DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

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28 February 1997

Engineering and Design
HANDBOOK FOR THE PREPARATION OF STORM WATER POLLUTION PREVENTION PLANS FOR CONSTRUCTION ACTIVITIES

1. **Purpose**. This pamphlet provides guidance for the preparation and development of plans for the prevention of storm water pollution at construction projects. Section 402 of the Federal Water Pollution Control Act (the Clean Water Act) requires that such plans be made.

2. **Applicability**. This pamphlet applies to HQUSACE elements and USACE commands having civil works and military construction responsibilities.

3. **Discussion**. In 1972, the CWA was amended to provide that the discharge of pollutants to waters of the United States from any point source is prohibited unless the discharge is in compliance with a National Pollutant Discharge Elimination System (NPDES) permit. In 1987, amendments to the CWA were added as Section 402(p) which established a framework for regulating municipal and industrial discharges of storm water under the NPDES. Regulations that established NPDES application requirements for these discharges were promulgated by the U.S. Environmental Protection Agency (EPA). In 1992, additional regulations broadened the classification for industrial discharges to include discharges associated with construction activities. EPA defined construction activities to include clearing, grading, or excavation that results in the disturbance of at least 5 acres of total land area. EPA regulations require that such activities disturbing 5 acres or more be regulated as an industrial activity and be covered by an NPDES permit. Construction activity on sites of less than 5 acres require an NPDES permit if the construction is part of a larger common plan of development or sale. Future revisions to the regulations are expected to require NPDES permits for construction activities at lest acres. Already some states are requiring an NPDES permit for construction sites less than 5 acres and for sites in environmentally sensitive areas.

4. **Intent**. The intent of this pamphlet is to provide the planner with guidance through the NPDES permitting process. It is not intended to be used as a directional or operations document.

FOR THE COMMANDER:

Otis Williams

OTIS WILLIAMS
Colonel, Corps of Engineers
Chief of Staff

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1.0 INTRODUCTION

1.1 Purpose

This pamphlet provides guidance for the preparation and development of Storm Water Pollution Prevention Plans for construction projects. The requirement for such plans is regulated by Section 402 of the Federal Water Pollution Control Act (henceforth referred to as the Clean Water Act or the CWA).

1.2 Applicability

The pamphlet applies to HQUSACE elements and USACE commands having civil works and military construction responsibilities.

1.3 Explanation of Terms

Terms and abbreviations used in this pamphlet are defined in Appendix J.

1.4 Regulatory Background

In 1972, the CWA was amended to provide that the discharge of pollutants to waters of the United States from any point source is effectively prohibited unless the discharge is in compliance with a National Pollutant Discharge Elimination System (NPDES) permit. Amendments to the CWA in 1987 added Section 402(p) to the Act, which established a framework for regulating municipal and industrial discharges of storm water under the NPDES. Regulations that established NPDES application requirements for regulated municipal and industrial storm water discharges were promulgated by the U.S. Environmental Protection Agency (EPA) and published in the Federal Register on 16 November 1990. Additional regulations promulgated by the EPA and published in the Federal Register on 9 September 1992 broadened the classification for industrial dischargers to include discharges associated with construction activities. EPA further defined construction activities to include any clearing, grading, or excavation which results in the disturbance of at least 2 hectares (5 acres) of total land area. The EPA regulations require that construction activities disturbing an area of 2 hectares or more be regulated as an industrial activity and covered by an NPDES permit. Construction activity on sites of less than 2 hectares requires a permit if the construction is part of a larger common plan of development or sale. Future revisions to the regulations are expected to require NPDES permits for construction activities at substantially less than 2 hectares. Presently, some states are requiring an NPDES permit for construction sites less than 2 hectares and for construction sites located in environmentally sensitive areas.

According to the Federal regulations, permit coverage for storm water discharges associated with construction activity can be obtained through *individual* permits or *general* permits. *Individual* permitting involves the submittal of specific data on a single construction project to the appropriate permitting agency who will issue a site-specific NPDES permit for the project. NPDES coverage under a *general* permit involves the submittal of a notice of intent (NOI) by the regulated construction project to comply with a *general* permit, to be developed by the EPA or a delegated State with general permitting authority.

The final Federal regulations (40 CFR 122.26[a][6]) require that storm water associated with industrial activity from point sources which discharge through a nonmunicipal storm sewer system be regulated either under a single NPDES permit issued to the system operator (the principal permittee) with each discharger to the system listed as a copermittee to the operator, or that each discharging entity to the nonmunicipal system obtain separate permit coverage. The sole permitting of the nonmunicipal system is not an available option according to the Federal regulations since the control of discharges into a private system is often beyond the control of the system operator. The selection of one of the two available options is at the discretion of the regulating authority.

1.5 Program Approach

In terms of implementing the final regulations, the states are divided into three basic categories: delegated NPDES states with general permitting authority; delegated NPDES states without general permitting authority; and states without NPDES delegated authority. Most states have moved toward implementation of the permitting process. However, not all state programs are in place at this time. Appendix A contains a list of contacts for each state, and readers are encouraged to contact the applicable regulatory representatives for up-to-date information early in the permitting process.

The first step in the NPDES permitting process is the development of a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP has two major objectives: (1) to identify the source of pollutants that affect the quality of the industrial storm water discharge; and (2) to describe practices which shall be implemented to reduce the pollutants in the industrial storm water discharge. The SWPPP is a requirement of the storm water discharge permit and is considered by EPA to be a very important requirement of the NPDES permit. EPA requires the development of a SWPPP for each construction activity covered by a general permit. SWPPP's shall be prepared in accordance with good engineering practices emphasizing storm water Best Management Practices (BMP's) and complying with Best Available Technology Economically Achievable (BAT) and Best Conventional Pollutant Control Technology (BCT). The SWPPP shall identify potential sources of pollution which may reasonably be expected to affect storm water discharges associated with the construction activity. In addition, the SWPPP shall describe and ensure the implementation of practices which are to be used to reduce pollutants in storm water discharges associated with the construction activity and to assure compliance with the terms and conditions of this permit. Facilities must implement the provisions of the SWPPP required under this part as a condition of this permit.

This pamphlet is to be used as an environmental guidance manual for developing SWPPPs for construction activities. It is *not* designed or intended to be used as a *directional or operations document.* Any operations developed for construction activity must be in compliance with EPA and other Federal and state regulations. The storm water control measures and practices described herein should be used only when they meet or exceed all applicable EPA or other Federal and state regulations concerning the control of hazardous or toxic materials, erosion, sedimentation, storm water management, pollutants, and worker safety. Any pollution prevention measures used on a construction site, but not identified herein, should be included in the SWPPP.

Construction activities that are covered by the EPA baseline general permit (issued 3 September 1992) must have a completed SWPPP prior to mobilization. It must include the following:

1. Certifications required under Part IV.E of the general permit, prior to the submittal of a notice of intent (NOI) to be covered under the permit and updated as appropriate;

2. For construction activities that have begun on or before October 1, 1992, except for sediment basins required under Part IV.D.2.a(2) (structural practices) of the general permit, the plan shall provide for compliance with sediment basins required under Part IV.D.2.a(a) of the general permit by no later than December 1, 1992;

3. For construction activities that have begun after October 1, 1992, the SWPPP shall provide for compliance with the terms and schedule of the general permit beginning with the initiation of construction activities.

Other facilities that have filed an individual application must comply with the conditions of their individual permit, when issued. In most states, the SWPPP is not submitted to the permitting authority, but it must be retained onsite at the facility generating the discharge in accordance with Part V of the general permit. The SWPPP must be made available upon request to the Program Director; to a state or local agency approving erosion and sediment control plans, grading plans, or storm water management plans; or, in the case of discharge through a municipal separate storm sewer system with an NPDES permit, to the municipal operator of the system. The SWPPP must be available for review by the permit authority and the public. The permit authority may notify the construction activity representatives if the SWPPP for the construction activity does not meet the minimal requirements. Table 1-1 gives a brief description of each state's status, concerning SWPPP's, as of October 1993.

1.6 Statement of Policy for the Storm Water Pollution Prevention Plan

The U.S. Army Corps of Engineers (COE) intends to develop and implement the SWPPP (with the expressed cooperation of any tenants, contractors, or subcontractors (contractors)) for the purpose of minimizing the potential for the release of sediments and toxic or hazardous substances directly, or indirectly, to the storm drainage system. To achieve this objective, the responsibilities of both the COE and any contractors for the facilities they individually operate include:

- Implementing the policies and procedures presented in the SWPPP.
- Conducting periodic reviews of policies and procedures to evaluate the effectiveness of the current SWPPP.
- Updating the SWPPP and related materials whenever there is a significant physical change in a construction activity or a significant change in the operational procedures of a construction activity that could result in the discharge of pollutants to the storm water drainage system, or an increased risk of such discharge.

Table 1-1
Comparison of State General Permits for Industrial Storm Water Dischargers

Permits				SWPPPs					Monitoring		
State	No. of Permits	Expiration date	Fees	Completion deadline	Implementation deadline	Special rqts SARA Title III W.P.C.	Require PE cert.	Submit SWPPP	Monitoring required	Submit results	Rep. discharge allowed
EPA baseline permit	1	10/1/97	N	4/1/93	10/1/93	Y	Y(1)	N	Y;industry-specific, risk-based	Y(2)	Y
AL	15	mid to late 1997	Y	varies	varies	N	N	N*	varies	Y	Y(3)
AK**	1	10/1/97*	N	4/1/93*	10/1/93*	Y*	Y*	N*	Y*	Y*	Y*
AZ**	1	10/1/97*	N	4/1/93*	10/1/93*	Y*	Y*	N*	Y*	Y*	Y*
AR	1	9/30/97	Y	4/1/93*	10/1/93*	Y*	Y*	N*	Y*	Y*	Y*
CA	1	1/15/97	Y	10/1/92	10/1/92	N	N	N	Y	Y	Y
CO	5	6/30/96	Y	5/1/93	11/1/93	Y*	N	Y(4)	Y*(4)	Y	Y
CT	1	10/1/97*	Y	4/1/93*	10/1/93*	N	Y	N*	Y(5)	N(6)	Y(7)
DE	1	8/6/98	Y	8/6/94	2/6/94	Y	N	N	Y(1)	N	Y*
FL**	1	10/1/97*	N	4/1/93*	10/1/93*	Y*	Y*	N*	Y*	Y*	Y*
GA	1	5/31/98	N	12/31/93	5/31/94	N	N	N	Y	N	Y*
HI	1	10/29/97	Y	120 days after coverage	180 days after coverage	Y*	Y	Y	Y	Y	Y
ID**	1	10/1/97*	N	4/1/93*	10/1/93*	Y*	Y*	N*	Y*	Y*	Y*
IL	1	10/1/97*	N	w/in 180 days of coverage	w/in 365 days of coverage	N	N	Y(8)	N	N	N
IN	permit by rule	none	Y	none	365 days after NOI	N	N	N	Y(5)	Y	Y

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Table 1-1 (Continued)

	Permits			SWPPPs					Monitoring		
State	**No. of Permits**	**Expiration date**	**Fees**	**Completion deadline**	**Implementation deadline**	**Special rqts SARA Title III W.P.C.**	**Require PE cert.**	**Submit SWPPP**	**Monitoring required**	**Submit results**	**Rep. discharge allowed**
IA	1	10/1/97*	Y	4/1/93*	10/1/93*	Y*	N	N*	Y	Y(9)	Y*
KS	draft										
KY	7	10/1/97*	N	180 days after coverage	365 days after coverage	N	N	N*	Y(5)	N	Y
LA**	1	10/1/97*	N	4/1/93*	10/1/93*	Y*	Y*	N*	Y*	Y*	Y*
ME**	1	10/1/97*	N	4/1/93*	10/1/93*	Y*	Y*	N*	Y	N	Y
MD	1	9/28/97	Y	9/29/93	3/29/94	Y	N	N*	N	N	N
MA**	1	10/1/97*	N	4/1/93*	10/1/93*	Y*	Y*	N*	Y*	Y*	Y*
MI	draft										
MN	1	9/30/97	Y	1 year from coverage	2 years from coverage	N	N	N	N	N	N
MS	98	7/13/97	N	4/1/93*	10/1/93*	Y	Y	Y	Y(10)	Y	Y
MO	many	varies	Y	varies	varies	varies	varies	varies	varies	varies	varies
MT	2	11/30/94	N(11)	6 months after coverage	12 months after coverage	N	N	Y	Y(5)	Y	Y
NE	1	varies	N	w/in 180 days of coverage	w/in 180 days of completion deadline	N	Y*	N	Y	Y	N
NV	3	5/14/98	Y	w/in 6 months of authorization	w/in 1 year of authorization	N	N	Y	Y(15)	Y(15)	N
NH**	1	10/1/97*	N	4/1/93*	10/1/93*	Y*	Y*	N*	Y*	Y*	Y*
NJ	1	11/1/97	Y	5/2/93	11/2/94	N	N	N*	N	N	N
NM**	1	10/1/97*	N	4/1/93*	10/1/93*	Y*	Y*	N*	Y(14)	Y	Y(13)

(Sheet 2 of 4)

Table 1-1 (Continued)

Permits				SWPPPs					Monitoring		
State	No. of Permits	Expiration date	Fees	Completion deadline	Implementation deadline	Special rqts SARA Title III W.P.C.	Require PE cert.	Submit SWPPP	Monitoring required	Submit results	Rep. discharge allowed
NY	1	8/1/98	Y	2/1/94	8/1/94	Y(14)	Y*	N*	Y	Y	Y*
NC	12	8/31/93	Y	12 months after coverage	12 months after coverage	Y(12)	N	N*(13)	Y(14)	Y	Y(13)
ND	2	3/31/95	N	w/in 90 days of coverage	w/in 180 days or 90 days of approval	Y*	Y*	Y(5)	Y	Y	Y(7)
OH	1	4/26/94	Y	4/1/93*	10/1/93*	Y*	Y*	N*	Y*	Y*	Y*
OK**	1	10/1/97*	N	4/1/93*	10/1/93*	Y*	Y*	N*	Y*	Y*	Y*
OR	12	9/30/96	Y	w/in 180 days of coverage	w/in 360 days of coverage	N	Y	N	Y(5)	Y	Y
PA	1	11/6/97	Y	before submitting NOI	before submitting NOI	Y	Y	N	Y	Y	Y*
RI	2		Y	4/1/93*	10/1/93*	Y*	Y*	N*	Y	Y*	Y*
SC	1	9/30/97	N	4/1/93*	10/1/93*	Y*	Y*	N*	Y*	Y*	Y*
SD**	1	10/1/97*	N	4/1/93*	10/1/93*	Y*	Y*	N*	Y*	Y*	Y*
TN	1	10/26/97	N	w/in 180 days of coverage	within 1 year of coverage	Y*	Y*	N*	Y	Y	Y
TX**	1	10/1/97*	N	4/1/93*	10/1/93*	Y*	Y*	N*	Y*	Y*	Y*
UT	1	9/30/97	Y	4/1/93*	10/1/93*	Y*	Y*	N*	Y*	Y*(2)	Y*
VT**	1	10/1/97*	N	4/1/93*	10/1/93*	Y*	Y*	N*	Y*	Y*	Y*
VA	emergency permits										

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Table 1-1 (Concluded)

Permits				SWPPPs					Monitoring		
State	No. of Permits	Expiration date	Fees	Completion deadline	Implementation deadline	Special rqts SARA Title III W.P.C.	Require PE cert.	Submit SWPPP	Monitoring required	Submit results	Rep. discharge allowed
WA	1	11/18/95	Y	11/18/93	11/18/94	N	N	N*	N	N	N
WV	1	6/7/97	Y	w/in 180 days of coverage	w/in 365 days of coverage	Y*	Y*	N*	Y	Y	Y(13)
WI	draft										
WY	1	8/31/97	N	w/in 180 days of coverage	w/in 365 days of coverage				N	N	N

Note:

Abbreviations and footnotes:

SWPPP Storm Water Pollution Prevention Plan
SARA Superfund Amendments and Reauthorization Act
W.P.C. Water priority chemicals
* Same as EPA requirements
** EPA State
PE Professional Engineer
Y Yes
N No
(1) If SARA Title III water priority chemicals are involved
(2) Only for semiannual monitoring requirements
(3) Request-by-request basis
(4) Heavy industry only
(5) All permittees
(6) Unless acute toxicity exceeds minimum
(7) Subject to the 20-percent rule
(8) Annual reports submitted; not SWPPP
(9) Only those subject to effluent limitations
(10) SARA Title III, coal piles, wood treaters
(11) Anticipated later
(12) Semiannual inspections required
(13) Upon request and approval
(14) Must post onsite

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2.0 PLANNING, ORGANIZATION, AND SWPPP CERTIFICATION

2.1 Organization

The U.S. Army Corps of Engineers (COE) has developed a comprehensive approach to address the permitting of storm water discharges associated with construction activity. Due to the location and complexity of COE construction-related activities, the many contractors and subcontractors, and the number of projects related to COE operations and maintenance, the COE has elected to assume a role as a principal permittee with contractors who conduct construction activities at COE sites included as copermittees on the permit. Individual construction project operators (COE, tenants, and contractors) are responsible for the implementation of SWPPP provisions and the monitoring and reporting requirements of the general permit.

