization of resources in the creation of full-time permanent jobs for the unemployed and underemployed in high distress redevelopment areas.
Types of Assistance	A minimum of 25 percent must be obtained from nonfederal sources, except for grants to Native American Tribes. This may be in the form of cash and in-kind contributions. The Secretary is authorized to fund up to 100 percent planning support grants to Native American Tribes.
Uses and Use Restrictions	Grants are used to staff salaries and other planning and administrative expenses of the economic development organization.
Eligible Applicants	(1) Public bodies and other nonprofit organizations representing groups of State-delineated adjoining counties, which include at least one area designated as a redevelopment area by the Secretary of Commerce and one or more centers of growth not over 250,000 population. (2) Native American Tribes, and (3) counties designated as redevelopment areas or nonprofit organizations representing redevelopment areas or nonprofit organizations.
Information Contacts	Director, Planning Division, Economic Development Administration, Room H7023, Herbert C. Hoover Building, Department of Commerce, Washington, DC 20230.

TABLE 3-2. SELECTED FEDERAL GRANT PROGRAMS (Continued)

Program Name	Economic Development—Public Works Impact Projects
1992 Catalog of Federal Domestic Assistance Number	11.304
Administering Office or Agency	Economic Development Administration, U.S. Department of Commerce
Legislative Authority	Public Works and Economic Development Act of 1965, as amended
Objectives	To promote long-term economic development and assist in providing immediate useful work (i.e., construction jobs) to unemployed and underemployed in designated project areas.
Types of Assistance	The basic grant rate for Public Works Impact Program areas is 50 percent, except for Native American areas, where the rate can be 100 percent. Severely distressed areas may receive supplementary grant assistance to bring the Federal contribution up to 80 percent. Local matching share may be waived if appropriate entity can demonstrate that it has exhausted its effective taxing and/or borrowing capacity. On average, EDA grants more than 50 percent of project costs.
Uses and Use Restrictions	Renovation or construction of public works and development facilities to provide immediate jobs to the unemployed and underemployed in project areas.
Eligible Applicants	Eligibility is based on designation of the county or city as a redevelopment area according to the criteria under Section 401(a)(6) of the Public Works and Economic Development Act of 1965 (Public Law 89-136).
Information Cont...	Director, Public Works Division, Economic Development Administration, Room H7236, Herbert C. Hoover Building, Department of Commerce, Washington, DC 20230.

TABLE 3-2. SELECTED FEDERAL GRANT PROGRAMS (Continued)

Program Name	Water Quality Management Planning 205(j)
1992 Catalog of Federal Domestic Assistance Number	66.454
Administering Office or Agency	Office of Water, U.S. Environmental Protection Agency
Legislative Authority	Clean Water Act, Section 205(j), as amended
Objectives	To assist States (including territories and the District of Columbia), Regional Public Comprehensive Planning Organizations, and Interstate Organizations in carrying out water quality management planning.
Types of Assistance	Formula Grants. Each fiscal year, the Administrator shall reserve under Section 205(j)(1) an amount not to exceed 1 percent of the amount allotted and available for obligation or $100,000, whichever is greater, for the purposes of making grants to the States to carry out water quality management planning. Forty percent of the State's annual award must be allocated to Regional Public Comprehensive Planning Organizations and Interstate Organizations, unless EPA approves a lesser amount.
Uses and Use Restrictions	Section 205(j)(1) and Section 604(b) funds are awarded under Section 205(j)(2), to the State water quality management agencies to carry out water quality management planning. States are required to allocate 40 percent of the State's annual award to Regional Public Comprehensive Planning Organizations and Interstate Organizations. EPA may approve a State's request to pass through less than 40 percent if, after consultation with its Regional Public Comprehensive Planning Organizations and Interstate Organizations, the Governor determines that pass through of at least 40 percent will not (1) result in significant participation by Regional Public Comprehensive Planning Organizations and Interstate Organizations unless in water quality management and (2) significantly assist in development and implementation of the State's water quality management plan.
Eligible Applicants	State water quality management agencies.
Information Contacts	Contact the appropriate EPA Regional Office.

ANNUAL REPORTS: ASSESSING THE EFFECTIVENESS OF THE STORM WATER PROGRAM

Purpose of Annual Reports

On the annual anniversary of permit issuance, the municipality is required to submit an annual report discussing the progress made toward achieving the specified storm water management program goals. As stated in Section 122.42(c) of the regulation:

> 40 CFR Part 122.42(c)(1)-(7)
>
> *The report shall include -*
>
> (1) Status of implementing components of storm water management program that are established as permit conditions;
>
> (2) Proposed changes to storm water management programs that are established as a permit condition. Such changes shall be consistent with §122.26(d)(2)(iii) of this part; and
>
> (3) Revisions, if necessary, to the assessment of controls and the fiscal analysis reported in the permit application under §122.26(d)(2)(iv) and (d)(2)(v) of this part;
>
> (4) Summary of data that is accumulated throughout the reporting year;
>
> (5) Annual expenditures and budget for the year following each annual report;
>
> (6) A summary describing the number and nature of enforcement actions, inspections and public education programs;
>
> (7) Identification of water quality improvements or degradation.

In developing their Part 2 municipal permit applications, applicants should have considered their strategy for preparing annual reports. While each municipality will take a different approach, in general, strategies will include identification of measures to track the long-term progress of their storm water management program goals, discussion of the role of monitoring data in assessing program effectiveness, and discussion of how the municipality plans to provide for future adjustment to this reporting strategy.

The annual report will be used by the municipality to provide an assessment of the program performance, and guidance in establishing longer term assessment strategies.

The annual report will be used by the permitting authority to monitor program compliance, and determine if the program is achieving the goal of improved storm water quality.

Benefits for Municipality

Completing annual reports is an invaluable exercise for municipalities because it allows them to gather all relevant information from the past year's storm water management activities and to assess the effectiveness of the program to date. If program goals are being met (or are in the process of being met), then the municipality can feel confident that its storm water management program has been designed and implemented in a relatively effective manner. If program goals are not being met, however, the municipality can reassess current program measures and make alterations if necessary. This annual evaluation should help permittees gauge tangible and intangible measures of progress (e.g. pollutant loadings or public awareness).

Benefits for State

Many municipalities are still in the early stages of developing storm water management programs suitable for controlling pollutants in discharges under an NPDES permit; others have relatively sophisticated programs in place. By reviewing the annual report, the State can determine whether various municipalities are developing their programs in a timely manner and can use information gathered in these reports to assess aquatic conditions on the State level.

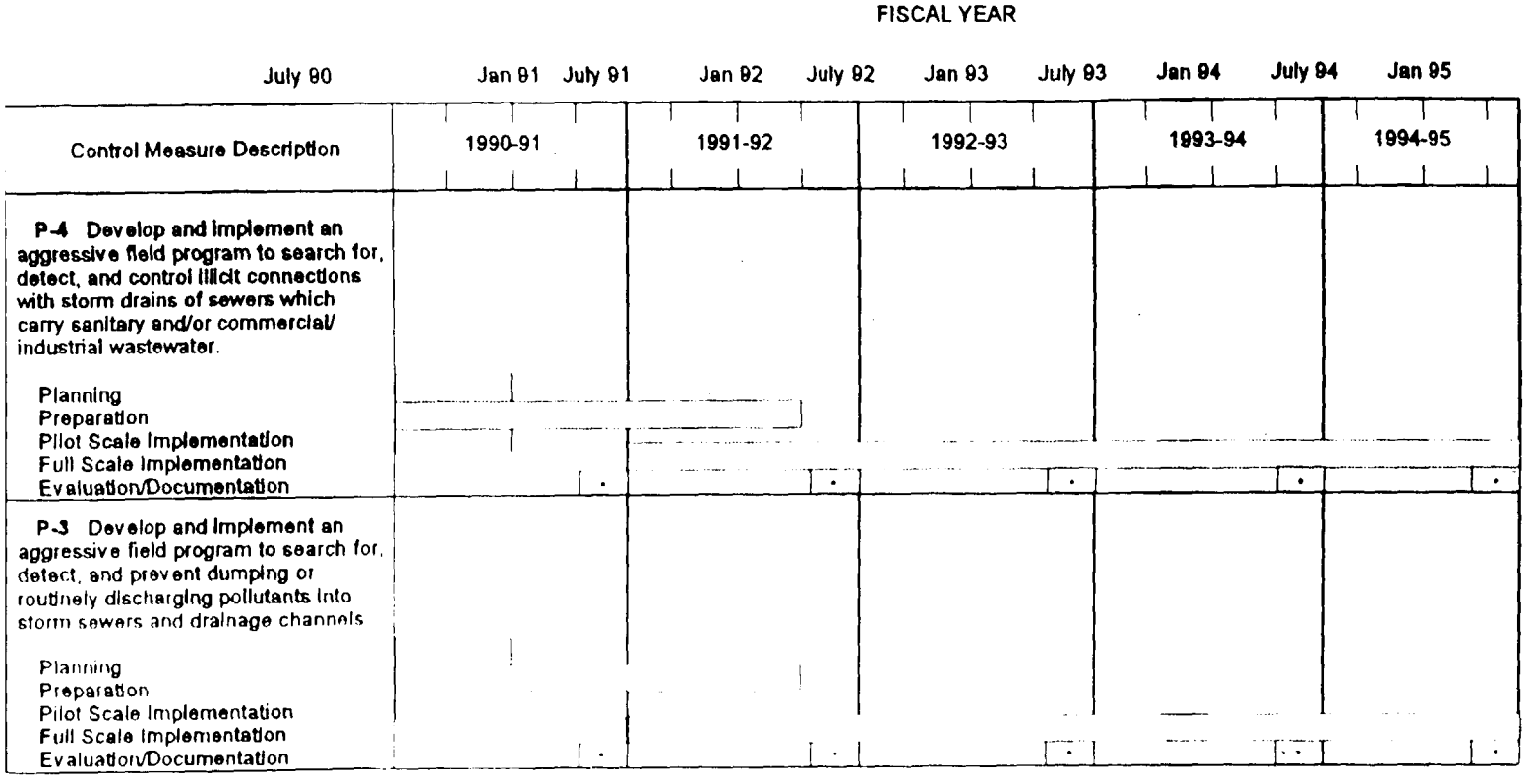
While the annual report may be used by the States to evaluate municipal compliance with permit conditions, it also may indicate to the permitting authority where permit conditions need to be modified to address specific problems. Access to monitoring data identifying water quality improvements or degradation is important to the State for several reasons. First, it can be used to evaluate the success or failure of a management program in reducing pollutants. Second, it provides the State with information to use in a watershed data base. Third, the State can use the data to meet the informational requirements of various Federal programs. Data drawn from the annual reports will be especially useful for programs such as the Coastal Nonpoint Source Pollution Control Program (CZARA), the Safe Drinking Water Act Program, the Clean Lakes Program (CWA 314), and among others, which are identified in Section 1.3 of this document.

Required Elements

The annual report contains several requirements aimed at evaluating the accomplishments of the past year. This information can be used to evaluate the relative effectiveness of the storm water management program and to determine which elements should be continued or dropped from the program. In some cases, the review will indicate that new methods or measures should be tried. The next several sections appear in the same order as in the permit; however, evaluating them in a slightly different order may be more productive.

Status of Implementing Components of Storm Water Management Program

This section addresses the relative degree to which storm water management program elements have been completed. Numerous approaches can be taken to accomplish this. You may want to b :n by providing an overview of the program approach and history. Then, using your permit requirements as a guide, look at each component and decide whether it can be evaluated directly (e.g., pollutant removal) or indirectly (e.g., the success of a public outreach program). To complete this section, you can refer to various documents, including ordinances proposed or enacted, documentation for design or completion of structural controls, inspection reports, site assessments, and progress reports on cleanups. For components that can be directly measured, an effective way to present the information is in a matrix format, as shown in Figure 3-2



• Submittal of annual report to RWQCB

NOTE: Schedules for tasks beyond the 1991 - 1992 fiscal year at *projected only* and will be re-evaluated and revised annually as part of the Annual Reporting Provision in the Permit. Implementation of control measures is contingent with results of planning, preparation, and pilot testing phases. Schedules for specific tasks may vary among the participants according to different conditions and considerations.

FIGURE 3-2. IMPLEMENTATION SCHEDULE FOR PROGRAM ELEMENT IV—ILLICIT CONNECTION ELIMINATION AND ILLEGAL DUMPING ELIMINATION

Figure 3-2 shows activity goals versus activities accomplished. If the component you are addressing is not directly measurable, a narrative description can be given to convey its status. For example, you might describe the effectiveness of a public education program by discussing the number of meetings held to generate community awareness, the results of a post-meeting survey, any followup inquiries or letters from the meetings, or by discussing the increase in the number of citizens reporting violations.

Once you have addressed the circumstances of each program component, the status of the SWMP as a whole should be summarized.

Proposed Changes to SWMP Established in Permit Conditions

After reviewing the effectiveness of your program components over the last year, you can determine which components require adjustments in order to meet long-term goals of water quality improvement. Among the reasons for proposing a change are:

- The existing component is not cost-effective
- The existing component has not performed as anticipated
- Physical circumstances have changed (e.g., the addition of an outfall or consolidation of existing ones)
- New technologies are available that produce better results.

When municipalities make programmatic changes, the background information used to formulate original decisions should be consulted. For example, you should be aware of the initial strategy used to develop the component, such as cost or time constraints. Consider how the initial strategy may have influenced component performance (e.g., lack of funding may have curtailed an activity before the end of the period). The next step is to explain the reason for requesting the change. A detailed description of the proposed component in terms of its impact on budget, schedule, and previously stated program goals should also be provided. For example, Santa Clara Valley's annual report included sections that described successes and shortfalls and future changes as a result of these two areas. All changes must be consistent with regulatory requirements in Section 122.26(d)(2)(iii). Requests for significant revisions to the storm water management program may require municipalities to partially resubmit their storm water permit application, as noted in Section 122.26(d)(2)(iv) and (d)(2)(v).

Revisions to the "Assessment of Controls/Fiscal Analysis" Sections of SWMP

Assessment of Controls

As part of the Storm Water Management Program, municipalities are required to provide an annual "assessment of controls," as well as a "fiscal analysis." This section should be completed only after you have reviewed and summarized the data gathered throughout the year. The municipality will compare the collected data and documented achievements of the program to the estimated data (e.g., reductions in pollutant loading and other site-specific measurements included in Parts 1 and 2 of the permit). Program components will not always meet the anticipated return value and others may exceed expectations. The effectiveness of controls should be modified based on the actual values from data gathered throughout the past year.

A number of control measures cannot be evaluated in terms of direct measures, such as pollutants removed, but instead must be evaluated in terms of indirect measures. Indirect measures can often be very effective when direct measures are not appropriate or when they do not tell the whole story. For example, public education campaigns generally cannot be assessed in terms of pollutant reduction. An increase in the number of citizens participating in a cleanup program, however, would be a good indirect indicator of program effectiveness. Similarly, an increase in the rate of volunteerism within the community could indicate the relative success of a particular program. Another indirect measure might be an increase in the volume of recycling materials collected. An indirect measure of success in lowering pollutant loads would be a lowering in the number of beach closings or fishing restrictions. Be aware of the possibility of these indirect indicators as you review your records.

Table 3-3 contains control activities and possible ways to indirectly measure their effectiveness. Some of these activities may be appropriate for your situation.

TABLE 3-3. SWMP COMPONENTS AND SELECTED MEASURES

SWMP Component	Indirect Measure
Classes/art or writing contests for school aged children	Attendance records, entries received
Public hearings/discussions/seminars	Attendance records
Community cleanup programs or adopt-a-highway campaigns	Number of volunteers or truckloads of trash collected
Public education/outreach programs (e.g., print, video, audio)	Number of handouts distributed, media spots, or citizen response (e.g., phone calls or letters)
Violations reported by citizens	Number and type of violation
Public awareness	Letters, reported violations, court records indicating citizen suits against specific facilities, or a rise in recycling program participation
Household hazardous waste/used oil collection program	Number of gallons of hazardous waste or used oil collected
Industry outreach programs	Increase in the number of permit applications or articles in industry/local publications

Fiscal Analysis

The fiscal analysis section will also be updated based on actual figures for the year past. The information to be updated will include the existing budget, estimated operation costs necessary for the storm water management program during the term of the permit, capital available to meet these costs, and the list of available sources of funding and legal restrictions on these sources. Information for this section and the section on assessment of controls can be presented in a number of ways, including graphs, pie charts, and matrices. When the projected and actual figures differ, the permittee should also include a narrative explanation. For example, if the monitoring program exceeded its budget in a particular area, the permittee may indicate in the narrative that this was caused by the addition of several outfalls that were not included in the original list.

