EROSION & SEDIMENT CONTROL STRUCTURES

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- **EROSION & SEDIMENT CONTROL STRUCTURES**

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STRUCTURES

EROSION AND SEDIMENT CONTROL STRUCTURES

DEFINITION

Erosion and sediment control structures encompass a host of specific structures that are designed to control a variety of surface drainage, erosion and sediment problems.

PURPOSE

Erosion and Sediment Control Structures protect the watershed and natural resources in a number of ways, for example:

* By preventing the formation of, or the advancement of rills and gullies;
* Reducing the flow velocity in watercourses or providing structures capable of with-standing high flow velocity;
* Stabilizing the grade and controlling head cutting in natural or artificial channels;
* Conveying water from one elevation to another;
* Diverting water away from unstable slopes; and
* By filtering and retaining sediment.

APPLICABILITY

These practices are applicable on sites where:

1. Flow velocity is such that structures are required.

2. Excessive grade or overfill conditions occur.

3. Water needs to be moved from higher to lower elevations.

4. Critical slopes have sheet erosion problems.

5. Vegetative cover is being established.

6. Concentrated runoff from unstabilized areas can be diverted onto stabilized areas.

7. There is a sedimentation or an erosion problem.

METHODS AND MATERIALS

Erosion and Sediment Control Structures include the following:

1. Chute Spillway
2. Flume
3. Pipe Drop
4. Straight Drop Spillway
5. Drop Inlet Spillway
6. Box Inlet Spillway
7. Check Dam
8. Waterbreaks or Waterbars
9. Retaining Walls

The location, design and installation of erosion and sediment control structures should be based on site requirements using qualified engineering assistance.

Material selection for construction should be made with consideration for economic feasibility, durability, and aesthetic values.

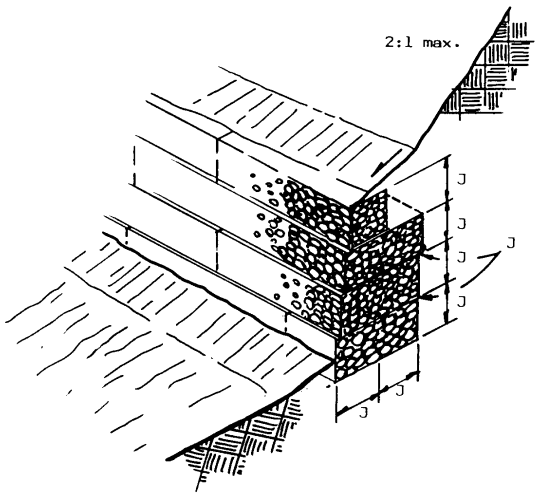
MAINTENANCE

Erosion and sediment control structures require regular inspection, maintenance and repairs given the specifics of the project site. During periods of runoff (i.e., spring snow melt, etc.) and precipitation events (i.e., snow, rain, thunderstorms, etc.), maintenance activities may require expansion. Erosion and sediment structures which are not properly maintained may not function and potentially risk failure, resulting in additional resource degradation.

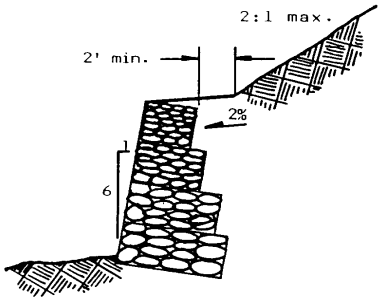
EFFECTIVENESS

Properly designed, installed and maintained, erosion and sediment control structures will effectively reduce the transport of sediments, minimize erosion and the degradation of water resources and reduce negative impacts to natural resources (i.e., vegetation, wildlife, etc.).

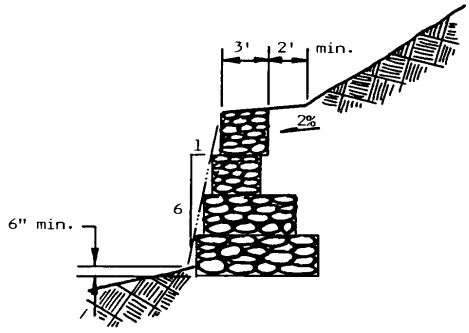
GABION RETAINING WALLS
FIGURE 1



3-DIMENSIONAL



SECTION



SECTION

GABION RETAINING WALLS

DIVERSIONS

RUNOFF INTERCEPTOR TRENCH OR SWALE

DEFINITION

A trench or swale designed and constructed along the contour of a slope to intercept surface runoff.