Many of the facilities under COE jurisdiction are comprised of numerous leaseholds and tenants which are part of a "larger common plan of development," (i.e., military installations). For this reason, COE will also require construction projects associated with these types of facilities which disturb less than 2 hectares (5 acres) to be included under permit coverage and thus subject to provisions of the SWPPP. COE will assemble a working list of proposed construction projects at each facility, and the list will be updated semiannually and incorporated into the SWPPP. COE will annually submit NOI's to cover construction activities at these types of installations.

This pamphlet is organized to function as a user's guide to meet SWPPP requirements. The step-by-step guidelines and checklists in the following sections are designed to assist in the organization of the required information. Using this information, the planner will develop and implement the SWPPP following the six basic phases listed below. Each phase is important and should be completed before advancing to the next one.

- Site Planning and Design Development Phase.
- Assessment Phase.
- Control Selection/Plan Design Phase.
- Notification/Approval Phase.
- Implementation/Construction Phase.
- Final Stabilization/Termination Phase.

Developing an SWPPP is basically a six-phase process. The first three phases are primarily the responsibility of the COE and any leasehold tenants planning construction activities. The final three phases are the joint responsibility of the COE and leasehold tenants and the construction site operators as co-permittees on a project-by-project basis. Because most aspects of the SWPPP take a significant amount of planning, its development must be closely connected to the development of the overall site plan for construction. Postconstruction storm water management controls must be considered in the planning stage.

The first phase in preparing an SWPPP for a construction project is to define the characteristics of the site and of the type of construction which will be occurring there. This phase is divided into three tasks: (1) Data collection, (2) Data Analysis, and (3) Site Plan Development. Section 3.0 describes these tasks in detail. The COE must address both project design considerations and the implementation of the SWPPP during construction and postconstruction phases of projects. Contractors will be primarily concerned with the implementation of the SWPPP during the construction and postconstruction phases of projects. The intent of this pamphlet is to place the various construction activities into perspective in terms of the intent of EPA with respect to storm water control of construction activities.

The reader should note the sections addressing special conditions, such as construction activities located on sites containing Title III, Section 313, water priority chemicals listed in the Superfund Amendments and Reauthorization Act of 1986 (SARA), and/or other priority pollutants. It is anticipated that most of the construction activities of the COE and leasehold tenants will not involve these special conditions, but some sites will—hence the inclusion of these sections. Appendix H lists the Section 313 water priority chemicals as published in the Federal Register on September 9, 1992. Since this list is subject to change, the designer should review 40 CFR 122 and 40 CFR 372 for the current list of priority pollutants.

In order to ensure that the plan is completely developed and adequately implemented, the regulations require that authorized representative(s) of the operator(s) sign and certify the plan. Section 2.4 details this requirement. Once the planning, design, and certification are completed, construction may commence. Section 6.0 details the requirements of implementation, documentation, and termination.

2.2 SWPPP Planning

The term planning could include the project as a whole as well as planning for the SWPPP. Design considerations for the project as a whole will affect the development of the SWPPP. Three tasks should be completed before developing the SWPPP document. These tasks are: (1) designating the person(s) responsible for developing and implementing the SWPPP, (2) reviewing existing pollution prevention plans for procedures which overlap the requirements and purpose of the SWPPP, such as state and local erosion and sedimentation regulations, and (3) reviewing and addressing specific permit regulations included in individual state NPDES Storm Water Permit requirements.

Designating a specific individual or team that will develop and implement the pollution prevention plan serves several purposes. Naming the individual or team members makes it clear that part of the job of the identified person(s) is to prevent storm water pollution. Identifying a specific individual(s) also provides a point of contact for those outside of the jobsite who may need to discuss aspects of the SWPPP.

Where setting up a pollution prevention team is appropriate, it is important to identify the key people onsite who know the construction activity and its operations well, and to provide adequate structure and direction for the construction activity's entire storm water management program. Specific activities of the pollution prevention team and the type and number of members vary for different sizes and types of projects.

Effective organization of the pollution prevention team is important in order for the team to accomplish the task of developing and implementing a comprehensive SWPPP. There are two important features in organizing a team of this nature: (1) selecting dedicated individuals to serve on the team and (2) establishing good channels of communication.

The formation and operation of any team involves decision-making and planning within a group environment. The team structure allows for people with different ideas and areas of expertise to share knowledge and collectively determine what works best for a particular construction activity. To broaden the base of involvement in the construction activity's storm water pollution prevention program, team members should represent all phases of the construction activity's operations.

It is advantageous to incorporate relevant provisions of best management practices (BMP's) or Spill Prevention and Control Countermeasure (SPCC) plans from other activities into the SWPPP. Many construction activities may already be subject to similar requirements under a number of different regulations. The following is a partial list of Federal regulations relevant to controlling potential releases to surface waters of hazardous wastes from the operations of construction activities (and their contractors):

- 29 CFR 1910 (Subparts G, H, I, J, and K) Hazardous Materials, Environmental Controls, and Personnel Protection.
- 29 CFR 1910.1200 OSHA Hazard Communication Standard.
- 40 CFR 112 Oil Pollution Prevention (SPCC Plans).
- 40 CFR 116,117 Hazardous Substances and Reportable Quantities.
- 40 CFR 122 NPDES Regulations (Storm Water Discharges).

- 40 CFR 260-262, 268, and 270-272 Hazardous Waste Management.
- 40 CFR 280-281 Underground Storage Tanks.
- 40 CFR 302 Designation, Reportable Quantities and Notification Requirements for Hazardous Substances Under CERCLA.
- 40 CFR 372 Toxic Chemical Release Reporting: Community Right-to-Know.
- 40 CFR 761 Toxic Substances.
- 49 CFR 171-173, 175, and 177 Department of Transportation Regulations.

It is the responsibility of the pollution prevention team to understand the NPDES Storm Water Permit requirements of the state where the construction activities are to take place and to determine which requirements of the SWPPP overlap with other plans or requirements and to so note them.

2.3 Storm Water Pollution Prevention Personnel

To ensure compliance with the NPDES permit regulations, it is necessary to establish a list of personnel who will be responsible for overseeing and coordinating and, when necessary, amending the policies, practices, and procedures of the SWPPP. These persons should be knowledgeable in construction operations and capable of understanding the technical aspects of the SWPPP. Trained personnel responsible for the execution of the SWPPP requirements should be available at the jobsite. Depending upon the size of the construction project and complexity of the SWPPP, it may be necessary to establish a team or committee of trained personnel to implement the SWPPP.

The personnel chosen should be identified by name and title. Exhibit D-1, in Appendix D, is provided to list names, titles, and phone numbers of the committee members. The storm water pollution prevention team concept is flexible and should be molded to conform to the resources and specific conditions of the construction activity. Specific activities of the storm water pollution prevention team and type and number of members vary for different projects.

The membership should be comprised of at least two responsible persons knowledgeable in the requirements of SWPPP.

For facilities leasing space to tenant operations, the SWPPP committee should include at least one representative from each tenant operation. The SWPPP committee will be responsible for overseeing the activities as outlined below and shall meet at least annually to address the implementation of these activities:

- Coordination of management in carrying out SWPPP objectives.
- Implementation of spill reporting procedures.
- Inspection programs for Stockpile Storage Areas.
- Identification of additional potential pollutant sources.
- Coordination of spill cleanup and containment activities.
- Reviewing the effectiveness of the SWPPP program.
- Updating the SWPPP program to comply with BMP policies and objectives.

2.4 SWPPP Certification

In order to ensure that the SWPPP is completely developed and adequately implemented, state-issued NPDES permits typically require that authorized representative(s) of the operator(s) sign and certify the plan. In signing the plan, the authorized representative certifies that the information is true and assumes liability for the plan.

Official signatures provide a basis for an enforcement action to be taken against the person signing the document. The permittee should be aware that Section 309 of the CWA provides for significant penalties where information is false or the permittee violates, either knowingly or negligently, the permit requirements. Specific signatory requirements for the SWPPP will be listed in the state-issued permits.

On the Federal level, the SWPPP certification must be signed in accordance with the provisions of Part VII. G of the baseline general permit. All reports, certifications, or other information required by the permit or requested by the permit authority shall be signed by a person described below:

1. For a corporation, by a responsible corporate officer. For the purposes of this section, a responsible corporate officer is a president, secretary, treasurer, or vice-president of the corporation in charge of principal business function, or any person who performs similar policy or decision-making functions for the construction activity; or the manager of the construction activity if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

2. For a partnership or sole proprietorship, by a general partner or the proprietor, respectively;

3. For a municipality, state, Federal, or other public agency, by either a principal executive officer or ranking elected official. For the purposes of this section, a principal executive officer of a Federal agency includes (1) the chief executive officer of the agency, or (2) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency.

The person who signs the document may also be a "duly authorized representative." A person is a duly authorized representative only if:

1. The authorization is made in writing by persons described above and retained as part of the SWPPP.

2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated construction activity,

such as the position of manager, operator, superintendent, or position of equivalent responsibility for environmental matters for the company. A duly authorized representative may thus be either a named individual or any individual occupying a named position.

3. If an authorization is no longer accurate because a different individual or position has responsibility for the overall operation of the construction activity, a new authorization must be attached to the SWPPP prior to submittal of any reports, certifications, or information signed by the authorized representative.

The SWPPP must clearly identify the contractor(s) and/or subcontractor(s) who will be responsible for implementing the plan, and each must sign a copy of the certification located in Appendix F. A certification page must also be signed by a duly authorized representative of the COE and retained in the SWPPP document.

2.4.1 Notice of Intent

The NOI is essentially an application and contains important information about the site, including site location, owner information, operator (general contractor) information, receiving water(s), existing NPDES permit number, if any, an indication of existing quantitative data, and a brief description of the project. EPA has developed a one-page form to be used by industrial facilities and construction activities when they submit NOI's. A copy of the Federal NOI form is located in Appendix B.

There are different deadlines for submitting NOI's depending on the permitting authority responsible for issuing the NPDES permit. Time required to submit NOI's can vary from 2 days prior to construction for Federal regulated permits to over 120 days prior to construction for some states. The reader is referred to Appendix A for a list of state contacts to determine who and where the NOI is to be submitted. NOI's for the EPA general permit must be submitted directly to EPA's central processing center at the following address:

Storm Water Notice of Intent (4203)
401 M Street, S.W.
Washington, DC 20460

Each party or each of the parties who have day-to-day responsibilities for site operations and each party or each of the parties who have control over the designs and specifications necessary to ensure compliance with SWPPP requirements and permit conditions must be identified in the NOI. It is anticipated that there will be projects where more than one entity (e.g., the owner, developer, or general contractor) will need to submit an NOI so that both of the requirements for an operator are met. In this case, those persons will become co-permittees.

2.4.2 Plan Location and Public Access

Some NPDES-delegated states may require SWPPP's to be submitted to the Program Director for review and approval, whereas other permits may only require that plans be maintained onsite. Permitting authorities may prefer not to require plans to be submitted to reduce the administrative burden of reviewing a large number of SWPPP's. However, when the Director requests the plan, permittees should submit the plan in a timely manner. In addition, when requested, permittees should also submit their plan to state or local sediment and erosion or storm water management agencies, or to a municipal operator where the site discharges through an NPDES storm water permitted municipal separate storm sewer system. Readers are again urged to examine the issued permit carefully to determine what requirements apply to the SWPPP regarding plan submittal.

Regardless of whether or not the SWPPP is submitted to the permitting authority or other public agency, the SWPPP and supporting materials must be kept at the site of the construction activity at all times throughout the project. In maintaining plans onsite, the SWPPP committee should keep all records and supporting documents compiled together in an orderly fashion. The state-issued permit may require that all records be maintained for a certain period of time after the project is completed. The Federal regulations require permittees to keep the SWPPP and all reports and data for at least 3 years after the project is complete. This provision ensures that all records are available in case a legal situation arises for which documentation is necessary.

Despite the fact that plans and associated records are not necessarily required to be submitted to the Director, these documents are considered to be "reports" according to Section 308(b) of the CWA and, therefore, are available to the public. State-issued permits may require the submittal of copies of the SWPPP to the permitting authority, municipal operator, or state or local agency upon request. However, permittees may claim certain portions of their SWPPP as confidential according to the regulations at 40 CFR Part 2. Basically, these regulations state that records which contain trade secret information may be claimed as confidential.

2.5 Record of Revision

SWPPP elements will be modified as required (site inspections, additional BMPs, etc.) under the general permit by the appropriate COE SWPPP coordinator. Elements specific to tenant construction projects can be modified by the tenant project coordinator or duly authorized representative, as required under the general permit. Copies of any changes made by the tenant construction project coordinator must be immediately provided to the local COE SWPPP coordinator. The SWPPP will also be amended at any time it inadequately addresses conditions of the general permit or any amendments to the permit. The record of revision forms are located in Appendix G and are labeled Table G-1 and Exhibit G-1.