Summary of Data Gathered Throughout the Year

This section of your annual report is used to present an overview of the data gathered during the past year and is an important step in evaluating the effectiveness of your program to date (e.g., data may indicate that efforts to reduce a particular pollutant have been successful). This section should address, at a minimum, the results of the storm water monitoring program and the seasonal pollutant load estimates for each major outfall identified in the application.

Your municipality was required to include, in the Part 2 permit application, a proposed monitoring program for data collection from the separate storm sewer system. The permit issued to your municipality should specify the required monitoring for the permit term. The amount, type, and schedule for monitoring data collection will vary, depending on the proposed program and on the permitting authorities need to characterize the discharge from the separate storm sewer system. The annual report should summarize the monitoring activities for the previous year indicating, at a minimum, the number of outfalls or screening points sampled, the number of times each outfall was sampled, and the [illegible] of the outfalls sampled. The annual report should also summarize the data collected in the monitoring [illegible]. The monitoring data should be organized by watershed. For example, the results of all monitoring [illegible] discharges to Smith Creek should be listed together in the same table. The report should include the [illegible] ...ation for each outfall sampled

- [illegible] the sampl[illegible]s collected
- The du[illegible] [illegible]f the storm event that generated the discharge
- The form of precipitation (rainfall or snow melt)
- The type of sample collected (grab, flow weighted composite, or time weighted composite)
- The results of the analysis performed on the samples (e.g., the concentrations of the pollutants).

Monitoring data are best presented in a table or matrix format. Monitoring data can also be given in line graphs, bar charts, pie charts, or other easily understood formats.

Municipalities are also required to submit in their Part 2 applications a schedule for providing estimates of the seasonal pollutant loads and event mean concentration of any parameter detected in any sample collected for the Part 2 application requirements. The proposed schedule will be reviewed by the permitting authority and should be included in the permit conditions. The annual report should present the estimates of pollutant loads and event mean concentrations in the years specified in the permit schedule. The following information should be provided:

- Location of the major outfall
- Estimates for four seasonal pollutant loads for each parameter
- Brief description of method used to estimate the pollutant load
- Estimate of the event mean concentration of each parameter for a representative event
- Brief description of the method used to estimate the event mean concentration.

The estimates of pollutant loads and event mean concentrations should be presented in tabular format by watershed. The description of the calculation methods should indicate the extent to which the monitoring data were used. You may also include a written evaluation addressing the results.

For instance, Santa Clara Valley has a 5-year monitoring program. This program contains 10 monitoring sites, including 5 new sites—an industrial site, two transportation corridors, and two outfalls at a detention basin. The objectives of the program are to:

- Gather data to determine long-term water quality trends
- Assess impacts of toxicity in storm water runoff and determine the pollutants causing the toxicity
- Evaluate the appropriateness of the WQOs in protection aquatic life
- Determine the treatment effectiveness of an existing detention basin under different hydrologic conditions
- Assess the role of stream sediments as pollutant sinks or sources
- Describe the management implications of the findings.

Annual Expenditures and Budget for the Upcoming Year

This section addresses the coming year's proposed budget and the previous year's expenditures. An analysis of last year's budget and actual expenditures is used to determine if targeted amounts in the new budget will be adequate. Note which of your program elements will be continued, which will be dropped, and whether any new ones are to be added. Compare this list of proposed program changes to your available budget to ensure adequate funding. Once you have listed the projected cost for each item, note the source of funding and its approval status. Tracking approval status of funding for planned activities is important because the program may not be able to achieve its goals or permit compliance without funding approval. For example, the Santa Clara Valley Water District (SCVWD) is the managing agency for the municipality's budget. A management committee is appointed to decide on budget matters. The committee is chaired by the SCVWD Manager of Operations and Water Quality and includes representatives from each of the 15 co-permittee municipalities. The nonpoint source division's program manager is responsible for the administration and management of the budget program.

Summary Describing the Number and Nature of Enforcement Actions, Inspections, and Public Education Programs

This section should describe each enforcement action, educational program, or inspection conducted during the past year. This may include actions initiated by citizens, private industry, or the municipality. Refer to legal notices, court records, and newspaper articles for this information. Permittees should note the number and type of each action and, where appropriate, the number of participants or the number of materials distributed (as in the case of educational programs). When addressing enforcement actions, it may be useful to indicate the types of outcome (e.g., the names of offenders published in the local newspapers, the number of fines levied and the amounts, or the number of closures or stop work orders issued). The total number of inspections, the types of facilities inspected, and the number of

violations cited due to these should also be indicated. It may be helpful to note the number of in-house training programs held for inspectors and the number of attendees. Public education programs may be assessed by noting the number of meetings or classes, subject matter, attendance figures, the number and type of media spots, printed materials distributed, etc. In evaluating program success, it may also be helpful to use some indirect measures, such as a decrease in illegal storm drain dumping, which may be attributable to storm drain stenciling. The key to Santa Clara Valley's enforcement program, for example, is the ordinance regulating industrial or other polluting activities within the municipality. The ordinance to be developed by Santa Clara Valley will include language addressing the following activities: controlling non-storm water discharges to storm drains, watercourse protection, regulation of outdoor material storage, control of improper grease disposal, and storm water management requirements for new development and redevelopment. For more specific information on how the ordinance will affect these areas, various subcommittees will develop guidance manuals on storm water controls.

Identification of Water Quality Improvements and Degradation

An important measure of the program effectiveness is the extent to which water quality has improved during the past year. In particular, municipalities should examine the water quality of the receiving waters to which the system discharges. This section should include such changes in receiving water quality and cite the reasons for them.

Municipalities were required to provide information on receiving waters and watersheds in Part 1 of the permit application. This information included a discussion of water bodies cited in State reports required by CWA Sections 305(b), 304(l), and 314(a), the State Nonpoint Source Report, and other reports identifying sensitive watersheds. To complete this section, you will need to review information gathered for these State and Federal programs during the past year and data from the required monitoring program. The municipality may have also gathered receiving water data as part of its strategy for continuing program assessment. In addition, information may be available from other Federal programs, as noted in Chapter 1. Be aware that numerical data are not the only way to determine water quality. One criterion you may use when judging water quality is how well the body of water meets its designated uses (e.g., recreational or industrial uses).

Once water quality improvement has been noted, the next step is to determine the cause for these changes. For instance, if the annual monitoring data indicate that discharge water quality and receiving water quality have improved proportionally, it may be attributable to the successful implementing of the SWMP. If monitoring data indicate an improvement in discharge quality yet receiving water quality has degraded over the past year, you must try to find the reasons (e.g., unforeseen weather conditions, such as flooding or drought, or sources upstream). Available computer water quality modeling programs may be helpful in completing this section.

Sample Annual Reports

An excerpt from an annual report on the Santa Clara County program is given after the summary.

SUMMARY

This chapter discussed the procedures on implementing the specific administrative requirements, which include public participation and public information programs, fiscal analysis, and annual reports. Each of these components is essential to the successful implementation of a municipal storm water management program. Public participation and

public information programs solicit public support by informing individuals of the importance of good storm water management and its effect on water quality. By conducting a thorough fiscal analysis program, a municipality examines all of the available sources of funding and selects the funding option(s) according to its specific needs. The annual report assesses the effectiveness of the management program and allows the municipality to revise the program based on the results of the assessment. The next chapter provides procedures for implementing an effective illicit connections detection program as a key element in the municipal storm water management program and provides examples of programs from different municipalities.

SANTA CLARA COUNTY STORM WATER MANAGEMENT Program

Public Information/Participation Program

Provision 4b of Santa Clara County's NPDES permit requires the individual co-permittees to implement educational control measu es to inform the public of and encourage participation in nonpoint source pollution control acuvities. Educational control measures are being implemented through a Public Information and Participation (PI/P) program.

Overview and Objectives

The main objective of the PI/P element is to implement educational control measures that provide information to the public and increase understanding of and participation in controlling nonpoint source pollution. The overall goals for FY 91-92 were to generate awareness of the program by defining the problem, inform individuals on ways to participate in solutions to the problem, and provide the means for participation. Specific industries were targeted for development of Best Management Practices (BMP) manuals, brochures, and posters. To aid in the development, publication, storage, and distribution of educational materials, the program established a PI/P Subcommittee in FY 90-91 to have primary responsibility for the implementation of this PI/P element.

Program Activities Completed and In Progress

The subcommittee produced nine types of educational material during FY 91-92. This included development and distribution of an Automotive Industry BMP manual and poster, a construction BMP poster, a "Recycle Your Used Motor Oil" poster, brochures describing how to decrease the use of toxic chemicals in the home, guidebooks, and stencils. The storm drain stencils developed in FY 90-91 were made available to co-permittees and volunteer groups to use during FY 91-92, and the remaining brochures developed in FY 90-91 were distributed to the co-permittees as needed. The co-permittees distribute them to the public through presentations, events, direct mailing, and billing inserts. In addition, the subcommittee distributes the materials to the public through presentations and events and to schools, teacher organizations, and specific businesses.

FY 92-93 Program Activities

The subcommittee will continue to be primarily responsible for implementation of this PI/P element, and to act as the central development and distribution point for all materials. The subcommittee will also be evaluating the effectiveness of the PI/P element activities of the past 2 fiscal years and developing recommendations for increasing the outreach effort. Activities planned for FY 92-93 include development of a program newsletter for nontechnical audiences with periodic distribution and development of a brochure for homeowners to use when dealing with contractors who offer potentially hazardous services (e.g., carpet cleaning, pest control). Other activities planned for FY 92-93 are creation and implementation of a distribution plan for program educational materials, translation of one brochure into Spanish, reprinting of existing materials to keep distribution points supplied, provision of funds to support other programs and for the purchase of educational materials produced by other programs in the Nation, development of a strategy for a recognition program for industry compliance efforts, and funding of the San Francisco Bay National Wildlife Refuge's Alviso Environmental Education Center.

Co-Permittee Activities Completed and in Progress

The activities conducted by the subcommittee and the co-permittees for the PI/P element are summarized below. The detailed reports submitted by the subcommittee and the co-permittees are presented in the "Public Information/Participation" Program Element Report.

Infrastructure

The funding, staffing, and organizational/institutional infrastructures established by the co-permittees are summarized in Table 3-4. Of the 15 co-permittees, 6 relied wholly or partially on their general fund for funding of PI/P element activities in FY 91-92, and 10 acquired funding through related program funds, fees, or utilities. Funding for the program element was sufficient for 14 co-permittees in FY 91-92, and 1 reported that the budget was constrained. Staffing for the PI/P element was sufficient in FY 91-92 for nine co-permittees and insufficient, overextended, or limited for six co-permittees. A total of five of the six co-permittees reporting insufficient or limited staff proposed changes to resolve the problem; one indicated no changes would be made due to a hiring freeze. The 4 co-permittees who reported organizational limitations to implementation of the PI/P element identified the problems as establishment of effective communication among departments and difficulties in analysis of activities; 11 co-permittees reported that there were no organizational limitations.

Public Information and Participation Activities

The activities conducted by the co-permittees to meet the objectives of the PI/P element included storm drain stenciling; publication of articles in newspapers, community reports and newsletters, preparation of advertisements for radio and TV; direct mailing of brochures, and distribution of billing inserts (Table 3-5). Brochures and posters were distributed at presentations and special events and were made available at community centers and public office buildings. Some co-permittees provide telephone and mail service to distribute materials on request. In FY 91-92, more than 21,000 storm drains were stenciled, 76 articles and advertisements were published, 238 presentations and events were presented or attended, and more than 77,000 brochures and posters and over 82,00 billing inserts were distributed. The city of San Jose took the lead in producing bookmarks for the co-permittees to distribute to libraries for summer reading programs. Copies of San Jose's co-permittee PI/P activities are attached.

E 3-4. PI/P PROGRAM ELEMENT INFRASTRUCTURE

Co-Permittee	ling		Staffing		Organizational Limitations
	Source	Amount	Current	Proposed	
Campbell	General Fund	Sufficient	Overextended	Recruit volunteers	None
Cupertino	Environmental Bill	Sufficient	Sufficient	No changes	None
Los Altos	Sewer Enterprise Fund	Sufficient	Sufficient	No changes	None
Los Altos Hills	General Fund	Constrained	Limited	Hire 1 staff	None
Los Gatos	General Fund	Sufficient	Insufficient	Contract with WVSD	Reorganization of departments
Milpitas	Capital Improvement Program	Sufficient	Sufficient	No changes	None
Monte Sereno	General Fund	Sufficient	Limited	Recruit volunteers for stenciling	None
Mountain View	Wastewater Enterprise Fund	Sufficient	Limited	No changes due to hiring freeze	Coordination between divisions
Palo Alto	Storm Drain Utility	Sufficient	Sufficient	No changes	None
San Jose	Storm Drain User Fee	Sufficient	Sufficient	No changes	None
Santa Clara	Capital Improvement Program	Sufficient	Limited	Hire labor as needed	None
Santa Clara Co.	Existing Programs	Sufficient	Sufficient	No changes	Activity analysis difficult
SCVWD	Water Utility/Flood Control	Sufficient	Sufficient	No changes	Coordination due to physical separation of departments

TABLE 3-5. PI/P PROGRAM ELEMENT ACTIVITY SUMMARY

Co-Permittee/Activity	Goals FY 91/92	Accomplished	Goals FY 92/93	Reasons Goals Not Met
CAMPBELL				
Storm drain stencils	200	200	600	Goal met
Newsletter articles	2	2	2	Goal met
Special events	No goals established	2	No goals established	Not applicable
Brochures/poster distribution	1,115	1,120	1,210	Goals met
CUPERTINO				
Storm drain stencil	All catch basins	Complete	Target businesses	Goal met
TV programs	2	2	1	Goals met
Articles in newsletters, newspapers, billings	5	7	2	Goals met
Adopt-a-creek program	Implement program	No	Implement program in 1992	Required additional research
Brochure/posters distribution	No goals established	As needed	Ongoing	Not applicable
Special programs/events	4	4	3	Goals met
LOS ALTOS				
Storm drain stencils	Ongoing (900 total)	200	Ongoing	Not reported
CATV announcements	10	6	12	Display period too long
Advertisements in newsletters, newspapers, billings	12	17	16	Goals met
New programs	1	1	1	Goals met
Brochures/poster distribution	No goals established	4,313	Ongoing	No goals established
Telephone service	500	32	Ongoing	*No goals* established
LOS ALTOS HILLS				
Storm drain stencils	Access activity	0	Implement alternatives	Aesthetics
Brochure mailing	8,000	8,000	800	Goal met
Brochure distribution	8,000	8,000	Ongoing	Goal met
Advertisement in newspaper	1	1	1	Goal met

Source: Santa Clara Valley Part II Municipal Permit Application

TABLE 3-5. PI/P PROGRAM ELEMENT ACTIVITY SUMMARY (Continued)

Co-Permittee/Activity	Goals FY 91/92	Accomplished	Goals FY 92/93	Reasons Goals Not Met
LOS GATOS				
Storm drain stencils	Not reported	Not reported	Not reported	Activity under consideration
News releases	6	Not reported	1+ article	Not reported
Brochure distribution	Not reported	90	0	Not reported
Brochure mailing	Not reported	Not reported	Not reported	Not reported
Brochure availability	Not reported	Not reported	Not reported	Not reported
MILPITAS				
Storm drain stencils	1,500	2,700	3,047	Goal met
Mailings	12,000	0	12,000	Scheduled for 11/92
CATV advertisement	3	3	3	Goal met
Brochure/poster distribution	No goal established	Ongoing	No goal established	Not applicable
Events/presentations	No goal established	0	3	Not applicable
MONTE SERENO				
Storm drain stencils	100%	0	100%	Volunteer program unsuccessful
Presentations	25%	0	25%	Not reported
Video presentation CATV	100%	0	100%	Program did not develop video
Article in newsletter	100%	100%	100%	Goal met
MOUNTAIN VIEW				
Storm drain stencils	1,555	1,127	600	Slowed to involve volunteer community group
Advertisements in newsletters, newspapers	7	5	6	Short reporting period
Brochure distribution	300	2,600	1,000	Goals met

