DEVENS

Draft

Stormwater Pollution Prevention Plan

Prepared for:

The Joint Boards of Selectmen

- Town of Ayer
- Town of Harvard
- Town of Lancaster
- Town of Shirley

The Massachusetts Government Land Bank

Prepared by:

Vanasse Hangen Brustlin, Inc.

July 1995

STORMWATER POLLUTION PREVENTION PLAN

Ayer, Harvard, Lancaster and Shirley, Massachusetts

Prepared for: The Massachusetts Government Land Bank
Joint Boards of Selectmen

Prepared by: Vanasse Hangen Brustlin, Inc.
101 Walnut Street
P.O. Box 9151
Watertown, Massachusetts 02272

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INTRODUCTION

This Stormwater Pollution Prevention Plan (SWPPP) is a guide for the Devens Enterprise Commission (DEC), for site developers, and site occupants at Devens to help meet the goal of preserving valuable environmental resources at Devens through responsible stormwater management.

The Devens Bylaws require that applications for Development Permits include a site-specific erosion and sedimentation control plan and a stormwater pollution prevention plan. This requirement recognizes that the wetlands and surface water bodies at Devens provide important functions and values that may be affected by changes in water quality and hydrology, and that the groundwater resources at Devens are important to public water supplies. The information provided in this document is intended to provide recommendations and guidance for the design and maintenance of stormwater management systems that protect wetlands and surface water resources by controlling the quality and quantity of surface runoff, and for the design of systems that protect ground water resources by maintaining or enhancing the quality and amount of water recharged to the subsurface aquifers.

Existing Conditions

The initial section of this plan provides an inventory and description of the sensitive surface and ground water resources at Devens, and provides an overview of the existing stormwater management infrastructure.

Construction and Operations

The sections of this plan which deal with stormwater pollution prevention during the construction and operations phases of site development provide guidance on measures and options that may be utilized to prevent erosion and sedimentation during construction activities, and information on the control of pollutants in stormwater discharges. These sections identify activities that may contribute to the quality of stormwater runoff; identify and discuss structural and non-structural Best Management Practices to prevent or control stormwater runoff pollution; and provide information on the monitoring of stormwater runoff to measure the effectiveness of controls and facilitate corrective actions.

Stormwater Pollution Prevention Plan

This section provides guidelines for the preparation of a Stormwater Pollution Prevention Plan (SWPPP) to be implemented during construction and/or operations of facilities at Devens. Step-by-step guidelines are presented for the

preparation of site-specific SWPPPs that will provide effective protection of surface and ground water resources for the redevelopment of existing sites, new construction in undeveloped areas, and roadway construction or reconstruction. Performance standards have also been developed for each type of construction, with modifications specified for each of the Water Resource Protection Districts. The goal of the performance standards and design criteria is to protect existing and future ground water supplies, wetlands, and surface water bodies, and where practicable reduce peak rates of runoff and improve water quality.

The guidelines in this document are intended to fulfill the requirements for Stormwater Pollution Prevention Plans under the EPA NPDES General Permit for Stormwater Discharges from Construction Activities. They exceed these NPDES requirements, by requiring the preparation of a SWPPP for all construction sites (rather than just sites larger than 5 acres). The Devens SWPPP also requires that all developed sites implement BMPs to protect water resources from potential adverse effects due to stormwater runoff from roadways and parking lots. This also exceeds NPDES requirements.

Industrial users of Devens must prepare a SWPPP for operations, whether users are undertaking new construction, are redeveloping an existing site, or are reusing an existing facility. This SWPPP is required by the EPA NPDES General Permit for Stormwater Discharges Associated with Industrial Activities. The Stormwater Pollution Prevention Plan section of this document provides an overview of the requirements for industrial facilities at Devens. However, since these SWPPPs must be individually prepared for each site and type of industrial user, it is not feasible to provide specific BMPs or performance standards in this document.

Rail Area Stormwater Plan

This section of the report outlines the purpose for developing a separate stormwater plan for the rail area, indicates sources of potential stormwater contaminants, provides a list of best management practices, and suggests guidelines for future plan development.

EXISTING CONDITIONS

This section provides a description of the Main and North Posts at Devens including surface water features, cover, drainage basins, and the uses of existing development. Specific attention is given to the existing stormwater management infrastructure throughout the Main and North Posts.

GENERAL SITE DESCRIPTION

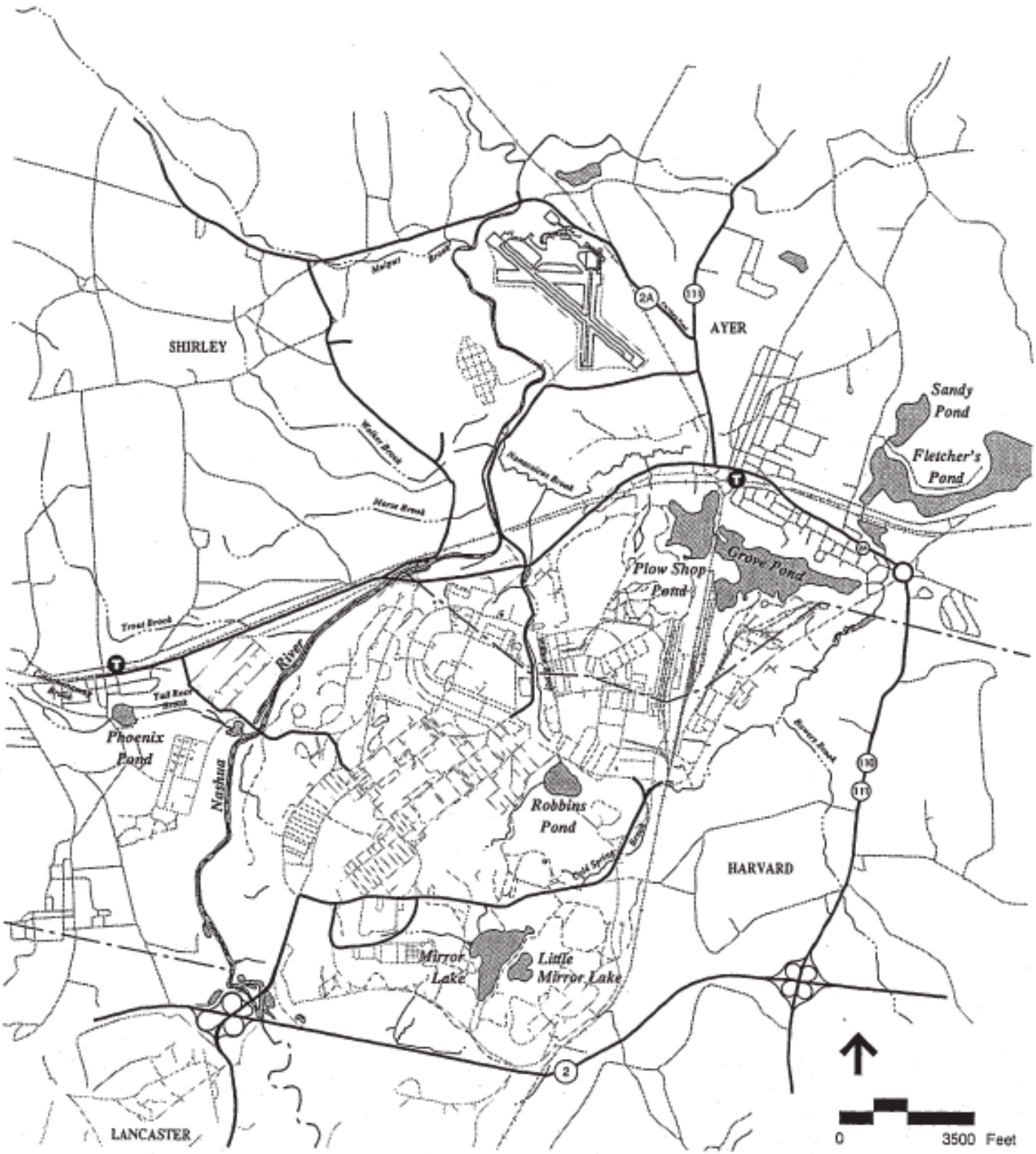
Devens is in the north central region of Massachusetts. It lies within Ayer and Shirley in Middlesex County, and Harvard and Lancaster in Worcester County. The site encompasses over 9,300 acres of land which have been extensively developed by the military. Devens is composed of three distinct areas, commonly referred to as the Main, North, and South Posts. Approximately 4,400 acres of the Main and North Posts are scheduled to be deactivated in 1995.

The North and Main Posts of Devens are functionally equivalent to a small city. Development includes residential neighborhoods, industrial/commercial areas (maintenance, administration, warehouse buildings), recreational facilities (golf course, riding stable, athletic fields, tennis courts), landfills, a wastewater treatment plan, and an airfield. Approximately 1/4 of the existing North and Main Post areas are undeveloped open space or recreational areas.

SURFACE WATER RESOURCES

The majority of the North and Main Post areas of Devens are within the watershed of the Nashua River, which flows northward along the western border of the Main Post and bisects the North Post between the airfield and the wastewater treatment plant (Figure 1). The Massachusetts DEP has classified the Nashua River as a Class B waterway, suitable for swimming and fishing. Despite recent improvements in water quality, excess levels of nutrients and biological oxygen demand frequently result in lower water quality and algal blooms in summer.

A portion of Devens is within a subwatershed draining to the Nashua River via Bowers Brook and Nonacoicus Brook. Major surface waters within this subwatershed include Robbins Pond, Grove Pond, Plow Shop Pond, and Willow Brook. Elevated levels of metals within Grove Pond and Plow Shop Pond have resulted in restrictions on fishing and other uses. Contamination has been found in Cold Spring Brook, presumably from leachate from an adjacent landfill.



DEVENS

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Surface Water Resources

Figure 1

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Several ponds within Devens (Mirror Lake, Little Mirror Lake) are isolated kettle ponds which have no surface water inlet or outlet. These are vulnerable to degradation from surface water runoff, since no surface dilution or flushing occurs under natural conditions.

To protect water quality and ground water recharge functions of wetlands and surface waters, the Devens Bylaws prohibit any alteration of the natural vegetation or substrate within 25 feet of the bank of any surface waterbody, and within 25 feet of any wetland bordering on a surface water, except for the construction of recreational facilities, public utilities and infrastructure, and structures which convey or contain stormwater drainage.

GROUND WATER RESOURCES

Portions of Devens are underlain by relatively thick deposits of high-transmissivity glacial outwash materials, which create an aquifer. The eastern edge of the Main Post, and the majority of the North Post, overlay a high-yield aquifer. A medium-yield aquifer is present along the west edge of the Main Post, in the Nashua River basin, and along the outer edges of the high-yield aquifer.

These aquifers are important ground water resources for Devens and surrounding municipalities. Four drinking water wells within the Main and North Post areas supply Devens (Grove Pond, Patton, MacPherson, and Sheboken wells), and one well provides non-potable water for the golf course. Four additional wells within the aquifer supply Ayer and Shirley. Although Harvard does not currently utilize the Devens aquifer, future use is likely.

Water quality protection for these wells is of high importance during future re-use or development at Devens. Wellhead protection areas, either as 0.5-mile radius Interim Wellhead Protection Areas, or mapped and approved Zone II protection areas, have been designated for all of the wells listed above. However, the lack of a confining layer above the aquifer makes it vulnerable to contamination. Occasional trace levels of TCE in the Grove and MacPherson wells confirm that ground water contamination is possible unless stringent protective measures are taken.

The Devens Bylaws establish a Water Resources Protection Overlay District (WRP) intended to preserve the quality of surface and ground water in the aquifer underlying Devens. Four WPR Districts are defined:

- Zone I, areas within 400 feet of a drinking water supply well,
- Zone II, areas that directly contribute to a drinking water well (as defined at 310 CMR 22.02),
- Aquifer District, areas over the aquifer but outside of any mapped Zone I or Zone II, and
- Watershed District, defined as all remaining areas of Devens.

