Nonpoint Source Pollution Control Program

U.S. Environmental Protection Agency Office of Water

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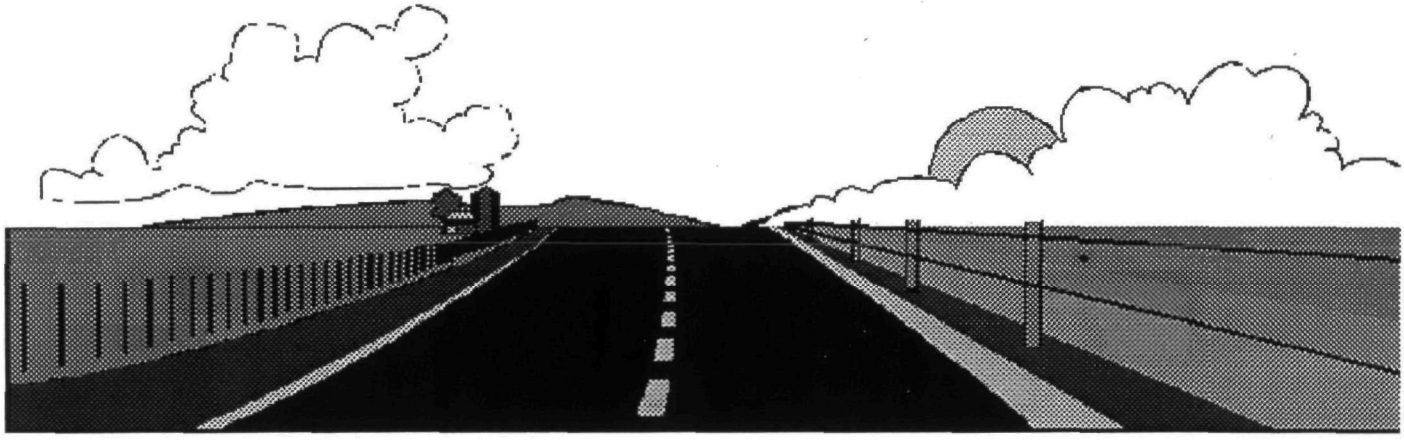
Erosion, Sediment, and Runoff Control for Roads and Highways



The Coastal Zone Management Act of 1972 established a program for states to voluntarily develop comprehensive programs to protect and manage coastal water resources. There are now 29 coastal states and territories with federally approved coastal management programs.

The Coastal Zone Act Reauthorization Amendments (CZARA) of 1990 specifically charged coastal states and territories with upgrading their runoff pollution control programs to protect coastal waters. The Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) jointly oversee the development and implementation of these *Coastal Nonpoint Pollution Control Programs*, or CNPCPs.

EPA published *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* to be used by states to implement management measures - economically achievable measures that reflect the greatest degree of runoff pollution control - to control the addition of runoff pollutants to coastal waters.

The *Guidance* also includes best management practices, technologies, processes, siting criteria, and operating methods for roads, highways, and bridges that states can use to implement the management measures. States can use alternative management measures if they provide the same or a greater degree of pollutant control as the management measures in the *Guidance*. States will begin implementing their CNPCPs in 1996 and achieve full implementation by 2004.

CZARA applies to site development and land disturbing activities in the coastal management area of each State with an approved coastal management program. Certain road, highway and bridge related activities are excluded from this program due to coverage under the National Pollutant Discharge Elimination System (NPDES) permitting program These activities include construction activities where 5 or more acres (2.02 ha) are disturbed, and activities within municipalities with municipal separate storm sewer systems that have populations of 100,000 or more

Why Runoff Control is Needed

Runoff controls are essential to preventing polluted runoff from roads, highways, and bridges from reaching surface waters Erosion during and after construction of roads, highways, and bridges can contribute large amounts of sediment and silt to runoff waters, which can deteriorate water quality and lead to fish kills and other ecological problems.

Heavy metals, oils, other toxic substances, and debris from construction traffic and spillage can be absorbed by soil at construction sites and carried with runoff water to lakes, rivers, and bays Runoff control measures can be installed at the time of road, highway, and bridge construction to reduce runoff pollution both during and after construction. Such measures can effectively limit the entry of pollutants into surface waters and ground waters and protect their quality, fish habitats, and public health.

Pesticides and fertilizers used along roadway rights-of-way and adjoining land can pollute surface waters and ground water when they filter into the soil or are blown by wind from the area.where they are applied Table 1 shows typical pollutants in runoff waters that can be traced to the operation of roads and highways.

Principles of Runoff Control for Roads, Highways, and Bridges

Preventing runoff pollution from road, highway, and bridge construction in coastal areas requires planning, education, inspection, and maintenance. An erosion and sediment control (ESC) plan that incorporates the most appropriate and cost-effective best management practices (BMPs) is essential to effective pollution control Affected highway personnel must be educated about the requirements of the ESC plan Inspection and enforcement authority are necessary to ensure awareness of and compliance with the adopted practices. Finally, BMPs require regular maintenance to ensure that they perform optimally The following principles apply to an effective erosion and runoff control program.