TABLE 3-5. PI/P PROGRAM ELEMENT ACTIVITY SUMMARY (Continued)

Co-Permittee/Activity	Goals FY 91/92	Accomplished	Goals FY 92/93	Reasons Goals Not Met
PALO ALTO				
Storm drain stencils	100	750	2,000	Goal met
Brochures/poster distribution	4,400	4,600	6,240	Goals met
Billing inserts	27,000	54,000	54,000	Goals met
Community report	1	0	1	Report space restriction
Advertisements in newspaper, TV	3	2	5	Insufficient staff time to coordinate
Presentations/events	4	6	13	One event canceled due to budget cuts
SAN JOSE				
Storm drain stencils	19,345	15,537	3,808	Not reported
Phone/mail service	1,000	1,200	1,000	Goals met
Brochures/poster distribution	8,100	11,880	6,000	Goals met
Advertisements in radio, TV, newspaper, newsletters, transit	22	22	As needed	Goals met
Special events	14	14	As needed	Goal met
SANTA CLARA				
Storm drain stencils	100% industrial areas 100% other	70% industrial 20% other	30% industrial 80% other	No reported
Advertisements in TV, newspapers, newsletters	5	7	6	Goals met
Phone service	50	50	50% as needed	Goals met
Presentations/events	7	7	As available	Goals met
Brochures/poser distribution	No goal established	As needed	Ongoing	Not applicable

TABLE 3-5. PI/P PROGRAM ELEMENT ACTIVITY SUMMARY (Continued)

Co-Permittee/Activity	Goals FY 91/92	Accomplished	Goals FY 92/93	Reasons Goals Not Met
SANTA CLARA COUNTY				
Storm drain stencils	Conducted pilot program	50%	100%	Goal met
Presentations/events	No goals established	5	As needed	Not applicable
Brochures/poster distribution	As needed	4,975+	Ongoing	Not applicable
Advertisements in newspapers, newsletters	As needed	4	As needed	Not applicable
HHW pilot program	Complete pilot program	8,800 door hangers	Expand program	Goal met
Mailings	No goals established	Not applicable	Develop industry mailing list	Not applicable
SCVWD				
Storm drain stencils	All at district headquarters	All inlets	No goal established	Goal met
Advertisement in newsletters	No goals established	3	4	Not applicable
Presentations/events	No goals established	187	As needed	Not applicable
Calendar distribution	No goals established	1,000	1,000	Not applicable
SARATOGA				
Storm drain stencils	25	240	240	Goal met
Brochures/poster distribution	28,000	30,000	Ongoing	Goals met
[illegible]esentation/display/events	No goals established	4	As needed	Not applicable
[illegible]vertisements in TV,	3	3	3	Goals met
Storm drain stencils	1,000	1,129	1,000	Goal met
Brochures/poster distribution	No goal established	5,865	1,700	Not applicable
Presentations/events	12	9	6	Events rescheduled
Mailings/billing inserts	38,400	38,400	38,400	Goals met
Newsletters, quarterly reports	No goals established	1 report	1 report/as needed	Not applicable

TABLE 3-5. PUBLIC AGENCY CONTROL MEASURES ACTIVITY SUMMARY—PART A

Co-Permittee/Activity	Goals FY 91/92	Accomplished	Goals FY 92/93	Reasons Goals Not Met
CITY OF CAMPBELL				
Street sweeping	5 events/259 miles per month	5 events/261 miles per month	13 events/326 miles per month	Goals met
Catch basin cleaning	As needed	Not reported	284	Not applicable
Conveyance cleaning	As needed	Not reported	12.5 miles	Not applicable
CITY OF CUPERTINO				
Street sweeping	6 events/628 miles per month	6 events/628 miles per month	8 events/628 miles per month	Goals met
Catch basin cleaning	1,420	2,840	2,840	Goals met
Conveyance cleaning	As needed	30 incidents	As needed	Not applicable
CITY OF LOS ALTOS				
Street sweeping	5 events/291 miles per month	7 events/332.5 miles per month	7 events/332.5 miles per month	Goals met
Catch basin cleaning	900	900	900	Goals met
Conveyance cleaning	As needed	None	As needed	Not applicable
TOWN OF LOS ALTOS HILLS				
Street sweeping	As needed	Not reported	No goals established	Not applicable
Catch basin cleaning	250	250	250	Goals met
Conveyance cleaning	5 miles	5 miles	5 miles	Goals met
TOWN OF LOS GATOS				
Street sweeping	23 days/700 miles per month	23 days/700 miles per month	23 days/700 miles per month	Goals met
Catch basin cleaning	500	325	600	Limited staff
Conveyance cleaning	20	20	20	Goals met
CITY OF MILPITAS				
Street sweeping	20 events/390 miles per month	18 events/390 miles per month	16 events/390 miles per month	Goals met
Catch basin cleaning	3000	2172	3000	Limited staff
Conveyance cleaning	85 miles	1.25 miles	4.5 miles	Limited staff

SAMPLE PUBLIC OUTREACH MATERIALS

The following pamphlets and booklets are examples of public education materials that attract attention, are easy to read, and provide steps that the public can take to help improve water quality.

PET WASTE and WATER QUALITY

PUBLISHED FOR THE WISCONSIN PRIORITY WATERSHEDS PROGRAM

Pet-Owners, Take Heed. When you clean up after your pet, do you dump the waste in the street or storm sewer? Do you leave it to decay on the sidewalk or on the grass near the street? If so, you may be causing pollution or health problems.

Are You Polluting Our Lakes and Streams?

Pollutants from improperly disposed pet waste may be washed into storm sewers by rain or melting snow. Storm sewers usually do not go to a sewage treatment plant. Instead, most storm sewers drain *directly* into our lakes and streams, carrying many pollutants along with the water.

Pollutants commonly found in urban lakes, streams and ponds include:

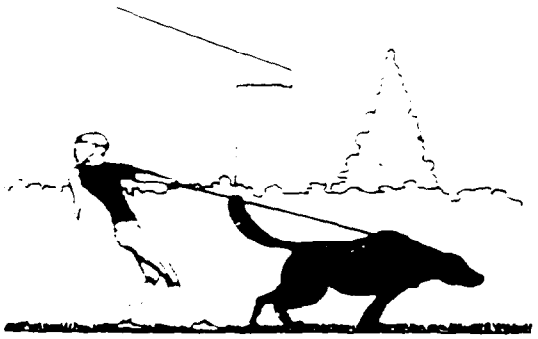
- Sediment
- Pesticides and fertilizers
- Oil and antifreeze
- Toxic chemicals
- **Pet waste**

When pet waste is washed into lakes or streams, the waste decays, using up oxygen and sometimes releasing ammonia. Low oxygen levels and ammonia combined with warm temperatures can kill fish.

Pet waste also contains nutrients that encourage weed and algae growth. Overly fertile water becomes cloudy and green—unattractive for swimming, boating and fishing.

Perhaps most importantly, pet waste carries diseases which make water unsafe for swimming or drinking.

About 90% of storm water samples collected recently in Wisconsin cities had very high levels of bacteria which violated water quality standards for recreational use. Common sources of bacteria include sanitary sewer overflows, pets, and urban wildlife.



Are You Risking Your Health?

When pet waste is disposed of improperly, not only water quality suffers—your health may be at risk, too. Pets, children who play outside, and adults who garden are most at risk for infection from some of the bacteria and parasites found in pet waste. Flies may also spread diseases from animal waste. Diseases that can be transmitted from pet waste to humans include:

Campylobacteriosis—A bacterial infection carried by dogs and cats that frequently causes diarrhea in humans.

Salmonellosis—The most common bacterial infection transmitted to humans by other animals. Symptoms include fever, muscle aches, headache, vomiting, and diarrhea.

Toxocariasis—Roundworms usually transmitted from dogs to humans, often without noticeable symptoms, but may cause vision loss, a rash, fever, or cough.

Toxoplasmosis—A protozoan parasite carried by cats that can cause birth defects such as mental retardation and blindness if a woman becomes infected during pregnancy; also a problem for people with depressed immune systems. Symptoms include headache, muscle aches, lymph node enlargement.

Pet waste may not be the largest or most toxic pollutant in urban waterways, but it is one of the many little sources of pollution that add up to a big problem for water quality. Fortunately, there are some simple things we can all do to help keep our water clean. See the other side for ways to keep pet waste out of local waterways.

You Can Make A Difference

Cleaning up after your pet can be as simple as taking a plastic bag or pooper scooper along on your next walk. What should you do with the waste you pick up? No solution is perfect, but here are the choices:

❶ Flush it down the toilet . . .

The water from your toilet goes to a septic system or sewage treatment plant that removes most pollutants before the water reaches a lake or stream.

To prevent plumbing problems, don't try to flush debris such as rocks, sticks, or cat litter. Cat feces may be scooped out and flushed down the toilet, but used litter should be put in a securely closed bag in the trash.

❷ Bury it in the yard . . .

Dig a hole or trench that is:

- About 5 inches deep;
- Away from vegetable gardens;
- Away from any lake, stream, ditch, or well.

Microorganisms in the top layer of soil will break down the waste and release nutrients to fertilize nearby plants.

Be cautious. Keep pet waste away from vegetable gardens and water supplies to prevent disease. Don't add pet waste to your compost pile. The pile won't get hot enough to kill disease organisms in pet waste.

❸ Put it in the trash . . .

This may be easy, but it is not the best solution. Waste taken to a landfill or incinerator can still cause pollution problems.

Check local ordinances. Putting pet waste in the trash is against the law in some communities.

Another option is to install an underground pet waste digester that works like a small septic tank. Before buying one from a pet store, check local laws that may restrict their use, design or location.

A Few Words of Caution

Around Your Home—If you leave pet waste to decay in your yard, be sure it does not become a problem. To prevent water pollution, clean up areas near wells, sewer inlets, ditches, and waterways. Always remove waste from areas where children play. They are the most frequent victims of diseases from pet waste. Of course, the best protection for children and adults is washing hands with soap and water.

In Your Community—Many communities have "pooper scooper" laws that govern pet waste cleanup. Some of these laws specifically require anyone who takes an animal off their property to carry a bag, shovel, or pooper scooper. Any waste left by the animal must be cleaned up immediately. Call your city or village clerk to find out more about local pet waste laws.

A publication of the University of Wisconsin–Extension, in cooperation with the Wisconsin Department of Natural Resources under funding from the Wisconsin Nonpoint Source Water Pollution Abatement Program. Jennifer A. Hill, intern and Carolyn D. Johnson, Urban Water Quality Educator, UWEX Southeast Area.

GWQ006 Pet Waste and Water Quality

This publication is available from your Wisconsin county Extension office or from Cooperative Extension Publications, Room 245, 30 N. Murray Street, Madison, Wisconsin 53715. Phone 608/262-3346.

Printed on recycled paper

G-06-92-10M-20-S

YARD CARE AND THE ENVIRONMENT

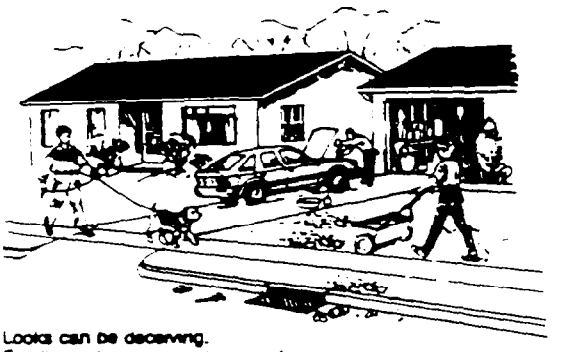
Practical Tips for Home and Yard

A SERIES OF WATER QUALITY FACT SHEETS FOR RESIDENTIAL AREAS

It's an unfortunate fact of urban life—many of our streams and lakes have been polluted. It may be a surprise, however, to learn that water pollution often starts right where you live.

In the community. Urban water pollution begins when development alters natural processes. Removing vegetation and replacing it with streets, rooftops and driveways greatly decreases the amount of water soaking into the soil. As a consequence, the amount of water running off to streams and lakes increases dramatically.

How does the water get from street to stream? Nearly every city street has storm sewer inlets, which open into a network of underground pipes. Leaves, litter, pet wastes, and other materials dumped or washed into storm sewer inlets *do not* go to a sewage treatment plant but flow *directly* to streams and lakes. Also, most storm sewer systems are designed to remove water from developed areas quickly during a storm. This allows pollutants to reach streams and lakes at a "rapid transit" pace.

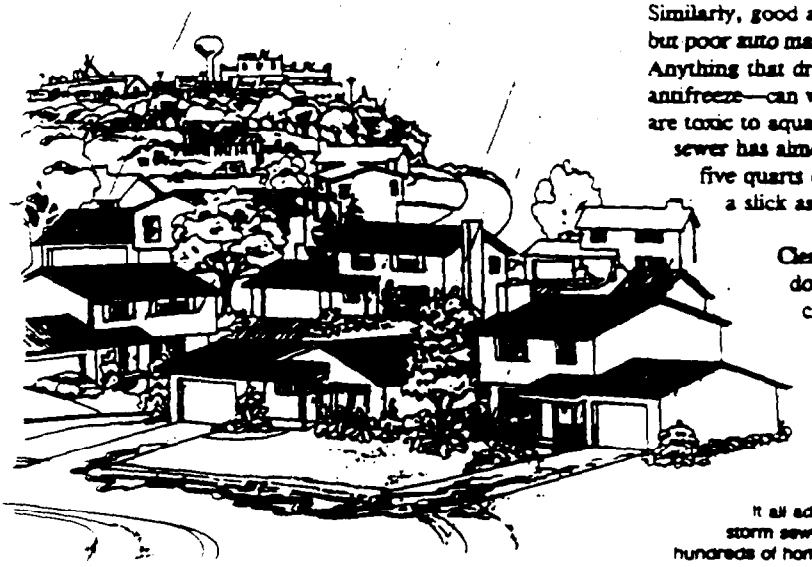


Looks can be deceiving. Fertilizing the lawn, working on the car, washing the dog and other home activities might seem far removed from water quality. But with gutters and storm sewers, it's as if we all live on a streambank.

Around the home. Our actions around home can either help or harm water quality. For example, rain can wash improperly applied lawn fertilizer and pesticides into lakes and streams. On the other hand, careful landscaping and sound lawn care practices can reduce the need for chemicals and protect water quality.

Similarly, good auto maintenance pays in the long run, but poor auto maintenance can seriously harm our waters. Anything that drips from a motor vehicle—oil, gas, antifreeze—can wash into storm sewers. These materials are toxic to aquatic life. Dumping them into a storm sewer has almost unthinkable consequences. Just five quarts of oil in a stream or lake can create a slick as large as two football fields.

Clearly, there is a need to rethink what we're doing at home if urban waters are to be clean and usable. Fortunately, by following the tips inside, we can all contribute to cleaner water while making our homes and communities more attractive and liveable.



It all adds up. Pollutants washed into storm sewers from dozens of streets and hundreds of homes can become major problems for streams and lakes in a community.

SIMPLE TIPS FOR CLEANER WATER

It really doesn't matter whether you live in the city or the country . . . whether your home is large or small . . . whether you have a lot of time and money to invest in your yard or just a little. There is something you can do to improve water quality. The following suggestions are ways that you can make a contribution to clean water and a healthy environment.

Around your home

- Mow often enough to leave grass clippings on the lawn. Alternatively, use clippings as a mulch or compost them along with leaves that might otherwise "fertilize" local waters.
- Keep fallen leaves out of the streetside gutter or ditch, using them around the yard as practical. Properly place the remainder near the curb (not in the street) just before municipal collection.
- Plant an extra tree for multiple environmental benefits, especially where it becomes part of a planting bed or "naturalized" landscape area that recycles leaves, twigs, and other yard "wastes."
- Seed bare soil and cover it with a mulch as soon as possible to minimize erosion. Disturb no more ground than necessary for a project, while preserving existing vegetation.
- Direct roof downspouts away from foundations and driveways to planting beds or lawns where water can safely soak into the ground. Consider using a rain barrel if practical.
- Use lawn and garden chemicals carefully and sparingly. Pesticides, including weed killers, should be considered a last resort—other controls come first.
- Limit the use of toxic or hazardous products in general. Keep them away from storm sewers, lakes, and streams.
- Collect oil and other automotive products preferably for recycling, or tightly seal and wrap them for proper disposal.
- Wash cars on the lawn, where soapy water can't quickly run toward the nearest storm sewer, picking up other pollutants as it goes.
- Keep cars tuned up and in good operating condition. Check especially for drips and repair leaks immediately to keep nuisance oils off pavement. Better yet, walk, bike or take the bus.
- For waterfront property, grow a "buffer strip" of dense, natural vegetation along the water's edge to filter pollutants and stabilize the shoreline.
- If using a septic tank system, maintain it properly through regular inspections and licensed pumping every two to three years.
- Monitor fuel use from any underground gas and oil tanks to make sure they are not leaking.