2.6 Special Requirements - SARA Title III, Section 313 Facilities

In addition to the minimum "baseline" requirements discussed previously, facilities may be subject to additional "special requirements." Not all facilities will have to include these special requirements in their SWPPP. Special permit requirements for all facilities regulated by SARA Title III, Section 313 [Emergency Planning and Community Right-to-Know Act (EPCRA)], include;

2.6.1 Control Measures

Control measures as listed below must be practiced in areas where Section 313 water priority chemicals are stored, handled, processed, or transferred: (A list of Section 313 water priority chemicals is located in Appendix H.)

- Provide containment, drainage control, and/or diversionary structures.
- Minimize discharges from liquid storage areas (install liquid materials in compatible storage containers and/or provide secondary containment or equivalent measures designed to hold the largest volume of the largest storage tank plus precipitation).
- Minimize discharges from material storage areas.
- Minimize discharges from loading/unloading areas (use drip pans and/or implement a strong spill contingency and integrity testing plan).
- Minimize discharges from handling/processing/transferring areas (use covers, guards, overhangs, door skirts and/or conduct visual inspections or leak tests for overhead piping).
- Minimize discharges from all the above-listed areas (use manually activated valves with drainage controls in all areas, and/or equip the plant with a drainage system to return spilled material to the storage facility).
- Introduce facility security programs to prevent spills (use fencing, lighting, traffic control, and/or secure equipment and buildings).

2.6.2 Preventative Maintenance

The SWPPP must include methods, controls, and procedures which will be incorporated to minimize, limit, and/or prevent leaks or spills of Section 313 water priority chemicals, as defined in the CWA, from occurring on the construction site. To prevent spills from occurring, these facilities are required to designate a person responsible for spill prevention, response, and reporting procedures. Any contaminated soil, material, or debris resulting from a spill of a priority chemical shall be removed promptly and disposed of in accordance with Federal, state, and local requirements and as described in the SWPPP. All areas of the construction activity must be inspected at appropriate intervals for the following as specified in the plan:

- Leaks or conditions that would lead to discharges of Section 313 water priority chemicals.
- Conditions that could lead to direct contact of storm water with raw materials, intermediate materials, waste materials or products thereof.
- Piping, pumps, storage tanks and bins, pressure vessels, process and material handling equipment, and material bulk storage areas for leaks, wind blowing loose material, corrosion, support or foundation failure, or other deterioration or noncontainment problems.

2.6.3 Training

Employees and contractor personnel must be trained in the following areas, at least once per year:

- Preventative measures, including spill prevention and response, construction activity inspections, and preventative maintenance.
- Pollution control laws and regulations.
- The construction activity's SWPPP.
- Features and operations of the construction activity that are designed to minimize discharges of Section 313 water priority chemicals, particularly spill prevention procedures.

2.6.4 Engineering Certification

Certain states require that SWPPP plans be reviewed and certified by a Registered Professional Engineer and recertified every 3 years or anytime the plan is significantly changed.

2.6.5 Monitoring Requirements

SARA Title III Section 313 facilities must monitor semiannually storm water discharges that come into contact with equipment, tanks, containers, or other vessels or areas used for storage of Section 313 water priority chemicals, or located at a truck or rail car loading or unloading area. Note that the permit provides an alternative to whole effluent toxicity (WET) testing. In lieu of monitoring for acute WET, the facility may monitor for pollutants that the facility "reasonably" believes are present onsite. Such determinations are to be based on reasonable best efforts to identify significant quantities of materials or chemicals present onsite. The pollutants are identified in Tables II and III of Appendix D of 40 CFR 122. Further, the permit provides that if the discharger certifies that industrial activities in a given drainage area are not exposed to storm water, monitoring is not required.

2.7 Special Requirements—Discharges to Municipal Separate Storm Sewer Systems

Additional requirements for storm water discharges associated with industrial activity discharging to municipal separate storm sewer systems serving a population of 100,000 or more include:

2.7.1 Compliance With Municipal Storm Water Management Programs

Activities must comply with applicable requirements in municipal storm water management programs developed under NPDES permits issued for the discharge of the municipal separate storm sewer system that receives the construction activity's discharge, provided the discharger has been notified of such conditions, in addition to complying with the permit requirements.

2.7.2 Availability of Plans

Permittees which discharge storm water associated with industrial activity through a municipal separate storm sewer system serving a population of 100,000 or more must make plans available to the municipal operator of the system upon request.

2.8 Special Requirements—Releases of Reportable Quantities

Due to the fact that construction activities may handle certain hazardous substances over the course of the project, spills of these substances in amounts that equal or exceed Reportable Quantity (RQ) levels are a possibility. EPA has issued regulations which define what reportable quantity levels are for oil and hazardous substances. These regulations are found at 40 CFR Part 110, 40 CFR Part 117, or 40 CFR Part 302. For oil, if an oily sheen is detectable in the storm water runoff, the reportable quantity level has been exceeded. For hazardous substances, the final RQ levels depend on the chemical. For example, for dieldrin, a pesticide, the level is 1 kilogram (kg). If there is a spill or other release of 1 kg or more, the RQ threshold has been exceeded. Spill events such as these can be avoided if the SWPPP addresses this possibility. Section 4 discusses spill prevention and control.

3.0 SITE DESCRIPTION

3.1 Data Collection/Data Analysis

An inventory of the existing site conditions which will be used in the development of the SWPPP will be required. The information obtained should be both plotted on a map and verbally explained in this portion of the plan. After all data are considered, an assessment of the site potentials and limitations should be made. The site planner or designer should be able to determine those areas which have critical pollutant generation potential. The following are some of the most important considerations in site analysis.

3.1.1 Topography

A small-scale topographic map of the site should be prepared to show the existing contour elevations at intervals of from 0.3 to 1.5 meters (1 to 5 feet) depending upon the slope of the terrain. Existing topographic maps (e.g., U.S. Geological Survey (USGS) or local government topos) can be a good starting point; however, the information should be verified by a field investigation. The primary topographic considerations are slope steepness and slope length. Because of the effect of accumulated runoff, erosion potential is greater on long, steep slopes. When the percent slope has been determined, areas of similar steepness should be outlined. Slope gradients can generally be grouped into three general ranges of soil erodability:

Slope	Erosion Hazard
0-7%	Low erosion hazard
7-15%	Moderate erosion hazard
>15%	High erosion hazard

Within these slope gradient ranges, the erosion hazard becomes greater as the slope length increases. Therefore, in determining potential critical areas, the site planner should be aware of excessively long slopes. As a general rule, the erosion hazard will become critical if the slope exceeds the following criteria:

Slope	Critical Length, meters (feet)
0-7%	91 (300)
7-15%	46 (150)
>15%	23 (75)

3.1.2 Drainage Patterns

All existing drainage swales and patterns on the site should be located and clearly marked on the topographic map. Perennial or intermittent streams, as well as wetland areas, should also be shown on the map. The existing drainage patterns, which consist of overland flow, swales and depressions, and natural watercourses, should be identified in order to plan around critical areas where water will concentrate. Where possible, natural drainageways should be used to convey runoff over and off the site to avoid the expense and problems of constructing an artificial drainage system. Man-made ditches and waterways can become part of the erosion problem if they are not properly designed and constructed. Care should also be taken to be sure that the increased runoff from the site will not erode or flood the existing natural drainage system. Possible sites for storm water detention should be located at this time.

3.1.3 Soils

Major soil type(s) on the site should be shown on the topographic map. Soils information can be obtained from a soil survey if one has been published for the county in which the project is proposed. If a soil survey is not available, a request can be made to a district Soil Conservation Service (SCS) office, a county extension service, or a state or Federal Department of Agriculture. Commercial soils evaluations may also be available. Soils information should be plotted directly onto the map or an overlay of the same scale for ease of interpretation. Such soils properties as natural drainage, depth to bedrock, depth to seasonal high water table, permeability, shrink-swell potential, texture, and erodibility should exert a strong influence on land development decisions.

3.1.4 Ground Cover

The existing vegetation such as tree clusters, grassy areas, and unique vegetation should be shown on the map. In addition, existing denuded or exposed soil areas should be indicated. Ground cover is the most important factor in terms of preventing erosion. Any existing vegetation which can be saved will help prevent erosion. Trees and other vegetation protect the soil, as well as beautify the site after construction. If the existing vegetation cannot be saved, the planner should consider staging construction and using temporary seeding or temporary mulching. Staging of construction involves stabilizing one part of the site before disturbing another. In this way, the entire site is not disturbed at one time. Temporary seeding and mulching involve seeding or mulching areas which would otherwise lie exposed for long periods of time. Thus, the time of exposure is shortened and the erosion hazard is reduced.

3.1.5 Adjacent Areas

Areas adjacent to the site should be delineated on the topographic map. Features such as streams, roads, houses or other buildings, and wooded or wetland areas should be shown. Streams which will receive runoff from the site should be surveyed to determine their carrying capacity. The analysis of adjacent properties should focus on areas downslope from the construction activity. Of major concern are watercourses which will receive direct runoff from the site. The potential for sediment pollution of these watercourses should be considered, as well as the potential for downstream channel erosion due to increased volume, velocity, and peak flow rate of storm water runoff from the site. The potential for sediment deposition on adjacent properties due to sheet and rill erosion should also be analyzed so that appropriate sediment-trapping measures can be planned and installed prior to any land-disturbing activity. Drainage from large areas upstream from proposed active construction sites should be diverted around the sites wherever possible. Whenever possible, diversionary drainage channels should be established and stabilized before active site disturbance activities begin.

3.1.6 State/Local Requirements

Federal, state, and local agencies that undertake land-disturbing activities are generally regulated by the same authorities that regulate private land-disturbing activities. Readers are encouraged to contact local jurisdictional agencies such as the County Engineer regarding permits, fees, and plan submission, as well as any other requirements. Facilities which are already operating under approved state or local sediment and erosion plans, grading plans, or storm water management plans are required to submit copies of the NOI to the agency approving such plans in accordance with Part II.A of the general permit (or sooner where required by state or local rules), in addition to submitting the NOI to EPA or the NPDES-delegated authority in accordance with paragraph II.C of the general permit.

3.2 Site Plan Development

The permits issued by NPDES-delegated states will specify deadlines for plan development and implementation. The sequence of events, assumably, will be that the SWPPP's will be completed and implemented at the time the project breaks ground and revised, if necessary, as construction proceeds. The SWPPP should be in place before project initiation because construction operations pose environmental risks as soon as activity begins. The initial clearing and grubbing operation may contribute a significant amount of pollutants to storm water runoff. The reader is urged to read the applicable permit carefully to determine what dates and deadlines apply to the project.

The planning for pollution prevention measures should be done concurrently with the development of the construction plans. The best SWPPP's are developed at the same time as the design of the site plan. However, if the site design has already been completed, it is not necessary to start the process all over again. Much of the information needed for the

SWPPP should already be included in the design documents. An SWPPP can be prepared for most construction projects by using information from the existing design, and modifying the design to accommodate the controls.

After analyzing the data and determining the site limitations, the planner can develop a site plan. When designing the site plan, the planner should keep in mind that increases in runoff may require structural runoff control measures or channel improvements. Both items are expensive, and even more so when the site plan has to be redesigned to accommodate the runoff control measures. Therefore, the planner should minimize the increase in runoff or include runoff control measures in the initial design. The following are some issues to consider when developing the site plan.

3.2.1 Controlled Grading

The development of an area should be tailored to the existing site conditions. This tailoring will avoid unnecessary land disturbance, thereby minimizing the erosion hazards and costs. Excessive cutting and filling should be avoided, if possible. Slopes should be at a maximum of 2:1 or less, depending on soil type to provide for final stabilization.

3.2.2 Critical Areas

Land disturbance in critically erodible areas may necessitate the installation of more costly control measures. See criteria for critical areas in Section 3.1.1.

3.2.3 Cluster Development

Whenever possible, developments in which facilities are clustered together, or performance of construction is in a sequence of clusters, is a desired approach. The cluster concept minimizes the amount of disturbed area, concentrates utility lines and connections in one area, and provides more open natural space. The cluster concept not only lessens the erodible area, but it generally reduces runoff and generally reduces development costs.

3.2.4 Minimization of Imperviousness

Keep paved areas such as parking lots and roads to a minimum. This pavement minimization goes hand-in-hand with cluster development in eliminating the need for duplicating parking areas and access roads. The more land that is kept in vegetative cover, the more water will infiltrate, thus reducing runoff and erosion.

3.2.5 Utilization of Natural Drainage

If the natural drainage system of a site has been determined that it can properly handle runoff generated during and after construction activities without resulting in bank and bed erosion, the natural system should be preserved instead of being replaced with storm sewers or concrete channels.

3.3 Storm Water Runoff Calculations

The problems associated with storm water runoff in rapidly urbanizing watersheds have become well known. These problems relate both to the quantity and quality of storm water runoff. Major problems include increased flooding magnitude and frequency, accelerated stream channel erosion, and water quality degradation. The basic underlying cause of these problems is not difficult to understand. The hydrologic systems which have reached a natural equilibrium over centuries simply cannot adjust to the sudden impact of urban development. Flooding occurs because the increased volume and peak rate of runoff exceed the natural carrying capacity of the streams. Stream channel erosion accelerates due to suddenly increased flow velocities and flooding frequency. The water quality itself is degraded by sedimentation and numerous other pollutants associated with urbanization that become available to be washed off the land surface and into water resources.

Studies have shown that most natural stream channels are formed with a bankfull capacity to pass runoff from a storm with a 1.5- to 2-year recurrence interval. As upstream development occurs, the volume and velocity of flow from these relatively frequent storms increase. Consequently, even smaller storms with less than 1-year recurrence intervals begin to cause streams to flow full or flood. According to one study, stream channels are subject to a three- to five-fold increase in the frequency of bankfull flows in a typical urbanizing watershed. This increase in the flooding frequency places a stress on the channel to adjust its shape and alignment to accommodate the increased flow. Unfortunately, this adjustment takes place in a very short time in geologic terms, and the transition is usually not a smooth one. Meandering stream channels, which were once parabolic in shape and covered with vegetation, typically become straight, wide rectangular channels with barren vertical banks. This process of channel erosion often causes significant property damage, and the resulting sediment is transported downstream, further contributing to channel degradation.

One strategy for dealing with this problem is to increase the carrying capacity and stability of affected streams through channel modifications. This strategy may be employed most effectively on man-made channels or small, intermittent streams. Significant modifications to natural, continuous flowing streams, however, can be the subject of intense local controversy.

Wherever modifications to natural flowing streams are being considered, extreme care must be taken to weigh the benefits of such modifications against the cost and the concerns of the local citizens. Where channel modifications are necessary, an attempt should be made to incorporate conservation practices that will minimize adverse impacts to fish, wildlife, and the aesthetic quality of the stream. In general, erosion and sedimentation controls, and the overall SWPPP, are focused on preserving existing streamflow quantity and quality, whenever possible.

The following storm water runoff requirements were developed to provide guidance for designers and planners in the absence of state regulatory guidance or local storm water management programs. These criteria are considered "rule of thumb" minimums:

- Increased volumes of sheet flow that may cause erosion or sedimentation on adjacent property must be diverted to a stable outlet, *adequate* channel, or detention facility.