EXISTING STORMWATER MANAGEMENT INFRASTRUCTURE

The stormwater management infrastructure at the Main and North Posts of Devens consists of several decentralized systems of closed conduits and open channels, which generally discharge directly to surface waters and wetlands. Lack of system maintenance and poor system design (undersized pipes, poorly located inlets) contributes to flooding in several localized areas, particularly along Willow Brook.

The existing system contains few or no engineered means of controlling stormwater runoff rates or providing water quality enhancement. Catch basins, where these exist, provide some sediment trapping. Drainage pipes, due to their length and diameter, may restrict runoff rates. Open swales or channels provide a minimal level of filtration and infiltration of stormwater runoff prior to discharge to surface waters or wetlands. Generally, filtration, biological uptake, and biochemical degradation in on-site wetlands provides the majority of stormwater treatment and protection of existing surface waters.

STORMWATER POLLUTION PREVENTION DURING CONSTRUCTION

This section describes stormwater pollution prevention techniques which can be used during typical construction activities and should be applied by site developers at Devens. While these activities are typical, site-specific conditions will dictate how construction procedures will be implemented and how stormwater pollution prevention measures will be designed. Best management practices (BMPs) and mitigation measures which can be implemented are outlined in each section.

PURPOSE

The purpose of this guidance document is to help site developers develop and implement a Stormwater Pollution Prevention Plan (SWPPP) as required as part of the Water Resources Protection Plan, and to comply with the EPA NPDES General Permit for Stormwater Discharges Associated with Construction Activities. The purpose of developing a SWPPP is to protect wetlands and water resources at Devens from construction related sedimentation, and construction related pollution.

CONSTRUCTION ACTIVITIES

Construction activities which will likely be conducted at Devens have the potential to impact water resources through sedimentation or accidental release of hazardous materials. The magnitude and location of these activities need to be assessed in order to develop an effective, site-specific SWPPP. A site-specific SWPPP for facility construction and operation, which details the proposed construction sequencing and specific construction activities proposed by each individual site user, will be required as part of an application for a Development Permit from the Devens Enterprise Commission. Specific activities which may affect water quality include:

- clearing,
- grading,
- staging areas,
- off-site tracking of sediments,
- storage of materials and equipment.

The following subsections describe critical construction activities, and measures that should be undertaken during different construction stages to reduce the potential for transport of sediments or other contaminants to surface waters.

Construction Staging Plans and Vehicle Access Plans

As noted in the Devens Bylaws and Water Resources Protection Report, construction planning for new development should be designed, where possible, to use pre-existing disturbed sites and to minimize new site clearing and disturbance. Each construction plan should identify staging areas and vehicle access points during the planning and design of each individual project, in a manner which minimizes impact to the surrounding area. The staging areas should provide worker parking, construction headquarters, and temporary sanitary facilities, and be located and designed in a way that minimizes the potential for pollutant discharges to waterways or drainage systems.

Tracking of sediments from construction sites onto existing roadways may result in increased turbidity or sedimentation of surface waters. Measures should be used to control off-site sediment tracking. Some effective measures include sediment tracking pads (see Appendix Figure A-1), stabilized construction entrances, and regular sweeping of any existing on-site paved areas and adjacent off-site roadways.

Material Storage/Vehicle Maintenance and Refueling

The storage of construction materials and equipment, and any maintenance or refueling of equipment, are potential sources of contaminants to surface or ground waters. To prevent pollution, staging facilities should be designated for storage and vehicles. These areas should be as far away from sensitive areas as possible to minimize the potential for contamination to water resources.

Storage, maintenance and refueling areas should be surrounded with sediment control measures to contain and filter runoff leaving the area. Any vehicle refueling should be done on an impervious surface enclosed in a temporary berm to prevent drips or spillage from contaminating soils or ground water. Oil/water separators may also be installed as temporary construction measures to contain spills or remove contaminants from runoff. All areas where vehicle maintenance or refueling occurs should be equipped with spill control materials, including absorbent pads. The necessary equipment, notification procedures and other spill response requirements for maintenance areas will be included in the Devens Spill Prevention Control and Countermeasure (DSPCC) Plan.

Site Clearing Sequence

Exposed soil surfaces, created through site clearing and grading, pose the greatest potential for erosion and the transport of sediments. To protect sensitive water resources, no site clearing should be undertaken until sedimentation control barriers have been installed at the site perimeter and between areas of clearing and any wetlands or surface waters. A rational construction sequence should be developed that minimizes the area of clearing and grading, and keeps vegetation or stabilized surfaces from being removed or disturbed earlier than necessary. Maintaining existing vegetation will minimize the amount of disturbed area, thereby minimizing the potential for sedimentation. The preservation of vegetation between construction areas and wetlands will also act as a buffer and filter strip to trap sediments.

Sediment and Erosion Control

All construction activities at Devens should be undertaken using appropriate erosion control to minimize potential impacts to environmental resource areas. Erosion of disturbed soils on-site, and the transport of suspended sediments to off-site surface waters or wetland resources constitutes one of the most common sources of construction-related contaminants. To reduce this potential impact, site-specific erosion and sedimentation control plans should be prepared for any development or construction activity at Devens, and should provide a plan for immediate stabilization of disturbed areas, installation temporary erosion controls, precise sequencing and coordination of construction, and implementation of inspection and maintenance programs.

Measures that can be utilized to reduce erosion and sedimentation include strategies and structural measures to:

- minimize the amount of disturbed soils,
- divert off-site runoff and reduce surface flows across exposed soils,
- install barriers or filters to trap sediments on-site,
- construct temporary sedimentation basins to collect surface runoff and allow settling of sediments,
- filter any dewatering effluent and discharge into upland areas.

Excavation, Grading and Borrow Materials

Excavation and grading will be required to construct new facilities at Devens. Some projects will require large amounts of material to be excavated and extensive amounts of fill to be placed to achieve final grades. Prior to grading, suitable topsoil should be stripped from the surface of the site, segregated, and stockpiled for use during final grading. Stockpiled soils should be surrounded by erosion control devices to prevent off-site sedimentation. If the soil is stockpiled for longer than one month, it should be seeded with annual rye for stabilization. Structural fill may be required including gravel, sand, or crushed stone which will be brought from off-site sources to prepare for the construction of foundations, parking areas, and ground water recharge systems. All fill material should be clean and free of hazardous materials which could potentially contaminate ground or surface waters. Borrow material from off-site sources will be inspected and tested to verify that clean materials are used during construction.

Stabilization

Soil stabilization is critical to the control of erosion and sediment transport in runoff. Temporary soil stabilization measures, including mulch and seeding with fast-growing annual grasses, should be utilized for any disturbed area between the completion of rough grading and final stabilization. These measures should be described and identified in any SWPPP prepared. Permanent stabilization (paving, landscaping) should be installed as soon as possible following final grading.

BEST MANAGEMENT PRACTICES

Water quality protection during construction can be accomplished by use of a combination of Best Management Practices (BMPs), a variety of structural and non-structural measures that reduce the quantity of pollutants in runoff entering surface and ground water resources. This section provides descriptions of commonly used BMPs for construction, an evaluation of their effectiveness, and discussions of appropriate uses. Illustrations of most structural BMPs which can be used or adapted for site-specific SWPPPs, are provided in the Appendix. The Environmental Protection Agency's document, titled "Stormwater Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices", provides additional information regarding best management practices for construction.

Non-Structural Stabilization Practices

The following non-structural controls provide stabilization of disturbed areas without requiring extensive engineered treatment systems and artificial runoff control measures. Any SWPPP prepared for use at Devens should identify which of these BMPs will be utilized, and provide information on the specific implementation. Non-structural controls focus on the preservation of existing vegetation or rapid revegetation of disturbed soil as the most effective ways to control erosion during construction. Vegetation reduces erosion by providing cover, slowing runoff velocities, and stabilizing soil.

Preservation of Natural Vegetation

Preservation of natural vegetation provides the most effective erosion and sedimentation protection. Natural vegetation reduces the force of falling rain, holds soil particles in place, maintains absorptive capacity of the soil, slows the velocity of runoff, and acts as a filter to catch sediment. Preserving natural vegetation also provides areas for infiltration, reducing the quantity and velocity of stormwater runoff. Natural vegetation also generally requires less intensive maintenance and little or no use of fertilizers or pesticides.

Temporary Seeding

Temporary seeding provides a short term vegetative cover on disturbed areas that reduces erosion and sedimentation by stabilizing soils. Temporary seeding is performed on areas which have been disturbed and which will be redisturbed over a period of time. Typical areas for which temporary seeding can be effective include soil stockpile areas, sides of sediment basins, dams, and temporary roadbanks. Temporary seeding also reduces maintenance costs of other BMPs such as temporary detention basins, by preventing the basins from filling with sediments too quickly. Temporary seeding, typically composed of annual rye, should be provided on disturbed areas that will remain disturbed for more than 14 days before construction resumes, if construction stops during the growing season.

Mulching

Mulching is a temporary soil stabilization or erosion control practice in which hay mulch, grass, straw or wood chips are placed on the soil surface to reduce the impact of rain and the velocity of stormwater runoff across disturbed areas. Mulching stabilizes the soil and retains moisture which aids plant growth. Mulching is used on steep slopes and in critical areas, such as waterways and provides immediate protection against erosion to exposed soils.

Dust Control

Wind can cause erosion particularly during dry soil conditions, especially where vegetation is sparse. Various methods of dust control can be used to prevent dust from being transported off-site including wetting, mulching, spray-on adhesives, and stone.

Sweeping

The removal of sediments from paved surfaces on the construction site, or from roadways over which construction vehicles travel, is an effective means of preventing sedimentation of surface water resources. A SWPPP should include a description of an appropriate street sweeping program to be used during construction.

Structural Stabilization Measures

Structural controls are engineered, constructed features which may include diversion dikes and swales, hay bales, silt fence, and sedimentation basins. These measures divert runoff, control stormwater flows, trap sediments, and filter sediments from surface waters. Any SWPPP prepared for use at Devens should identify the appropriate structural BMPs for the specific construction site, and identify where and when during the construction process these should be implemented.

Staked Hay Bales and Silt Fence

Hay bales or siltation fence, installed either individually or in combination, are temporary erosion control measures which achieve sedimentation control by reducing runoff velocity and trapping the sediment load transported in runoff. Hay bales and silt fence may also provide a physical barrier that defines the limits of work of the construction site. These measures should be installed prior to site clearing, and maintained throughout construction.

Hay bales/siltation fencing may be installed at the perimeter of a site to reduce stormwater flow velocities onto disturbed areas and to trap sediment leaving the site in stormwater. In addition, these may be installed at the top of steep slopes, or part way along long slopes, to reduce erosive velocities of storm flows. Sedimentation barriers must be installed between any disturbed area and a wetland or surface water, and at the inlet and outlet points of open drainage structures.

Figure A-2 (see Appendix) illustrates a properly installed sedimentation barrier consisting of a combination of both measures. To operate effectively, these barriers must be securely staked and installed in a trench below surface level.

Throughout construction these devices should be inspected and maintained following all major storm events, until the disturbed soil surfaces are stabilized.

Checkdams

Checkdams may consist of either hay bales or crushed stone placed in areas where sediment is being transported within a drainage ditch or swale. Checkdams reduce the speed of concentrated flows and trap and remove sediments from surface runoff. Figure A-3 (see Appendix) illustrates the proper placement of a hay bale checkdam.

Sediment Basins

A sediment basin is a dry basin used for settling, which has a controlled stormwater release structure used to collect and store sediment. Sediment basins treat and enhance water quality primarily through sedimentation. Runoff waters are retained which allow sediments and associated pollutants to settle out of the water column. Sedimentation basins should be installed at any location where concentrated stormwater flows outlet (at the outlet of perimeter controls, drainage swales or dikes). Basins must be designed to drain areas less than 5 acres, and with a capacity to hold 3600 cubic feet per acre of drainage area. Basins should have a minimum depth of 2 feet, and outlet through a riser pipe wrapped in filter fabric, or similar device designed to provide surface water protection.

Diversion Dikes/Drainage Swales

Diversion dikes and swales are temporary devices used to direct upslope surface runoff away from disturbed areas. Diversion dikes are also used to divert sediment-laden runoff to sediment basins. Dikes are usually constructed of compacted earth, stone, or hay bales.