- Plan your landscape with environmental health in mind, reducing the area that is heavily maintained.
- Clean up pet wastes, from which nutrients and bacteria could be washed toward lakes and streams.
- Conservatively use salt in winter. Use sand or chip the ice off pavement when possible.

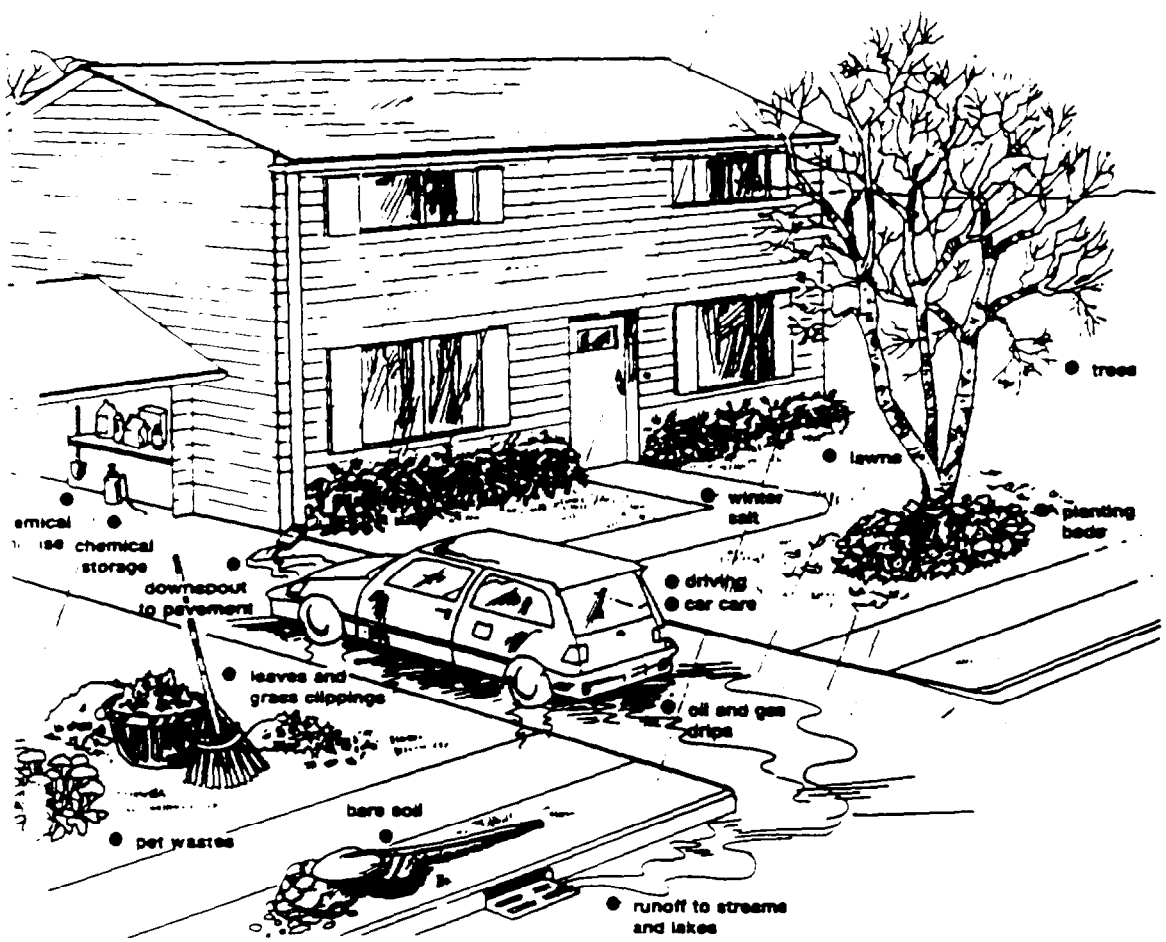
In your community

- Support and follow ordinances that limit soil erosion from construction sites.
- Encourage stormwater management practices that reduce runoff pollution by temporarily holding water in ponds or letting it soak into the ground.
- Encourage the safe but conservative use of salt on roads and limit application to critical areas.
- Tell public officials about your interest in cleaning up local waters and about their value to recreation and the economy.
- Support the preservation of wetlands as natural filters that protect water quality, prevent flooding, and provide vital open space.
- Promote "environmental or parkway corridors" adjacent to streams and waterways for water quality, wildlife, and multiple-use benefits alike.
- Participate in groups, projects, and events that promote conservation, waterfront recreation, or shoreline clean-ups.

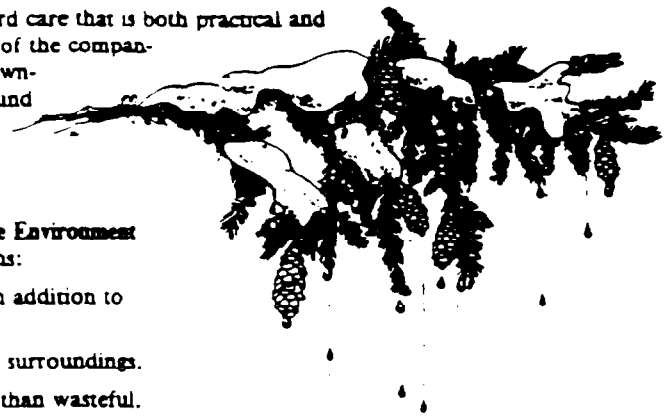
Home Hot Spots for Water Quality

Around every yard are spots where your activities affect water quality. The illustration shows a few of them. Take a look around your own home with an eye toward water quality.

● Good for water quality ● Bad for water quality
● Could be good or bad, depending on your actions



PRINCIPLES OF ENVIRONMENTALLY SOUND YARD CARE



This publication describes an approach to yard care that is both practical and environmentally sound. As a shorter version of the companion piece, *Rethinking Yard Care*, it offers down-to-earth tips for protecting water quality around your home and in your community. Look inside for information on home "hot spots" for water quality.

As stressed throughout the **Yard Care and the Environment** series, environmentally sound yard care means:

- Thinking of environmental consequences in addition to conveniences.
- Planning for greater harmony with natural surroundings.
- Being conservative and resourceful, rather than wasteful.
- Believing that small changes collectively make a big difference.
- Capitalizing on the time and cost-savings that rethinking yard care can bring.

Fact sheets in the **Yard Care and the Environment** series are designed to illustrate principles of environmentally sound yard care. They provide specific information about pesticides, fertilizers, landscaping, watering and related topics. These and other publications can be obtained from your local UW-Extension office, usually located in the county courthouse or another public building. Help is also available there regarding soil testing, pest identification, plant selection and other important items related to yard care and water quality.

A publication of the University of Wisconsin–Extension, in cooperation with the Wisconsin Department of Natural Resources under funding from the Wisconsin Nonpoint Source Water Pollution Abatement Program. Gary K. Korb, Water Quality Education Coordinator, Southeast Area UWEX. Editorial and design assistance from Bruce Webendorfer, Environmental Resources Center, UWEX. Illustrations by Carol Watkins.

GWQ007 Practical Tips for Home and Yard

This publication is available from your Wisconsin county Extension office or from Cooperative Extension Publications, Room 245, 30 N. Murray Street, Madison, Wisconsin 53715. Phone 608/262-3346.

R–09–92–10M–60–S

Please call or visit any of these offices:

LEXINGTON COUNTY

Clemson Extension Service
219 East Main Street
Lexington, SC 29072
359-4265

U.S. Soil Conservation Service
219 East Main Street
Lexington, SC 29072
359-1165

U.S. Agricultural Stabilization and Conservation Service
219 East Main Street
Lexington, SC 29072
359-1205

S.C. Forestry Commission
219 East Main Street
Lexington, SC 29072
359-2415

OTHER OFFICES

S.C. Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201
734-5228

S.C. Land Resources Conservation Commission
2221 Devine St., Suite 222
Columbia, SC 29205
734-9100

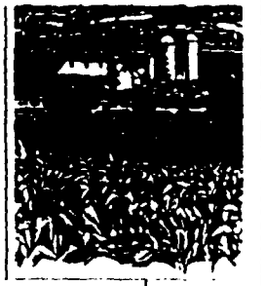
Some of these materials developed by the Tennessee Cooperative Extension Service and the Alliance for the Chesapeake Bay

Extension

Printed on recycled paper with soy ink

Clean Water:

A Clear Choice for Bush River and Camping Creek



FOR MORE INFORMATION:

Please call or visit any of these offices

LAURENS COUNTY

Clemson Extension Service
219 Laurens Street
Laurens, SC 29360
984-2514

U.S. Soil Conservation Service
P.O. Box 348
Laurens, SC 29360
984-6921

U.S. Agricultural Stabilization and Conservation Service
221A West Laurens Street
Laurens, SC 29360
984-7741

S.C. Forestry Commission
West Main Street
Laurens, SC 29360
984-7511

NEWBERRY COUNTY

Clemson Extension Service
P.O. Box 160
Newberry, SC 29108
276-1091

U.S. Soil Conservation Service
P.O. Box 434
Newberry, SC 29108
276-0032

U.S. Agricultural Stabilization and Conservation Service
P.O. Box 638
Newberry, SC 29108
276-0001

S.C. Forestry Commission
P.O. Box 129
Newberry, SC 29108
276-4821

(List continued on back panel)

10 Ways You Can Help Keep Your Lake Clean.

1. ***Get Involved*** Each of us pollutes ground and surface water. Each of us can help save it. Our contributions may seem small but they join with those of others on the lake. Here are nine more ways you can help keep the lake clean.

2. ***Save Water*** Saving water will help water quality by reducing the volume of water going through septic tanks. A dripping faucet wastes 20 gallons of water a day and a leaking toilet wastes 200 gallons. Use water sparingly while [illegible]shing your teeth, washing dishes, or shaving. Install a water conservation shower head and take short showers instead of baths. A bath uses 30-50 gallons of water, a short shower only 10.

3. ***Soil Test for Fertilizer Application.*** Many farmers apply the same fertilizer at the same rate every year. Excessive amounts of nitrogen, phosphorus, or potassium that are not used by the crop leach through the soil and contaminate groundwater. Soil testing allows farmers to determine the exact needs of their fields. This insures optimum yields, a clean groundwater supply, and helps farmers save money by using less fertilizer.

4. ***Control Soil Erosion.*** Utilize conservation practices such as conservation tillage and strip cropping to reduce soil erosion. Nutrients and pesticides bond with soil particles. When these particles are eroded into streams and rivers the chemicals are carried with them. Use filter strips near surface water areas and drainage ditches to help prevent water contamination.

5. ***Practice Sensible Pest and Weed Control.*** Apply pesticides and herbicides at the labelled rate. Excessive amounts will leach through the soil and can cause damage to crops and beneficial insects. Make sure the pesticide is labelled for the specific weed, insect and the crop to be treated. Do not apply in windy conditions, when rain is forecast, or to other areas as a precaution.

6. ***Dispose of Pesticide Containers Properly.*** All pesticide containers have a residue of the chemical stored in them. Triple rinsing the containers will remove over 99% of the residue. Use this rinsate in your applicator and be sure to puncture all old containers to prevent re use. Take the rinsed containers to an approved landfill for disposal. NEVER pour rinsate on the ground!

7. ***Protect Your Wellhead Area.*** Many farmers mix chemicals at or near a wellhead. Any spills near a well can easily contaminate the well water by flowing down against the well casing to the water. Always mix chemicals at least 100 feet from the well. In hilly areas make sure the mixing site is below the wellhead. A concrete pad with low curbs to catch any spills is an excellent mixing site.

8. ***Manage and Utilize Animal Wastes Properly.*** Concentrated animal wastes can chemically and biologically impair water supplies. Maintain lagoons and manure storage areas properly. Apply animal wastes to land to build up soil organics and lower commercial fertilizer costs. Incorporate applied wastes into the soil as soon as possible to obtain the greatest nutrient benefit. Do not apply wastes to streambanks or flooding areas.

9. ***Use Equipment Service Products Wisely*** Petroleum products, antifreeze, and battery acid contaminate water supplies just as easily as pesticides and wastes. Capture all used motor oil for disposal or re use in lubricating chains or blades. Dispose of motor oil and antifreeze at recycling centers. Do not use gasoline as a parts cleaner or weed killer. Never pour oil or grease on the ground!

10. ***Dispose of Household Products Carefully*** Many products under your kitchen sink or in the garbage can harm the water quality. Never pour paints, preservatives, brush cleaners, and solvents down a drain. Sewers or septic tanks do not treat these materials and they can enter the groundwater untreated. Buy the product with the least amount of toxic material. Used turpentine and brush cleaners can be filtered and reused. Strain paint cans and other chemical containers with newspapers before discarding.

The Lake Bowen TMDL Project is a group effort of local, state, and federal agencies. The USDA Soil Conservation Service (SCS) is assigned the overall leadership responsibility and also provides technical assistance to landowners. Financial cost sharing funds are provided by the USDA Agricultural Stabilization and Conservation Service (ASCS), and information and education assistance are coordinated by Clemson University Cooperative Extension Service.

Household alternatives for source control of heavy metals.

Often it is impossible to tell whether a product contains metals or not. Product ingredient lists are incomplete for one reason or another. Gradually this will change as the public demands "green" or environmentally sensitive products and more complete labelling information. In the meantime, research into the contents of household products is continuing, locally and nationally.

Testing conducted by the Washington Toxics Coalition of Seattle and other organizations has shown that certain products contain lower levels of metals than others. The information in this brochure is only a partial listing of products and alternatives, and will be updated and expanded from time to time.

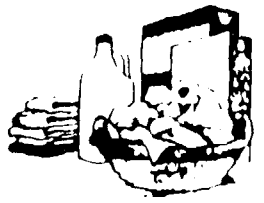
And choices don't have to be all or nothing.

Say for example that you have a favorite detergent that contains heavy metals. Try a substitute every second or fourth washload. You'll still be reducing the amount of metals by 25 to 50%—and eventually you may choose to make the substitution completely.

Garden:

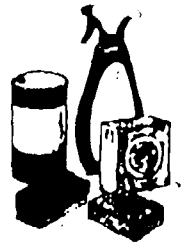
Product	Alternative
Root Killer	Crystals that are flushed down the toilet to control the growth of roots in sewer lines may contain copper. Mechanical removal may be an alternative.
Pesticides	May contain copper. Try attracting birds or introducing lady bugs or praying mantis to your garden. For small infestations, wipe leaves or use a high-pressure water sprayer and plain soap.
Weed control	Pull by hand or cover area with mulch, fabric, or plastic.
Fertilizers	Start a backyard compost bin, or use organic soil additives such as peat moss.

Laundry:



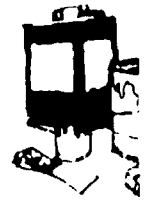
Product	Alternative
Detergents	In general, phosphate-free liquid laundry detergents contain lower levels of metals than do powdered varieties. Cheer liquid, Life Tree, Shaklee Liquid L, and White King Soap contain the lowest metals levels of products tested.
Bleach	Non-chlorine liquid bleaches are lowest in metals. Avoid bleaches containing phosphates. Try less bleach per load, with baking soda added, or presoak heavily-soiled items for 30 minutes in warm water with a half cup washing soda.
Fabric softeners	Sheets have lower metals levels than liquids. Or add one cup vinegar or a quarter cup baking soda during final rinse.
Dishwashing Detergents	No difference between powder and liquid. An alternative is sodium hexametaphosphate, in same quantity as detergent. Hand-washing detergents have less metals than machine detergents, but do not use them as an alternative in the machines.