- **Develop a comprehensive erosion and sediment control (ESC) plan prior to earth-moving activities.** Write ESC requirements into plans, specifications, and cost estimates for highway and bridge projects.

  Four key factors affect the potential for soil erosion from a site: soil characteristics, vegetative cover, topography, and climate. Take all of these factors into consideration to develop an ESC plan that will minimize soil loss, limit the area exposed to construction, maximize the vegetative cover, use natural topographic features to the best advantage, and include BMPs suitable to the regional climate

  The Federal Highway Administration Local Transportation Assistance Program, the Association of American State Highway and Transportation Officials, and many state highway departments can provide ESC guidelines.

- **Apply ESC practices to prevent excessive onsite damage.** Use ESC BMPs to control the flow of

runoff water and thereby prevent or lessen soil erosion. Limiting land disturbance and preserving natural vegetation are excellent ESC practices.

- **Apply perimeter control practices to protect the disturbed area from offsite runoff and to prevent sedimentation damage to areas below the construction site.** A sediment and runoff barrier surrounding the disturbed area prevents construction site runoff from moving offsite and fouling surface waters downstream

- **Keep runoff velocities low and retain runoff on the site.** The erosive power of runoff increases dramatically as distance and slope increase. BMPs can be used to effectively control runoff velocity and detain it to remove 80 to 90 percent of the sediment from runoff

- **Stabilize disturbed areas immediately after final grade has been attained.** Any exposed soil is subject to erosion from rainfall, wind, and vehicles BMPs to stabilize soil should be applied as quickly as possible after the land is disturbed Temporary stabilization practices include seeding, mulching, and erosion control blankets or mats.

- **Develop a schedule and implement a comprehensive inspection and maintenance program.** This principle is vital to the success of erosion control. BMPs must receive regular inspection and maintenance to ensure that they are operating effectively and optimally, both during and after construction

Best Management Practices

CZARA defines management measures as economically achievable measures to control the addition of pollutants to our coastal waters. Management measures are achieved by the application of one or more BMPs. The BMPs described below are especially useful for erosion and runoff control for roads, highways, and bridges.

Best management practices can be organized by the function they perform. General maintenance BMPs (listed below) are usually vegetative practices used to contain polluted runoff from the operation of highways or from erosion and sedimentation generated at small construction sites A variety of practices are used at construction sites to control both erosion and polluted runoff. These are identified as Construction Site BMPs. Practices developed as permanent erosion and sediment control devices are both structural and nonstructural. Several of these BMPs are listed below as long-term or Permanent Control BMPs

Construction Site BMPs

- **Straw bale barriers** should be bound, entrenched, and securely anchored to prevent deterioration A row of straw bales slows runoff flow and creates a pond behind the barrier where sediment can settle out Straw bale barriers are most effective for filtering low to moderate storm flows, where structural strength is not required

- **Filter fabrics** are engineering fabrics designed to retain sediment particles larger than a certain size and allow water to pass through. Filter fabrics can be used in silt fences (see below) or erosion control mats Erosion control mats protect soil and seed from erosion and can be designed to allow vegetation to grow through the material

- **Silt fences** are vertical fences of filter fabric that are stretched across and attached to support poles

The fabric retains sediment on the construction site and allows relatively sediment-free water to pass through Silt fences are placed to protect streams and surrounding property from sediment-laden runoff.

- **Sediment basins** are ponds created by excavation or the construction of a dam or barrier Sediment basins primarily serve to retain or detain runoff to allow excessive sediment to settle out during construction Sediment basins can be converted into permanent detention ponds or wetlands after construction.

- **Stabilized entrances** reduce the amount of sediment carried off a construction site by vehicles when pressure-washed on-site. These entrances are designed to include stabilized pads of aggregate underlain with a filter fabric. Stabilized construction site entrances should be located at any point in the construction zone where vehicles enter and leave Wheels and undercarriages of vehicles should be washed before leaving the site.

Operation and Maintenance

Inspection and maintenance of erosion and sediment control BMPs after construction has been completed is important to ensure that the BMPs are operating properly and effectively Some key operation and maintenance procedures include:

- **Prepare and adhere to a schedule of regular maintenance for temporary erosion and runoff control BMPs.** Two critical maintenance operations that must be performed regularly are cleaning out accumulated sediment and replacing worn-out or deteriorated materials, such as silt fence fabrics, so that the effectiveness of the controls is maintained. Maintenance can include dredging and reshaping sediment basins and revegetating the slopes of grassed swales.