Drainage swales are shallow watercourses used to collect and convey surface runoff across the ground surface to a release or discharge point. Drainage swales can be naturally occurring or man-made features. A swale may be a natural depression or wide, shallow, or stone-lined waterway used to temporarily store, route or filter runoff. Swales of sufficient length can be very effective in enhancing the quality of stormwater runoff.

Storm Drain Inlet Protection

Storm drain inlet protection is a filtering measure in which gravel or stone, hay bales, silt fence, or sod is placed around a stormwater inlet to intercept sediment laden runoff prior to entering the stormwater collection system (see Appendix Figure A-4). This measure should be used where proposed construction occurs on previously existing paved areas with a subsurface drainage system. This method also prevents the silt-in of inlet structures. The type of material used will depend on site conditions and the size of the drainage area. At a minimum, filter fabric should be placed under the catch basin grate to trap sediments, and should be installed so that the grate can easily be removed without dislodging the fabric and trapped sediment.

Storm drain inlets may also be protected by placing a fabric filter sack into the catch basin. The weight of the catch basin grate holds the filter sack in place.

The filter sacks, which are available in a variety of sieve sizes, must be inspected regularly and replaced when full to maintain their effectiveness.

Dewatering Measures

Dewatering may be required during construction to remove excess water from excavations. Dewatering may also be required to lower the ground water table. Prior to discharging accumulated water, filtering should be provided to minimize adverse impacts to water resources. Pumping should be done from a perforated pipe, wrapped in filter fabric, installed in a crushed stone sump pit to minimize the amount of sediments contained in the water. A hay bale and silt fence corral or filter bag may also be used to filter sediments during the dewatering operation. All dewatering effluent should be discharged into upland areas, and not directly into any surface water, wetland, or drainage system. The direct discharge of dewatering effluent into a surface water or wetland would require the issuance of an industrial discharge permit from the DEP and the EPA.

Erosion Control Fabrics

Erosion control fabrics are manufactured from synthetic and natural materials generally woven together to create a netting or matting. Mulch mattings (jute, wood fiber) are used to hold mulch materials to the ground surface. Erosion control fabrics may also contain the mulch materials and can be used alone to stabilize soils. Erosion control fabrics are used on planted slopes to protect seedlings until they become established. These should be used to provide temporary stabilization on any slope with a gradient of 2:1 or steeper.

INSPECTION, MAINTENANCE AND MONITORING

This section describes standard procedures for monitoring the effectiveness of stormwater management controls during construction at Devens. The Devens Enterprise Commission (DEC) should impose monitoring requirements for construction such as inspection reports, stormwater sampling, and compliance with performance standards. Also, where necessary, DEC should require site users to establish ambient water quality conditions through surface and ground water monitoring to serve as a baseline to measure future monitoring results. The DEC should determine on a site-by-site basis, based upon materials, site location in relation to water resources, and other relevant criteria at each site, which site users will be required to conduct baseline and ongoing water quality sampling.

Monitoring during construction focuses on inspection and maintenance of temporary erosion and sedimentation controls (e.g. hay bales, silt fence). Monitoring requirements may vary widely depending on the type of facility, site conditions, downstream receiving water bodies, and regulatory jurisdictions. At a minimum, periodic inspection of stormwater controls is necessary to maintain their continued effectiveness.

Because of the likely variation in future site-specific uses at Devens, this section provides both standard procedures to be used in most situations and additional guidance which will allow a monitoring program to be tailored to the needs of individual site users at Devens. Whatever the use, monitoring typically includes visual inspection of controls and sampling of stormwater flows discharged from a

facility site. The following monitoring programs for construction apply to all Water Resource Protection (WRP) Districts at Devens.

Inspection and Maintenance

An inspection and maintenance program for stormwater controls should be required as part of the Development Permit issued by the Devens Enterprise Commission (DEC). Maintenance includes ensuring that those procedures used to maintain vegetation, to control erosion and sedimentation, as well as other protective measures identified in the site-specific Erosion and Sedimentation Control Plan, are maintained in good and effective operating condition.

An effective program will identify the person responsible for inspection and monitoring; require written inspection records documenting the date of inspection, condition of sedimentation controls and any corrective actions taken; identify an inspection schedule that includes regular routine inspections as well as inspections prior to and following a storm event; specify corrective actions; and require on-site stockpiling of a quantity of hay bales, silt fence, or crushed stone for emergency repairs.

Water Quality Monitoring

Water quality samples may be required for facilities that receive a Development Permit, where the site is adjacent to a sensitive water body. This will be determined on a site-specific basis depending on the size of the project and the potential impact of construction on receiving waters. Where the DEC determines that a water quality sampling program is required in order to protect surface waters, a monitoring program should be undertaken. Monitoring should remain in place throughout the construction period to assure that construction will not adversely affect water resources at Devens.

Prior to construction, baseline sampling should be done to establish potential impacts as a result of construction. During construction, turbidity samples should be required upstream and downstream of the construction site during dry conditions and for rainfall events in excess of 0.50 inches. Construction monitoring is intended to serve as a "trigger" for careful inspection of erosion and sedimentation controls to identify any defects in the BMPs established on the site. Exceedance of the threshold value is not intended to require the initiation of penalties or other actions by the DEC. Where turbidity immediately downstream of the site exceeds turbidity immediately upstream of the site by more than 50 percent, and where no difference in turbidity was recorded during pre-construction monitoring, immediate action should be taken to identify the source of sedimentation and corrective actions should be immediately undertaken.

Individual site developers should be responsible for preparing a sampling program which will be submitted to the DEC for approval. The sampling plan will include at a minimum: sampling objectives, sampling collection and analysis summary, and quality assurance/quality control procedures. Stormwater quality monitoring reports should be submitted to the DEC on a monthly basis during facility construction. These reports will document the rainfall amount, results of sampling, and any corrective action taken.

STORMWATER POLLUTION PREVENTION DURING OPERATIONS OF NON-INDUSTRIAL ACTIVITIES

This section is intended to provide guidance for the design of site-specific stormwater management plans to protect surface and ground water resources at Devens following site construction. It describes a range of stormwater pollution prevention techniques which should be applied by site users at Devens. While these techniques are typical, site-specific conditions will dictate which stormwater pollution prevention measures are appropriate and should be incorporated into an ongoing, site-specific operations plan.

PURPOSE

The purpose of the section is to provide general guidance on the availability of BMPs that can be designed and implemented to minimize impacts from stormwater runoff during facility operations.

The stormwater contaminants, and BMPs for protection of water resources, described in this section pertain to stormwater runoff generated from roadways, commercial, and business users. This plan does not specifically address the quality of stormwater generated by facilities designated as "Industrial Activities" by the EPA's NPDES program. Where several new development or redevelopment activities are proposed within the same subwatershed of Devens, the DEC should encourage site developers to coordinate preparation of their SWPPPs and investigate means of providing stormwater management at the watershed level.

SOURCES OF STORMWATER CONTAMINANTS

Business, residential, recreational and infrastructure developments and facilities may contribute contaminants to stormwater runoff, which may affect the quality of surface or ground water. Roadways and parking lots (collectively, "paved areas") are important contributors to non-point source pollution. Metals, hydrocarbons, salts, and sediments are the contaminants most commonly transported in stormwater runoff from roadways. Traces of metals such as lead, iron, chromium, cadmium, copper, mercury, and zinc as well as various hydrocarbon compounds accumulate on paved surfaces as a result of wear of the roadway, vehicle engines, tires, brakes, and leakage of vehicle fluids. Salts and sediments used in parking lot or roadway maintenance activities also accumulate on road surfaces. During storm events, these accumulated materials are carried to receiving waters via stormwater runoff. The contaminants carried

in runoff from paved areas may have adverse affects on water quality and aquatic ecosystems if they occur in surface waters in sufficient concentrations.

Erosion of sediments from exposed soil surfaces and the siltation of downgradient water bodies may potentially result in short-term or cumulative water quality impacts. The transport of sediments to water bodies results in increased suspended solid concentrations within the water column of the receiving waters. Recreational, residential, or landscaped areas within commercial developments may also contribute nutrients (nitrogen and phosphorus) from lawn or garden fertilizers or animal wastes, as well as pesticide or herbicide residues.

BEST MANAGEMENT PRACTICES

This section describes a range of Best Management Practices (BMPs) that should be incorporated into the design and operations of new or reconstructed facilities at Devens to mitigate and reduce impacts associated with stormwater contaminants. It also outlines various treatment mechanisms which can be applied by each site user in developing a site-specific SWPPP, reports their effectiveness, and discusses their appropriate use. Water quality treatment objectives can be met through a variety of structural and non-structural BMPs. Site-specific proposals should be reviewed by the Devens Enterprise Commission to see that Devens water quality objectives will be accomplished.

Structural BMPs

Structural BMPs are engineered and constructed elements of site drainage design intended to remove sediments and other contaminants from stormwater runoff prior to discharge to a street drainage system, a wetland or surface water body, or a ground water recharge system.

Catch Basins

Catch basins with hood traps and sumps are drainage structures located at low points or along water flow paths throughout the drainage area to intercept and collect surface stormwater runoff. Catch basins convey stormwater via pipes into a closed drainage system, and should be used as the first measure in stormwater management from paved areas and parking lots.

When stormwater flows into the catch basin, sediment settles into a sump. The hood trap is designed to retain floatable debris and petroleum products within the catch basin, and thereby improve water quality. Figure A-5 (see Appendix) provides a schematic illustration of a typical catch basin with a sump and hood trap. When designed with sumps and hood traps, catch basins can effectively remove sediments and adsorbed pollutants from stormwater runoff. When properly maintained, catch basins remove 50-70 percent of sediment present in stormwater runoff.

Oil/Water Separators

Oil/water separators are underground structures used within a drainage system to collect and separate oil, gas, grease, and other floatable petroleum-based chemicals from stormwater runoff. Oil/water separators are used to treat

stormwater runoff from parking areas to remove floatable materials and suspended solids not removed by the catch basin. When catch basins and oil/water separators are used in combination, the drainage system provides an even greater degree of pollutant removal efficiency. Figure A-6 (see Appendix) presents a schematic diagram and details on characteristics and requirements of the oil/water separators which could be installed by individual site users at Devens.

The oil/water separators should be located to intercept potential releases of petroleum products or floating material resulting from an accidental release or spill. The chambers of the oil/water separator provide for a freeboard volume to capture floating petroleum hydrocarbons, accommodating an accidental release of petroleum product. For maximum effectiveness, oil/water separators should be designed to be "off-line" to intercept low flows which constitute the "first flush" of stormwater runoff. Larger storm flows should bypass the structure to avoid flushing accumulated sediments. Separators should be installed where stormwater discharge may affect sensitive surface or ground water resources, or where facility use creates a potential for spills.

Filter Strips/Level Spreaders

Filter strips are linear features over which low volumes or low velocity stormwater flows pass. The rough surface and absorptive substrate of a filter strip slows stormwater velocity and removes and traps sediments. These are typically installed along the edge of a parking lot or roadway, particularly where the drainage area is small.

A vegetated filter strip is a vegetated area, contiguous to a developed area, designed to accept overland sheet flow. Filter strips can be composed of an undisturbed forested area or created from a disturbed area by proper seeding and planting. Level spreaders are structural devices used to capture and evenly distribute runoff while reducing the potential for channelization. Filter strips should only be located on slopes of 5 percent or less to avoid channelization and enhance filtering and infiltration of stormwater runoff. A level spreader should be used along the entire top edge of a vegetated filter strip. This can be a stone filled trench that evenly distributes the stormwater runoff. The length and width of the filter strip will be determined based on site-specific conditions to achieve the desired removal efficiency.

Grassed Swales

A grassed swale (see Appendix Figure A-7) is a grassed waterway used to convey stormwater runoff. Swales have a limited capacity for stormwater management and are used primarily in combination with other BMPs to meet stormwater management requirements. Swales can improve water quality through infiltration and sediment deposition. Swales can be made more effective if check dams are installed along the flow path to reduce runoff velocity thereby promoting infiltration and sediment deposition. The bottom of the swale must have slopes close to zero to prevent excessive velocities and erosion within the swale. There must be a minimum separation distance of two feet between the bottom of the swale and the seasonal high water table. Swales should be designed to accommodate peak runoff volumes from the 100-year storm.