- Concentrated storm water runoff leaving a development site must be discharged directly into an *adequate* natural or man-made receiving channel, pipe, or storm sewer system.

- An adequate channel is defined as "a watercourse that will convey a chosen frequency storm event without overtopping its banks or causing erosive damage to the bed, banks, and overbank sections of the watercourse."

- A receiving channel may be considered *adequate* if the total drainage area to the point of analysis in the channel is 100 times greater than the contributing drainage area of the project site.

- For natural channels, the 2-year frequency storm is used to verify that storm water will not overtop the channel banks nor cause erosion of the channel bed or banks.

- For man-made channels, the 10-year frequency storm is used to verify that storm water will not overtop the channel banks and the 2-year storm is used to demonstrate that storm water will not cause erosion of the channel bed or banks.

- For pipes and storm sewer systems, the 10-year frequency storm is used to verify that storm water will be contained within the pipe or storm sewer.

If existing natural receiving channels or previously constructed man-made channels or pipes are not *adequate*, the applicant must choose one of the following options.

- Improve the channels to a condition where the 10-year frequency storm will not overtop the channel banks and the 2-year frequency storm will not cause erosion to the channel bed or banks. The applicant must provide evidence of permission to make the improvements.

- Improve the pipe or storm sewer system to a condition where the 10-year frequency storm is contained within the appurtenances. The applicant must provide evidence of permission to make the improvements.

- Develop a site design such that when runoff discharges directly to a natural channel, the postconstruction peak flow for the 2-year storm will be no greater than the predevelopment peak flow. When discharge is directed to a man-made channel, the postconstruction peak flow for the 10-year storm will be no greater than the predevelopment peak flow.

- Provide a combination of channel improvements, storm water detention, or other measures satisfactory to the plan-approving authority to prevent downstream erosion.

If the applicant chooses an option that includes storm water detention, the applicant must obtain approval from the locality for a plan for maintenance of the detention facility. The plan must establish the maintenance requirements for the facility and identify the person or entity responsible for performing the maintenance.

Each receiving channel must be tested for *adequacy*. A channel is considered adequate if any of the following conditions can be met:

- The bankfull capacity of the *natural* receiving channel is sufficient to pass the postdevelopment peak flow from the 2-year frequency storm *and* the channel velocity (2-year frequency storm) does not exceed the permissible (non-erodible) velocity of the channel lining.
- The bankfull capacity of the *man-made* receiving channel is sufficient to pass the postdevelopment peak flow from the 10-year frequency storm *and* the channel velocity (2-year frequency storm) does not exceed the permissible (nonerodible) velocity of the channel lining.
- The storm sewer conduits (pipes) must pass the 10-year frequency storm.
- The contributing drainage area of the development site is less than 1 percent of the total drainage area to the point of consideration in the channel.
- There is no increase in the peak runoff rate for the 2-year frequency storm (for natural receiving channels) or the 10-year frequency storm (for man-made channels) at the point of discharge after development.

If the receiving channel is found to be *inadequate*, the applicant should incorporate measures to either improve the receiving channel to an adequate condition, or detain runoff on the site so that the postdevelopment peak runoff rate for the 2-year storm will not exceed the predevelopment peak rate. The plan-approving authority may also approve a combination of channel improvements and detention or other measures deemed satisfactory to protect the channel

- If a channel-improvement option is chosen, the applicant must obtain necessary easements and comply with applicable regulations regarding channel modifications. Channel improvements must extend downstream until an adequate channel section is reached or until a point is reached where the total drainage area is at least 100 times greater than the drainage area of the development site.

- If a storm water detention option is chosen, the applicant must submit a plan for the continued maintenance requirements of the structure and designate someone, who has consented to be responsible, to carry out the maintenance. The local government may choose to accept the maintenance responsibility for detention structures. However, where the local government does not accept responsibility, the responsibility must be borne by the COE, other Federal agency, landowner, a homeowners' association, or other legal entity.

3.3.1 Calculation Method

Selection of the appropriate method of calculating runoff should be based upon the size of the drainage area and the output information required. Table 3-1 lists the acceptable calculation methods for different drainage areas and output requirements. The plan-approving authority may require or accept other calculation methods deemed more appropriate for local conditions.

3.4 Erosion and Sediment Control Plan

Simply stated, an erosion and sediment (E&S) control plan is a document that describes the measures to be taken to control the potential for erosion and sedimentation on a construction project.

Table 3-1
Runoff Calculation Methods: Selection Criteria

Calculation Methods*

1. Rational Method
2. Peak Discharge Method
3. Tabular Method (TR-55)
4. Unit Hydrograph Method

Output Requirements	Drainage Area	Appropriate Calculation Methods
Peak discharge only	Up to 81 hectares (200 acres) Up to 809 hectares (2,000 acres) Up to 52 sq km (20 square miles)	1,2,3,4 2,3,4 3,4
Peak discharge and total runoff volume	Up to 809 hectares (2,000 acres) Up to 52 sq km (20 square miles)	2,3,4 3,4
Runoff hydrograph	Up to 52 sq km (20 square miles)	3,4

* There are numerous publications that describe the four methods listed in Table 3-1. A comprehensive discussion of each of these methods is beyond the scope of this pamphlet; readers are encouraged to consult other sources. One such source is McCuen, Richard H., *Hydrologic Analysis and Design*, Prentice-Hall, Inc., Englewood Cliffs, NJ, 1989.

The E&S control plan should be an independent entity from the construction drawings of a project. While it is a good idea to include E&S control standards and specifications in contract documents, the E&S control plan itself should contain measures to ensure that the controls are installed, inspected, and maintained properly.

The plan narrative should explain the E&S control decisions made for a particular project and the justification for those decisions. The narrative is especially important to the plan-approving authority because it contains concise information concerning existing site conditions, construction schedules, and other pertinent items which are not apparent in a typical site plan. Since a plan reviewer cannot always visit the site or discuss the project at length with the site planner, it is essential that the necessary information be provided for the plan review.

The narrative is also important to the construction superintendent and inspector who are responsible for seeing that the plan is implemented properly. The narrative provides them with a single report that describes where and when the various erosion and sediment control practices should be installed.

An E&S control plan must contain sufficient information to satisfy the plan-approving authority that the problems of erosion and sedimentation have been adequately addressed for a proposed project. The length and complexity of the plan should be commensurate with the size of the project, the severity of site conditions, and the potential for offsite damage. Obviously, a plan for constructing a small structure on smaller area does not need to be as complex as a plan for a large multistructure project involving many acres. Also, plans for projects undertaken on flat terrain will generally be less complicated than plans for projects constructed on steep slopes where erosion potential is greater. The greatest level of planning and detail should be evident on plans for projects which are directly adjacent to flowing streams, dense population centers, or high value properties where damage may be particularly costly or detrimental to the environment. As a guide to E&S plan content, the site planners should use the checklists located on the following pages.

CHECKLIST

FOR EROSION AND SEDIMENT CONTROL PLANS

NARRATIVE

_____ Project description - Briefly describe the nature and purpose of the land-disturbing activity and the area (hectares or acres) to be disturbed.

_____ Existing site conditions - Describe the existing topography, vegetation, ground cover, and drainage.

_____ Adjacent areas - Describe neighboring areas such as streams, lakes, residential areas, and roads which might be affected by the land disturbance.

_____ Offsite areas - Describe any offsite land-disturbing activities that will occur (including borrow sites, waste or surplus areas, etc.). Will any other areas be disturbed?

_____ Soils - Describe the soils on the site giving such information as soil name, mapping unit, erodibility, permeability, depth, texture, and soil structure.

_____ Critical areas - Describe areas on the site which have potentially serious erosion problems (e.g., steep slopes, channels, and wet weather/underground springs).

_____ Erosion and sediment control measures - Describe methods which will be used to control erosion and sedimentation on the site.

_____ Permanent stabilization - Provide a brief description, including specifications, of how the site will be established after construction is completed.

_____ Storm water runoff considerations - Will the development site cause an increase in peak runoff rates? Will the increase in runoff cause flooding or channel degradation downstream? Describe the strategy to control storm water runoff.

_____ Calculations - Present detailed calculations for the design of temporary sediment basins, permanent storm water detention basins, diversions, channels, etc. Include calculations for pre- and postdevelopment runoff.

CHECKLIST
FOR EROSION AND SEDIMENT CONTROL PLANS
(continued)

SITE PLAN

_____ Vicinity map - Provide a small map locating the site in relation to the surrounding area. Include any landmarks which might assist in locating the site.

_____ North arrow - Indicate the direction of north in relation to the site.

_____ Limits of clearing and grading - Show areas which are to be cleared and graded.

_____ Existing contours - Show the existing contours of the site.

_____ Final contours - Indicate changes to the existing contours, including final drainage patterns.

_____ Existing vegetation - Show the existing tree lines, grassed areas, or unique vegetation.

_____ Soils - Show the boundaries of different soil types.

_____ Existing drainage patterns - Indicate the dividing lines and the direction of flow for the different drainage areas. Include the size (area in hectares or acres) of each drainage area.

_____ Critical erosion areas - Show areas with potentially serious erosion problems.

_____ Site development - Show all improvements such as buildings, parking lots, access roads, and utility construction.

_____ Location of practices - Show the locations of erosion and sediment controls and storm water management practices used on the site.

_____ Offsite areas - Identify any offsite land-disturbing activities (e.g., borrow sites and waste areas). Show location of erosion controls. (Is there sufficient information to assure adequate protection and stabilization?)

_____ Detail drawings - Note that any structural practices used that are not referenced to an erosion and sedimentation handbook or local handbooks should be explained and illustrated with detail drawings.

_____ Maintenance - Furnish a schedule of regular inspections and repair of erosion and sediment control structures.

Erosion and sediment control planning should be an integral part of the site planning process, not an afterthought. The potential for soil erosion should be a significant consideration when deciding upon the layout of buildings, parking lots, roads, and other facilities. Costly erosion and sediment control measures can be minimized if the site design can be adapted to existing site conditions and if good conservation principles are used. Note that sedimentation ponds, often used for erosion and sedimentation control during construction, can be adapted to site amenities, if properly preplanned. The owner or lessee of the land being developed has the responsibility for plan preparation and submission. The owner or lessee may designate someone (e.g., an engineer, architect, or contractor) to prepare the plan, but the owner or lessee retains the ultimate responsibility.

3.4.1 Technical Assistance

There are a number of possible sources of erosion and sediment control planning assistance within most states.

1. Soil and Water Conservation Districts: These districts usually have elected representatives (directors) from different localities throughout the state. One of the primary functions of these districts is to provide assistance to landowners for soil conservation planning and implementation. Requests for assistance in preparing an erosion and sediment control plan for a construction site can be made through the local district.

2. Natural Resource Conservation Service (NRCS): The NRCS is formerly the Soil Conservation Service. The NRCS provides technical assistance on conservation planning through local soil and water conservation districts to landowners throughout the country. In addition, the NRCS, in conjunction with many state universities, is involved with soil surveys throughout many states. Many localities have existing published soil surveys. Requests can be made through an NRCS field office or a university soil survey field office for a soil survey on a specific site. Requests will generally be acted upon according to local priorities.

3. State Cooperative Extension Service: The Extension Service can provide valuable information on site planning and establishment of lawns and plant materials. The extension service has a number of useful publications and in

addition will have soil samples analyzed upon request to determine fertilization and liming needs for establishing vegetation on a particular site.

4. Local Government Offices: Many localities have a separate department that is responsible for administering the local erosion and sediment control program. Local staff can be a valuable resource for technical assistance and information concerning local requirements. Often, the County Engineer's office is a good place to start in the development of the basic information needed to prepare an SWPPP.

3.4.2 Limits of Disturbance

After the layout of the site has been determined, a plan to control erosion and sedimentation from the disturbed areas must be formulated. Decision concerning which areas must be disturbed in order to accommodate the proposed construction must be made. Special attention is directed to critical areas that may be disturbed.

3.4.3 Drainage Map

The site should be divided into drainage areas. Potential runoff flow paths over the developed site should be determined. Considerations concerning how erosion and sedimentation can be controlled in each small drainage area should be made before considering the entire site. The guiding principle is that it is easier to control erosion than to contend with sediment after it has been carried downstream.

3.4.4 Erosion and Sediment Control Best Management Practices

Erosion and sediment control practices can be divided into three broad categories: vegetative controls, structural controls, and management measures. Each of these categories have temporary and permanent control measures to be considered. Vegetative and structural practices should be selected and designed in accordance with Federal, state, and/or local specifications if they exist. In lieu of any local standards and specifications, the best management practices described in Appendix C should be utilized. The Best Management Practices (BMP) listed in Appendix C were obtained from the following sources:

(1) Virginia Department of Conservation and Recreation Division of Soil and Water Conservation's *Virginia Erosion and Sediment Control Handbook*, 1992 Third Edition.

(2) Washington State Department of Ecology's "Stormwater Management Manual For Puget Sound Basin," 1992.

(3) United States Department of Agriculture, Soil Conservation Service's Guidelines for the Control of Erosion and Sediment in Urbanizing Areas Within Mississippi, 1975.

(4) United States Environmental Protection Agency's *Summary Guidance For Storm Water Management For Construction Activities - Developing Pollution Prevention Plans and Best Management Practices,* 1992.

In the event of overlap or conflicting specifications (i.e., riprap gradations or filter fabric design specs), the appropriate geographic district should be contacted to resolve any discrepancy. The following are summary overviews of the erosion and sediment control practices recommended for use. Management measures are construction management techniques which, if properly utilized, can minimize the need for physical controls and possibly reduce costs.

3.4.4.1 Vegetative Controls

Planners should keep in mind that the first line of defense is to prevent erosion. Erosion prevention is accomplished by protecting the soil surface from raindrop impact and overland flow of runoff. The best way to protect the soil surface is to preserve the existing ground cover. Where land disturbance is necessary, temporary seeding or mulching should be used on areas which will be exposed for long periods of time. Erosion and sediment control plans must contain provisions for permanent stabilization of denuded areas. Selection of permanent vegetation should include the following considerations:

- Applicability to site conditions.
- Establishment requirements.
- Maintenance requirements.
- Aesthetics.

The vegetative BMP's in Appendix C are numbered according to the following categories of use:

BMP No.	Description
29-30	Site Preparation for Vegetation Establishment
31-34	Grass Establishment
35-36	Mulches
37-38	Other Vegetative Controls
39	Dust Control

The local agricultural extension service should be consulted concerning suitable vegetation and vegetative treatments.

3.4.4.2 Structural Controls

Structural control practices are generally more costly than vegetative controls. However, they are usually necessary since not all disturbed areas can be protected with vegetation. Structural controls are often used as a second or third line of defense to capture sediment before it leaves the site. It is very important that structural practices be selected, designed, and constructed according to BMP's of which many are listed in Appendix C. Improper use or inadequate installation can result in failure of the control and subsequent release of any trapped sediment.