Household Cleaners:



Product	Alternative
Scouring Powder	Dissolve baking soda in water; or sprinkle on surface to be cleaned or on a sponge. Shaklee at Ease liquid and Soft Scrub have lowest metals levels of products tested.
General Purpose	Liquids are generally lower in metals.

Paints & Preservatives:



Product	Alternative
Paints	Avoid oil based paints. Buy latex or water based type. Estimate quantity carefully.
Paint removers	To remove paint from hands, massage with margarine or a few drops of baby oil. Wipe dry and then wash with soap. To strip paint, use a hook scraper, a abrasive block or sandpaper. Clean brushes right after use. Never use gasoline. Soften hard paint brushes in hot vinegar and wash with soap and water.
Preservatives	Avoid products with copper, arsenic creosote. Use decay resistant wood products such as redwood and ceda
Stains	Use finishes derived from natural sources, such as shellac, tung oil, and linseed oil.

Automotive:

Product	Alternative
Used motor oil	May contain metals; never pour on land or down a sewer drain. San Jose and other cities have curbside recycling pick up; or check with service stations/autocenters. Also, try to buy recycled oil - even for high performance autos.
Fluids	Spent antifreeze and brake fluid should be stored properly until they can be disposed of at a hazardous waste collection event.

Cultivate Clean Water!

Fertilizer runoff, eroded sediments, septic wastes and pesticide residues are leading causes of water pollution.

- ★ Have your soil tested; use the right fertilizer at the right time, and don't use more than is needed.
- ★ Use pesticides only when other methods have failed—follow the manufacturer's instructions for use, storage and disposal. Buy only as much as you can use this season.
- ★ Help prevent erosion by planting slopes and resodding bare spots.
- ★ Keep your septic system running properly; keep the tank and leachfield areas clear.
- ★ Don't dispose of trash, lawn clippings, leaves or brush in drainage ditches or on flood control lands.

REFERENCES

Ayres, 1991. Douglas W. and Scott Thorpe. *Financing Capital Improvements*. American Water Works Journal.

City of Seattle, Washington. 1992. *Part II NPDES Permit Application for Discharges from MS4s.*

County of Grand Traverse, Michigan. 1992. *Mitchell Creek Watershed Case Study.*

County of Prince George's, Maryland. 1992. *Part II NPDES Permit Application for Discharges from MS4s.*

County of Santa Clara Valley, California. 1992. *Part II NPDES Permit Application for Discharges from MS4s.*

Government Finance Offices Association. 1989. *Tax Reform and State Revolving Funds: An Analysis of The 1986 Tax Reform Act.* A Report to the U.S. Environmental Protection Agency.

Lindsey, Greg. 1988. *Financing Storm Water Management: The Utility Approach.* Sediment and Storm Water Administration, Maryland Department of the Environment. Dundalk, Maryland.

National League of Cities. 1987. *Financing Infrastructure: Innovations at the Local Level.* Washington, D.C.

Moody's Public Finance Perspective on Municipal Issues. *1992. State Revolving Funds Finance Local Wastewater Treatment*, 1992. Moody's Public Finance Perspective on Municipal Issues. Washington,

U.S. EPA, Office of Wastewater and Compliance. 1991. *State Revolving Fund (SRF) Final Report to Congress: Financial Status and Operations of Water Pollution Control Revolving Funds.* Washington, D.C.

U.S. EPA, Office of Water. 1992. *State and Local Funding of Nonpoint Source Control Programs.* Washington, D.C., EPA-841-R-92-003.

U.S. EPA, Office of Water. 1993. *Guidance on the Award and Management of Nonpoint Source Program Implementation Grants Under Section 319(h) of the Clean Water Act for Fiscal Year 1994 and Future Years.* Washington, D.C.

U.S. EPA, Office of Wetlands, Oceans, and Watersheds. *1993. Watershed Protection: Catalog of Federal Programs.* Washington, D.C., EPA-841-B-93-002.

U.S. GSA, 1991. *Catalog of Federal Domestic Assistance.* Office of Management and Budget, Executive Office of the President and U.S. General Services Administration. Washington, D.C.

Zachmann, Bill. 1990. *A Nonpoint Source Pollution Control Fee Proposal.* Shorelands and Coastal Zone Management Program, Washington Department of Ecology. Prepared in continuation of the SF-6 Task of the 1989 Puget Sound Water Quality Management Plan.

CHAPTER 4

PROCEDURES FOR IMPLEMENTING A PROGRAM TO IDENTIFY AND REMOVE ILLICIT DISCHARGES FROM STORM SEWER SYSTEMS

INTRODUCTION

The previous chapters presented information on municipal storm water management program regulatory requirements, guidance for municipal officials to rank storm water management activities for maximum cost effectiveness, and detailed procedures on how to implement specific administrative requirements. This chapter describes the procedures for identifying illicit discharges and implementing illicit discharge programs. Specifically, it discusses the components of an effective illicit discharge detection program, EPA's method for identifying illicit discharges, and examples of illicit discharge programs that have been or will be implemented in different municipalities.

Current interest in illicit connections to storm drainage systems is an outgrowth of investigations into the larger problem of determining the role of urban storm water runoff as a contributor to receiving water quality problems. Water discharge from storm water drainage systems often includes waters from many non-storm water sources. A 1987 study in Sacramento, California, found that almost half the water discharged from the storm water drainage system was not directly attributable to runoff. Illicit entries to the storm drainage system are likely sources of this discharge and can account for a significant amount of the pollutants discharged from storm drainage systems.

Common sources of non-storm water entries include sanitary wastewater, automobile maintenance and operation waste products, laundry washwater, household toxic substances, accident and spill waste streams, runoff from excess irrigation, and industrial sources of cooling waters, rinse water, and other process wastewater. Although these sources can enter the storm drainage system various ways, they generally result from either direct connections (e.g., wastewater piping either mistakenly or deliberately connected to the storm drains) or indirect connections (e.g., infiltration into the storm drain system or spills collected by drain inlets). Sources can be further divided into those discharging continuously and those discharging intermittently. Table 4-1, presented in *Investigation of Illicit Pollutant Entries Into Storm Drainage Systems* (EPA 1993), gives a simple overview of typical pollutant sources and their most likely characteristics. The table lists the potential sources for illicit pollutant entries into the storm sewer system from residential, commercial, and industrial areas.

TABLE 4-1. POTENTIAL ILLICIT ENTRIES INTO STORM DRAINAGE SYSTEMS

Potential Source	Storm Drain Entry		Flow Characteristics		Contamination Category		
	Direct	Indirect	Continuous	Intermittent	Pathogenic/ Toxic	Nuisance	Clear
Residential Areas							
Sanitary wastewater	X	x	X	x	X	x	
Septic tank effluent		X	X	x	X	x	
Household chemicals	x	X		X	X		
Laundry wastewater	X			X		X	
Excess landscaping watering		X		X	x	x	X
Leaking potable water pipes		X	X				X
Commercial Areas							
Gasoline filling station	X	x		X	X		
Vehicle maintenance/repair	X	x		X	X		
Laundry wastewater	X		X	x	x	X	
Construction site de-watering		X	X	x		X	
Sanitary wastewater	X	x	X		X		
Industrial Areas							
Leaking tanks and pipes	x	X	X	x	X		
Miscellaneous process waters	X	x	X	x	X	x	x

Note: X: most likely condition
x: may occur
blank: not very likely

REQUIRED COMPONENTS OF AN ILLICIT DISCHARGE DETECTION AND REMOVAL PROGRAM

The regulations under 40 CFR 122.27 require that the Storm Water Management Programs include "a description of a program . . . to detect and remove . . . illicit discharge into the storm sewer." The regulations further require the following components be included in the program:

- Prohibition of illicit discharges
- Field screening of outfalls within the drainage area
- Investigation of potential illicit discharges

- Spill response and prevention
- Public awareness and reporting program
- Control of infiltration of seepage from sanitary sewers to municipal separate storm sewer systems (MS4s).

Prohibition of Illicit Discharges

Applicants must develop and implement an effective program to prohibit illicit discharges from entering MS4s. This is accomplished through the implementation of inspection procedures, local ordinances, and other legal authorities. In addition to adopting prohibition procedures, a schedule of the implementation process should be developed, and sufficient staff and resources should be allocated. The prohibition of illicit discharges should be linked to legal authority to ensure proper enforcement.

Field Screening

Applicants must propose procedures for a continued outfall field screening program. They can use the procedures from their Part 1 applications or use alternative methods. The field screening procedures in the Part 2 application should identify target areas to be examined for continued field screening and the reasons for selecting these areas. Also, any additional major outfalls recently identified should be included in the Part 2 field screening process. Of particular concern are areas of older development, areas with automobile-related industries, and areas with high concentrations of industrial facilities, among others.

This section should provide a detailed summary of the departmental responsibility for field activities, frequency of inspections, inspection procedures, inspection equipment, and documentation procedures for field activities.

Investigation of Potential Illicit Discharges

Applicants should propose criteria to identify the parts of the MS4 that need investigation. Procedures for investigating likely locations for illicit discharge connections include an MS4 inspection, use of remote control cameras, onsite facility inspections and dye-testing, and additional monitoring to pinpoint pollutant sources. To adequately address these procedures, a checklist should be developed to ensure a comprehensive evaluation of the problem. The checklist should emphasize the use of the easiest, least expensive, and most effective methods for detecting illicit discharges. EPA suggests that a map be developed to supplement the investigation by identifying the illicit discharge locations.

Spill Response and Prevention

The purpose of spill response programs is to reduce the risk of spills to the public. These programs usually require coordination among fire, police, health, and public works departments. The municipal departments responsible for implementing the program should be identified and should address topics such as employee training, reporting procedures, spill containment, storage and disposal activities, documentation, and followup procedures. For each of these elements, particular attention should be given to good housekeeping and materials management practices.

Procedures can be implemented through modification of the land use planning process and ordinance enforcement or through coordination with existing spill prevention or spill containment programs.

Public Awareness and Reporting Program

Applicants should promote, publicize, and facilitate public reporting of illicit discharges or water quality impacts associated with discharges from MS4s. The public awareness program should stress that the public is the beneficiary of this program. Typical public awareness and reporting programs may include developing a hotline number, educating school students, using inserts in utility bills, and media announcements. Effectively implementing these programs should lead to a reduction in the residential discharges noted in Table 4-1.

Proper Management of Used Oil and Toxic Materials

This program component should facilitate the proper disposal of used oil and toxic materials from households, industrial, and commercial users by establishing municipal collection sites or identifying private collection sites. This program should also include any outreach programs for handlers of used oil, as well as the general public.

Control of Infiltration of Seepage

This program component should describe procedures that would control infiltration of seepage from sanitary sewers to MS4s. Some controls to consider for limiting seepage include inspection programs, preventive maintenance surveys, and ongoing infiltration and inflow programs for locating seepage sites. Seepage from malfunctioning septic systems should also be controlled.

EPA'S SUGGESTED METHOD FOR DETECTING ILLICIT CONNECTIONS

EPA's suggested method for detecting illicit discharge connections, developed by the Office of Research and Development, is described in *Investigation of Inappropriate Pollutant Entries into Storm Drainage Systems* (user's guide EPA 1993), which is available from the Center for Environmental Research Information, (513) 569-7562. This method focuses on data collection and quantitative analysis to implement a proper illicit discharge connection program.

The user's guide may be used as part of a comprehensive storm water management program that addresses all sources of storm water pollution. Correcting only the most obvious pollutant entries is unlikely to significantly improve the quality of storm water discharges or receiving waters.

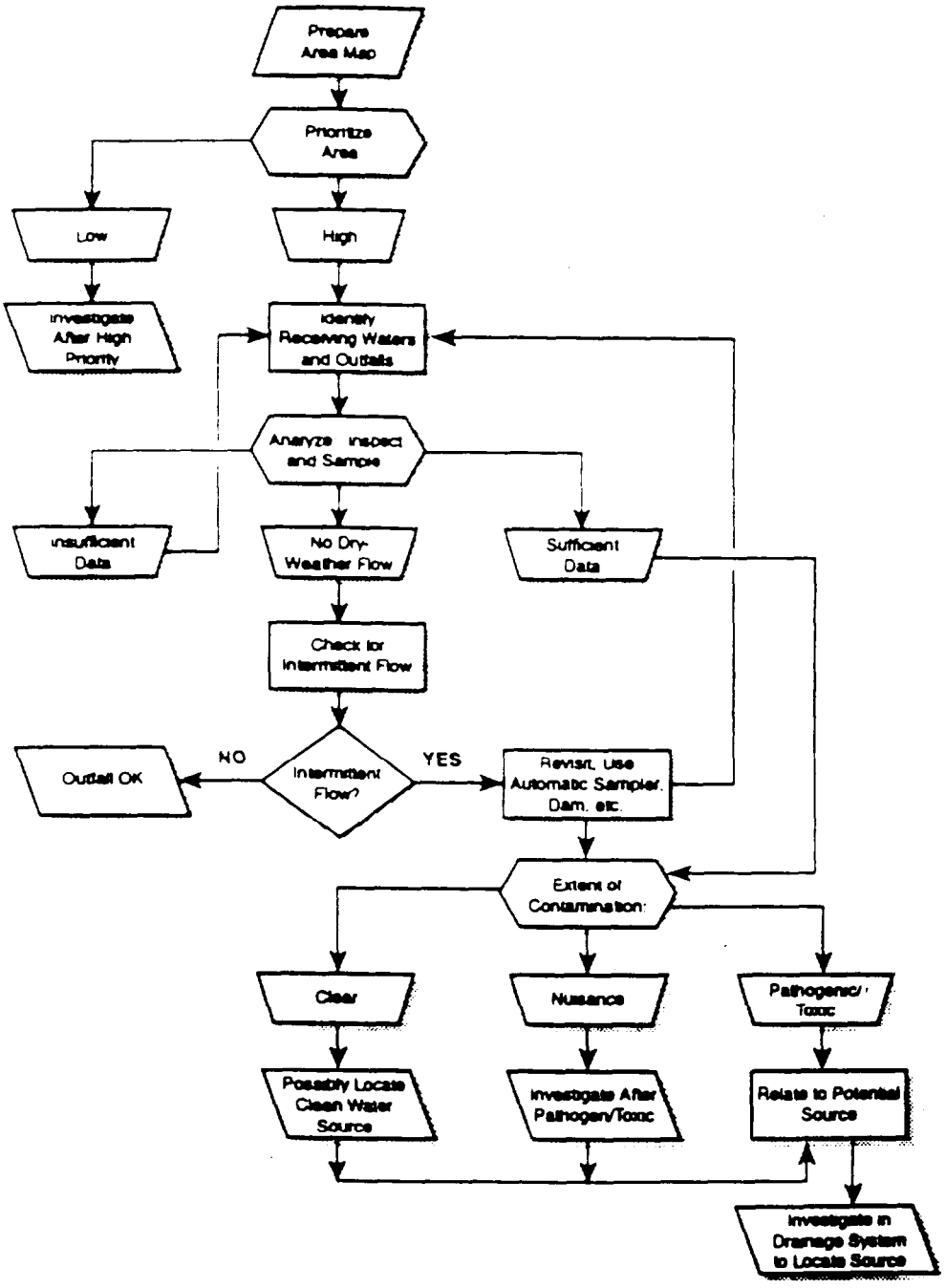
A municipality planning to investigate illicit entries to its storm drainage system needs to base this on local conditions. This user's guide describes the issues and provides examples to facilitate the design of a local investigation.

All the applicable procedures described in the user's guide may be used to successfully identify pollutant sources. For example, attempting to reduce costs by only examining a certain class of outfalls or using illicit testing procedures will significantly reduce the utility of the testing program and result in inaccurate data. Cursory data analyses are also likely to result in inaccurate conclusions.

The methodology (appropriately modified) can also be applied to other types of sewerage systems, such as combined and separate sanitary sewerage, to locate illicit entries (e.g., untreated or toxic industrial wastewater/wastes and infiltration/inflow) into sanitary systems

Figure 4-1 presents a flow chart for the methodology for detecting illicit discharge connections.