Outlet Protection

Outlet protection is required at the discharge points from any stormwater basin, grassed swale, or pipe conveyance system to minimize soil erosion due to high velocity stormwater flows. An effective means of outlet protection should reduce stormwater flow to a non-erosive velocity (less than 2 feet per second) and eliminate the potential for scouring below the outfall. Acceptable measures include rip-rap aprons or stilling basins, generally in combination with flared-end sections. Outlets from stormwater drainage/management systems should be set back as far as practicable from wetlands or surface waters, to allow infiltration and sediment trapping to occur in upland areas.

Stormwater Management Basins

Constructed stormwater management basins are effective BMPs for control of the rate and quantity of stormwater runoff. This section describes three types of constructed basins, and identifies general construction and design standards.

Wet Basins - Wet basins are constructed stormwater basins which maintain constant ponded water. These are extremely effective water quality BMPs, if proper design and maintenance procedures are followed (see Appendix Figure A-8). A high removal rate of sediment, contributors to biological oxygen demand (BOD), organic nutrients, and trace metals can be accomplished using a wet basin. This type of BMP also reduces the peak discharge rates from stormwater runoff. Gravity settling is the primary water quality treatment mechanism for particles and sediments in the basin.

The following general considerations should be followed for basin siting and design for site users at Devens. Wet basins should be located in a naturally low area in the landscape, however, the basin floor should be at least four feet above the seasonal high water level to reduce the potential for contaminants to enter the ground water. Basin side slopes leading down to the permanent pool should be 3:1 or flatter. Low slopes promote vegetative diversity, erosion control, pollutant removal, and safety. A low shelf should be constructed within and around the basin for vegetation establishment, maintenance and safety.

The minimum required permanent pool volume is determined by multiplying the total impervious surface areas (not including roof tops) of the contributing watershed by one inch. A minimum length to width ratio of 3:1 is required for any basin. The average depth should be approximately three to six feet; the deep section of the permanent pool must have a minimum depth of three feet and a maximum depth of 10 feet. All basins must have an emergency outlet to accommodate storm flow volumes in excess of the 100 year storm. All inlet and outlet concentrated flow areas should be protected from erosion and scouring. Inlets and outlets should be separated by the maximum practicable distance, to increase flow path length and promote settling or removal of sediments and contaminants. Wherever possible, basins should be designed to provide an indirect or interrupted flow path between the inlet or outlet.

Extended Detention Basins - Extended detention basins are very useful for controlling excessive peak discharge rates, removing pollutants, and controlling increases in downstream bank erosion. Extended detention basins provide two stages of detention. The upper stage is used to store runoff volumes from larger infrequent storms, while the lower stage detains runoff water quality volume

from the site and is managed as a shallow wetland area. Extended detention basins are effective in controlling post-development peak discharge rates at or below pre-development levels for specified design storms.

The basin should be designed as a two stage facility with the upper stage sized to contain the 2, 10, 25, and 100-year storms. The minimize size for the lower stage must be equal to the runoff volume of one inch multiplied by the impervious area. The minimum length to width ratio of the basin should be 3:1. The design bottom of the basin will be at least three feet above the seasonal high water level. All inlet and outlet concentrated flow areas should be protected from erosion. Inlets and outlets should be separated by the maximum practicable distance, to increase flow path length and promote settling or removal of sediments and contaminants. Wherever possible, basins should be designed to provide an indirect or interrupted flow path between the inlet or outlet.

Infiltration Basins - Infiltration basins are effective in removing both soluble and fine particulate pollutants in stormwater runoff. These basins are designed to retain all runoff from high-frequency storm events and provide ground water recharge. When properly designed and sized, infiltration basins can completely manage peak discharges from design storms, provide ground water recharge and low flow augmentation, reduce storm runoff volumes, and protect downstream channels from erosion.

Coarse sediments should be removed before entering the infiltration basin. This requirement can be satisfied by installing catch basins, sediment control basins, or oil/water separators of sufficient storage capacity. The maximum allowable ponding time for infiltration systems is 72 hours to insure the necessary storage volume for subsequent storm events. The basin should be designed to hold the volume generated by a 2-year storm. A sediment forebay should be installed to prevent sediment from clogging the basin over time. A minimum of three feet of clearance is needed between the floor of the basin and the seasonal high water table. The floor of the basin should be stabilized by a dense turf of water tolerant vegetation, and inlet and outlet concentrated flow areas should be stabilized to prevent erosion.

Non-Structural BMPs

Non-structural BMPs include long-term maintenance programs and practices intended to provide source control of potential stormwater contaminants.

Deicing

Salts (sodium or calcium chlorides) applied to remove ice and snow from roads, parking lots and sidewalks may enter surface and ground waters from stormwater runoff. Due to their extreme solubility, almost all salts applied for snow and ice removal end up in surface and ground water. Conventional BMPs such as wet basins and grassed swales which rely on settling to remove contaminants are not effective in removing salts in stormwater runoff.

In order to minimize the effects of deicing compounds on surface and ground water quality, alternative methods of removing ice and snow will be encouraged at Devens. The following minimum criteria for salt storage and application, should be required in all water resource protection areas at Devens:

- Piles of sodium chloride, and other chemicals used for snow removal on roads should be stored under cover on flat, impervious surfaces protected from runoff. Drainage structures should be in place to direct runoff away from deicing materials storage areas.

- Outfit deicing material application equipment with calibrated delivery systems for optimal control of application rates.

- Direct application of 100 percent road salt to parking areas is prohibited by the Devens Bylaws. A 4:1 ratio of sand to salt (by weight) has been demonstrated to be effective.

- Deicing materials should be applied at the minimum amounts necessary for public safety.

- The use of deicing materials for roadways is not to exceed the low-salt application rate of 150 pounds/lane mile per pass. For parking lots, this is approximately 100 lbs per acre per pass.

- The use of alternative deicing materials for parking areas will be encouraged. Parking lot maintenance practices should emphasize snow removal, with minimum (spot application) use of deicing chemicals.

Pavement Sweeping

A pavement sweeping program is an effective means of controlling sediments before reaching the stormwater treatment system, and has been demonstrated to provide an 80 percent removal effectiveness. Pavement sweeping removes excess sediments from paved areas, which reduces the amount of sediments entering the treatment system. Facility operators are encouraged to develop a pavement sweeping program as part of the site-specific SWPPP to reduce contaminant loading by providing control of particulates and adsorbed contaminants at the source, before these particulates become components of runoff.

INSPECTION, MAINTENANCE AND MONITORING

This section describes standard procedures for inspection, maintenance, and monitoring the effectiveness of stormwater management controls during operations at Devens. For site developers and users at Devens, the Devens Enterprise Commission (DEC) should impose monitoring requirements for operations such as inspection reports, stormwater sampling, and compliance with performance standards. Also, where necessary, DEC will require site users to establish ambient water quality conditions through surface and ground water monitoring to serve as a baseline to measure future monitoring results. The DEC should determine on a site-by-site basis which site users will be required to conduct baseline and ongoing water quality sampling based upon materials, site location in relation to water resources and other relevant criteria at each site.

Maintenance and Inspection Requirements

Effective long-term stormwater treatment facilities require regular inspection and maintenance. Failures of stormwater management structures can be attributed to a poor inspection and maintenance program and require costly repairs. As part of the Development Permit, site owners or operators should be required to submit an inspection and maintenance program for proposed stormwater treatment facilities included as part of their site development. The following are minimum requirements for an effective maintenance and inspection program.

- develop a maintenance schedule for each type of BMP in the proposed development listing the frequency and type of maintenance operations and responsible parties,
- mow side-slopes and embankments of detention/infiltration basins at least once per year to prevent the establishment of woody vegetation,
- remove trash and litter from stormwater facilities on a regular basis,
- remove sediments from basins at least every 10 years or more frequently if accumulation reduces the design volume by more than 10 percent,
- correct all deficiencies to treatment facilities such as unwanted ponding or scouring,
- stabilize erosion problem areas by reseeding or other corrective measures, and
- prepare and submit semi-annual reports to the Devens Enterprise Commission documenting inspection and maintenance, indicate problem areas, and any corrective measures implemented.

Regular maintenance of all components of proposed stormwater management systems at Devens is required to provide ongoing protection to surface and ground water quality. The key to successful long-term operation of stormwater facilities is proper, regularly scheduled maintenance. The DEC should require routine maintenance operations for facility operators and should require site users to prepare a maintenance schedule for all stormwater facilities and prepare an annual report documenting compliance with the maintenance schedule. The following list describes at a minimum the type and schedule of maintenance required during facility operation for a typical stormwater management system:

- Catch basin grates should be checked monthly and following heavy rainfalls to see that the inlet openings are not clogged by debris. Any debris should be removed from the grates and disposed of properly. Catch basin sumps should be inspected and cleaned semi-annually of all accumulated sediments. Material removed from catch basins should be disposed of by a licensed contractor in accordance with all applicable regulations.
- Oil/water separators should be inspected semi-annually. Depending upon expected inflows into the separator, accumulated petroleum products or other floatables should be removed from the structure by a vacuum pump

truck on an annual or semi-annual basis. Sediment deposited on the bottom of the separator should be removed annually.

- Outfall protection measures should be inspected semi-annually and following major storm events to check for signs of erosion. Any necessary repairs should be performed promptly. All outlet protection structures should be inspected semi-annually and cleaned to remove accumulated sediment.

- Drainage swales should be checked for debris accumulation on a monthly basis. Trash, leaves, branches, etc., should be removed from channel areas. If significant accumulation of silt, sand, and sediment occurs, it should be removed annually. Any channel erosion within the swale should be stabilized as soon as practical.

- Detention basins should be checked monthly and immediately after heavy rainfall events to ensure outlets and inlets are not blocked by litter or other debris. Accumulated debris should be removed as soon as possible. Basin slopes and embankments should be checked for signs of erosion. Eroded slopes should be stabilized to eliminate future deterioration of the structure.

- Wet basins should be checked periodically during wet seasons and after heavy rains to ensure the basin is functioning as designed and containment dikes are not being overtopped. The basin embankment should be stabilized so as not to erode or result in sedimentation within the basin. Accumulated debris and sediment within the basin should be checked at least annually and removed as necessary. Sediment accumulation should be monitored and removed when it reduces the volume of the basin by more than 10 percent.

- Vegetative growth within the basin should be monitored and maintained as needed. Tree and brush growth should be removed annually to protect the structural integrity of the embankment.

- Infiltration trenches should be checked semi-annually and following major storms to check for surface ponding that might indicate clogging. Infiltration trenches may have to be replaced as their permeability decreases over time. Pre-treatment inlets of underground trenches should be checked periodically and cleaned out when sediment depletes more than 10 percent of the available capacity.

- Infiltration basins should be inspected annually for settling, cracking, eroding, leaking, and accumulating sediment. Repairs should be made as necessary. Particular attention should be given to the standing water in the basin. Standing water in the basin beyond the designed specification would indicate that the infiltration capacity of the basin has diminished. Factors that influence clogging such as accumulated sediment or excessive compaction should be determined and any repairs made.

Stormwater Quality Monitoring

A stormwater quality monitoring program should be developed for facility operations to determine whether stormwater treatment systems are effectively removing pollutants from site runoff after development at Devens. The DEC should determine if stormwater quality monitoring is required on a site-specific basis, based on the potential to impact water resources. Any water quality monitoring program should include a statement of objectives, sampling procedures, sampling locations, parameters to analyze, methods of analysis, and details of all quality assurance/quality control (QA/QC) procedures utilized.

Sampling should be planned to determine if stormwater runoff from the site adversely affects water quality in the receiving surface water, and to monitor the effectiveness of the stormwater management and treatment system. To assess impacts to surface waters, samples taken immediately upstream and downstream of the site or its discharge point should be compared. To assess effectiveness of the stormwater management system, samples should be collected at the inlet and outlet of the system.