The structural BMP's in Appendix C are numbered according to the following categories of use:

BMP No.	Description
1	Safety
2-3	Road Stabilization
4-8	Sediment Barriers
9-12	Dikes and Diversions
13-14	Sediment Traps and Basins
15-16	Flumes
17-21	Waterway and Outlet Protection
22-27	Stream Protection
28	Subsurface Drainage

3.4.4.3 Management Measures

Good construction management is as important as structural and vegetative practices for erosion and sediment control, and there is generally little or no cost involved. Management measures must be properly addressed in the SWPPP to identify responsible parties and duties required for implementing these measures. Following are some management considerations which can be employed:

- Include erosion and sediment control as an agenda item for the pre-construction meeting.
- Sequence construction so that no area remains exposed for unnecessarily long periods of time.
    - Work in a logical sequence, especially for drainage items.
    - Anticipate the site conditions that will exist as the construction progresses toward the final product.
    - Have the materials on-hand to complete the work without delay.
    - Apply temporary stabilization immediately after grading.
- On large projects, stage the construction, if possible, so that one area can be stabilized before another is disturbed, whenever possible.

- Consider the time of year.
  - Be prepared for sudden thunderstorms.
  - Install erosion and sediment controls immediately.
  - Use straw mulch for grass seed, especially during poor germination periods.
- Physically mark off limits of disturbance on the site with tape, signs, or other methods, so that workers can see areas to be protected.
- Develop and carry out a regular maintenance schedule for erosion and sediment control practices.
- Designate one individual (preferably the job superintendent or Quality Control Chief) responsible for implementing the erosion and sediment control plan. Make sure that all workers understand the major provisions of the erosion and sediment control plan. Establish reporting procedures for problems identified by workers.

4.0 SOURCE IDENTIFICATION

4.1 The Erosion Process

The principal source of pollutant export associated with construction activities is erosion. Soil erosion is the process by which the land's surface is worn away by the action of wind, water, ice, and gravity. Natural, or geologic erosion, has been occurring at a relatively slow rate since the earth was formed and is a tremendous factor in creating the earth as we know it today. Except for some cases of shoreline and stream channel erosion, natural erosion occurs at a very slow and uniform rate and is a vital factor in maintaining environmental balance.

4.1.1 Types of Erosion

Water-generated erosion is unquestionably the most severe type of erosion, particularly in areas of development. Consider the erosive action of water as the effects of the energy developed by rain as it falls, or as the energy derived from its motion as it runs off the land surface. The force of falling raindrops is applied vertically, and the force of flowing water is applied horizontally. Although the direction of the forces created is different, they both perform work in detaching and moving soil particles. Water-generated erosion can be classified into the following types:

- Raindrop erosion is the first effect of a rainstorm on the soil. Raindrop impact dislodges soil particles and splashes them into the air. These detached particles are then vulnerable to the next type of erosion.
- Sheet erosion is the erosion caused by the shallow flow of water as it runs off the land. These very shallow moving sheets of water are seldom the detaching agent, but the flow transports soil particles which are detached by raindrop impact and splash. The shallow surface flow rarely moves as a uniform sheet for more than a meter (3 feet) on land surfaces before concentrating in the surface irregularities.

- Rill erosion is the erosion which develops as the shallow surface flow begins to concentrate in the low spots of the irregular contours of the surface. As the flow changes from the shallow sheet flow in these low areas, the velocity and turbulence of flow increase. The energy of this concentrated flow is able to both detach and transport soil materials. This action begins to cut small channels of its own. Rills are small but well-defined channels which are normally less than 100 mm (4 inches) deep. The rills are easily obliterated by harrowing or other surface treatment.

- Gully erosion occurs as the flow in rills comes together in larger and larger channels. The major difference between gully and rill erosion is in magnitude. Gullies are too large to be repaired with conventional tillage equipment and usually require heavy equipment and special techniques for stabilization.

- Channel erosion occurs as the volume and velocity of flow causes movement of the streambed and bank materials.

4.1.2 Factors Influencing Erosion

The erosion potential of any area is determined by four principal factors: the characteristics of the soil, vegetative cover, topography, and climate. Although each of these factors is discussed separately herein, they are interrelated in determining erosion potential.

Soil characteristics which influence the potential for erosion by rainfall and runoff are those properties which affect the infiltration capacity of a soil and those which affect the resistance of the soil to detachment and being carried away by falling or flowing water. The following four factors are important in determining soil erodibility:

1. Soil texture (particle size and gradation).
2. Percentage of organic content.
3. Soil structure.
4. Soil permeability.

Soils containing high percentages of fine sands and silt are normally the most erodible. As the clay and organic matter content of these soils increases, the erodibility decreases. Clays act as a binder to soil particles, thus reducing erodibility. However, while clays have a tendency to resist erosion, once eroded, they are easily transported by water. Soils high in organic matter have a more stable structure which improves their permeability. Such soils resist raindrop detachment and infiltrate more rainwater. Clean, well-drained and well-graded gravel and gravel-sand mixtures are usually the least erodible soils. Soils with high infiltration rates and permeabilities either prevent or delay and reduce the amount of runoff.

Vegetative cover has an extremely important role in controlling erosion as it provides the following five benefits:

1. Shields the soil surface from raindrop impact.
2. Protects root systems by holding soil particles in place.
3. Maintains the soil's capacity to absorb water.
4. Slows the velocity of runoff.
5. Removes subsurface water between rainfalls through the process of evapotranspiration.

By limiting and staging the removal of existing vegetation and by decreasing the area and duration of exposure, soil erosion and sedimentation can be significantly reduced. Special consideration should be given to the maintenance of existing vegetative cover on areas of high erosion potential such as moderately to highly erodible soils, steep slopes, drainageways, and the banks of streams.

Topography. The size, shape, and slope characteristics of a watershed influence the amount and rate of runoff. As both slope length and gradient increase, the rate of runoff increases and the potential for erosion is magnified. Slope orientation can also be a factor in determining erosion potential. For example, a slope that faces south and contains droughty soils may have such poor growing conditions that vegetative cover will be difficult to re-establish.

Climate. The frequency, intensity, and duration of rainfall are fundamental factors in determining the amounts of runoff produced in a given area. As both the volume and velocity of runoff increase, the capacity of runoff to detach and transport soil particles also increases. Where storms are frequent, intense, or of long duration, erosion risks are increased. Seasonal changes in temperature, as well as variations in rainfall, help to define the high erosion risk period of the year. When precipitation falls as dry snow, no erosion will take place. However, when the temperature rises, melting snow adds to runoff, and erosion hazards are high. Because the ground may still be partially frozen, its absorptive capacity is reduced. Frozen soils are relatively erosion-resistant. However, soils with high moisture content are subject to uplift by freezing action and are usually very easily eroded upon thawing.

4.2 Sedimentation

Normally, runoff builds up rapidly to a peak and then diminishes. Excessive quantities of sediment are derived by erosion, principally during the higher flows. During lower flows, as the velocity of runoff decreases, the transported materials are deposited to be picked up by later peak flows. In this way, sediments are carried downslope, or downstream, intermittently and progressively from their source or point of origin.

4.2.1 Sediment Pollution and Damage

Sediment pollution is soil out of place. It is a product accentuated by the activities of man which leads to severe soil loss. When these large quantities of soil enter our waters, then sediment pollution occurs.

Over four billion tons of sediment are estimated to reach the ponds, rivers, and lakes of our country each year, and approximately one billion tons of this sediment are carried all the way to the ocean. Approximately 10 percent of this amount is contributed by erosion from land undergoing highway construction or land development. Although these latter quantities may appear to be small compared to the total, they could represent more than one-half of the sediment load carried by many streams draining small subwatersheds which are undergoing development.

Excessive quantities of sediment cause costly damage to waters and to private and public lands. Obstruction of stream channels and navigable rivers by masses of deposited sediment reduces their hydraulic capacity which, in turn, causes an increase in subsequent flood crests and a consequent increase in the frequency of damaging storm events.

Sediment may fill drainage channels, especially along highways and railroads, and plug culverts and storm drainage systems, thus necessitating frequent and costly maintenance. Municipal and industrial water supply reservoirs lose storage capacity, the usefulness of recreational impoundments is impaired or destroyed, navigable channels must be continually dredged, and the cost of filtering muddy water preparatory to domestic or industrial use may become excessive. The added expense of water purification in the United States, because of sedimentation, amounts to hundreds of millions of dollars each year.

In an aquatic environment, the general effect of fine-graded sediments such as clays, silts, and fine sands is to reduce drastically both the kinds and the amounts of organisms present. Sediments alter the existing aquatic environment by screening out sunlight and by changing the rate and the amount of heat radiation. Particles of silt settling on stream and lake bottoms form a blanket which creates a hostile environment for the organisms living there and literally smothers many of them and their eggs.

Coarser-grained materials also blanket bottom areas to suppress aquatic life found in these areas. Where currents are sufficiently strong to move the bedload, the abrasive action of these materials in motion accelerates channel scour and has an even more severely deleterious effect upon aquatic life. The aesthetic attraction of many streams, lakes, and reservoirs used for swimming, boating, fishing, and other water-related recreational activities has been seriously impaired or destroyed by bank cutting and channel scour, accelerated by a higher flood stage induced by sedimentation.

4.2.2 Costs

Many state and local jurisdictional agencies require that land-disturbing activities have an approved E&S control plan prior to commencement of work. The owner is responsible for the development of E&S control plans. Once a plan is approved, generally a contractor will be responsible for implementing, installing, and maintaining the E&S control plan. However, the owner is ultimately responsible and in many instances must certify that the plan will be carried out. Once the project has moved through the bid process, the cost of implementation becomes the primary concern. Proper implementation of the E&S plan can save the developer and the contractor money in excavation costs. If denuded areas are stabilized initially, little or no additional work will be required later. This can speed up completion dates, and overall savings will be realized. This strategy requires that planning take on a more important role in the management of a project. Good management throughout the life of a project will lead to increased savings.

On the other hand, failure to implement an E&S plan or failure to maintain controls during construction of a project can mean additional costs to the developer and the contractor. These additional costs exist at three levels. The primary level is the cost of work being stopped for noncompliance with an approved plan; the secondary level is the cost of repairing damage to adjacent properties; the tertiary level would be the costs associated with missed deadlines, litigation with damaged parties, and extra charges by the contractor for additional work. The perception by the public that the developer and the contractor were negligent in performing their responsibilities may also pose a negative cost, if not immediately, sometime in the future.

4.3 Other Potential Nonsediment Pollutants

The general permit requires the listing of potential nonsediment pollutants likely to be present in storm water in significant quantities. The sections below discuss potential pollutants which are commonly associated with construction activities.

4.3.1 Nutrients

Nitrogen, phosphorus, and potassium are the major plant nutrients used for the fertilizing of new landscape at construction sites. Heavy use of fertilizers can result in the discharge of nutrients to water bodies resulting in excessive algal growth and eutrophication, and in some states a violation of water quality standards.

4.3.2 Trace Metals

Galvanized metal, painted surfaces, and pressure-treated lumber comprise many of the surfaces exposed to storm water as a result of construction activity. These coatings and treatments contain metals which enter storm water as the surfaces corrode, flake, dissolve, decay, or leach. Acid rain can accelerate these processes.

4.3.3 Pesticides

Herbicides, insecticides, and rodenticides are commonly used at construction sites. The unnecessary or improper application of these pesticides may result in direct contamination, indirect pollution through drift, or the transport of soil surfaces into water.

4.3.4 Spills and Illegal Dumping of Construction Materials

Petroleum products, pesticides, and other synthetic organic compounds (glues, sealants, solvents, etc.) are used widely at construction sites and may be improperly stored and disposed. Deliberate dumping of these materials, which can migrate into surface or groundwater resources, is a direct violation of the CWA. On parking lot or highway construction projects, the application of diesel fuel to the contact surfaces of the "hot mix asphalt" application and transport vehicles is a common practice that should be discontinued immediately.

4.3.5 Miscellaneous Wastes

Miscellaneous wastes include wash from concrete mixers; solid wastes resulting from the clearing and grubbing of vegetation; wood and paper materials derived from packaging of building products; food containers such as paper, aluminum, and steel beverage cans; and sanitary wastes. In addition to erosion and sediment controls, the SWPPP must address the other potential pollutant sources that may exist on a construction site. These controls include proper disposal of construction site waste; compliance with applicable state or local waste disposal, sanitary sewer, or septic system regulations; control of offsite vehicle tracking; and control of allowable nonstorm water discharges which are discussed in Section 6.5.

4.4 Allowable Nonstorm Water Discharges

The following discharges are generally allowed if they do not commingle with contaminated material or other discharges associated with industrial activity:

- Uncontaminated flows from fire fighting.
- Fire hydrant flushing.
- Potable water sources including water line flushing.
- Uncontaminated groundwater resulting from dewatering activities.
- Uncontaminated flows from foundation or footing drains.
- Naturally occurring flows such as springs, wetlands, and riparian habitats.

- Irrigation water discharged during seeding, planting, and maintenance, provided fertilizers and pesticides are applied correctly.
- Pavement wash waters for dust control and general housekeeping practices providing that spills or leaks of toxic or hazardous materials have not occurred and where detergents are not used.

It must be emphasized that the flows described above are uncontaminated flows. For example, if the discharge from potable water line flushing were to collect significant amounts of sediment or contaminants while flowing over soil or pavement, it would be considered contaminated and, therefore, could not be discharged directly to the storm drain system.

4.5 Pollutant Lists

The construction activity should list any pollutants that have a reasonable potential to be present in the storm water discharge in significant quantities. The definition of significant quantities varies from item to item. In general, a significant quantity is taken to be any quantity that is not consumed within a normal day's operations or would result in spills beyond the immediate cleanup capabilities of the individual charged with the use of the materials. A significant quantity also relates to a "reportable" quantity for those substances that are regulated under SARA Title III Section 313, or any of the programs mentioned in Section 2.6. Table E-1 in Appendix E has been provided to inventory materials found onsite.

Some of the primary contaminants associated with construction activities are as follows:

- CCA treated lumber
- AZCA treated lumber
- Boiler treatment chemicals
- Creosote
- Tribucide
- Diesel fuel
- Fire retardant
- White wood
- Fuel oil
- Detergents
- Gasoline
- Hydrogen peroxide
- Maintenance and motor lubricants and coolants
- Paints, thinners, and sealants
- Pentachlorophenol treated lumber
- Metal studs
- Propane
- Solvents
- Sulfuric acid
- Timbor
- Mold inhibitor
- Water repellant
- Refrigerant
- Concrete
- Tar

- Fertilizers
- Hydraulic fluid
- Masonry block
- Roofing shingles

4.6 Significant Spills or Leaks

Because construction activities may handle certain hazardous substances over the course of the project, spills of these substances in amounts that equal or exceed Reportable Quantity (RQ) levels are a possibility. EPA has issued regulations that define the reportable quantities for oil and hazardous substances. These regulations are found at 40 CFR Part 110, 40 CFR Part 117, and 40 CFR Part 302. If a release occurs, a contingency plan should be put into effect. The single most important action required in the contingency plan should be to minimize environmental impacts or health threats. If there is a RQ release during the construction period, the following actions must be taken:

- Notify the National Response Center immediately at (800) 424-8802; in Washington, DC, call (202) 426-2675.
- Within 14 days, submit a written description of the release to the EPA Regional office providing the date and circumstances of the release and the steps to be taken to prevent another release.
- Modify the SWPPP to include the information listed above.