FIGURE 4-1. SIMPLIFIED FLOW CHART SHOWING THE DETAILED METHODOLOGY CONTAINED IN THE USER'S GUIDE



The initial phase of the investigative protocol includes initial mapping and surveys. These activities require minimal effort and result in little chance of missing a seriously contaminated outfall. More detailed watershed surveys are then performed to locate and correct the sources of the contamination in the identified problem areas. After corrective action has been taken, repeated outfall field surveys are required to ensure that the outfalls remain uncontaminated. Receiving water monitoring should also be conducted to analyze water quality improvements. If expected improvements are not noted, then additional contaminant sources are likely present, and additional outfall and watershed surveys are needed

The user's guide is designed to provide information and guidance to agencies planning or implementing an investigation of illicit entries to a storm water or wastewater drainage system. This is achieved by:

- Providing a methodology to identify and describe potential sources of non-storm water pollutant entries into the storm drainage system

- Describing an investigative procedure that will allow a user first to determine whether significant non-storm water entries are present in a storm drain and then to identify the potential type of industrial, residential, or commercial sources responsible, as an aid to determining the ultimate location of the source

Procedure

The user's guide describes the following investigation steps:

- Drainage area mapping
- Tracer identification
- Field survey and data collection
- Analyses of data collected
- Categorization of outfalls
- Investigation and remediation
- Pollution prevention program.

Mapping

The mapping exercise is carried out as both a desktop operation by using existing information and with field visits to collect further data and to confirm existing information. The maps should provide complete descriptions of the drainage areas, including outfall locations, watershed boundaries for each outfall, critical land use areas (mostly commercial and industrial areas), permitted discharges to the storm drainage system, city limits, major streets, and streams. The user's guide discusses critical land use areas and lists major industries and their potential to be non-storm water entry sources.

The drainage areas are ranked in the order of their potential to cause problems. This allows priorities to be set for field investigation of the outfalls. Note that all outfalls will eventually require investigations, and the mapping stage is important because the entire investigation is based on it.

GIS are computer-based tools that can be used to store, display, and analyze geographical information; GIS can be used by municipalities when mapping their storm sewer systems for the purpose of documenting illicit discharge connections. The GIS also serve as a data base to store information about the illicit discharge connections, such as field screening and enforcement activities. If GIS are not being used or are not available to a municipality, then zoning maps, marked with important features (e.g., identification of potential discharge points) can also be used to target potential discharges for identification and further action, as necessary.

Tracer Identification

To detect and identify non-storm water entries, dry-weather outfall discharges are analyzed for selected tracers (e.g., ammonia, surfactant), which are found in the potential contaminating sources. Ideally, the selected tracers should be unique for each potential non-storm water contaminating source and should exhibit the following properties:

- Significant difference in concentrations between possible pollutant sources
- Small variations in concentrations within each likely pollutant source category
- A conservative behavior (i.e., no significant concentration change due to physical, chemical, or biological processes)
- Ease of measurement with adequate detection limits, good sensitivity, and repeatability.

The user's guide suggests tracers for common pollutant sources (e.g., sanitary wastewater, septic tank effluent, laundry wastewater, and vehicle washwater, as well as potable water and "natural waters"). A non-storm water entry investigation may need to select additional tracers specific to potential pollutant sources, especially industries, in the study area (e.g., major ions, specific heavy metals). For each selected tracer, the concentration means and standard deviations in all the potential source flows in the drainage area are needed (use of data from other drainage area investigations is not recommended).

Local data collected on tracers will be essential to identify the contamination sources in the outfall discharge. It is important that the tracer data be accurate. Guidance is provided in the user's guide on representative sampling and on the number of samples required for valid data.

Field Survey and Data Collection

Field investigations are used to locate and record all outfalls, including outfalls not previously identified from the mapping exercise. During field investigations, outfalls are physically inspected and samples are taken of any dry-weather flow for analyses. The field survey should, at a minimum, include:

- Accurately locating outfalls and assigning ID numbers
- Photographing outfalls
- Estimating outfall discharge flow rate (or identifying likely intermittent discharge)

- Physically inspecting and recording outfall characteristics, including discharge odor, color, turbidity, floatable matter (e.g., solids, oil sheen), temperature, deposits, stains, vegetation affected by pollutants, and damage to outfall structure

- Collecting dry-weather discharge samples for tracer analyses of specific conductivity (can be field measured with temperature), fluorides, hardness, ammonia, potassium, surfactants, fluorescence, and pH, as well as other samples, depending on industrial activities.

Intermittent flows will be more difficult to confirm and sample. Additional field visits, use of automatic samplers, and flow damming techniques may prove successful for obtaining samples of intermittent flows.

Analyses of Data Collected

Simple testing procedures are suggested for analyzing the tracer parameters. Except for temperature and specific conductivity measurements, the analyses should be carried out in a laboratory and not in the field to ensure consistent results. The laboratory need not be sophisticated; it can be a room or a trailer set up on a temporary basis.

The recommended analytical procedures for each tracer parameter are based on the following criteria:

- [illegible] detection limits
- [illegible] rences
- [illegible] sion
- Low cost, good equipment durability
- Reasonable operator training requirements.

The user's guide also includes guidance on appropriate levels of analytical detection and precision (repeatability) needed to achieve acceptable results.

[illegible]ategorization of Outfalls

Three levels of outfall discharges are defined: (1) pathogenic or toxic substance pollution, (2) pollution that is a nuisance or threatens aquatic life, and (3) unpolluted.

Pathogenic and toxic pollutants can cause illness upon water contact or consumption. They can cause significant water treatment problems for downstream consumers, especially if the pollutants are soluble metal and organic toxicants. These pollutants may originate from sanitary, commercial, or industrial wastewater non-storm water entries; household toxicant disposal; automobile engine degreasing; and excessive use of fertilizers and pesticides.

Nuisance and aquatic-life-threatening pollutants include laundry wastewaters, lawn irrigation runoff, vehicle washwaters, construction site dewatering, and washing of concrete ready-mix trucks. These pollutants can cause excessive algal growths, tastes, and odors in downstream water supplies, offensive coarse solids and floatables, and noticeably colored, turbid or odorous waters.

Clean water discharged through storm water outfalls can originate from natural springs feeding urban creeks that have been converted to storm drains, infiltrating ground water, infiltrating domestic water from watering leaks, etc.

Outfalls can be classified by comparing the collected dry-weather outfall discharge data with potential sources flow data. At the very least, outfalls with major pollutant sources should be identified for immediate remediation.

Investigation and Remediation

Drainage area investigations to locate the source(s) of non-storm water entries can take a number of forms:

- In-depth watershed evaluation (e.g., evaluate whether sources are likely to be an individual industry or an areawide problem, such as general failure of sanitary wastewater sewers)
- Drainage system upstream surveys (e.g., tracer analyses, visual inspections, smoke and dye tests, and TV surveys to trace the individual sources of the pollutant)
- Industrial and commercial site studies (e.g., identify materials/chemicals used and/or produced and whether the sites discharge to a storm drainage system)

Pollution Prevention Program

The goal of eliminating all non-storm water entries will probably not be achieved completely; however, any action that prevents future entries should be promoted. Typical actions include educating the public (industrial, commercial, residential, and governmental) and developing zoning and ordinances.

Discussion

In addition to these steps, the user's guide provides background information in the form of discussions, tables, and checklists to assist the user in identifying contaminated outfall discharges and potential sources and in using the tracer data to estimate the proportion of each contaminating source flow in the outfall flow.

SUMMARY

This chapter discussed the components of an effective illicit discharge detection program. The presence of illicit discharge connections within a storm sewer system can adversely affect water quality. By implementing an effective illicit discharge detection program, a municipality can identify the source(s) of illicit discharges and take the action necessary to eliminate the discharges. Before the development of an adequate illicit discharge detection program, however, municipalities must identify the available fiscal resources, assess the public's knowledge of water quality issues, and develop an SWMP that will successfully complement the illicit discharge program. This chapter presented the components of an effective program, EPA's method of detecting illicit discharges, and detailed examples of programs from various municipalities. The components of an effective program include a mechanism for prohibiting illicit discharges, field screening, investigation of potential illicit discharges, spill response and prevention procedures, public awareness and reporting program, used oil/toxic materials

management and disposal procedures, and methods to control infiltration from sanitary sewers to storm sewers. Within these components, the use of GIS for mapping illicit discharge connections and for maintaining a data base of information on illicit discharges throughout the municipality is essential. EPA's method for detecting illicit discharge connections is discussed within the user's guide. This method relies on the quantitative analysis of dry weather flows to identify the pollutants within illicit discharges. This information is then used to locate the potential source(s) of the discharges.

CASE STUDIES

The following case studies provide information on the various ways illicit discharge programs can be developed and implemented. These municipalities have incorporated the components of an effective program in ways that are most effective to their specific needs.

FORT WORTH, TEXAS

In 1985, the Fort Worth Public Health Department (Health Department) developed and implemented a unique program for detecting illicit discharge connections to its MS4s. The program, known as the Drainage Water Pollution Control Program, focuses on empowering people to take action against illicit dischargers and places less emphasis on excessive data collection. As a result, Fort Worth's program is cost efficient and ensures corrective compliance. The four components of Fort Worth's program are:

- Problem detection
- Source investigation
- Correction of problems
- Prevention of problems

Problem Detection

The Health Department identified three means of detecting surface water contamination: (1) a drainage water quality assessment and monitoring program, (2) a biotoxicity testing method, and (3) a program for determining the concentrations of six metals in drainage sediments.

Assessment and Monitoring

The drainage water quality assessment and monitoring program examines the types of discharges entering a receiving water body (Trinity River). To properly assess the affect these discharges have on the water body, the Health Department thinks it is essential to monitor the discharges over an extended period of time. The monitoring technique used, however, is not one of quantitative analysis but relies mostly on visual observation of the outfalls or drainage ways. From its observations, the Health Department concluded that the presence or absence of persistent features (e.g., vegetation, animal life) at an outfall are directly related to water quality. Even though persistent features are a direct indication of water quality, one has to know which features are associated with good water quality and vice versa. One indication of a healthy waterway is the presence of a variety of plant and animal life; unhealthy waterways have little or no plant and animal life.

The assessment and monitoring phase of this program is based on detecting subtle changes in the waterways from frequent observations and by the use of modified versions of conventional chemical tests. The Health Department's methodology does not readily utilize consulting firms or laboratories to determine if a problem exists; however, if exact determinations are required, then the services of the aforementioned are solicited.

The Health Department chose 24 drainage outfalls and one control site for monthly water quality monitoring to assess the presence or absence of the undesirable features in the outfalls. Undesirable features include filamentous sewage bacteria, mosquito larvae, fish kills, water color, water odor, water clarity, water pH, oil sheen, floatable solids, and positive water tests to Nessler reagent. The information gathered from the monthly monitoring is recorded on data sheets. The data are compiled from all of the sites and displayed on a table with a 45-month profile. The occurrence and persistence of undesirable features indicate the impact that outfall drainage has on the Trinity River and the effectiveness of correction and prevention measures within the program.

Biotoxicity Testing

The 24 drainage outfalls are then subjected to biotoxicity testing. The purpose of the testing is to determine the presence of toxins in the waterway, the hazard level created by the toxins, and the source of the toxins. The object of the test is not to define the properties of toxic substances. Instead of a laboratory biotoxicity test, the Health Department conducts in-situ toxicity tests. Native aquatic species are used to assess the environmental affects of the toxins on the waterway habitat. The use of native species is key because they are accustomed to the environmental characteristics of the ecological region. To test these species, the Health Department used homemade minnow buckets which are floating, ventilated, transparent combiners used to hold test organisms. The test is also used to examine [illegible] water contamination.

Metal Testing

In addition to biotoxicity, the 24 sampling sites are analyzed for 6 metals. Water and sediment samples are collected for the following metals: cadmium, chromium, copper, lead, nickel, and zinc. To establish a basis for comparison, three nonpolluted background sampling sites were chosen to reflect the natural occurrence of these six metals within the waterway. The samples are analyzed according to the protocol within Standard Methods for the Examination of Water and Wastewater.

Source Investigation

After the detection of a drainage source of pollution, an investigation follows to determine whether the source of the problem is known or unknown. If the source is known, then the responsible party is connected, and action is taken to stop the discharge as soon as possible. The notification is done by a pollution control officer or other designated official. Unknown sources are traced back from the detection point to the source. The Health Department has a specially trained Storm Tunnel Investigation Team to trace illicit discharges through the sewer system to the source. The Health Department uses the following tools for source investigation: Storm Tunnel Investigation Team; a safety equipment Step Van; biotoxicity testing devices; fluorescent dyes and smoke generators for obscure tunnels and leaks; water evaluation equipment; Federal, State, and local regulations; and drainage maps.

All investigative activities are documented with photographs, reports, and samples. Required sampling is done according to Standard Methods and is handled through the chain of custody procedures specified by the legal authority. Other important information recorded during the investigation include time and date of the violation and investigation, location of the violation, location of the responsible party, name and telephone number of the responsible party and witnesses, description and results of any tests conducted during the investigation, and the name(s) of the investigator(s). All of this information is recorded on a Discharge Report Form.

Correction of Problems

The Health Department's approach is to correct the problem at the source, instead of the typical "end-of-the-pipe" treatment. Correcting problems at the source is essential because the drainage way below the outfall improves and the responsibility is placed on the pollution generator and not the municipality. Fort Worth notifies the responsible party, explains the violation(s) and the need to make corrections, issues time-dated notices on when to make corrections, and checks the violator's progress. If the pollution generator refuses to make corrections, then legal enforcement agencies (e.g., EPA) are notified.

Prevention of Problems

In addition, the Health Department uses a strategy of "concentric containment." Concentric confinement includes the recognition, containment, and resolution of existing illicit discharge connections to prevent their spread to other areas of the city. To achieve this, the Health Department conducts weekly "roving patrols" of various city sectors and critiques the development programs of new industries and businesses. Public education programs (e.g., videotapes, workshops) are also available to community groups, schools, and other regulatory organizations.

To receive more information about Fort Worth's program, contact Gene Rattan at (817) 871-5463.

CHARLOTTE, NORTH CAROLINA

In Charlotte, North Carolina, controlling illicit discharges is an important issue. In conjunction with Mecklenburg County, Charlotte is in the process of developing an extensive program for detecting and removing sources of illicit discharges. A discussion of the components of Charlotte's illicit discharge connections program follows.

Ordinances

Presently, Charlotte does not have an ordinance prohibiting illicit discharges into storm sewers or surface waters. However, the city is proposing an ordinance that will prohibit plumbed-in connection, intermittent discharges, and the dumping of trash and wastes (hazardous and nonhazardous) into surface waters. Other aspects of the ordinance will define non-storm water discharges and address the enforcement process, penalties for violation, and due process for appeals of violations. The development effort will be coordinated with Mecklenburg County's ordinance and will occur during the first year of the permit. The cost is estimated to be about $11,300.

Field Screen

Charlotte's proposed field screening program will result in a one-time visual field screen of every outfall in the city. The program will specifically address improving the efficiency of field screening methodology; a one-time visual screen of all outfalls; field screening of problem area outfalls; continuation, support, and expansion of Mecklenburg County's Stream Walk program; and maintenance of a GIS storm water data base.

Field Screening Methodology

To improve the efficiency of the field screening methodology, Charlotte takes a two-phased approach. Phase one will utilize the observation protocol used in the Part 1 application process. Observations will be made for the presence of dry weather flow, color, turbidity, and oil sheen. Phase two will identify sources of the illicit discharges and ensure compliance with the illicit discharge ordinance. The cost of this program is $10,000.

One-Time Visual Field Screen

Charlotte is in the process of developing a storm water utility, which includes a preventive maintenance program for the storm drainage infrastructure. The storm drainage system is currently being inventoried. As part of this inventory, Charlotte has initiated a 2-year, one-time visual field screen for dry weather flow of all outfalls. The cost of the program is $8,000 per year.

Problem Area Outfalls

As part of field screening the problem areas, Charlotte and Mecklenburg County investigated known water quality problems throughout the municipality. The city was broken down into polygons, which represented

neighborhoods, land uses, and stream segments. These polygons were then prioritized on the types and magnitudes of the problems. To address the problems identified in the investigation, the city will be divided into zones and each zone will be assigned a zone team. This will be implemented in the second year of the permit and costs $130,000.

Mecklenburg County Stream Walk Program

The Mecklenburg County Department of Environmental Protection (MCDEP) sponsors a Stream Walk program. The participants in the program are volunteers from the county, Charlotte, and other surrounding counties. The volunteers are split into teams and assigned a resource person from the MCDEP staff. They walk streams that are affected by point and nonpoint source pollution and are responsible for investigating and determining the pollutant source(s). The weaknesses of the program, to be addressed by Charlotte and MCDEP, are available personnel, volunteer motivation, volunteer training, and public education. The program will cost approximately $36,000.