- **Remove temporary BMPs from construction areas when they are no longer needed and replace them, where appropriate, with permanent BMPs.**

- **Schedule and periodically inspect and maintain permanent erosion and runoff controls.** This should include a periodic visual inspection of permanent BMPs during runoff conditions to ensure that the controls are operating properly. Clean, repair, and replace permanent erosion and runoff control BMPs when necessary.

General Maintenance BMPs

- **Seeding with grass and fertilizing** to promote strong growth provide long-term stabilization of exposed surfaces. Disturbed areas can be seeded and fertilized during construction and after it is completed. Sufficient watering and refertilizing 30 to 40 days after the seeds germinate help establish dense growth.

- **Seeding with grass and overlaying with mulch or mats** is done to stabilize cleared or freshly seeded areas Types of mulches include organic materials, straw, wood chips, bark or other wood fibers, or decomposed granite and gravel. Mats are made of natural or synthetic material and are used to temporarily or permanently stabilize soil.

- **Wildflower cover** has been successfully used by many state and county highway departments to provide attractive vegetation along roadways and erosion control Careful consideration must be given to visibility, access, soil condition, climate, and maintenance when choosing sites for

wildflower cover.

- **Sodding** with established grass blankets on prepared soil provides a quick vegetative cover to lessen erosion Proper watering and fertilizing are important to ensure the vitality of newly placed sod

Permanent Control BMPs

- **Grassed swales** are shallow, channeled grassed depressions through which runoff is conveyed The grass in swales slows the flow of runoff water, which allows sediment to settle out and water to infiltrate into the soil. Grassed swales can remove small amounts of pollutants such as nutrients and heavy metals Check dams (see below) can be added to grassed swales to further reduce flow velocity and promote infiltration and pollutant removal

- **Filter strips** are wide strips of vegetation located to intercept overland sheet flows of runoff They can remove organic material, sediment, and heavy metals from runoff. Filter strips can consist of any type of dense vegetation from woods to grass but they cannot effectively treat high-velocity flows They are therefore best suited to low-density developments.

- **Terracing** breaks a long slope into many flat surfaces where vegetation can become established Small furrows are often placed at the edge of each terraced step to prevent runoff from eroding the edge Terracing reduces runoff velocity and increases infiltration

- **Check dams** are small temporary dams made of rock, logs, brush, limbs, or another durable material, placed across a swale or drainage ditch. By reducing the velocity of storm flows, sediment in runoff can settle out and erosion in the swale or ditch is reduced

- **Detention ponds or basins** temporarily store runoff from a site and release it at a controlled rate to minimize downstream flooding. Pollutant removal effectiveness is quite good for well-designed basins Effectiveness is greatest for suspended sediments (80 percent or more removal) and related pollutants such as heavy metals.

- **Infiltration trenches** are shallow, three to eight feet deep (.91 to 2.44 m), excavated trenches that are backfilled with stone to create underground reservoirs Runoff is diverted into the trenches, from which it percolates into the subsoil. Properly designed infiltration trenches effectively remove sediment from runoff and can remove some other runoff pollutants

- **Infiltration basins** are relatively large, open depressions produced by either natural site topography or excavation. When runoff enters an infiltration basin, the water percolates through the bottom or the sides and the sediment is trapped in the basin. The soil where an infiltration basin is built must be permeable enough to provide adequate infiltration. Some pollutants other than sediment are also removed in infiltration basins

- **Constructed wetlands** are areas inundated by water for a sufficient time to support vegetation adaped for life in saturated soil conditions Wetlands effectively filter sediment, nutrients, and some heavy metals from runoff waters.

Table 1. Typical pollutants found in runoff from roads and highways.

Sources of Pollution in Highway Runoff		
	Pollutant	**Source**
Sedimentation	Particulates	Pavement wear, vehicles, the atmosphere and maintenance activities
Nutrients	Nitrogen & phosphorus	Atmosphere and fertilizer application
Heavy Metals	Lead	Leaded gasoline from auto exhausts and tire wear
	Zinc	Tire wear, motor oil and grease
	Iron	Auto body rust, steel highway structures such as bridges and guardrails, and moving engine parts
	Copper	Metal plating, bearing and brushing wear, moving engine parts, brake lining wear, fungicides & insecticides
	Cadmium	Tire wear and insecticide application
	Chromium	Metal plating, moving engine parts and brake lining wear
	Nickel	Diesel fuel and gasoline, lubricating oil, metal plating, bushing wear, brake lining wear and asphalt paving
	Manganese	Moving engine parts
	Cyanide	Anti-caking compounds used to keep deicing salt granular
	Sodium, calcium & chloride	Deicing salts
	Sulphates	Roadway beds, fuel and deicing salts
Hydrocarbons	Petroleum	Spills, leaks, antifreeze and hydraulic fluids and asphalt surface leachate

Adapted from Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters

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OW-GENERAL@epamail.epa.gov
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