At each sampling event, surface water samples should be analyzed for a variety of constituents. The parameters should include but not be limited to total suspended solids, total petroleum hydrocarbons, metals (lead, zinc, copper), oil and grease, pH, and turbidity. Stormwater samples should be collected by filling sample bottles directly from the water source. Samples should be bottled in appropriate containers using proper preservation methods.

Chain-of-Custody protocols should be used to ensure the integrity of the sample from the time of collection to date reporting. A Chain-of-Custody Form developed specifically for this sampling effort should be completed at the time of sampling. A Massachusetts-certified laboratory should be contracted to analyze the surface water samples. The selected laboratory should have a QA/QC program to ensure the integrity of the analysis as well as the results of the analysis.

Reports of sampling results should be prepared quarterly and submitted to the DEC. All sampling reports should include the following information:

- Executive Summary,
- Summary of Monitoring Plan,
- Figure showing sampling locations,
- Table of sampling results,
- Narrative discussion of results,
- Narrative discussion of QA/QC, and
- Appendix with copies of laboratory certificates of analysis.

EFFECTIVENESS OF BMPS

Several studies indicate the effectiveness of stormwater operational BMPs in removing contaminants from stormwater runoff from paved areas. In each of these studies, the estimated concentration of contaminants in untreated stormwater runoff at the site was determined using mean concentrations from the EPA's Nationwide Urban Runoff Program report (1983). The concentration of contaminants in treated stormwater runoff at each site was either measured directly, or estimated using the P8 Urban Catchment Model.

The results of four studies are presented in Tables 1 through 4 below. These studies demonstrate that stormwater management systems consisting of catch basins, oil/water separators, and detention basins are effective at removing typical stormwater contaminants. Removal of suspended solids by such systems generally exceeds 90 percent, while removal of organic compounds and metals exceeds 50 percent. This value is lower for compounds with a high level of solubility, such as copper. In most cases, more than 80 percent of hydrocarbons present in parking lot runoff are removed by these systems. The data (see Table 4) also indicate that removal efficiency is high even for systems consisting only of catch basins, when an aggressive pavement sweeping program (a non-structural BMP) is also implemented.

Table 1 **COMPARISON OF ACTUAL (MEASURED) POLLUTANT LOADINGS VS. ESTIMATED UNTREATED LOADINGS AT LOGAN AIRPORT***

Constituent	Actual Loading**	Estimated Loading	Removal Efficiency
TSS	156,000	1,750,000	91%
Copper	575	447	0
Lead	10	3300	99%
Zinc	1090	2840	62%

* Treatment system consists of catch basins and oil/water separators. Estimated loadings based on NURP mean values (EPA National Urban Runoff Program, 1983).

** lbs/year

Source Boston-Logan International Airport, Final Generic Environmental Impact Report, July 15 1993.

Table 2

COMPARISON OF ESTIMATED TREATED AND UNTREATED STORMWATER RUNOFF AT A PROPOSED MALL*

Constituent	Untreated Runoff**	Treated Runoff	Removal Efficiency
TSS	100	9.5	90%
Phosphate	0.33	0.125	62%
Total Nitrogen	1.5	0.68	55%
Copper	0.035	0.02	54%
Lead	0.04	0.01	82%
Zinc	0.16	0.07	55%
Hydrocarbons	2.5	0.44	83%

* Treatment system consists of catch basins, oil/water separators, and wet basins. Estimated concentrations of untreated runoff based on NURP mean values (EPA National Urban Runoff Program, 1983). Estimated concentrations of treated runoff determined using P-8 Urban Catchment Model.

** mg/l

Source Shrewsbury Mall, Draft Environmental Impact Report, August 1993.

Table 3

COMPARISON OF ESTIMATED TREATED AND UNTREATED STORMWATER RUNOFF AT A PROPOSED POSTAL SERVICE FACILITY*

Constituent	Untreated Runoff**	Treated Runoff	Removal Efficiency
TSS	307	19.4	93.3%
Phosphate	0.72	0.26	62.9%
Total Nitrogen	3.37	1.53	54.1%
Copper	0.09	0.043	54.1%
Lead	0.05	0.008	84.1%
Zinc	0.51	0.23	54.1%
Hydrocarbons	5.11	0.79	84.1%

* Treatment system consists of catch basins, extended detention basins, and filter berms. Estimated concentrations of untreated runoff based on NURP mean values (EPA National Urban Runoff Program, 1983). Estimated concentrations of treated runoff determined using P-8 Urban Catchment Model.

** mg/l

Source Stormwater Management Plan Summary, Northwest Mail Processing Center, Waltham MA, April 1994.

Table 4

COMPARISON OF ESTIMATED TREATED AND UNTREATED STORMWATER RUNOFF AT THE SOUTH SHORE PLAZA*

Constituent	Untreated Runoff**	Treated Runoff	Removal Efficiency
TSS	180	33	82%
Phosphate	0.15	0.04	73%
Copper	0.043	0.05	0
Lead	0.182	0.04	78%
Zinc	0.202	0.08	60%
PAH	-	ND***	-

* Treatment system consists of catch basins, oil/water separators, and wet basins. Estimated concentrations of untreated runoff based on NURP mean values (EPA National Urban Runoff Program, 1983). Estimated concentrations of treated runoff determined using P-8 Urban Catchment Model.

** mg/l

*** Not detectable

Source South Shore Plaza, Braintree MA, Final Environmental Impact Report, April 15, 1992.

STORMWATER POLLUTION PREVENTION PLAN

The Devens Enterprise Commission (DEC) is committed to protecting the surface and ground water resources at Devens through enforcing Devens Enterprise Zone, state and federal environmental regulations. The purpose of developing performance standards for Devens is to control both the quantity and quality of stormwater runoff at Devens. Historic development at Devens has resulted in uncontrolled releases of stormwater runoff from impervious areas which over time have contributed to the degradation of the water quality of the Nashua River. Adherence to the following criteria, by all site users at Devens, should result in the design and construction of effective stormwater treatment systems which will protect and preserve the Devens aquifer, wetlands and surface water bodies, and other environmental resources at Devens.

OBJECTIVES

Stormwater Pollution Prevention Plans (SWPPP) are intended to document that appropriate BMPs have been selected to provide protection of surface and ground water resources during and after construction at any site at Devens. During construction, the primary objective of the SWPPP is to avoid or minimize the transport of sediments off the construction site through the design and implementation of an effective set of BMPs and a site-specific inspection and monitoring program. Following construction, the primary objectives of the SWPPP are to minimize increases in the rate or volume of stormwater runoff, remove pollutants from runoff (primarily by trapping or retaining sediments), reducing pollutant sources, and encouraging ground water recharge of treated runoff.

A SWPPP is required by the EPA under the National Pollutant Discharge Elimination System (NPDES) permit program for all construction sites greater than 5 acres in extent. The guidelines for SWPPP preparation provided below are intended to meet the requirements of the EPA permit program as well as allow site-specific solutions that will protect surface and ground water resources at Devens. Although not required by the EPA, it is recommended that any site construction at Devens be required to complete a SWPPP to protect water quality during construction. For construction sites larger than 5 acres, a Notice of Intent to perform construction under the EPA General Permit must be submitted to the EPA (Stormwater Notices of Intent, P.O. Box 1215, Newington VA 22122) at least 48 hours prior to the start of construction.

GUIDELINES FOR STORMWATER POLLUTION PREVENTION PLANS

Stormwater Pollution Prevention Plans (SWPPP) should be prepared for any construction activity at Devens, including the redevelopment of existing sites, road construction, and construction on previously-disturbed sites. The SWPPP should clearly indicate the specific BMPs that should be implemented during and after construction to control sedimentation, prevent alteration of surface waters, and provide long-term protection for surface and ground water resources. The following should be required elements of any SWPPP prepared for Devens.

Analysis of Existing Conditions

An analysis of existing site conditions should be prepared to determine what site conditions could contribute to erosion or sedimentation problems during the construction process. This should include an analysis of any existing stormwater drainage system, a site cover (pervious vs. impervious areas) analysis, drainage areas and runoff rates, locations of steep slopes or erodible soils, depth to ground water, and should identify wetlands or surface waters within the project area.

Construction Analysis

An analysis of construction activities should be prepared to determine what construction activities could contribute to erosion or sedimentation during the construction process. This should include an analysis of the length and gradients of any slopes within the construction area, areas to be disturbed, changes in surface drainage flow patterns, potential discharges to existing drainage systems or surface waters, areas where dewatering may be likely, and a sequence of construction activities by area.

Construction BMPs

Site-specific BMPs should be identified for the project site, based on the construction analysis described above. At a minimum, the SWPPP should include a list of BMPs, specifications and standard details for each BMP, and a plan that identifies where each BMP should be used during construction. It may be necessary to prepare several construction sequencing plans showing different locations for BMPs during site development. A SWPPP should also identify the person(s) with primary responsibility for implementation of the Plan.

BMPs should be included in any SWPPP to address the following issues:

- Erosion and sedimentation control,
- Construction sequence,
- Staging areas,
- Equipment storage, maintenance and refueling,
- Sedimentation basins,
- Dewatering,
- Dust control,
- Waste disposal,
- Spill response,
- Off-site tracking of sediments,
- Temporary stabilization,

- Inspection and monitoring.

Analysis of Proposed Conditions

An analysis of proposed conditions should be performed to identify sources of sediment or other stormwater contaminants, drainage areas and patterns, stormwater runoff rates, areas where recharge is feasible, and rates of recharge. The purpose of this analysis is to identify sources of pollutants and potential means of reducing discharge of stormwater and associated contaminants.

Operations BMPs

The SWPPP should identify site-specific BMPs for the project site, based on the analysis described above. At a minimum, the SWPPP should include a list of BMPs, specifications and standard details for each BMP, and a plan that identifies where each BMP should be installed. An on-going inspection and maintenance program is essential to continued protection of water resources. A SWPPP should also identify the person(s) with primary responsibility for implementation of the Plan.

BMPs should be included in any SWPPP to address the following issues:

- Structural BMPs for control of stormwater runoff rates,
- Structural BMPs for reduction of sediment loading,
- Structural BMPs for reduction of contaminant loading (particularly oils and other hydrocarbons),
- Non-structural BMPs for source reduction of potential contaminants,
- Spill response,
- Inspection and maintenance, and
- System monitoring.

Industrial Activities

The EPA requires preparation of a Stormwater Pollution Prevention Plan for any industrial activity where equipment or materials may come into contact with precipitation or where stormwater is discharged to a surface water body or municipal street drainage system. The majority of designated industrial activities do not require Individual NPDES discharge permits, but are subject to the General Permit which requires preparation of and adherence to a SWPPP. The EPA publication "Stormwater Management For Industrial Activities. Developing Pollution Prevention Plans and Best Management Practices" (U.S. EPA, 1992, EPA/832/R-92/006) provides detailed guidance on the preparation of site-specific SWPPPs.

"Industrial Activities" include facilities subject to stormwater effluent limitation guidelines or toxic pollutant effluent standards; heavy manufacturing facilities; hazardous waste treatment, storage or disposal facilities; recycling facilities; transportation facilities; or other industries where materials or equipment are handled or stored in areas where they may be exposed to precipitation. Any facility meeting these definitions must prepare a SWPPP that includes the

following elements:

- Designation of a responsible individual or team,
- Identification and evaluation of pollutant sources and risks,
- Site map,
- Identification and implementation of appropriate BMPs, including good housekeeping practices and stormwater management,
- Spill response plan,
- Stormwater sampling plan,
- Monitoring plan,
- Record keeping procedures and responsibilities,
- Process and schedule for evaluation and amendment of SWPPP.

PERFORMANCE STANDARDS

The design of post-construction stormwater management systems requires guidance to conform to the requirements of the Devens Bylaws for protection of surface and ground water resources. This section provides performance standards that have been prepared for construction on existing developed sites, roadway construction, and new construction on undeveloped sites that are specific to each of the Devens Water Resources Protection Districts.