GIS Data Base Maintenance Program

A GIS data base will be used to track all field screening activities. The results of initial and follow-up field screening will be entered into the data base and used to identify the problem areas. The program is currently in use and the estimated cost is high.

Follow-up Investigation

The program tries to identify and remove all sources of illicit discharges by enhancing MCDEP's current program. The only two possible improvements to the program are to add more staff and to computerize it. Charlotte will be:

- Developing follow-up program procedures
- Developing and implementing a training program
- Implementing the follow-up procedures
- Maintaining a GIS data base.

Follow-up Procedures Development

The follow-up procedures will respond to the problems identified by the visual field screenings, MCDEP's Stream Walk, MCDEP's monitoring programs, problem area investigations, and citizen complaints. The areas to be addressed will be prioritized based on the urgency and magnitude of the problem. Teams will be assigned to the problem areas and are responsible for the determination and elimination of pollutant sources. To accomplish this task, the teams have to review existing data on the area, perform field reconnaissance, locate and identify problem sources, perform source identification methods (e.g., video, smoke, and dye testing), distribute violation notices, perform other enforcement actions, and notify higher authorities when appropriate. The program will be implemented during the first year and will cost $22,200.

Training Program

The training program for the follow-up investigations team will be developed with the training programs for industrial and related facilities. Charlotte will also coordinate the development of this training with supervisors of MCDEP's Stream Walk and Charlotte Mecklenburg Utility Department (CMUD). The training will address the reconnaissance follow-up methods (e.g., observation techniques, chemical screening), detailed follow-up methods (e.g., closed circuit television, dye and smoke testing), and enforcement methods. Training should begin in the middle of the first year and is estimated to cost $23,100 over the 5-year period.

Follow-up Procedures Implementation

During field investigations, the follow-up teams will identify sources of illicit discharge connections using the prioritization system and the follow-up procedures. This will begin in the second half of the first year and will cost $50,000 annually.

GIS Data Base Maintenance

All of the information, including information on violations, received during the follow-up investigations will be entered into a GIS data base. This data base will be used to track repeat offenders and to produce annual reports to be presented to the State. The data base will cost approximately $14,000 per year.

Spill Response Program

The objective of the spill response program is to prevent and respond to spills. The existing program is well developed; therefore, Charlotte will only enhance the public education and awareness aspect of the program. In Charlotte, the Fire Department is responsible for the spill response program and maintains a Hazardous Materials (HAZMAT) team. The city will review the types of spills and their causes in order to minimize the risk to storm systems and surface waters. The public education and awareness component will educate people on the illicit discharge connections ordinance and encourage public reporting of spills. This program, which has an estimated cost of $30,000, will begin immediately.

Public Reporting Program

The objective of this program is to increase and improve public reporting of spills and improper disposal. The program will focus on public education and information to inform the public of the importance of reporting spills and illicit discharges. This program will be coordinated with other public education programs and will include information on:

- Charlotte's overall storm water management program
- The importance of the illicit discharge connections component

- Charlotte's illicit discharge connections ordinance
- Proper disposal and recycling programs
- The purpose of stenciling catch basins.

In addition, the program will:

- Publicize Charlotte's storm water hotline
- Encourage the public to readily report signs of illicit discharges
- Urge the public to participate in MCDEP's Stream Walk.

Information will be disseminated through public speaking, distribution of written materials at civic functions, participation of neighborhood groups and associations, and local media announcements. This program will begin immediately with an estimated cost of more than $70,000.

Used Oil/Household Hazardous Waste Program

The objective of this program is to properly dispose of and manage used oil and household hazardous waste. Charlotte will address this problem with public education and changes to existing programs. The program will include used oil recycling, permanent household hazardous waste program, and a review of the current small quantity generators.

Used Oil Recycling Program

The used oil program is currently based on extensive public education. The components to revise/expand this program include:

- Review of the public and private facilities that accept used oil and a determination of *additional facility* locations
- Review of the existing Mecklenburg County program to determine the feasibility of expanding the program to include recycling other automotive parts
- Review of the possibility of providing curb-side pick-up of nonhazardous materials
- Inventory of used oil recycling facilities and implementation of a regular inspection program to prevent storm water pollution.

Household Hazardous Waste Program

The used oil public education program will provide information to the public and private sectors and will be coordinated with the household hazardous waste program. It will include education on:

- Illicit discharge connections ordinance
- Negative impacts of dumping used oil into storm sewers
- Stenciling of catch basins
- Misconception that dumping in sanitary sewer is an alternative to the storm sewer
- Education of operators of recycling facilities the proper handling procedures of materials
- Economic incentives for private companies to encourage participation in used oil program.

The development of this program will begin immediately but will not be implemented until the third year. The estimated cost is $30,000 per year.

Charlotte, in conjunction with Mecklenburg County, will develop a permanent household hazardous waste turn-in program. The proposed methods of disposing of the wastes will include:

- Modular Structures (Bare Bones): This is a continuous service program in which the public would bring their household hazardous wastes to a permanent site for temporary storage to be removed later by a licensed contractor. There is a minimum allocation for storage space.
- Modular Structures: This is the same program as above but it allows for more storage space.
- Fixed Structure: A continuous service program that will operate similarly to the modular structure except that it would be in a fixed place and allow for maximum storage.
- Independent Fixed Structure: This is the same as the fixed structure but would be located at a site different than the fixed location.
- Mobile Unit: This is a continuous service program in which the public would bring their household hazardous waste to a mobile unit that would move from one place to another.

Mecklenburg County currently has an educational program which utilizes videos and brochures. This program will be expanded by the use of utility bill inserts and media announcements. The planning of the household hazardous waste program is in progress and will be implemented in the second year. The costs for the city and county are estimated to be high.

Review of Small Quantity Generators

The purpose of the small quantity generators review is to determine what is required of the participants and how they impact storm water runoff. The data base of small quantity generators will be reviewed with HAZMAT and MCDEP to decide if any spill-related problems or contaminated site runoff have occurred in the past. As a result

of this review, these facilities may included in Charlotte's inspection program for industrial facilities. The review program will begin immediately with an estimated cost of $15,000.

Infiltration and Seepage Program

Sanitary Sewer Program

The object of this program is to reduce and eliminate sanitary sewer seepage into the storm sewer system. This program should also increase city/county coordination in dealing with problems related to infiltration and seepage from sanitary sewers and septic systems to storm sewers and surface waters. Charlotte currently has city codes in place that require new and replacement sanitary and onsite waste disposal systems to be built to lessen or eliminate leakage and infiltration of floodwaters into the system and discharge from the system into floodwaters. There is also a code that allows the city to fix inoperative sanitary sewer lines on private property and requires payment from the property owner.

MCDEP responds to sanitary flow issues on a complaint basis. CMUD has a cross connection program for the sanitary sewer that requires periodic inspection for leakage and overflows. The Mecklenburg County Health Department issues septic tank permits for the inspection of new and failed septic systems within Charlotte. The Health Department also requires remediation of failed septic systems, which are usually reported by citizen complaint, an MCDEP stream walker, or government inspector.

CMUD is currently developing a dynamic sanitary system model, along with a monitoring program for sanitary system flows and rainfall. Charlotte's role in the development of this program includes:

- Coordinating the preparation of ordinances to enforce the programs
- Ascertaining whether storm water detention facilities should continue to be built over sanitary sewer lines
- Ensuring that illicit disconnections from the storm sewer will not increase connections to sanitary sewer
- Implementing a source control program that will limit the dumping of materials into the sanitary sewer that are not treatable
- Developing public education and awareness programs.

The review and coordination of the infiltration and cross connection program with CMUD will begin immediately with an estimated cost of $15,000.

Septic Tank Program

Charlotte, in conjunction with the Mecklenburg County Health Department, will review and revise the current septic tank program. The weaknesses they will address include:

- Notification/inspection procedure
- Lack of contractor supervision
- Abandoned septic tanks not required to be sealed
- Allowable construction of septic tanks in sensitive areas.

The septic tank program will also include a public education component and a data base of septic tank failures. The review and revisions will begin immediately with an estimated cost of $15,000.

SEATTLE, WASHINGTON

The city of Seattle realizes the negative impacts of illicit discharges and currently operates a program that detects and eliminates such discharges. Public education and awareness is an important component of this program, but emphasis is also placed on enforcement.

Ordinances

Seattle's key ordinance to prevent illicit discharges is the Storm Water, Grading and Drainage Code. Other ordinances, with pollution prevention components, include the Side Sewer Ordinance, the Street Use Ordinance, and the Solid Waste Ordinance. The Storm Water, Grading and Drainage Code prohibits certain discharges into the storm drainage system, requires existing dischargers and land users to implement pollution prevention practices to minimize the pollutants entering storm water discharges, requires the city to review programs for drainage control and grading activity, regulates sediment and erosion controls for construction sites, designates responsibility for maintenance of drainage control facilities and erosion practices, and establishes enforcement procedures. The Storm Water, Grading and Drainage Control Code is enforced by the Department of Construction and Land Use (DCLU), the Department of Engineering - Street Use Section, and the Department of Engineering Drainage and Wastewater Utility (DWU).

Metro's Key Manhole Monitoring Program

The Municipality of Metropolitan Seattle (Metro) uses a manhole monitoring program to ascertain whether or not illicit discharge connections are present and, if so, to identify the sources. After the sources are identified, companies are brought into compliance with Metro's discharge limits and pretreatment standards. This program also requires inspections of facilities that violate the permit requirements.

Field Screening

Seattle DWU's field screening program consists of responding to citizen complaints, responding to city employees or other agency calls, and implementing source control programs and long-term monitoring of surface waters. Seattle will rely on its ordinances, the erosion control program, citizen response, and field personnel to control future illicit discharge connections problems.

Follow-up Investigation Program

The objectives of Seattle's Source Control Program are to eliminate cross connections, reduce spill-related risks, promote better waste disposal, promote good housekeeping practices, provide educational materials on water quality, and require routine maintenance of storm water control facilities where new storm drains will be constructed to reduce combined sewer overflows. This program is implemented on a watershed basis and responds to the unique characteristics of that watershed. The Source Control Program is first implemented in watersheds identified by the Department of Ecology as having surface waters of concern. These are areas of concern because *they are* used for recreation or as a fisheries resource. The Source Control Program contains the following steps:

- Data Gathering: All the water and sediment quality data from the storm drainage system and all the basin information (e.g., size, topography, industry type) are compiled. Drainage maps and side sewer cards identify outfalls and sewer lines.

- Initial Investigation: Drainage basins are field checked. The side sewer cards are examined, industrial sites are inspected, historical information from the owner is obtained, dye testing is performed to prove connections, and a television inspection is done when necessary. Seattle's storm drain lines and catch basin maintenance schedule is evaluated and when necessary revised to improve water quality.

- Business Inspection and Education Program: Businesses with a high potential to pollute storm water discharges are visited by Source Control Water Quality Investigators. During the visit, the operator will receive a copy of the written inspection procedures. If necessary, follow-up visits are conducted to guarantee compliance. The operators are encouraged to implement new BMPs or improve old ones to ensure compliance. The facilities are also given information on current programs, including enforcement information. Repeat offenders are referred to the appropriate agency for enforcement action.

- Education and Outreach. Educational materials describing the negative impacts illicit discharges have on the storm sewers and surface waters are distributed within watersheds to the public and to industrial facilities. An incentive program is provided for businesses to encourage participation.

The Source Control Program approach by watershed allows for onsite visits and for pipes to be checked for illicit discharge connections and has been very effective. Seattle also works with Metro's Industrial Waste Staff because of their authority to enforce pretreatment limits on discharges from industries.

Spill Prevention Program

As required by the Source Control Program, site inspections are performed at industries identified as significant polluters. The inspectors ensure that each facility has a spill prevention program, including the materials to respond to a spill. The Seattle Municipal Code requires all industrial facilities to develop and implement spill prevention programs.

Seattle Fire Department - Hazardous Materials Unit

Within Seattle, the Fire Department is the main responder to spills within the city, as well as those to surface waters. The Fire Department enforces sections of the Uniform Building Code that address buildings used for storing, handling, or using hazardous wastes. Each industry that uses or stores certain amounts of hazardous wastes is required to obtain a permit from the Fire Department. Facilities are inspected when they apply for the permit and are inspected each year after permit issuance.

Seattle Police Department - Harbor Patrol Unit

The Seattle Harbor Patrol is responsible for the enforcement of oil spill regulations within the Seattle Harbor Code. The patrol investigates complaints received from a 24-hour hotline and reports from the Department of Ecology and the U.S. Coast Guard. If a pollution problem exists, the source is traced and enforcement actions taken.

Trouble Call Network

Metro runs a Trouble Call Network for public use for handling potential water quality problems, including spills. Seattle works with Metro on this project.

Public Reporting Program

DWU published literature with telephone numbers for citizen use when reporting water quality problems or for requesting information on disposal of hazardous materials.

DWU recognizes the importance of public education in relation to protecting water quality and has taken an approach that combines the following three components: public involvement, in-school education, and general public outreach.

Public Involvement

Citizen involvement was important in developing Seattle's storm water program, and DWU involves citizens at various levels of the decision making process. The public involvement programs include the following:

- Comprehensive Drainage Program Citizens Advisory Committee: Citizens were key in developing the DWU. The DWU is charged with developing a Comprehensive Drainage Program to determine which areas would benefit the most from the new fees. A Citizens Advisory Committee (CAC) was created to represent the community interests. The Comprehensive Drainage Program is the foundation of Seattle's water quality projects and will be updated in 5 years with public involvement.

- Drainage and Wastewater Utility Citizens Advisory Committee: The CAC is now the advisory committee for the ongoing activity of the DWU. The Drainage and Wastewater Utility Citizens Advisory Committee (DWUCAC) has expanded its membership to include minority communities and industrial interests that are concerned about water quality and utility services.

- Capital Project Development: When programs for new capital facilities are developed, DWU involves the public. The public interest usually focuses on the impacts of construction but may expand to include water quality and environmental improvement.

- Watershed Planning: The Puget Sound Water Quality Authority and the Department of Ecology administer a program that addresses planning for the control of nonpoint source pollution within watersheds. The watershed programs are developed by a Watershed Management Committee (WMC),

which comprises members from community and business organizations and government agencies that are interested in the watershed.

Schools Education Pro

These educational programs emphasize respect for water resources and encourage responsible behavior. DWU's schools program builds on existing environmental education and has reached 80 Seattle schools. The following list describes several of these programs:

- Salmon in the Classroom. DWU has provided the training and equipment for teachers in schools to raise salmon from egg to fry and then release the fry into local receiving waters. The salmon are raised in aquariums that simulate spawning stream conditions. DWU trains the teachers participating in the project and provides a manual for additional training and lesson planning. DWU also sponsors field trips one to obtain the eggs and the other to release the fry.

- Field Trip. DWU sponsors a field trip every year for fourth or fifth grade students to the Seattle Aquarium to learn about aquatic species, their habitat, and the impacts of human activity on their habitat. DWU also sponsors a fishing field trip to a trout farm. Students receive a tour and learn about the impacts of nonpoint source pollution.

- Middle School Water Quality Education Video Program: "Water You Doing?" is a 35-minute educational video produced by DWU with a grant from the Department of Ecology. The video's audience is middle school students and includes a teacher's manual and field trip guide. Five video segments address five different water quality issues. The manual describes lesson planning, is a resource guide, and contains a field trip directory. DWU has given workshops on how to use the video and has distributed it to every public middle school in Seattle.

- Speakers Bureau: DWU employees who work on water quality issues, community volunteers, and others are part of DWU's speakers bureau. The speakers give classroom presentations on water quality education activities sponsored by the DWU.

- Puget Sound on Wheels: DWU is sponsoring the development of a mobile educational display by the Seattle Aquarium. The display will include a truck outfitted with a walk-through exhibit describing the Puget Sound water resource, habitat, and pollution issues. The exhibit will be shown at schools and community fairs.

- Education Coordination: Other educational efforts sponsored by DWU include a teachers advisory committee that evaluates the water quality classroom and field trip activities to help DWU enhance its programs; DWU participation on Seattle's Environmental Education Committee and promotion of its programs, as well as work with other organizations; and membership in the Washington Environmental Education Committee sponsored by the State Superintendent for Public Instruction.