If a spill occurs and the above actions are taken, the single most important action is to document all calls, correspondence, and any other communications relative to the spill. Record names, titles, phone numbers, dates, times, and any other information that may be used to prove that the actions were taken.

The construction activity must list all historical spills or leaks of toxic or hazardous pollutants to the storm water system that have occurred in the last 3 years. This list must include: toxic chemicals listed in 40 CFR Part 372 that have been discharged to storm water as reported on EPA Form R, and oil or hazardous substances in excess of reportable quantities, 40 CFR

Part 110, 117, or 302. Table E-2, in Appendix E may be used to record the lists described previously.

The SWPPP should designate a person who is accountable for spill response at the construction site. The designated person will be responsible for emergency procedure action and documentation. The responsible person should be thoroughly trained and familiar with all aspects of the response plan as well as the operations and daily activities of the construction activity. In addition this person must have the authority to commit the resources needed to accomplish the spill plan response.

Contingency plans are required by law for proper response to a hazardous waste, chemical, or oil spill. The plans are designated Exhibit E-1, -2, and -3, in Appendix E. These plans are provided as a guideline only and should be customized by the construction activity. These plans and lists of contacts should be posted in obvious locations to facilitate a quick response to any spill.

The key to a successful SWPPP is that no matter what quantities of materials are dispensed and stored, proper and safe management can reduce the risk of spills and leaks substantially. The following sections highlight the most common activities with a reasonable potential for spill or releases of hazardous materials to ground or surface water resources.

4.6.1 Bulk Chemical and Fuel Storage or Transfer Areas

Underground fuel storage has been addressed in other EPA programs. The use of double containment tanks, monitoring wells, and other controls has been established and all facilities should be in compliance. (The construction activity management should assure itself that all regulated underground storage tanks meet requirements.) Not all tanks fall under existing programs. The objective is to assure that tank contents do not leak into the storm sewer system or into the groundwater.

Aboveground storage tanks are not regulated in the same way that underground tanks are regulated. Areas containing fuel, lubricants, chemicals, waste oil, waste solvent, and other such tanks or storage barrels should be covered (preferably under roof) wherever possible. Storm water flows should be directed around the storage locations. Protective dikes around the sites which can provide containment are also in order, particularly if the potential spill volume exceeds the sump volume or what can be contained using absorbent "pillows" or other material and containment booms.

The construction activity should identify areas in which a leak or a spill of significant materials could result in contact with storm water runoff and enter the storm water drainage system. These areas will coincide with areas of material handling, transfer, and storage. After areas of concern are identified, specific material handling procedures, storage requirements, and cleanup equipment and procedures should be established. Table E-4, in Appendix E, will be used to record the spill control and countermeasures established by the construction activity. Additional documentation relating to spill prevention countermeasures and control must be added to the SWPPP document.

Aboveground tanks are primarily used for the bulk storage of chemicals, diesel, gasoline, coolants, and lubricants. These tanks may be serviced by any combination of below ground or aboveground piping systems. Bulk shipments are generally received from tank trucks. The products are off-loaded adjacent to the storage tanks and are dispensed to equipment as needed. Hazardous wastes generated from construction activity operations primarily consist of contaminated sediments from the fueling or maintenance areas.

Waste oils are stored in both aboveground and underground tanks. Generally, the tanks are less than 1,900 liters (500 gallons) in capacity. All outdoor, aboveground tanks should be contained by dikes having adequate volume to hold a spill and, depending upon the region, an appropriate precipitation event. Underground storage tanks (UST's) must conform to their own set of regulations. The SWPPP should contain appropriate references to UST management.

Outdoor storage of chemicals, including petroleum substances, is a major environmental concern at construction sites. Aboveground tanks are subject to solar heating resulting in potential explosive gases near vents, collisions from moving equipment, acts of vandalism, acts of disgruntled employees, etc. UST's may be a source of leaks. Storm water discharges have a potential of being contaminated during excavation, backfilling, maintenance, and remediation activities involving fuel storage tanks. Construction activities may have outdoor collection tanks for waste oil. These tanks may leak or overflow if they are not properly maintained.

4.6.2 Vehicle and Equipment Fueling Areas

Fuel is usually delivered to construction activities by tank truck. The bulk storage area should be contained by dikes and loading/unloading areas should be served by oil/water separators. Dispensing to vehicles and equipment is usually accomplished through standard fuel dispensers. Most spills are relatively minor. Spills are usually cleaned up by construction activity personnel and/or private contractors under the supervision of the local fire department. In the event a spill does reach the storm sewer system, a licensed cleanup contractor should be immediately dispatched to clean out the storm lines and recover spilled fuel.

4.6.3 Vehicle and Equipment Maintenance Areas

Most construction activity vehicles and equipment are maintained by construction activity personnel and are frequently repaired and serviced on the jobsite. Substantial volumes of petroleum oils, including engine oil, transmission fluid, brake fluid, and other lubricants, are used in vehicle maintenance operations. As a result, there is a potential for illicit discharges or storm water discharge contamination by oils, solvent, lubricants, fuel, and coolants.

Equipment maintenance typically takes place in one of two locations: (1) the construction activity maintenance area or garage; or (2) wherever the equipment breaks down. The potential for storm water contamination where the equipment is serviced must be considered.

The following fluids have the potential to enter the storm water system from spillage: diesel fuel, gasoline, engine oil, hydraulic fluid, transmission fluid, lubricants, refrigerants, and solvents. All spillage other than potable water should be prevented from entering the storm water system. Engine oil and hydraulic fluids are used in relatively small quantities but may enter the storm drain system during precipitation events. If the garage area has unsealed cracks, spillage may result in groundwater contamination. Maintenance activities which occur inside garages may result in storm water contamination through floor drains connected to the storm sewer system. Hydrocarbon spillage should be minimized and cleaned up when it occurs. Residual cleanup waters should be passed through an oil/water separator into a sanitary sewer system if available or transported to a permitted treatment facility.

4.6.4 Vehicle and Equipment Cleaning Areas

The spent wash water from vehicle and equipment cleaning may be contaminated with surface dirt, rust, flash metal, or paint from the surface of the equipment and fluids (fuel, hydraulic fluid, oil, lubricants, etc.). Most construction activity vehicles and equipment are maintained by construction activity personnel and are frequently repaired and serviced on the jobsite. As a result, there is a potential for illicit discharges or storm water discharge contamination by oils, solvents, lubricants, fuel, and coolants.

EPA regulations prohibit the discharge of wash water from car and truck cleaning facilities without a permit. The potential for storm water runoff contamination and the presence of illicit discharges from these facilities must be considered. The discharge should be treated for the removal of oil, grease, solvents, soaps, and solids prior to discharge to receiving waters. Although some vehicle-cleaning activities are not currently covered separately by the EPA storm water regulations, these activities must be addressed under the SWPPP wherever storm water may come into contact with the results of activities that are covered.

4.6.5 Combined Sewer Overflow (CSO)

Many of our nation's older and more-established cities are coping with problems related to a deteriorated infrastructure stressed beyond capacity. Chronic flooding occurs in some areas where storm sewer trunk lines were not designed to convey the extent of development that has occurred. As a result of this flooding, deteriorated sanitary sewers are overloaded by infiltration and inflow (I & I). This I & I laden sewage often overflows during high intensity or long duration storms washing pollutants into surface waters. Several older cities combined sanitary and storm sewers into a single combined sewer system, These also overflow during larger storm events as combined sewer overflows. These discharges containing raw sewage threaten the health of all who come into contact with them. In addition to being a threat to public health, CSO's jeopardize the beneficial use of surface waters. High bacterial counts result in beach closings and shellfish contamination. Low dissolved oxygen levels affect the health of fish and other aquatic life. Toxic pollutants tend to settle out and increase the level of contamination in the sediments. Floating debris, containing materials commonly associated with sewage, is offensive and greatly reduces the enjoyment of streams, rivers, and coastal zones.

Federal and state regulatory agencies are currently struggling to develop the proper program for monitoring and controlling CSO's. They are struggling because each system varies from one community to the next, and each CSO solution is inherently complex and potentially expensive. Programs are in place to attempt to control I & I problems with sanitary sewer systems. The required level of control for the CSO discharges is not clearly specified in current NPDES discharge permits, nor are CSO control requirements defined in most state water quality standards. Construction designers and managers should be aware of the state and local trends concerning CSO's. Impacts concerning problems could conceivably result in sanitary sewer user fees, moratoriums on expansion, or even requiring onsite sewage disposal.

4.6.6 Onsite Sewage Disposal Systems

Onsite sewage disposal systems (OSDS) include conventional septic systems, large-scale conventional systems, alternative and innovative designs, and private sewage treatment facilities. The term applies to any residential or industrial sewage that is not treated or planned for treatment in a centralized public sewer system.

Proper treatment of wastewater effluent with onsite disposal systems is an essential component of surface water quality protection. When properly sited, designed, permitted by state or local health authority, installed, and maintained, individual sewage disposal systems can be used to treat most pollutants found in construction activity wastewater simply and effectively. Treated wastewater usually reaches surface waters by ground water recharge or by ground/surface water interfaces.

4.7 Summary of Sampling Data/Existing Water Quality

If storm water runoff from the proposed construction site has been sampled and analyzed for the presence of any pollutant (e.g., total suspended solids), then the results of the analyses must be included in the SWPPP. In most cases, existing runoff water quality data are not available for a specific site, particularly an undeveloped site. However, if the construction is on or adjacent to an existing industrial facility, that facility may have collected runoff water quality data to satisfy another permit. If there are no existing data on the quality of runoff from the site, then it is not necessary to collect samples for the general permit. Runoff water quality data may sometimes be available from your state or local government. You may also be able to obtain runoff water quality information from the USGS or state or local watershed protection agencies. The sampling event(s) information should be recorded in Table E-3, in Appendix E, and a one-page summary included from the sampling data report package. Previous sampling data will be useful in determining the source of pollutants and in initiating controls.

5.0 STORM WATER MANAGEMENT CONTROLS

This section of the SWPPP describes storm water management measures to control and abate water quality impairment associated with the activities described in the preceding sections.

Land conversion associated with development has resulted in the loss of vegetation and sensitive wetlands, alteration of natural drainage patterns, and the creation of expanded areas of imperviousness. This loss of infiltration capacity has correlated with increases in the velocity, volume, and frequency of storm water runoff. Mitigation of this process is inherently complex in that sources are somewhat diverse, changes in water quality tend to be gradual and cumulative, and the site-specific physical and safety constraints associated with the configuration of the different facilities tend to limit the number of viable measures for implementation at each site. However, since pollutants have a limited number of pathways by which they reach water resources, the practices that constitute management measures for the various source categories tend to be somewhat similar for each construction activity.

The design and implementation of effective source control measures is achieved from a management systems approach as opposed to an approach that focuses on individual practices. That is, the pollutant control achievable from any given management system is viewed as the sum of the parts, taking into account the range of effectiveness associated with each single practice, the costs of each practice, and the resulting overall cost and effectiveness of the system. Some individual practices may not be effective alone but, in combination with others, may provide a key function in a highly effective system. This is analogous to the use of "treatment trains" or a series of treatment steps.

This guidance adopts the approach of specifying management measures as systems of management practices. This approach is primarily reflected in two ways: (1) the management measures are usually presented as systems, and (2) for those sources that generate pollutants from a number of discrete activities, or unit areas, the guidance includes management measures for each activity, or area.

It is generally not possible to prescribe a highly specific management measure that will be uniformly applicable over an expanded region. For example, when designing erosion and sediment control systems, one considers soil types, antecedent moisture conditions, land use, precipitation patterns, and slopes to determine the proper set of practices. The multitude of combinations of site-specific factors that arise within a state, region, and even within a watershed, makes it difficult to develop a list of specific management measures to be used.

Congress has defined management measures as "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint sources of pollution which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint pollution control practices, technologies, processes, siting criteria, operation methods, or other alternatives." Congress has not defined the term "economically achievable," nor has it explained the term in legislative history. This distinction relates to the extensive flexibility inherent in implementing pollution prevention management measures. The ability of a particular management measure to deal with nonpoint source pollution from a particular site is subject to a variety of factors (e.g., geography, geology, soils, hydrology, and production methods) too complex to address in a single set of simple, mechanical prescriptions at the state or regional level, so this guidance provides considerable flexibility for local selection. These considerations make it difficult to predict the costs and economic impacts of measures that will ultimately be developed, applied, and implemented on a localized basis. Many of the proposed management measures are regarded as low-cost, yet highly effective. Examples include source control measures such as spill prevention or pesticide management. Others are more expensive, yet widely practiced (e.g., construction management measures such as erosion and sediment control practices, storm water management measures such as constructed wetlands or pond systems). This guidance provides a set of management practices for each source category. The number and type of systems identified per source category are based upon the range and diversity of substantively different subcategories and pollutants. Pollution prevention is generally considered as the first component of management measures. Pollutant delivery reduction measures are typically added only after it is determined that additional control is necessary to reach the greatest degree of pollutant reduction economically achievable.

For each management measure, a list of management practices that can be used in designing an equivalent or better system is provided. The list of practices reflects the best available set of practices, or components of best available systems, but is not all-inclusive of those practices that could be used to develop systems that are equivalent to or better than specified management measures.

The pollutant reduction estimates that can be achieved using the specified management practices are also described in this guidance, quantitatively wherever possible. These reductions serve as the benchmarks for equivalent or better management measures. All estimates provided are based upon the best available data currently available, but are somewhat empirical. Further monitoring will provide data to support the effectiveness of this portion of the SWPPP.

The controls to be implemented at each construction activity will reflect the identified potential sources of pollutants at each construction site. This list of sources will be different for each construction activity. It is recommended that the SWPPP personnel or committee be responsible for implementing the appropriate control measures for the construction activity. Each construction activity will find some solutions more appropriate or feasible than others.

5.1 The Nonpoint Source Pollution Process

Nonpoint source pollutants are transported to surface water by a variety of means, including runoff and ground water infiltration. Ground water and surface water are both considered part of the same hydrologic cycle when designing management measures. Ground water contributions of pollutant loadings on surface waters are often very significant. The transport of nonpoint source pollutants to surface waters through ground water discharge is governed by physical and chemical properties of the water, pollutant, soil, and aquifer.

The combination of source control and delivery reduction measures and the application of those measures as components of management systems are dependent upon site-specific conditions. Technical factors that may affect the suitability of management measures include, but are not limited to, land use, climate, size of drainage area, soil permeability, slopes, depth to water table, space requirements, the type and condition of the receiving waters, depth to bedrock, and the pollutants to be addressed.

5.2 Source Control Measures

Source control is the first opportunity in any nonpoint source control effort. Source control methods vary for different types of nonpoint source problems. Examples of source control include:

(1) Reducing or eliminating the introduction of pollutants to a land area.