Water Resources Protection Districts

The overall goal of the following performance standards and design criteria is to minimize adverse impacts on the surface and ground water resources at Devens while allowing development to proceed in an environmentally responsible manner. To achieve this goal the Devens Enterprise Zone has been divided into four Water Resource Planning Areas over which differing levels of water resource protection will be applied. The zones are defined as:

- Zone I: area within 400 feet of a well,
- Zone II: areas which contribute ground water to existing wells,
- Aquifer Zone: areas over the aquifer which are not included in Zone I or Zone II, and
- Watershed Areas: all remaining areas of the Devens Enterprise Zone outside the Aquifer Zone, Zone I, and Zone II.

Through the Devens Bylaw, varying levels of protection have been provided for each zone based on its level of sensitivity with the highest levels of control established for Zone I and Zone II. Lesser levels of control, with specific standards, have been established for the Aquifer Zone and Watershed Areas. Implementing the following objectives for stormwater management will enhance the water quality and quantity of runoff recharged to the aquifer through the use of BMPs.

In order to protect and enhance existing water quality at Devens, performance standards to control both water quantity and quality have been developed for each Water Resource Protection (WRP) District. The minimum standards for water quality and flood control may be achieved through a combination of site

design, and structural and non-structural measures. The intent of stormwater management is to first reduce the volume of runoff generated, by minimizing the extent of impervious surfaces and enhancing overland flow and infiltration, and then to treat or control the off-site transport of runoff.

No performance standards have been prepared for Zone I because only work related to the maintenance or operation of a well will be allowed within Zone I. No development will occur within this area, which is defined as the area within 400 feet of a well.[1]

The following objectives should be met by all individual site users within all Water Resource Protection (WRP) Districts at Devens:

- Meet or reduce the peak rate and volume of runoff leaving the site to pre-existing conditions in order to minimize the risk of downstream flooding,
- Maintain adequate surface water flows to existing wetlands or surface water bodies,
- Maintain or improve water quality in stormwater leaving the site, and
- Maximize recharge of stormwater runoff to the aquifer.

The stormwater management objectives listed above are intended as guidelines for users, with the primary objective being to maintain or improve existing stormwater quality. Therefore, any reasonable means of meeting these objectives should be considered acceptable by the DEC, provided that supporting documentation is presented to the DEC for review. Some standards require specific methods of construction or evaluation to be used to meet the requirements. Methods which have been evaluated or approved for use have been identified. The intent of these standards is to encourage innovation to meet the water quantity and quality goals.

Methods

The following methods are recommended for use in the analysis of stormwater runoff rates, volumes and quality.

- Runoff volumes or rates should be calculated for the 2-, 10-, 25-, and 100 year frequency, 24-hour duration, Type III distribution storm events.
- Measurement of peak discharge rates must be calculated using the property boundary as the design point.
- Technical Release 55 (TR-55) developed by the Soil Conservation Service (SCS), and revised in 1986, should be used for calculating runoff volume.
- Stormwater control measures should be designed to control the peak discharge rate of the 100-year, 24-hour storm event.

1/ The only exception to this is that two existing roads, Patton Road and MacPherson Road, are within Zone I. These roads will continue to be used.

- Water quality data are based on the point of discharge which is defined as "a conveyance (including pipes, conduits, ditches and channels) primarily used for collecting and conveying stormwater runoff".

- Water quality evaluations must be based on a 1-year storm event.

DEVELOPMENT IN UNDEVELOPED AREAS

Construction of new facilities within areas of Devens that are currently undeveloped, provides the greatest opportunity for the protection of water resources. Such sites generally are not constrained by existing drainage infrastructure, and have adequate space to construct stormwater management and treatment systems. These sites should be held to the highest standards in review of SWPPPs or permit applications.

Best Management Practices

For new construction on undeveloped sites, minimum levels of stormwater protection through use of BMPs may be specified. Such construction should utilize catch basins with hood traps and sumps, oil/water separators above any point of discharge from the site, and a source reduction program that includes sweeping and salt reduction. Additional BMPs should be identified for each site if necessary to meet the appropriate performance standards.

Performance Standards

Performance standards for management of stormwater runoff quality and quantity should be specified for any new construction on undisturbed sites. These should include, at a minimum, the following:

- The stormwater management system should result in an 80 percent reduction in total suspended sediment loading to surface waters or wetlands, based on a comparison of water entering and leaving the stormwater management system. This 80 percent standard only applies to particles larger than 50 microns (0.05 millimeters), and does not include fine silt/clay particles that are not removed by settling or filtration.

- The stormwater management system should result in an 80 percent reduction in petroleum hydrocarbon loading to surface waters or wetlands, based on a comparison of water entering and leaving the stormwater management system.

- In Aquifer and Zone II areas, projects should not result in any decrease in ground water recharge.

- The project should not result in any increase in runoff rates from the site.

- No new direct discharge of runoff to a wetland or surface water should be created. Any runoff should be discharged into upland areas, generally set back from the limits of wetlands or water bodies, and should flow across vegetated areas wherever practicable.

- On-site stormwater recharge for the 2-year storm event is required for all sites within Aquifer Protection districts.

- Post development total runoff volume from a site should in no case, increase over the pre-development total runoff volume for a 2-year storm by more than 10 percent. All efforts should be taken to ensure that the post development runoff volume is less than or equal to the pre-development runoff volume.

- Wet basins are the preferred method of water quality treatment.

- If the project is located in Zone II, runoff from paved areas should be treated to remove 80 percent of sediments and hydrocarbons prior to discharge to an infiltration or ground water recharge structure.

- If the project is located in Zone II, there should be no increase in runoff volume to a surface water, wetland, or off-site drainage system.

DEVELOPMENT OF PREVIOUSLY DEVELOPED AREAS

Construction of new facilities within areas of Devens that are currently developed is generally constrained by existing drainage infrastructure and site size limitations. These sites may not have adequate space to construct stormwater management and treatment systems. The objective for "retrofitting" such existing sites should be to provide improvement in water quality leaving the site, to the greatest extent practicable given specific constraints and circumstances. The transport of sediments and petroleum hydrocarbons to surface or ground water should be reduced, and runoff rates should be maintained or reduced. Where extensive redevelopment of large parcels occurs, the complete redesign and reconstruction of the local drainage system may be appropriate.

Best Management Practices

For reconstruction of developed sites, minimum levels of stormwater protection through use of BMPs should be specified. During construction, the existing drainage system should be protected against the entry of sediments or contaminants, and measures should be implemented to prevent transport of sediments off-site. Existing catch basins, and any new catch basins, should be replaced with catch basins with hood traps and sumps. Oil/water separators should be installed above any point of discharge from the site, and a source reduction program that includes sweeping and salt reduction should be implemented. Additional BMPs should be identified for each site where feasible, to meet the appropriate performance standards.

Performance Standards

Performance standards for management of stormwater runoff quality and quantity should be specified for any development of previously developed areas.

These should include, at a minimum, the following:

- The stormwater management system should result in an reduction in total suspended sediment loading to surface waters or wetlands, based on a comparison of water entering and leaving the stormwater management system.

- The stormwater management system should result in an reduction in petroleum hydrocarbon loading to surface waters or wetlands, based on a comparison of water entering and leaving the stormwater management system.

- The project should not result in any decrease in ground water recharge for any project within an Aquifer District or a Zone II.

- The project should not result in any increase in runoff rates from the site.

- No new direct discharge of runoff to a wetland or surface water should be created. Any runoff should be discharged into upland areas, generally set back from the limits of wetlands or water bodies.

- If a discharge is being reconstructed, it should be set it back if possible.

STORMWATER POLLUTION PREVENTION FOR ROADWAYS

The construction of new roadways, or reconstruction of existing roadways, has the potential to affect surface or ground water quality. Performance standards are provided below that are specific to roadway construction within each of the WRPs at Devens.

Best Management Practices

For any roadway construction, minimum levels of stormwater protection through use of BMPs may be specified. Erosion and sedimentation control during construction should be developed to prevent off-site transport of sediments. During roadway reconstruction, any existing drainage system should be closed or protected against the entry of sediments. Additional BMPs should be identified for each site to ensure that the appropriate performance standards are met.

Performance Standards

It is difficult to specify performance standards for roadway construction, as it is generally not feasible to construct stormwater management basins or other constructed BMPs within roadway corridors, and may not be possible to control some potential sources of roadway contaminants. For roadways, it is more appropriate to specify BMPs that protect surface or ground water to the levels required within each of the Devens WRPs. These should include, at a minimum, the following for all roadway construction projects:

- No new direct discharge of runoff to a wetland or surface water should be created. Any runoff should be discharged into upland areas, generally set back from the limits of wetlands or water bodies.

- Outlet protection should be used at any point where concentrated runoff leaves a component of the drainage system.

- A source reduction program, using regular sweeping and reduction in salt usage (a maximum of 150 lbs/lane-mile per pass).

- Install detention or infiltration basins where practicable, particularly where these would provide protection to wetlands or surface water bodies.

Watershed District

Protection of water resources within the Watershed District may be enhanced if roadways are constructed/reconstructed using the following BMPs:

- Grass swales to convey stormwater runoff, filter sediments, and enhance recharge,

- Installation of catch basins with hood traps and sumps,

- Outlet protection at the ends of any swales or discharge points.

Aquifer District

Aquifer Districts require a higher level of protection for surface and ground water resources, particularly where roadways are designated as primary routes for transport of hazardous materials. The following BMPs are intended to be used as performance standards within this District.

- Install a closed drainage system with catch basins with sumps and hood traps.

- Catch basins on any designated primary route should be equipped to intercept floating product.

- Utilize outlet protection at the discharge from any drainage system point.

- Install extended detention basins wherever feasible to reduce runoff rates, improve water quality, and promote recharge.

Zone II

Zone II areas require the highest level of protection for surface and ground water resources, particularly where roadways are designated as primary routes for transport of hazardous materials. The following BMPs are intended to be used as performance standards within this District.

- Install a closed drainage system with catch basins with sumps and hood traps.

- Oil/water separators should be installed on any designated primary route, and designed to intercept and contain spills.

- Utilize outlet protection at the discharge from any drainage system point.

- Install extended detention basins wherever feasible to reduce runoff rates, improve water quality, and promote recharge.

RAIL AREA STORMWATER PLAN

The Devens Reuse Plan contains land uses that reflect federal government requests, enhancement of the site's natural resources, development of innovation and technology businesses, and development of rail-related industries. Because the infrastructure system developed over many years of Army use is extensive, the Devens Reuse Plan sought to maintain infrastructure, where possible, in its established location. The existing Rail Area, because it is located over a sensitive portion of the Aquifer and is adjacent to surface waters of Plow Shop and Grove Ponds, presents a challenge for water resource protection planning.

PURPOSE

The Water Resources Protection Plan for Devens calls for a specific stormwater control plan to be provided for the Rail/Industrial area, including an area-wide stormwater management system designed to improve water quality. For the Rail-Related Use Area, specific controls and design measures have been proposed to provide compatibility with and protection of existing water resources. These controls and design measures allow the generation, transportation, storage, and treatment of hazardous waste, associated with the ongoing operations of rail/industrial and trade-related businesses, while providing necessary protection to existing water resources. Acknowledging the sensitivity of the site, efforts must be made to mitigate existing conditions which threaten the ground water, and to establish best management practices using the best available technology to prevent future contamination.

SOURCES OF STORMWATER CONTAMINANTS IN THE RAIL AREA

Potential contaminants from railroad yards and maintenance areas include acids, bases, chloride, metals, nitrate, pesticides and herbicides, phenols, sodium, sulfate, surfactants, and VOCs. The B&M/Springfield Terminal Railway Company owns and operates a rail yard (the Hill Yard) adjacent to the Industrial Zone of the Main Post, in proximity to Grove Pond. The B&M Railroad has been identified as a potentially responsible party for a spill area along the rail line between Plow Shop and Grove Ponds.

BEST MANAGEMENT PRACTICES

Portions of the Rail-Related Use Area lies within Watershed, Aquifer and Zone II Water Resource Protection WRP Districts. All provisions mentioned above which apply to the WRP Districts apply to the respective portions of the Rail-Related Use Area, with the exception that the Rail Area provisions allow generators of hazardous waste beyond the level of Very Small Quantity Generators (VSQGs). The following site-specific BMPs have been established for the Rail-Related Use Area:

- On-site disposal of hazardous wastes is prohibited,
- Detention, treatment, and on-site recharge for pavement and roof runoff to hold peak rates below current rates, must be provided,
- The stormwater system must be designed to intercept and isolate potential spills and provide for timely clean-up,
- Response capabilities to respond to releases must be provided on-site,
- The stormwater treatment system must be designed to preserve and improve current water quality conditions,
- The area-wide stormwater system designed for the Rail Area must be phased in, in advance of sites as they are developed.