PURPOSE

To decrease the uninterrupted slope length, store and divert surface runoff from the slope face and to reduce the erosion potential from concentrated surface runoff.

APPLICABILITY

Used on slopes with comparatively gentle gradients (3:1 or less), but having long uninterrupted slope lengths, e.g., abandoned dirt roads, easements, and gently sloping cuts and fills.

PLANNING CRITERIA

1. Determine through topographical mapping the length and degree of slope, contributing watershed and associated drainage ways.

2. **Depending on the magnitude of the project and the expertise of the proponent, utilize a qualified engineer to design the size, capacity, length and location of the runoff interceptor trench or swale.**

3. Identify and include in the design adequate runoff conveyance and discharge areas to receive the surface runoff captured by the trench or swale.

METHODS AND MATERIALS

Construct the trench along the slope contour including a conveyance to outlet flow to a level spreader or other stabilized discharge. Excavated materials should be placed on the downslope side of the trench or swale and spread to conform with the natural slope. The trench or slope and the surrounding disturbance area should be stabilized and revegetated immediately after construction.

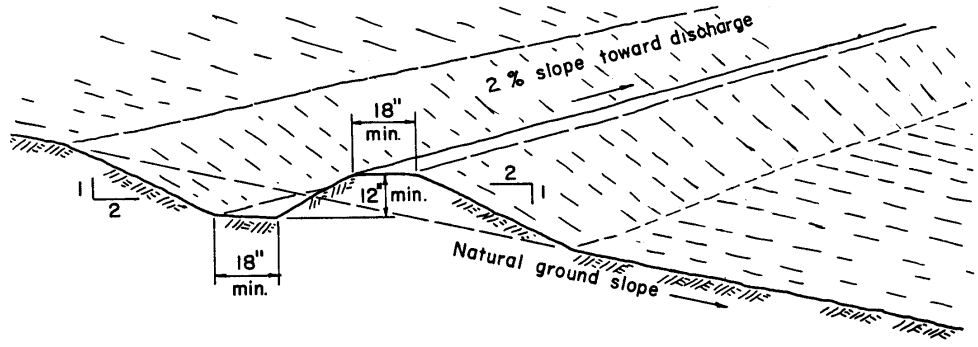
MAINTENANCE

Inspections should be conducted for damage after each major precipitation or runoff event. Repair damage immediately as required.

EFFECTIVENESS

Properly designed, installed and maintained a runoff interceptor trench or swale will effectively convey surface runoff, minimize soil erosion resulting from surface runoff and reduce the degradation of receiving water resources.

RUNOFF INTERCEPTOR TRENCH OR SWALE
FIGURE 2



ISOMETRIC SECTION
not to scale

DIVERSION DIKE

DEFINITION

A runoff interceptor designed and constructed at the top of a cut or fill slope to divert surface flow.

PURPOSE

To divert overland runoff flow away from slopes, reduce the potential for surface erosion and reduce uninterrupted slope length.

APPLICABILITY

All slopes, cut or fill, which may receive runoff from upslope areas.

PLANNING CRITERIA

Diversion dikes should be designed and constructed to intercept all runoff flow from above cut and fill slopes and upon benches on large slope faces to prevent collected runoff from flowing onto slope faces below.

1. Determine through topographical mapping the length and degree of slope, contributing watershed and associated drainage ways.

2. Diversion dikes should be engineered and designed such that diverted runoff does not overtop the dike.

3. The outlet of the diversion dike should be designed to dissipate energy via dense and durable vegetation, or artificially stabilized with rock, matting or other material. Runoff flow can also be conveyed to a downdrain, chute or flume for conveyance down slope.

4. Discharge - Discharge should be to an area, mechanically and/or vegetatively stabilized, or to an established drainage system.

5. **Depending on the magnitude of the project and the expertise of the proponent, utilize a qualified engineer to design the size, capacity, length and location of the diversion dike.**

METHODS AND MATERIALS

The diversion dike consists of a trench and a dike. The trench may be constructed using mechanized equipment or hand tools. The dike should be compacted as specified in the engineering design. The trench, dike and the surrounding disturbance area should be stabilized and revegetated immediately after construction.