(2) Preventing nonintroduced pollutants (such as loose dirt and sediments) from leaving the site during land-disturbing activities.

(3) Preventing interaction between precipitation and introduced pollutants.

(4) Protecting wetlands or riparian habitat and other sensitive areas.

(5) Protecting natural hydrology.

5.2.1 Preventive Maintenance (PM)

A Preventive Maintenance (PM) program is an effective and cost-efficient measure in pollution prevention. It is easily performed at a relatively low cost and may yield great savings in the long run. Preventive maintenance includes inspection of construction activity/contractor equipment and systems, such as equipment cleaning facilities, all vehicular and maintenance facilities, and any structural source controls already in place, such as drip pads, sumps, and tank containment. Each contractor should be directly responsible for inspection, testing, adjustment, and repair of their contractor-owned facilities and equipment, subject to the supervision and review by the SWPPP committee. Contractor-owned facilities, equipment, and maintenance records will be reviewed by construction activity SWPPP personnel on a regular scheduled basis.

5.2.2 Requirements in PM Program

The preventive maintenance program should include the following:

- Identification of the equipment and systems to which the preventive maintenance program should apply.
- Periodic inspections of identified equipment and systems.
- Periodic testing of equipment and systems.
- Appropriate adjustments, repair, or replacement of parts.
- Maintenance of all records of inspections and follow-up actions.

Preventive maintenance inspections should be carried out by trained personnel or the designated SWPPP committee. It is important that the personnel be familiar with the systems and equipment to be monitored and tested. The inspection schedules should be established by the committee, in conjunction with the construction activity manager, and brought to the attention of all employees. Inspection frequencies can be established in part by reviewing any "Risk Identification and Assessment" studies that may have been completed for the construction activity, equipment, facilities, or contractor activity. In some cases, monthly inspections will be appropriate. A testing schedule can be developed in the same manner; however, testing frequencies will not need to be as often as inspection frequencies. Adjustments or repairs of any type to the equipment or systems must be completed by trained personnel.

Documentation and retention of records is a critical element of a good preventative maintenance and inspection program. A tracking or follow-up procedure will be used to ensure that the appropriate response to the inspection findings has been made. All inspection documentation and records must be maintained with the SWPPP documentation for a period of 3 years following final stabilization. The tables and exhibits located in Appendix D should be used to record inspection and maintenance activities and any corrective actions implemented.

Inspection and maintenance guidelines for construction equipment should follow the manufacturer's specifications. The equipment itself should be serviced in designated areas as indicated above. Special attention must be given to those portions of the equipment that come into contact with any suspected pollutant. These portions include, among others: trams or conveyor mechanisms, pipes for liquid conveyance (including vacuum hoses for liquid extraction), tanks and associated valves, fittings, nozzles, and tank seams. Particular attention should be given to remedying leaks and replacement of deteriorated rubber or plastic hoses, pipes, washers, and gaskets.

Good housekeeping refers to the cleaning and maintenance practices conducted at the construction activity. Good housekeeping is an important component of the pollution prevention plan. Periodic training of employees in housekeeping techniques for those areas of the construction activity where pollutant sources are found reduces the significant material contamination of storm water. Housekeeping practices include:

- Maintenance of material loading/unloading areas.
- Safe and orderly storage of construction debris, chemicals, and other significant materials.
- Stimulating employee interest in good housekeeping.

Maintenance areas should be kept clean. Chemicals, grease, oil, solvent, and fuel spills should be collected by use of absorbents and booms where necessary. Disposal of these materials should be by qualified hazardous materials handling contractors. Material loading and unloading areas should be cleaned manually or with heavy equipment. Liquids should be removed using absorbent materials or with vacuum machinery.

Cleaning protocols should be site-specific. The protocols should fit the nature of construction activity (and tenant organizations). The protocols should be developed to meet the site-specific requirements of the construction activity. The protocols should cover:

- Areas, operations, and equipment to be inspected.
- Frequency of inspection.
- Checklists and procedures to be used.
- Records of inspection and filing requirements.
- Records of resulting maintenance and filing requirements.
- Mechanism for revising protocols.

5.3 Delivery Reduction Measures

Pollution prevention often involves delivery reduction (intercepting pollutants prior to delivery to the receiving waters) in addition to appropriate source control measures. Management measures include delivery reduction practices to achieve the greatest degree of pollutant reduction economically achievable, as required by NPDES regulations.

Delivery reduction practices intercept pollutants leaving the source by capturing the runoff or infiltrate, followed either by treating and releasing the effluent or by permanently keeping the effluent from reaching a surface or ground water resource. By their nature, delivery reduction practices often bring with them side effects that must be accounted for. For example, management practices that intercept pollutants leaving the source may reduce runoff, but also increase infiltration to ground water. These devices, although highly successful at controlling suspended solids, may not, because of their infiltration properties, be suitable for use in areas with high ground water tables and nitrate or petroleum residue problems. The performance of delivery reduction practices is to a large extent dependent on suitable designs, operational conditions, and proper maintenance. For example, filter strips may be effective for controlling particulate and soluble pollutants where sedimentation is not excessive, but may be overwhelmed by high sediment input. In many cases, filter strips are used as pretreatment or supplemental treatment for other practices within a management system.

5.3.1 Storm Water Management BMP's

The evolution of the need to manage or control storm water runoff has directly paralleled the evolution of land development and its impact on the environment. In the past, control of storm water was attempted by maximizing conveyance with rapid downstream disposal of surface water. The cumulative effects of this practice have created frequent downstream flooding and depletion of underground water supplies. Until the early 1970's little or no consideration was given to the downstream impacts of such activity. Current practices dictate the attenuation of design peak flows to predevelopment rates. While this approach has proven reasonably effective in curtailing flooding problems, it does not mitigate the adverse impacts of pollutant export. The first flush of pollutants refers to the higher concentrations of storm water pollutants that characteristically occur during the early part of a storm with concentrations decaying as the runoff continues. Concentration peaks and decay functions vary from site to site and from region to region, depending on contributing land use, the pollutants of interest, and the characteristics of the drainage basin. Studies have indicated that for a variety of land uses the first 1.25 cm (0.5 in.) of each runoff contains 80 to 95 percent of the total annual loading of most storm water pollutants. The best available procedures for storm water management include both structural and nonstructural components and involve a combination of detention, infiltration, and filtering devices. Treatment systems, rather than individual practices, will tend to achieve the greatest pollutant reduction goal. Treatment systems should include source control, storm water management, and riparian protection to achieve the highest level of effectiveness.

Storm water treatment systems are site-specific and their effectiveness is highly variable and dependent on many factors. Practices or combinations of practices that are considered to be "best available" in some or in many situations, nevertheless, may not be the most effective or economically achievable for a particular site, and may even be entirely ineffective for the site. A system of practices should be tailored to a particular site to avoid selection of unsuitable practices, maintenance problems, or failure to achieve desired pollutant reduction.

Storm water management controls are constructed to prevent or control pollution of storm water after the construction is completed. The general permit requires that the pollution prevention plan include a description of the measures that will be installed to control pollutants in storm water after construction is complete. For sites in which the development results in runoff flows that are higher than preconstruction levels, the SWPPP must include a technical explanation of why a particular storm water management measure was selected.

Selection of the most appropriate BMP depends upon a number of factors associated with site conditions. EPA expects that most sites can employ measures to remove 80 percent of the total suspended solids from postconstruction runoff. When selecting BMP's for a development project, consider the impacts of these measures on other environmental media (e.g., land, air, and ground water).

In addition to pollutant removal, the SWPPP must address velocity dissipation at discharge locations. Development usually means an increase in speed with which the site will drain because of the addition of paved areas, storm sewers, curbs, gutters, etc. The general permit requires that the velocity dissipation devices be placed along the length of any outfall where the discharge from the developed area may erode the channel. See Section 3.3 for further information on runoff calculations.

5.3.2 Storm Water Retrofit

Retrofit projects must take into account a number of site-specific factors. Nature of pollutants, loading rates, classification of receiving waters, location and condition of existing storm drains, existing and proposed land uses, location of existing utilities, soil characteristics, and floodplain location are but a few. A brief discussion of these practices follows:

Pond Systems

The ponds described in the following paragraphs range from completely dry structures to permanently wet structures with various combinations included. In addition, wetland components are discussed for their ability to enhance pollutant removal, create habitat diversity, and provide visual interest.

<u>Wet Extended Detention Pond</u> - A permanent pool system containing a forebay near the inlet to trap sediments and a deeper pool near the riser. This pond system provides an optimal combination of downstream channel protection and pollutant removal. Extended detention wet ponds are generally the most cost-effective urban/coastal practices available for pollutant removal and storm water control.

<u>Wet Pond</u> - A pond system with all of its storage utilized as a permanent pool. This system traps sediments and may provide pollutant removal through biological uptake from aquatic wetland plant species. In addition, a wet pond can be an attractive aesthetic feature.

<u>Extended Detention (ED) Micro-Pool</u> - A dry ED system containing one or two small permanent pools for pollutant removal. One micro-pool located near the inlet acts as a sediment forebay. The micro-pool system has a much lower maintenance burden than conventional dry ED pond systems and is a particularly useful design for fingerprinting a pond into a sensitive woodland or wetland area.

Extended Detention Shallow Marsh - A system utilizing emergent aquatic wetland plant species as its principal pollutant removal mechanism. The ED shallow marsh typically consists of a 0- to 1-meter- (0-3 feet) deep irregularly shaped permanent pool, creating diverse wetland habitats in a relatively small space, while providing moderate levels of soluble pollutant removal.

Shallow Marsh - A system with much of its storage devoted to a shallow marsh, this pond design can consume a great deal of land area. However, with proper grading, design, and propagation techniques, this system can result in the creation of an extensive, high quality emergent wetland habitat. The shallow marsh can achieve high removal rates of soluble and particulate pollutants through the biological uptake mechanism of emergent aquatic plants.

In-Filter Dry Pond - An innovative dry pond system for sites having permeable soils that promote infiltration. Design includes storm water detention, pretreatment via plunge pools and grassed swales, and a series of infiltration trenches and basins.

Dry Extended Detention Pond - A pond system typically comprised of two stages: The upper stage is graded to remain dry except for infrequent storms; whereas the lower stage is designed for regular inundation. Runoff pretreatment is difficult to achieve with this pond system, and it is equally difficult to prevent clogging of the ED control device.

Wet Ponds and Wet Extended Detention Ponds are extremely effective water quality practices. When properly sized and maintained, Wet Ponds and Wet Extended Detention Ponds can achieve high removal rates for sediment, biochemical oxygen demand (BOD), nutrients, and trace metals. Biological processes within the pond also remove the soluble nutrients (nitrate and ortho-phosphorus) that contribute to nutrient enrichment (eutrophication). Soluble nutrient removal is achieved through a process known as biological uptake where algae and other aquatic plants convert the soluble nutrients into biomass which eventually settles into pond sediments and is later consumed by bacteria. Some of the nutrients are recycled to the water column, but most nutrients remain in the consolidated sediments.

Wet Extended Detention Ponds are most cost effective in larger, more intensely developed sites. Pond practices normally require a significant contributing watershed area (greater than 4 hectares or 10 acres) to ensure proper operation. Positive impacts associated with wet pond systems can include: creation of local wildlife habitat, increased property values, recreation, and landscape amenities.

Extended Detention Ponds are effective in controlling postdevelopment peak storm water discharge rates to a desired predevelopment level for the design storm(s) specified. If storm water is detained for 24 hours or more, as much as 90-percent removal of particulates or suspended solid pollutants is possible. It should be noted, however, that extended detention ponds have the disadvantage of elevating water temperatures, thus potentially contributing to thermal pollution. Their use may be inappropriate in some locations, such as, adjacent to trout streams. In addition, care should be taken not to reduce base flows below those necessary to sustain the resident aquatic habitat.

Infiltration Systems

The infiltration systems described below range in design from stone-filled trenches and basins to permeable asphalt pavement. All utilize differing methods for removing soluble and fine particulate pollutants found in storm water runoff. To prevent infiltration systems from becoming clogged with fine sediment, it is essential to pretreat the incoming runoff. Methods of pretreatment range from filter cloth to vegetated filter strips. With pretreatment, infiltration systems can be an effective component of a water quality management measure.

It is important to recognize that infiltration systems create a risk of transferring pollutants from surface water to ground water. Therefore, infiltration systems should not be used near wells, in wellhead protection areas, in areas with high ground water, or in karstic terrain or in settings in which drinking water supplies may become contaminated. Furthermore, concentrations of toxic materials leached into the substrate could result in a hazardous waste designation for the area subject to regulations under CERCLA.

Infiltration Trench #1 - An infiltration trench works by diverting storm water into a shallow (1 to 2.5 meter or 3 to 8 feet) excavated trench which has been backfilled with stone to form an underground reservoir. Runoff is then either exfiltrated into the substrate or collected in underdrain pipes and conveyed to an outfall. Infiltration trenches are an adaptable practice that adequately removes both soluble and particulate pollutants. They are primarily an onsite control and are seldom practical or economical for drainage areas larger than 2 to 4 hectares (5 to 10 acres). Infiltration trenches are one of the few practices that adequately provide pollutant removal on small sites of infill development. They preserve the natural ground water recharge capabilities of a site and can often fit into margins, perimeters, and other unused areas of the site. A disadvantage is that infiltration trenches require careful construction, pretreatment, and regular maintenance to prevent premature clogging. Infiltration trenches can be used effectively in sandy or sandy loam soil areas but are much less effective for clayey or silty soils.

Infiltration Trench #2 - Similar to the trench system described above, this design accepts sheet flow from the lower end of a parking lot or paved surface. Runoff is diverted off the paved parking lot through slotted curbs. The slotted curbs function as a level spreader for storm water. A grass filter strip separates the trench from the paved surface for capture of sediments. This trench includes a perforated PVC-type pipe for passage of large design storm events. At the end of the trench is a grassed berm to ensure that runoff does not escape.

Infiltration Basin - Infiltration basins are an effective means for removal of soluble and fine particulate pollutants. Unlike other infiltration systems, basins are easily adaptable to provide full control for peak storm events. Basins can also serve large drainage areas (up to 20 hectares or 50 acres). Basins are a feasible option where soils are permeable. Basins are advantageous in that they can preserve the natural water table of a site, serve larger developed areas, be used as a construction sediment basin during construction and converted later to a long-term BMP, and are reasonably cost-effective in comparison to other practices.

One disadvantage is the need for frequent maintenance. In addition, infiltration basins have sometimes failed because they were installed in unsuitable locations or soils.

Dry Well - A small infiltration system designed to accept storm water from a roof-drain downspout. Rather than dispersing its storm water across a paved surface or grassed area, the downspout pipe connects directly into the dry well which filters rooftop runoff into soils. This system should not be used near foundations where expansive soils are found, as foundations may be damaged.