Because this is a common system maintenance will be provided by the Land Bank as the provider of Municipal Services.

FUTURE PLAN DEVELOPMENT

In advance of development, the Land Bank will provide detailed design and supporting calculations for the rail area drainage system. The system will be designed to be implemented in phases. Once constructed, Land Bank will conduct regular monitoring, inspection, and maintenance of the system to ensure that the system provides long-term protection of water quality.

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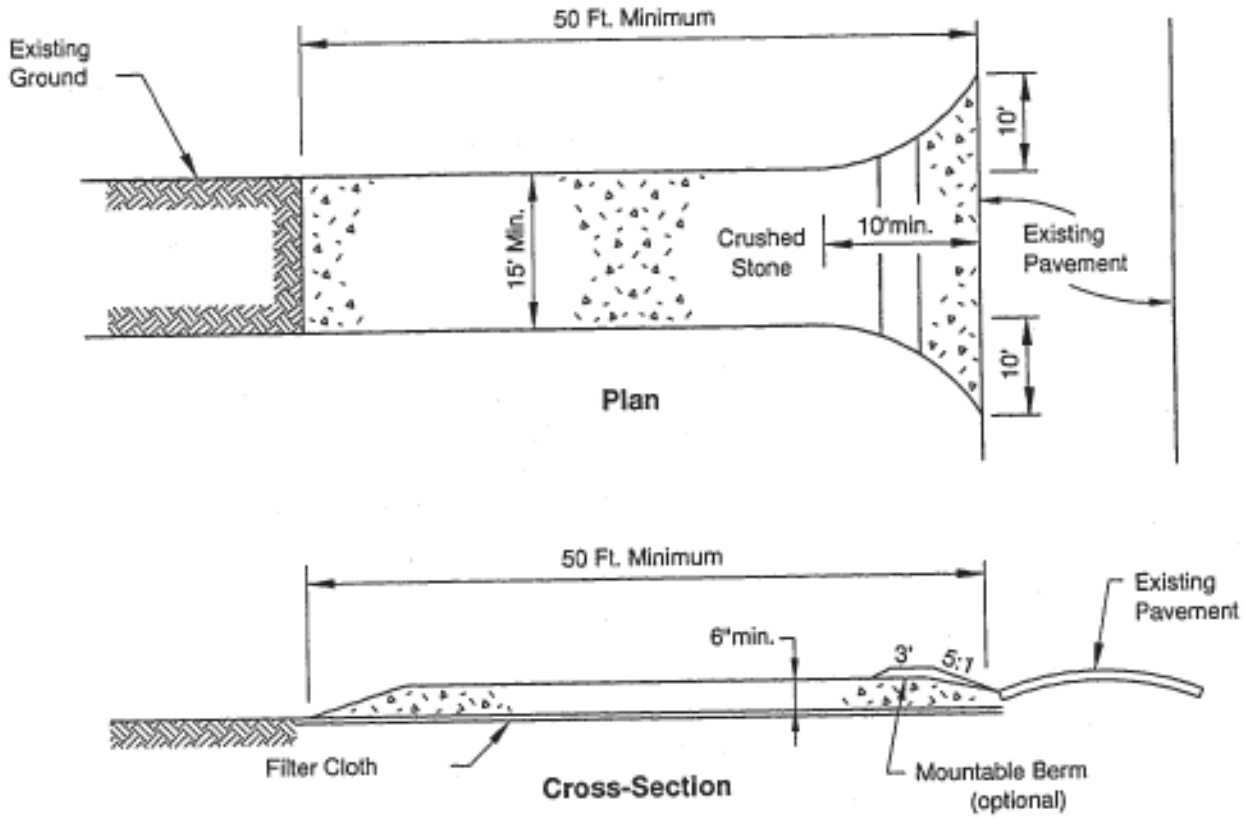
APPENDIX



Construction Specifications

- Stone size - use 2" crushed stone.
- Length - recommend greater than or equal to 50 feet where soils are sands and gravels, and 100 feet in silts and clays.
- Thickness - not less than six (6) inches.
- Width - fifteen (15) foot minimum, but not less than the full width at points where ingress or egress occurs.
- Filter cloth - should be placed over the entire area prior to placing of stone.
- Surface water - all surface water flowing or diverted toward construction entrances should be piped across the entrance. If piping is impractical, a mountable berm should be permitted.
- Maintenance - the entrance should be maintained in a condition which prevents tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand and repair or cleaning of any measures used to trap sediment. All sediment spilled, dropped, washed or tracked onto public rights-of-way must be removed immediately.
- Periodic inspection and needed maintenance shall be provided.

Not to Scale

DEVENS

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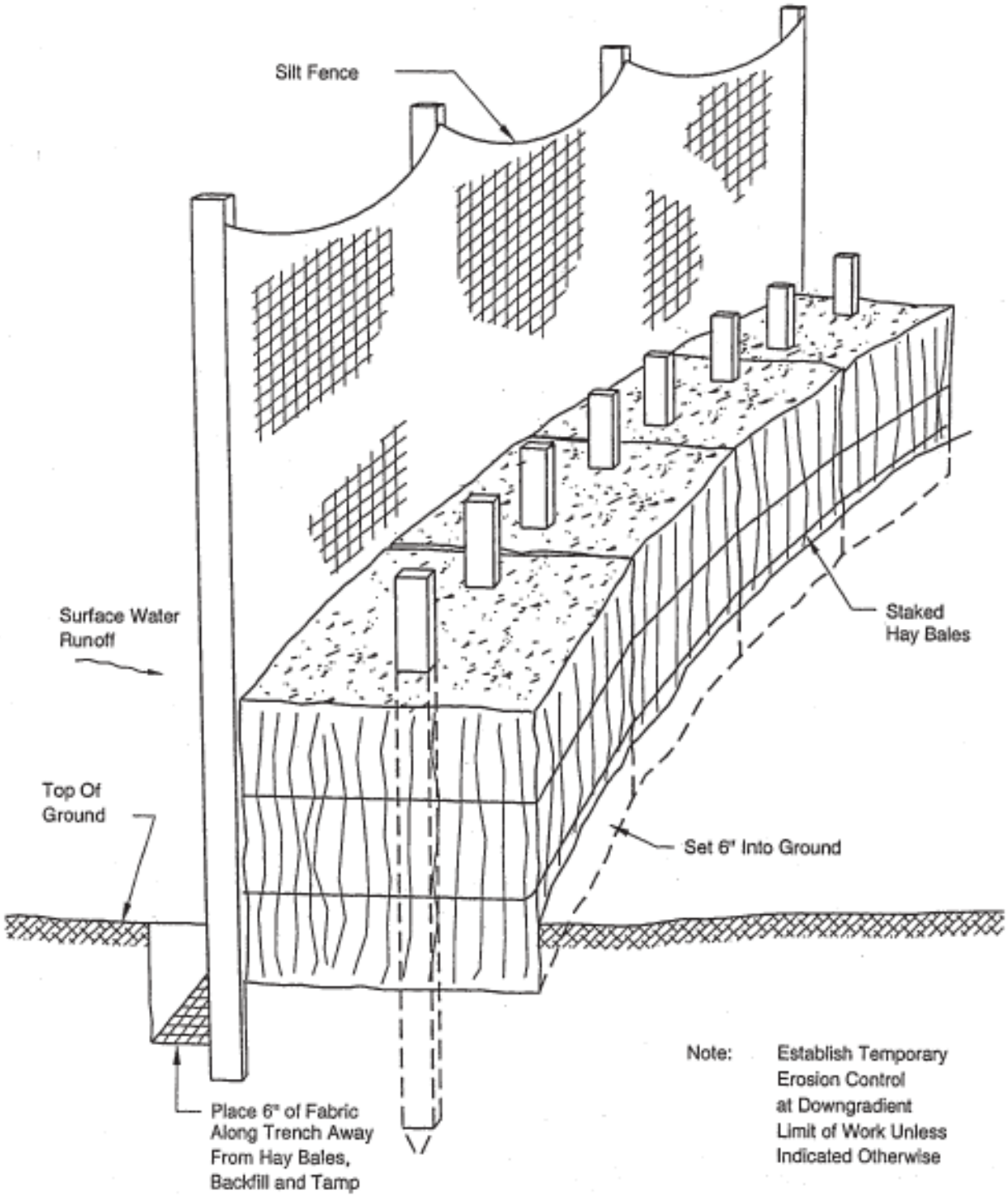
Construction Tracking Pad

Figure A-1



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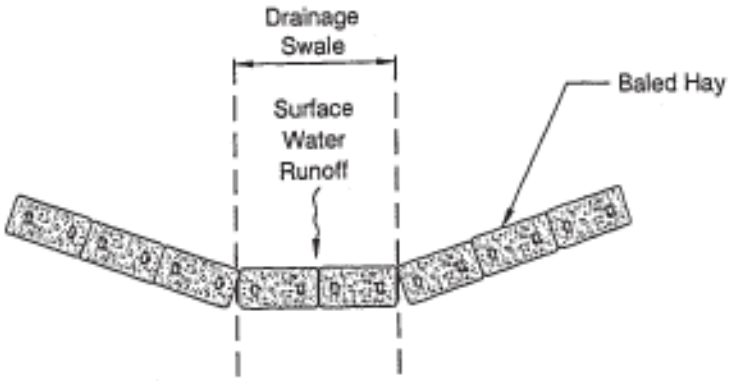
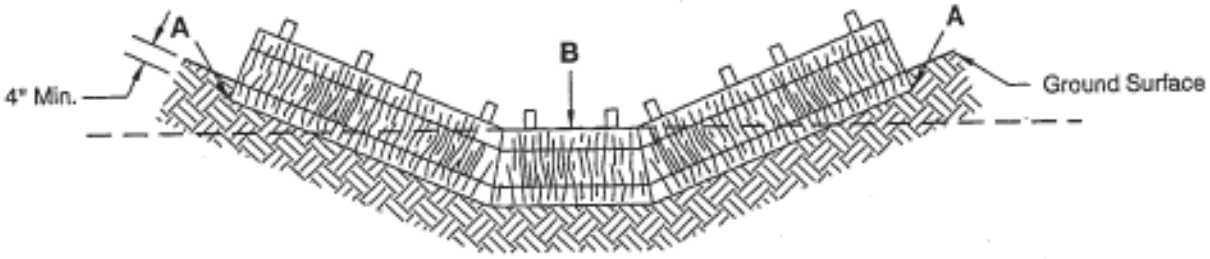
Staked Hay Bales and Silt Fence

Figure A-2

April 1995



Plan



Points A Should Be Higher Than Point B

Section

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Source: Installation of Straw and Fabric Filter Barriers for Sediment Control, Sherwood and Wyant.