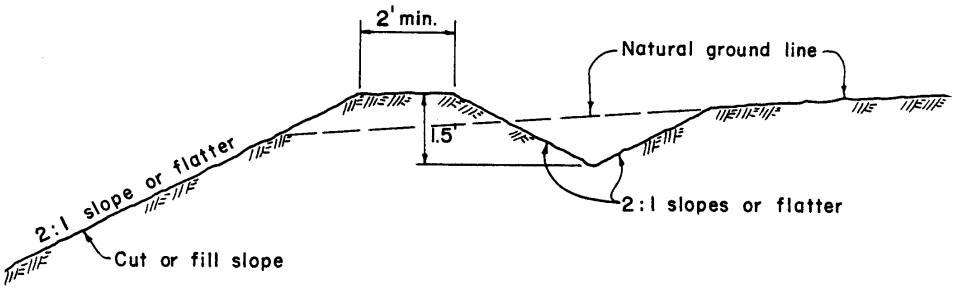
MAINTENANCE

Inspect after each major precipitation or storm event to identify any damaged areas. Repairs should be completed before the next storm. Any channel obstructions should be removed.

EFFECTIVENESS

Properly designed, installed and maintained a diversion dike will effectively reduce the transport of sediments, minimize erosion resulting from surface runoff and reduce the degradation of receiving water resources.

DIVERSION DIKE
FIGURE 3



SECTION
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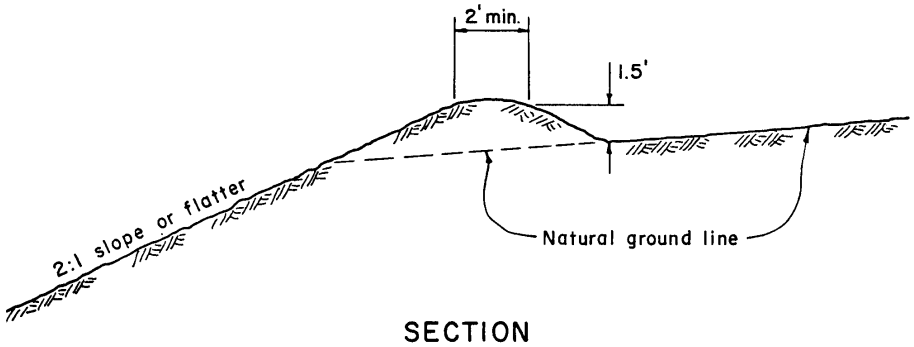


SECTION

Dike constructed by dozer moving soil upslope and dumping at top of slope.

DIVERSION DAM

DEFINITION

A structure built to divert part or all of the water from a waterway or stream into a different watercourse, an irrigation canal or ditch, or a water spreading system.

PURPOSE

The purpose of a diversion dam is:

1. To divert part or all of the water from a waterway in such a manner that it can be controlled and applied to a beneficial use; or
2. To divert periodic damaging flows from a watercourse to another watercourse having characteristics which reduce the damage potential of the flows and thus protect the watershed.

APPLICABILITY

This BMP includes structures of a permanent nature, constructed of materials having an expected life span consistent with the purpose for which the structure is designed. It does not include Floodwater Diversion, Floodwater Retarding Structure or Erosion and Sediment Control Structures. The BMP applies:

1. Where a diversion dam is needed as a integral part of an irrigation system or for a water spreading system which has been designed to facilitate the conservation of soil and water resources.

2. Where it is desirable to divert water from an unstable watercourse to a stable watercourse.

3. Where the water supply available is adequate for the purpose for which it is to be diverted.

4. Where the construction of a dam and the diversion of water are permitted by applicable federal, state, and local statutes and regulations.

PLANNING CRITERIA

1. Determine through topographical mapping the length and degree of slope, contributing watershed and associated drainage ways. Baseline soils data should be gathered and analyzed for stability and erodibility.

2. Materials - All materials to be used in construction of the diversion dam and appurtenances should have the strength, durability and workability required to meet the installation and service conditions at the site.

3. Outlet works - Where partial diversions are required, the outlet works should provide for positive control of both maximum and minimum diversions consistent with the purpose for which the diversions are made. Where all the flow is to be diverted, the outlet works should provide for safe diversion of all expected flows based on site conditions.

4. By-pass works - The by-pass works should be capable of passing all flows needed to satisfy downstream priorities and all flows in excess of diversion requirements. This may require a combination of orifices and gates designed to meet the requirements of the site.

5. Special purpose works - Where debris or sediments are present under flow conditions subject to diversion, provision should be made to bypass or remove those materials which may be detrimental to the functioning of the outlet works, to other portions of the works, or areas to which diversion is made. This may involve the use of settling basins, debris traps, trash guards of sluiceways depending on the site conditions.