Porous Pavement - Porous pavement is a permeable pavement having the capability to remove both soluble and fine particulate pollutants in runoff and provide ground water recharge. Use is generally restricted to low-traffic-volume parking areas. Porous pavement systems can receive runoff from adjacent rooftops. This reasonably cost-effective practice is only feasible on sites with gentle slopes, permeable soils, deep water tables, and bedrock levels. It also requires careful design, installation, and maintenance. Although porous pavement has the high capability to remove both soluble and fine particulate pollutants from storm water runoff, it can become clogged easily and is difficult and costly to rehabilitate.

From a pollutant removal standpoint, Infiltration Trenches, Basins, and Porous Pavement have a moderate to high removal capability for both particulate and soluble pollutants, depending upon how much of the annual runoff volume is effectively exfiltrated through the soil layer. It should be noted that infiltration practices should *not* be entirely relied upon to achieve high levels of particulate pollutant removal (particularly sediments), because these particles can rapidly clog the device. For these systems to be effective, particulate pollutants must be removed before they enter the structure by means of a filter strip, sediment trap, or other pretreatment devices, and these devices must be regularly maintained.

Filter Strips

The filter systems described below rely on various forms of erosion-resistant vegetation to amplify particulate pollutant removal, improve terrestrial habitat, and enhance the appearance of a site. In addition, filter systems can improve both the performance and amenity value of pond and infiltration practices via storm water pretreatment.

Grass Filter Strip - These are similar to a grassed swale, but they can only accept overland flow. Filter strips are effective when used to protect surface infiltration trenches from clogging by sediment. They are effective in removal of sediment, organic material, and trace metals. They should be used as a component in an integrated storm water management system. Filter strips are inexpensive to establish if preserved prior to site development. As with all filter systems, long-term maintenance (mowing, inspection for short circuiting, etc.), should be included in overall costs.

Riparian Buffer Strip - Riparian buffer strips improve water quality by removing nutrients, sediment and suspended solids, and pesticides and other toxins from surface runoff as well as from subsurface and ground water flows. The pollutant removal mechanism associated with riparian vegetation combines the physical process of filtering and the biological processes of nutrient uptake and denitrification.

Grassed Swale - This is a grassed, low gradient conveyance channel that provides some water quality improvements for storm water via natural filtration, settling, and nutrient uptake of the grass cover. Often used as an alternative to curb-and-gutter drainage conveyance, grassed swales affect peak discharges by lengthening the time of concentration. They can also be fitted with low check dams to increase removal efficiency via temporary ponding.

Sand Filters - Sand filters are a water quality control filtration system used to remove large particulates from runoff and protect filter media from excessive sediment loading at storm water quality control basins. Sand filters can be used independently or with a dry pond basin element.

Peat/Sand Filters - This is a man-made soil filter system utilizing the natural absorptive features of peat. The system features a grass cover crop and alternating sublayers of peat, sand, and a perforated pipe underdrain system. Systems are presently used for municipal waste effluent treatment and are being adapted for use in storm water management.

Filter strips have a low-to-moderate capability of removing pollutants in urban runoff and exhibit higher removal rates for particulates rather than soluble pollutants. Pollutant removal techniques include filtering through vegetation and soil, settling and deposition, and uptake by vegetation. Riparian buffer strips appear to have a higher pollutant removal capability than grass filter strips. However, length, slope, and soil permeability are critical factors that influence the effectiveness of any strip. Another practical design problem is prevention of storm water from concentrating and thereby "short-circuiting" the strip.

Filter systems are an essential component of a comprehensive nonpoint source control strategy but should generally be used in conjunction with infiltration systems and pond systems as a pretreatment for runoff.

Oil/Water Separators

There are several types of oil-water separators. The basic separators that could be utilized at a construction activity are listed as follows:

SC Separator - An SC separator consists of an underground vault or manhole with an inlet pipe and "T" outlet. The structure of the separator allows for separation of floating oil only and has a capacity for small spills.

API Separator - The API separator consists of a rectangular vault with a series of baffles. Some systems have sophisticated equipment for skimming and removal of oil and other materials.

CPI Separator - The CPI separator consists of a vault that contains a series of closely aligned parallel plates made of fiberglass. The plates are positioned at an angle to the direction of inflow from 0 to 60 degrees.

Oil/water separators may be used within a storm drainage system or as a pretreatment for discharge into the sanitary system or hold tank for removal. An SC separator is effective for retaining small fuel or oil spills. The API and CPI separators are effective in removing diluted oil droplets from storm water. Maintenance must be performed regularly. Oil/water separators must be cleaned frequently to keep accumulated oil from escaping during larger storm events.

6.0 Mobilization, Implementation, Monitoring, and Documentation

6.1 Mobilization/Implementation

The first step of mobilization should be the implementation of controls. The controls should be constructed or applied in accordance with state or local standard specifications. If there are no state or local specifications for control measures then the controls should be constructed in accordance with Appendix C. In any event the controls must be constructed in accordance with good engineering practices and in compliance with NPDES regulations. Appendix C lists typical design standards for structural control measures. The controls should be constructed and the stabilization measures applied in the order indicated by the sequence of major activities.

To ensure that controls are adequately implemented, it is important that the work crews installing the measures are experienced and/or adequately trained. Improperly installed controls can have little or no effect and may actually increase pollutant export. It is also important that all other workers on the construction site be made aware of the controls so that they do not inadvertently disturb or remove them.

6.2 Site Inspections

Inspection and maintenance of the control measures are as important to pollution prevention as proper planning and design. Inspection should be performed at the frequency specified in the SWPPP and/or the issued permit. **Each state has different inspection and reporting requirements, the reader is encouraged to contact the permit authority for the states in question.** The inspector should note any damage or deficiencies in the control measures in an inspection report. An example of an inspection report can be found in Appendix D, as Exhibit D-2. The operator should correct damages or deficiencies as soon as practicable after the inspection, and any changes that may be required to correct deficiencies in the SWPPP should be made as soon as practicable after the inspection. In addition to the inspection and maintenance reports, the operator should keep records of the construction activity on the site. In particular, the operator should keep a record of dates when each activity starts and is completed. Exhibits D-2 through D-4, in Appendix D may be used to record this information. The Inspection and Maintenance Report Forms are organized into three basic management measures: (1) Structural Controls, (2) Vegetative Controls, and (3) Management Measures. The particular practices associated with these measures are located in Appendix C, and are categorized in Section 3.4.4. The general permit requires inspection every 7 days or within 24 hours of a storm event of 12.5 mm (0.5 inch) or more. All disturbed areas of the site, areas for material storage, locations where vehicles enter or exit the site, and all of the erosion and sediment controls that were identified as part of the plan must be inspected. Controls must be in good operating condition until the area they protect has been completely stabilized and the construction activity is complete. The construction project manager will designate an inspector for monitoring BMP's (these inspections can be performed as part of a regular construction inspection program). As the principal permittee, COE will also regularly inspect each construction site to determine compliance with provisions of the SWPPP. Construction sites which do not comply with provisions of the SWPPP will be shut down by COE until compliance is achieved.

6.3 Personnel Designation

Designated personnel for each contractor/tenant construction project should be listed in the Pollution Prevention Committee Members form, Exhibit D-1, in Appendix D.

6.4 Training

Personnel performing site inspections (COE and tenant projects) are required to be experienced in construction practices and erosion and sediment control practices. Many states and organizations offer general training programs in sediment and erosion control. Training as a whole should address:

- The location and type of control measures.
- The construction requirements for the control measures.
- Spill response.
- Inspection and maintenance record-keeping requirements.
- Pollution control laws and regulations.
- Good housekeeping and material management practices.
- Particular construction activity features and operations designed to minimize storm water pollution.

COE will review SWPPP requirements with each tenant or contractor before approving construction activities.

A large part of the success of an SWPPP is the capability and interest of the employees responsible for implementing and maintaining the program. Personnel must understand the importance of the program and the goals of the SWPPP. Personnel must be trained in the techniques of response, removal, and documentation. The permit authority representatives will be inspecting the general permit participants, and it is important that they are received by trained, knowledgeable personnel who have access to the SWPPP, environmental files, and other documentation. The SWPPP documentation must be current and complete when inspected.

Annual training workshops and meetings should be established, at which time employee participation and input should be encouraged. Training schedules should be recorded (see Table E-5, Appendix E). New techniques of storm water management controls as well as changes in permit compliance or limits should be explained to the employees.

6.5 Nonstorm water discharges

6.5.1 Certification

The general permit requires nonstorm water discharges to be eliminated prior to the implementation of the SWPPP. Existing industrial facilities must certify that there are no nonstorm water discharges present in the storm water drainage system. All facilities must certify and monitor outfalls for dry weather discharges.

The certification page for nonstorm water certification is shown in Appendix F. A certification page should be signed and retained as part of the SWPPP documentation. All forms filled out while surveying and evaluating outfalls should also be inserted into the nonstorm water discharge section of the SWPPP. A record of methods used, dates, and time conducted should be listed on the form.

If certification is not feasible because of the inability to eliminate the nonstorm water discharge because of the need for significant structural changes, the construction activity must notify the permit authority. This notification should include a summary of why the extension in eliminating nonstorm water discharges is required and a schedule indicating when nonstorm water discharges will be eliminated. The schedule is subject to modification by the permit authority.

6.5.2 Nonstorm Water Inspection

The inspection for nonstorm water discharges should take place concurrently with the inspection of the drainage system (Section 6.5.3).

6.5.3 Drainage System

There may be several drainage systems serving the construction activity depending on topography. The inspection for each drainage system should begin at the farthest discharge point from the center of construction activity operations. The farthest discharge point may be at the property boundary, or it may be at the point where the "waters of the United States" cross the construction activity property and intersect with a drainage system.

Physical inspection of the outfalls should include (principal issues identified):

- Flow — If flow is present, and precipitation has not occurred within the past 3 days, there may be a problem requiring further investigation unless the source is positively known and is nonpolluting.
- Odor — The presence of any odor from the drainage system may indicate an unnatural occurrence.
- Clarity — If water is present, standing or flowing, and it is not clear, pollution should be suspected.
- Floatables — If there is floating debris, garbage, sewage, or an oily sheen, the source of the material should be identified.
- Stains, etc. — If stains are present on lined channels/pipes, or other than the normal vegetation or soil color, this may be an indicator requiring further investigation.
- Vegetation — If vegetation in the discharge channel is more luxurious or, conversely, appears stressed in comparison to adjacent vegetation, this is likely an indicator of excess nutrients or other problems and requires further investigation.

In addition, inspection should note siltation or scour problems below outfalls, or at system confluences, for referral to construction activity maintenance officials.

Chemical inspection of outfalls may make use of dry weather monitoring kits if dry weather flow is observed from the discharge points(s) or stagnant pools are observed at the discharge point(s). The results of the tests using these kits can assist in identifying possible problem sources upstream in the system.

From the discharge point(s), the inspection should proceed upstream. Similar inspections should be made of each intervening discharge point, if the storm drain is not continuous to its final outfall. If the storm drain is continuous, inspections should be made at each manhole upstream to the inlets of the storm water drainage system. **(Inspectors shall not enter manholes unless OSHA-approved confined space entry procedures are followed.)** The inspectors should make note of any of the items listed above. Particular attention should be given to connections in the storm water drain lines or any inlet lines not shown on the plans. Patched pavements may be indicators of postdesign connections.

Attention should be given to determine the discharge destination of floor drains. These drains must be connected to the sanitary sewer system.

The flow paths to each of the inlets must be inspected, as well as the inlets themselves. Particular attention should be given to the presence of grease, oil, fuel, chemical, or solvent residues along these flow paths, as well as any other staining that could indicate a pollutant that could be washed down the storm drain. Inlet sumps should be inspected. Debris collected in inlet sumps should be removed regularly and before any substantial buildup occurs.

The physical condition and cleanliness of the components of the drainage system must be inspected as well. The inspector should make sure that the drainage areas are clean and free of debris. The physical integrity of all conveyances and discharge points should be inspected for corrosion, seam and joint connections, erosion, silting, leaks, and condition of dikes, berms, and other structures of the storm water controls.

These inspections, related to the construction activity SWPPP's, are important to ensure that pollutants arising from other industrial activities are not incorrectly ascribed to the construction activity.

Table D-6, Appendix D, will be used to record drainage system maintenance and inspection observations.

Inspection of paved areas is not a difficult task, because all surfaces can be easily seen. With respect to storm water pollution, if the paved areas are free of visible pollutants, storm water contamination is less likely.

Inspections will focus on maintenance activities that assure that paved surfaces are clean of chemicals, grease, oil, solvents, and fuels, and that other potential pollutants are kept off the paved areas, or that they are kept covered and out of storm water flow paths.

Paved areas will also be inspected for cracks. Where there is a significant potential for a spill, such as drip pads or fueling stations, cracks may allow pollutants to seep into the soil where ground water contamination could occur. Maintenance activities could include proper grouting of all pavement joints.

Herbicides and petroleum products are sometimes applied to pavement cracks and at joints to control vegetation growth. The use of herbicides or other chemicals should be reviewed, as these materials may combine with storm water runoff or infiltrate into the underlying soil. If herbicides must be used, those with low toxicity and persistence should be considered. The frequency of application should be reduced to the minimum required. Grouting of joints and cracks may offer an alternative to herbicide application.

6.6 Final Stabilization/Termination

As soon as practicable after construction activities have been completed in a disturbed area, permanent stabilization should be started to prevent further erosion of soil from that area. All disturbed areas of a site, except those portions which are covered by pavement or a structure, should be finally stabilized once all construction activities are completed. Final stabilization requirements may vary from permit to permit. Final stabilization is defined by the EPA General Permit as meaning that all soil-disturbing activities at the site have been completed, and that a uniform perennial vegetative cover with a density of 70 percent of the cover for the unpaved areas has been established or equivalent stabilization measures, such as the use of riprap, gabions, or geotextiles, have been employed.

Operators of a construction site must continue to comply with permit conditions until: (1) they no longer meet the definition of an operator of a construction site; or (2) the construction activity is complete, all disturbed soils have been finally stabilized, and temporary erosion and sediment controls have been or will be removed. A permittee should submit a Notice of Termination (NOT) to inform EPA that they are no longer an operator of a construction activity. The NOT is a one-page form (see Appendix F) which should be completed and submitted to the permitting authority when a site has been finally stabilized or when an operator of a construction activity changes. The NOT is typically the final task required to comply with the requirements of an NPDES storm water permit for a construction activity. The NOT communicates to the permitting authority that the construction activity has ceased and the area is stabilized.

Note that when there is a change in operators of a construction activity, then the new operator must submit an NOI to be covered by the permit at least 2 days before the change in operator.

Where the NOT's are submitted depends on the permitting authority. Some state agencies do not require submittal of NOT's. Federally regulated NPDES permits require NOTs to be submitted to the following address:

Storm Water Notice of Termination
P.O. Box 1185
Newington, Virginia 22122

Following the termination of construction activities, the permittees must keep a copy of the SWPPP and records of all the data used to complete the NOI for a period of at least 3 years following final stabilization. The record retention period may be extended by the permitting authority's request.

FOR THE COMMANDER:

10 Appendices
(See Table of Contents)

ROBERT H. GRIFFIN
Colonel, Corps of Engineers
Chief of Staff