DEVENS

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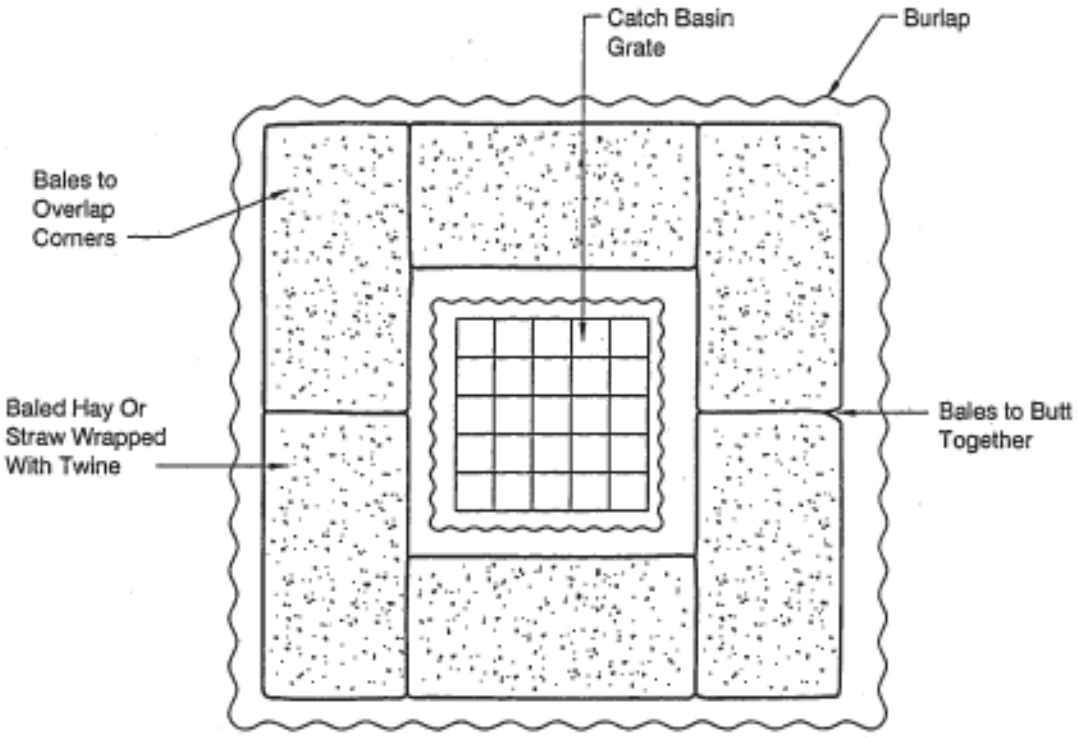
Proper Placement of Hay Bale Barrier
Check Dam in Drainage Way

Figure A-3

April 1995



- Surround street drainage structure inlet with hay bales prior to construction and maintain until construction is completed. Accumulated sediments shall be removed.
- Hay Bales placed on pavement should have burlap placed between pavement and hay bale.

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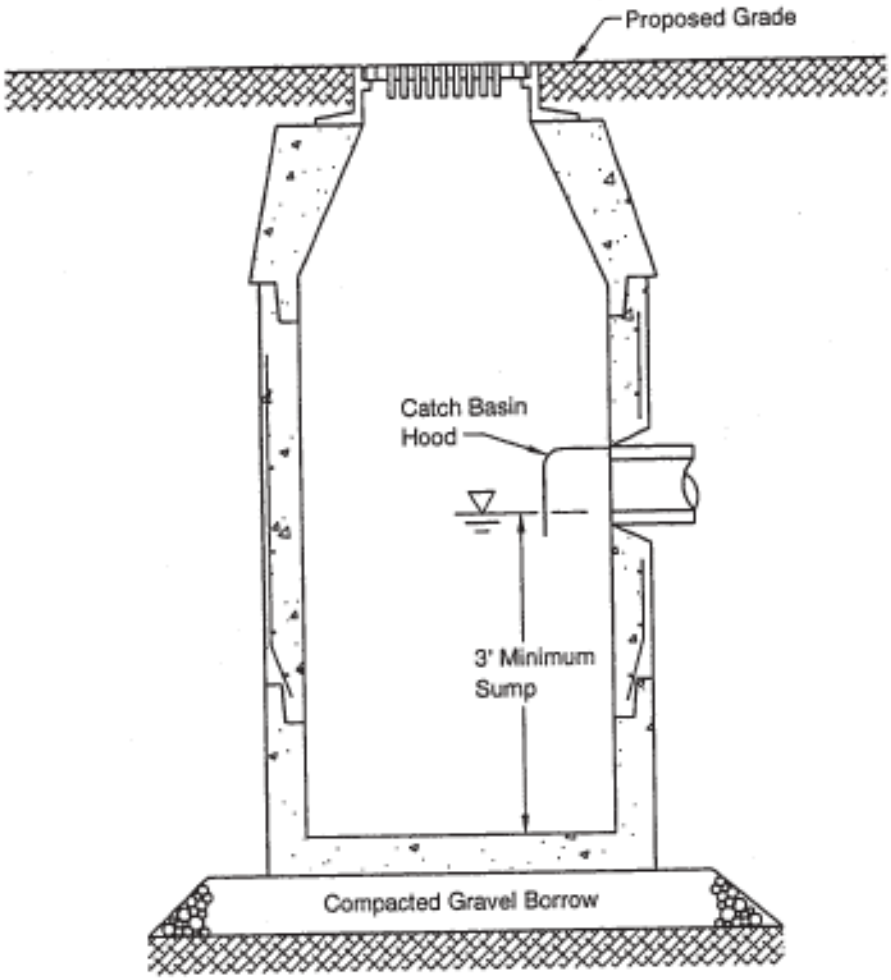
Storm Drain Inlet Protection

Figure A-4



Design Criteria:

- 1/2 acre maximum tributary area.
- Capable of conveying the 25 year storm.
- 3 foot minimum sump for sediment removal.
- Outlet to be fitted with hoods to enhance sediment removal and enhance oil/water separation.
- Precast structure with tight joints to prevent leakage.
- Regular maintenance schedule.

Size:

- Standard 4 foot diameter catch basin with 3 foot sump..

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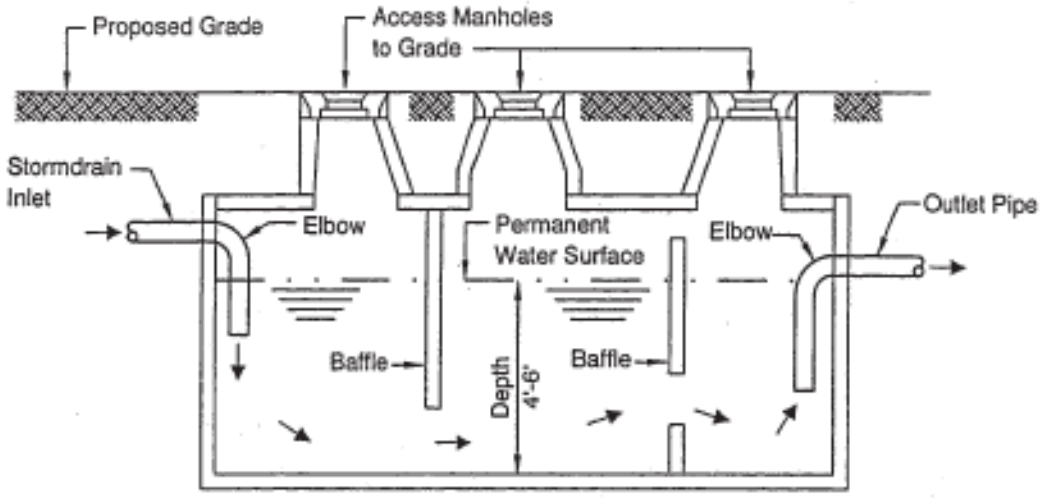
Catch Basin

Figure A-5



Design Criteria:

- Capture the initial half inch of stormwater runoff from paved surfaces.
- Set off-line from the main stormwater trunk lines in conjunction with a diversion manhole.
- Overflow should be maintained in the main drainage trunk line.
- Three compartment watertight unit with an access manhole provided for each compartment.
- Sized to detain the runoff for a minimum of two minutes.
- Inverted elbow pipe extends 3 feet into permanent pool to adequately separate oil from water.
- Baffle plates installed from side walls to prevent resuspension and upward migration of sediments.
- Periodic removal of oil deposit to be accomplished by skimming/pumping.
  Tank must not be pumped dry.

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Oil / Water Separator
Three Chamber Design

Figure A-6

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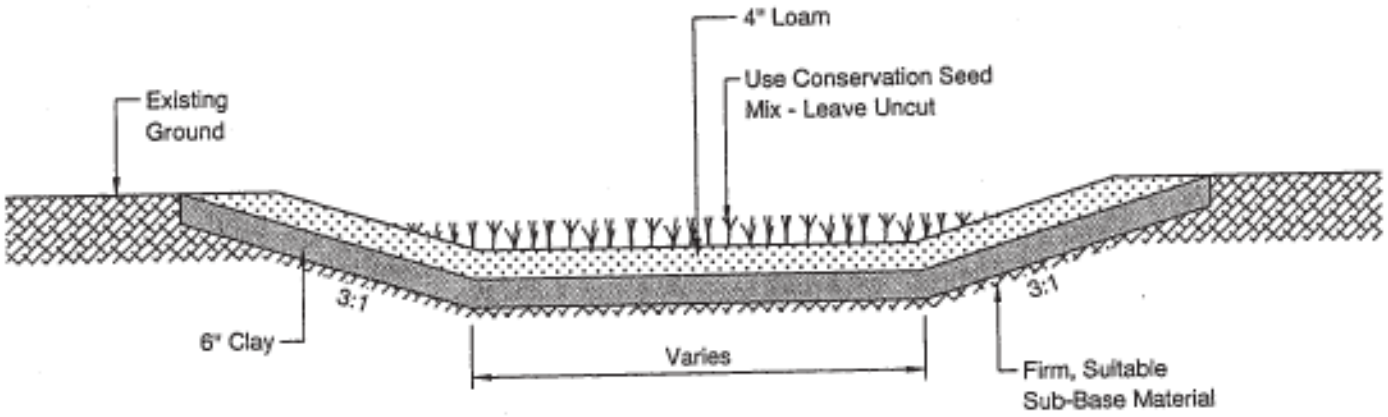

Grassed Swale

Not to Scale

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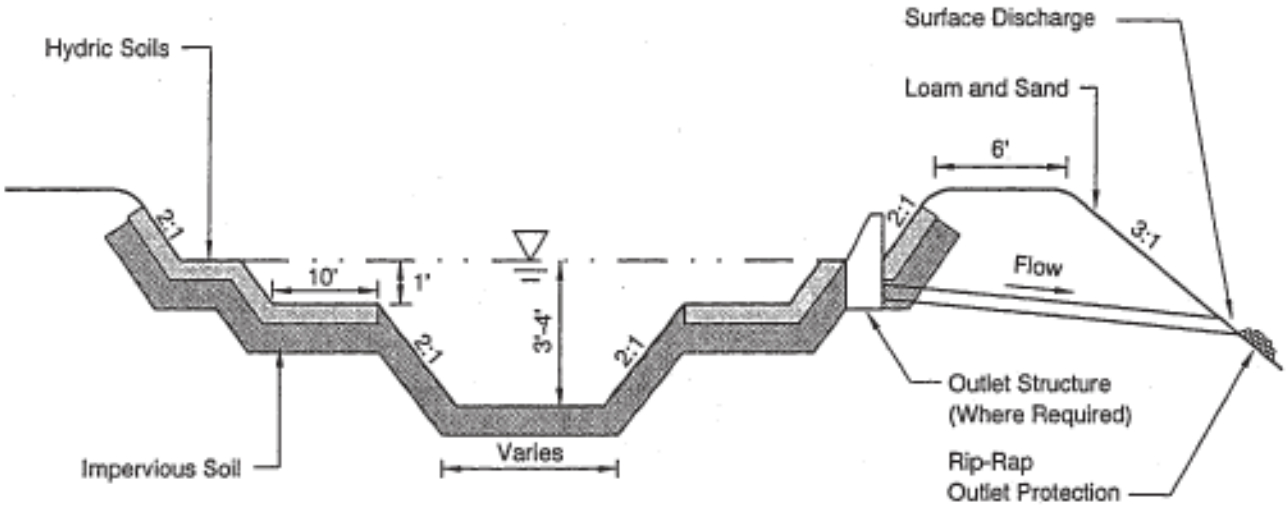
Grassed Swale

Figure A-7



Design Criteria:

- Sized to maximize sediment removal by reducing runoff velocity allowing settlement.
- Bottom of permanent wet basin to be lined with an impermeable barrier to restrict exfiltration from basin.
- If basin is for use only during construction, impervious lining is optional.
- 3 to 4 foot average depth with a shallow underwater bench (10 feet wide) around the perimeter.
- Outlet sized to control the 100 year storm event.
- Provide over flow channel for storms, less frequent than 100 year.

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Cross Section of Typical
Wet Basin

Figure A-8

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