6. Federal, State, & Local Laws - Laws concerning water use must be complied with.

7. **Depending on the magnitude of the project and the expertise of the proponent, utilize a qualified engineer to design the size, capacity, length and location of the diversion dam.**

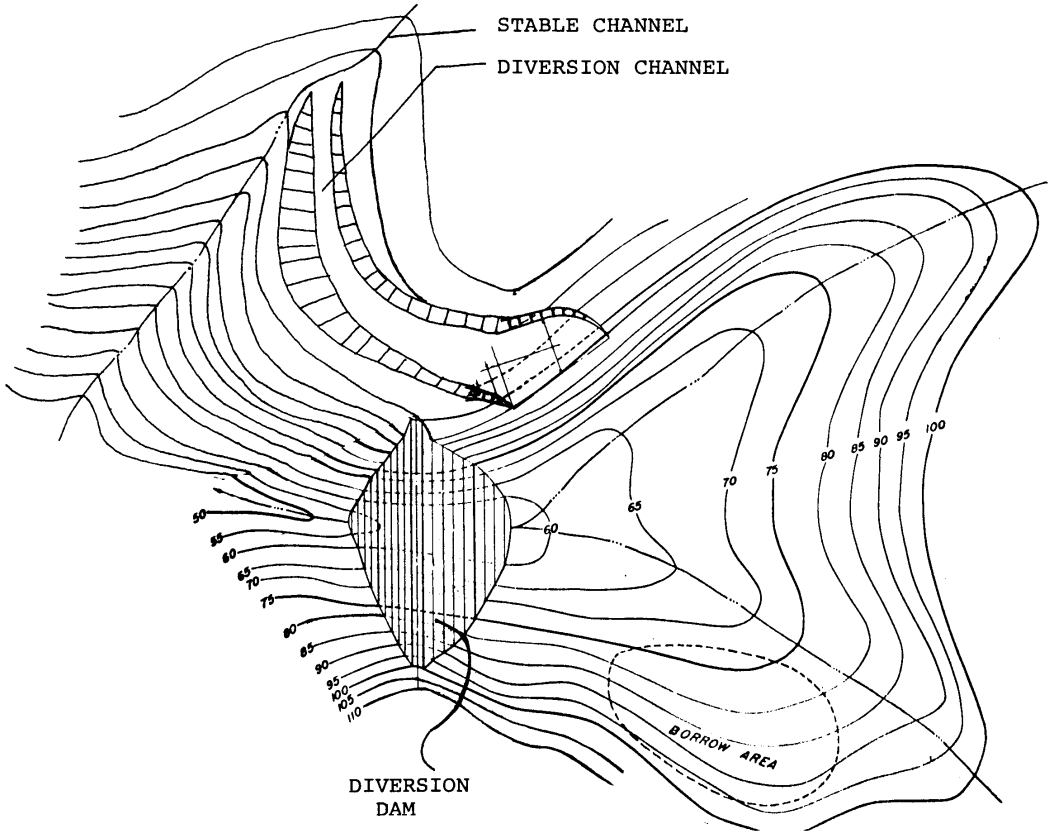
MAINTENANCE

A regular inspection schedule is necessary to ensure that the structure has not developed any faults and that sediments or debris are not interfering with its functioning. Inspections should also occur after precipitation or runoff events and identified repairs made before the next storm event.

EFFECTIVENESS

Use of diversion dams is effective in diverting surface water flow when properly designed, installed, operated and maintained.

DIVERSION DAM
FIGURE 4



LEVEL SPREADER

DEFINITION

An outlet constructed at zero grade across a slope to disperse concentrated runoff.

PURPOSE

To convert concentrated flow into sheet flow for surface application at non-erosive velocities onto stabilized areas.

APPLICABILITY

Used at locations where concentrated runoff from unstabilized areas can be diverted onto stabilized areas under sheet flow conditions, e.g., at diversion dike or runoff interception trench outlets.

PLANNING CRITERIA

Detailed design is not required, but extreme care must be used during construction to ensure that the outlet lip is exactly level and uniform from end to end. Failure to meet these requirements will cause concentrated flow and consequent erosion of the stabilized area. The excavation for the spreader should be on well stabilized soils (vegetated or rock armored).

1. Determine through topographical mapping the length and degree of slope, contributing watershed and associated drainage ways. Baseline soils data should be gathered and analyzed for erodibility.