General Public Education Program

Many residents have an out-of-sight, out-of-mind attitude about their behaviors concerning water quality. General public education should change the negative everyday activities people perform on a regular basis. The following DWU programs encourage appropriate behavior and community initiative to protect water quality:

- Source Control Education: With a grant from the Department of Ecology, DWU has implemented a program to control nonpoint source pollution at the source. DWU accomplishes this through a three-pronged approach: Consumer Education, Clean Water Business Partners, and Targeted Education Campaigns.

- Watershed Education: DWU currently sponsors two watershed action programs in Seattle. The WMC responsible for developing the programs concluded that the people living and working within the watersheds must be educated on water quality in order to prevent further degradation of the watersheds.

- Storm Drain Stenciling: DWU uses volunteer school and community groups to paint a message on Seattle's storm drain inlets. With this program, DWU hopes to rid Seattle of the out-of-sight, out-of-mind attitude.

- Motor Oil Recycling: DWU and the Seattle Solid Waste Utility coordinate a used oil recycling program. Waste oil collection tanks are located at the 12 locations of an auto supply store in Seattle. The supply store, along with the utilities, publicizes the program.

- Waterfront Awareness Company: DWU and an association of waterfront businesses have initiated a cleanup campaign for the waterfront. DWU has also added a pollution prevention message to the effort and has recruited children to paint pollution prevention messages on trash cans.

- Seattle Aquarium Intertidal Exhibit: DWU has contributed to a new aquarium exhibit displaying an intertidal ecosystem and explaining the potential negative impacts of human activity on the ecosystem.

- Bill Inserts and Citywide Direct Mailings: DWU includes education and public awareness materials in its bimonthly billings. Customers are also mailed brochures about water quality protection and storm water management.

- Outreach to Non-English Speaking Communities: DWU is developing water quality messages in different languages for publication in community newspapers.

- Television Public Service Announcements: DWU has developed four public service announcements for broadcast on local television. The announcements address the importance of watersheds, the difference between sanitary and storm sewers, nonpoint source pollution, and pet waste.

- Seattle Public Libraries: DWU is currently working to distribute copies of the educational videos to all branches of the public library. The video has also been made available for broadcast on the public access cable station. DWU will develop educational displays for all of the libraries.

Local Hazardous Waste Management Program for Seattle-King County

Seattle is part of the local hazardous waste management program and is currently developing and implementing programs for small businesses. The components of the program are to provide free onsite consultations to small businesses; organize seminars, workshops, and classes for business persons; create brochures, booklets, and other materials; create a resource library on hazardous waste issues; provide response to complaint calls and agency referrals; conduct onsite surveys of business practices; and research new treatment methods. Participating agencies include the Seattle-King County Health Department, King County, Seattle, Metro, and 29 suburban cities.

Solid Waste Utility Household Hazardous Waste Program

The Seattle Solid Waste Utility operates one permanent household hazardous waste collection site and sponsors a used motor oil collection system. The household hazardous waste component also provides educational materials to the public on alternative products, collection services, and the proper use and disposal of products.

Metro's Small Quantity Generator Program

This program provides small businesses with information and assistance on the proper use and disposal of hazardous wastes and on ways to minimize the pollutants entering storm drains and surface waters. The Waste Information Network was developed through this program and consists of private businesses, public agencies, and other groups that try to resolve waste management concerns.

Seattle-King County Department of Public Health Environmental Services Program

The health department operates a telephone information line that provides information on waste reduction and the proper storage and disposal of household hazardous wastes. The health department also operates a materials exchange, known as "Industrial Materials Exchange" (IMEX). IMEX oversees the transfer of hazardous materials from the generator to a party that can use them.

Infiltration Control Program

If infiltration from the sanitary sewer to the storm sewer occurs, the city's maintenance crew will conduct a television or walk-through inspection to locate the leak and make the necessary repairs. Storm drain maintenance activities include upgrading surface drainage facilities (e.g., inlets, catch basins, junction boxes, ditches) and removing debris from detention facilities. Sewer maintenance includes inspection, routine cleaning, and system repairs.

VIRGINIA BEACH, VIRGINIA

Virginia Beach presently facilitates or participates in existing programs that address illicit discharges and other forms of pollution. The illicit discharge program described below will supplement the current programs for detecting and eliminating sources of illicit discharges.

Ordinances

The city of Virginia Beach has developed the Storm Sewer Discharge Ordinance, which authorizes the city to regulate non-storm water discharges to storm sewers and surface waters. This ordinance will supplement other codes currently in effect, specifically the building code, which requires sanitary and storm sewers of a building to be kept separate. The Department of Public Works will be responsible for implementing and enforcing the ordinance. The Storm Sewer Discharge Ordinance also grants inspection and monitoring authority, as necessary, for administration and enforcement to the Department of Public Works. An existing program conducted by Public Works through the Department of Permits and Inspections inspects construction sites for illicit discharges. Other city agencies that perform inspections are to report violations to the Department of Public Works.

Ongoing Field Screening Program

The purpose of this program is to test field screening points throughout the term of the permit for dry weather flows and other indications of possible illicit discharges. The program will screen points identified in the city's Part 1 application and screen new points.

Part 1 Sites

Out of the 112 field screening points with dry weather flow identified in Part 1, 30 sites were chosen for continued dry weather monitoring. The sampling results are compiled and added to the existing GIS data base. If dry weather flow continues at these sites, the possible source(s) will be investigated.

New Sites

New field screening sites will be chosen from areas with high concentrations of commercial, industrial, and older residential areas and from major highways and roads that have automotive and commercial service areas. The final selection of the new screening points will be determined by field inspection. The chosen outfalls are examined for dry weather flow. If flow is present, then a sample is taken. Twenty-five new field screening points will be evaluated during each year of the permit. The sampling data for each site will be compiled and entered into the GIS data base. If dry weather flow continues at these sites, the possible source(s) will be investigated.

Investigation of the Storm Sewer System

To locate the sources of illicit discharges, sections of the storm sewer will have to be investigated. Investigations will be conducted based on analysis of the data received from field screening activities and any other information the city receives concerning illicit discharge connections. This program will emphasize public reporting to aid investigations. Investigations will occur at the problem areas and will involve mapping and evaluation, field surveys, and source identification.

Mapping and Evaluation

Each area to be investigated will be highlighted on the storm sewer map, and the drainage area will be defined. The types of land uses will also be evaluated to determine the types of residential, commercial, and industrial areas that may be potential polluters. Other areas that will receive special attention include sanitary, septic tanks, and vehicle maintenance activity sources.

Field Surveys

The city will utilize the strategy of "halving-intervals" to locate the area of the source. This method will be applied to the main trunk of the sewer system and branch lines as necessary. Investigations will occur halfway between the field screening points and the upper most headwater locations. These investigations will use the same criteria as the field screening, except only one site visit will be conducted. The Department of Public Works will perform the field surveys.

Source Identification

After the area and the probable activity have been identified, field visits will be conducted to identify the source(s). Five actions are taken to eliminate a source once it is identified: sending a letter with a questionnaire; site visit and interview; dye tests or smoke tests, if needed; noncompliance notification; and follow-up inspections.

- Letter with Questionnaire: The Department of Public Works will send a letter to the owner/operator of the suspected source to advise the owner/operator of the problem and to request that the owner/operator complete the attached questionnaire. The completed questionnaire should describe the industrial activities and indicate the possible sources of non-storm water discharges.

- Site Visit and Interview: After the questionnaire is received, a staff person from the Department of Public Works will conduct a site visit and interview to further pinpoint the source.

- Dye Tests and Smoke Tests: If the questionnaire, site visit, and interview do not support the field screening data, then it is necessary to perform fluorometric dye tests of plumbing fixtures and floor drains. If several sources are suspected, a smoke test may be needed to limit the number of possible sources and to allow for a more detailed analysis. These tests will be performed by the Department of Public Works.

- Notification of Noncompliance: Once the suspected source is confirmed, the owner/operator will be issued a notification of noncompliance with the Storm Sewer Discharge Ordinance and will be subject to the penalties in the ordinance.

- Follow-up Inspection The Public Works staff will conduct follow-up inspections to ensure that corrective action was taken and the illicit discharge has been eliminated. If the negligent violation continues, the Virginia Water Control Board (VWCB) and/or the news media will be notified.

Spills Program

The spills program in Virginia Beach has two components: hazardous material spill response and inspection of sites for proper compliance with State and Federal regulations for gas, oil, and hazardous chemicals.

Spill Response Program

The city will continue to implement its Hazardous Materials Emergency Response Program through the Virginia Beach Fire Department. The program is structured to comply with SARA Title III, Emergency Planning and Community Right-to-Know legislation. The response program details the proper procedures to be followed in the event of a hazardous materials spill, which could affect persons, property, or the environment. The program also describes the roles and responsibilities of local government and private agencies when responding to hazardous materials emergencies.

The Fire Department is responsible for the command and control of activities during a spill event. The Fire Department provides initial containment, fire suppression, rescue operations, and evacuation procedures. However, cleanup is the responsibility of the spiller, or owner/operator of the facility, with monitoring from the Fire Department. When necessary, the Fire Department contacts local, State, and Federal government offices. The Department of Public Works will be notified if any spills enter or have the potential to enter the storm sewer or surface waters. Public Works will then assist the Fire Department with material and equipment to prevent the spill from entering the storm sewer and/or to remove an existing spill from within the storm sewer.

Inspection Program

The VWCB is responsible for regulating waste materials for wastewater and petroleum products, and the Virginia Department of Waste Management regulates solid and hazardous wastes. Under the Hazardous Waste Management Regulations, the Virginia Department of Waste Management requires facilities that generate more than 1,000 kilograms per month of hazardous waste to develop a contingency program and emergency procedures. The Federal Government requires a spill prevention and containment countermeasures (SPCC) program for facilities that have the potential to discharge oil in reportable quantities to surface waters. VWCB requires facilities covered under an SPCC to develop an oil discharge contingency program for bulk storage of 25,000 gallons or more.

- The city has an inspection program that delineates the proper methods for the storage and handling of hazardous wastes to prevent spills from entering the storm sewer or surface waters. The Fire Marshal's office inspects all commercial properties for compliance. Inspection frequency is based on the nature of the perceived hazard. New buildings and construction sites are inspected by the Permits and Inspections Division of the Department of Public Works to ensure compliance with State and Federal regulations for gas, oil, and hazardous chemicals.

Reporting of Illicit Discharges and Water Quality Impacts

Virginia Beach has implemented various programs to address water quality issues. Public education programs in relation to storm water are coordinated through the Public Information Office at Public Works. The city's local cable television channel has shown videos on water quality, litter control, sediment and erosion control, and storm water management. The city has also distributed literature in the form of leaflets and brochures on similar topics. On a regional level, storm water public information programs are developed through the Hampton Roads Municipal Communicators (HRMC). HMRC's membership includes the cities/counties of Virginia Beach, Norfolk, Hampton, Chesapeake, James City, Newport News, Portsmouth, Suffolk, and York. Upcoming projects include stenciling storm drains and developing public service announcements for media broadcast.

Awareness and Reporting

The current programs increase public awareness of water quality issues and of potential impacts of illicit discharges. The city would like the public to increase reporting of illicit discharges. The Department of Planning within the Division of Environmental Management, along with other departments, takes reports of odor, color, turbidity, and the presence of trash in storm sewers and waterways. The following information programs will continue to increase public awareness and encourage the public to report signs of illicit discharges. These information programs include a brochure, Cityline message, and a slide show:

- Brochure: The brochure will address "what to look for" and "who to report to." The public will receive discharges. The brochure will present the options of a hotline and a mailing address for reporting. The Public Information Office will develop and distribute the brochure with funding from Public Works. The brochure will be mailed with the water/sewer bill every 2 years and be distributed to schools and community groups.

- Cityline Message: Virginia Beach has a public information service line called Cityline. A taped message concerning illicit discharges will be developed for Cityline and will include information similar to that in the brochure.

- Slide Show: A slide show with accompanying text will be developed by the Public Information Office. The target audience will be children and community groups. The slide show will be presented once a year at elementary, middle, and high schools. A copy of the slide show will also be given to the Virginia Marine Science Museum.

Proper Management and Disposal of Used Oil and Toxic Materials

The City currently participates in programs that facilitate the proper disposal of used oil and toxic materials. The Southeastern Public Service Authority (SPSA) has various recycling programs, including curbside collection and drop-off centers. SPSA produces and distributes brochures explaining the recycling program and listing the locations of the drop-off centers. Household hazardous wastes are accepted at the regional landfill and at seven transfer stations free of charge to private citizens. The State of Virginia operates a used oil recycling program through the Department of Mines, Minerals and Energy. This program recruits service stations to accept and properly dispose of used oil. A toll free number that gives the names and locations of the service stations is available to the public.

New Programs

The following new programs will be developed:

- Brochure: The Public Information Office will develop and distribute a brochure to promote and explain all programs within the city that handle the proper management activities of used oil and toxic materials. The brochure will list the telephone numbers of the various agencies with such programs. The brochure will be available at slide show presentations and mailed every 2 years with the water/sewer bill separate from the illicit discharges brochure.

- Cityline Message: A hyped message will be developed by the Public Information Office that will state the major programs and information sources that deal with the management and disposal of used oil and toxic materials.

- Slide Show: A slide show will be developed on the proper management and disposal of used oil and toxic materials. The slide show will be made available to schools, community groups, and the Virginia Marine Science Museum.

Controls to Limit Infiltration from Sanitary Sewers and Septic Systems

Sanitary Sewers

Problems with infiltration of seepage from sanitary sewers to storms sewers in Virginia Beach are rare because the storm sewer is located under the curb and the sanitary sewer is in the middle of the road. The Sewer and Water Standard Specifications and Details of the Department of Public Utilities requires consideration of design, pipe depth, and alignment to avoid conflict between the two sewer systems and to facilitate maintenance. When a leak or spill does occur from the sanitary sewer to the storm sewer, the sewage is contained in the storm sewer and pumped to the sanitary sewer or tanker trucks to prevent discharge to surface waters. If the sewage cannot be collected, Public Utilities will disinfect the site and obtain a special discharge permit from VWCB. Sanitary overflows are reported to VWCB's Tidewater Regional Office within 24 hours. A written report is also required within 5 days. Public Utilities reports any overflows to Public Works.

The Department of Public Utilities has an inspection program for locating defects within the sanitary sewer system. Television inspections for infiltration problems are performed on 80,000 feet of sewer lines per year.

Septic Systems

Subdivision regulations require every subdivision to have an adequate sanitary sewerage system cohesive with the type of development proposed. If public sewerage is not an option, then private septic tanks must be built. These individual sewerage systems must be permitted by the Virginia Beach Health District in cooperation with the Virginia State Health Department.

If the public health director determines that the area chosen for the septic system has poorly drained soils, then a land management program must be developed by the property owner and approved by the director. The program must contain the location of the septic tanks and a proposed drainage program. The owner is also responsible for the construction, repair, maintenance, and operation of the system.

If septic tanks are located in the Chesapeake Bay Preservation Area, the Chesapeake Bay Preservation Area Ordinance requires the property owner to provide a reserve sewage disposal drainfield site with a capacity at least equal to the primary sewage disposal drainfield site. The same is true for septic systems located in the Southern Watersheds, as stipulated in the Southern Watersheds Management Ordinance.

REFERENCES

American Public Health Association, American Water Works Association, and Water Environment Federation. 1992. *Standard Methods for the Examination of Water and Wastewater.*

City of Charlotte, North Carolina. 1992. *Part II NPDES Permit Application for Discharges From MS4s.*

City of Seattle, Washington. 1992. *Part II NPDES Permit Application for Discharges From MS4s.*

City of Virginia Beach, Virginia. 1992. *Part II NPDES Permit Application for Discharges From MS4s.*

The City of Fort Worth Texas. 1989. *Operational Guide, City of Fort Worth Drainage Water Pollution Control Program.* Department of Public Health.

U.S. EPA, Office of Research and Development. 1993. *Investigation of Inappropriate Pollutant Entries Into Storm Drainage Systems - A User's Guide.*

U.S. EPA, Office of Water. 1992. *Guidance Manual for the Preparation of Part II of the NPDES Permit Applications for Discharges from MS4s.*