2. Level spreaders should not be located on slopes steeper than 3:1.

3. General criteria include:

    a. Material - Must be constructed in undisturbed soil and must outlet into a stabilized area.
    b. Inflow - Runoff to the spreader should be from areas which have been stabilized to eliminate sediment buildup in the spreader.
    c. Discharge - When discharge is to a slope steeper than 3:1 or the soil is highly erodible, the length of the spreader should be increased.

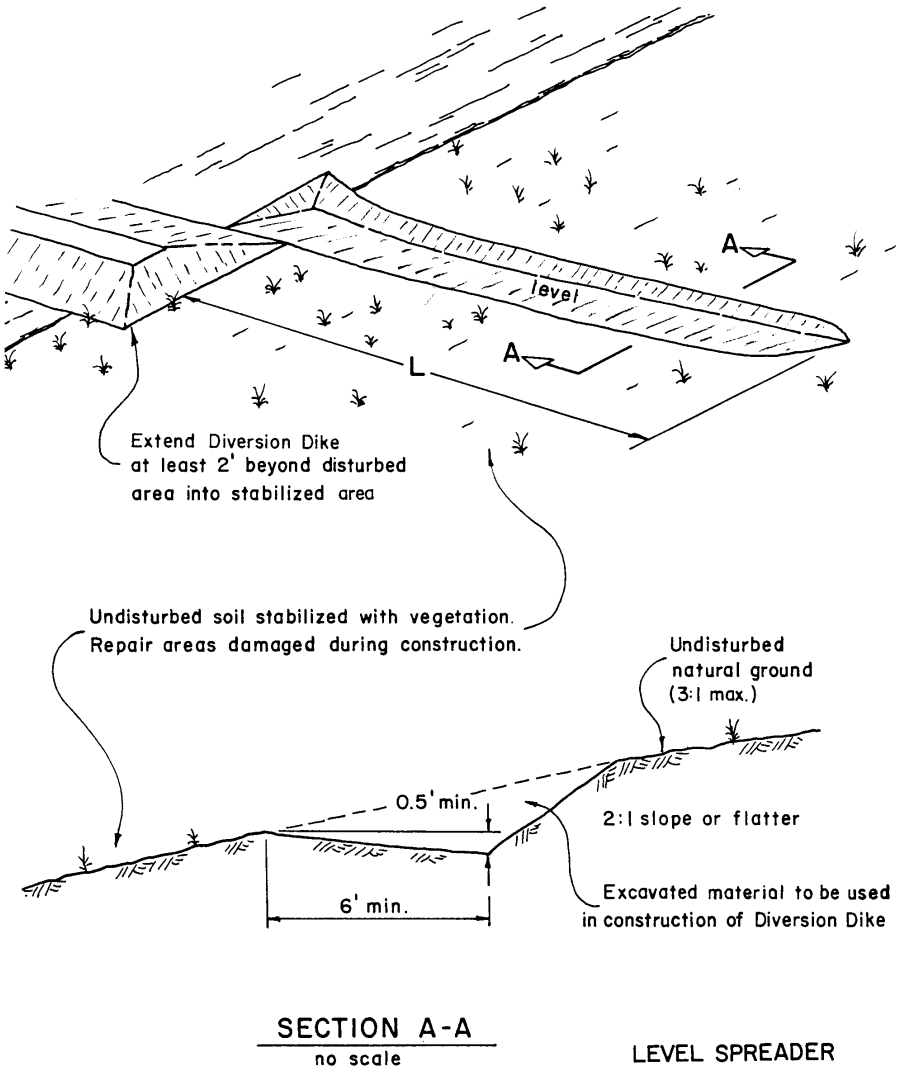
MAINTENANCE

Inspect for damage after each precipitation or storm event and repair as required before the next storm event. Remove sediment as necessary, given the specifics of the site.

EFFECTIVENESS

Level Spreaders are effective for surface runoff dispersion if they are designed, constructed and maintained properly. Maintenance is critical to the effectiveness of the spreader.

LEVEL SPREADER
FIGURE 5



SECTION A-A
no scale

LEVEL SPREADER

SEDIMENT RETENTION

SILTATION OR FILTER BERMS

DEFINITION

Siltation or filter berms are utilized in conjunction as temporary barriers and filters constructed across access roads or highways, and around or within development, mining and construction sites.

PURPOSE

To capture and retain runoff from construction sites or roadways, to allow sediments to settle out, and to direct runoff water through filter berms at outlets to stabilized drainage ways.

APPLICABILITY

The siltation or filter berms are applicable to relatively flat construction sites and should be installed on the downslope sides of the disturbed areas.

PLANNING CRITERIA

Impervious siltation berms are used to capture and retain runoff from construction sites. The berms should be sized to contain the runoff water from a design storm per applicable regulations. The sediments in the runoff water are allowed to settle out and the water is directed through permeable filter berms located at points leading to stable drainage ways.

METHODS AND MATERIALS

To construct a siltation berm a ridge of gravel or crush rock (.75- to 1.5-inches) should be mounded along the contour of the slope at the downhill side of the construction site. The height of the ridge should be sufficient to contain the specified volume of runoff. The height of the ridge should be at least 1 1/2 feet. The side slopes of the ridge should not exceed 2:1. Plastic sheeting (six mil thick) is placed over the berm. The sheeting width should be wide enough to cover the berm and allow at least one foot of additional sheeting on each side of the berm to allow anchoring. The sheeting is anchored by placing gravel or crushed rock on the edges to a depth of at least three inches and width of at least eight inches.

Filter berms should be constructed of well graded gravel or crushed rock (.75 to 3 inches). The material should be compacted to dimensions of up to: 1 1/2 to 2 feet in height, top width of three to five feet with side slopes of 3:1 slope. Filter fabrics are available which can be incorporated into the top layer of the berm and are very effective, particularly on sites which slope.

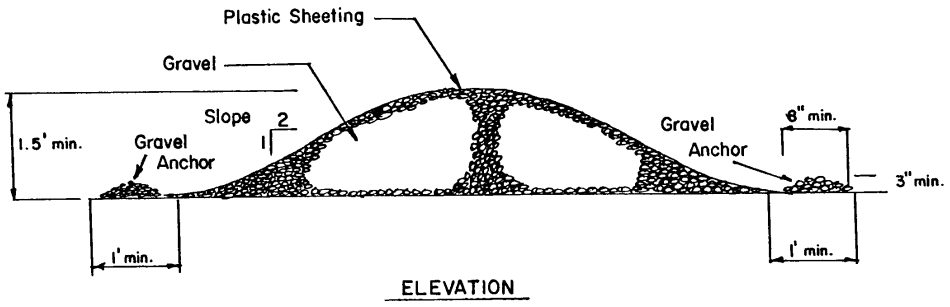
MAINTENANCE

Siltation and filter berms should be inspected periodically, especially after each precipitation or storm event, and maintained to keep functional. The plastic sheeting should be replaced as necessary in order to retain runoff water and sediments on-site. Sediments must be removed regularly, given the specific of the site to maintain functionality.

EFFECTIVENESS

Siltation berms and filter berms can be effective if they are properly installed and maintained on relatively flat sites. Filter fences are more effective in most situations, except where runoff needs to be directed to certain discharge points.

SILTATION OR FILTER BERM
FIGURE 6



ELEVATION

FILTER OR SILT FENCE

DEFINITION

Filter or silt fences are a sediment barrier consisting of a pervious sheet of synthetic polymer filter fabric attached to wire mesh fencing and supported by fence posts.

PURPOSE

Filter or silt fences are constructed to intercept and capture sediment by decreasing the velocity of surface runoff.

APPLICABILITY

All development, mine, construction sites, areas of erosion, reclamation sites, etc. may utilize filter or silt fence to reduce sediment transport. These barriers are temporary in nature and are limited to slowing and filtering sediment associated with surface stormwater runoff, not concentrated, heavy flows.

PLANNING CRITERIA

Filter or silt fences are designed to intercept surface runoff on slopes of varying degrees. Barriers should be constructed in series depending on the size of the contributing drainage area. A rule of thumb is approximately 100 feet of fence for every 0.25 acre of drainage area. Fences require regular maintenance to maintain functionality so access is necessary. Average usable life of filter or silt fences is six months to a year.

METHODS AND MATERIALS

Construction of filter or silt fences involves attaching filter fabric to wire mesh fencing and steel T-Bar fence posts. Depending upon the specifics of the site, fence posts should be placed on three-to-six-foot centers. A trench is constructed along the base of the fence and approximately eight inches of the filter fabric is buried both vertically and horizontally to "toe in" the fabric. The wire mesh and the filter fabric are securely attached on the uphill side of the fence posts. The trench is then backfilled, and soil is compacted against the filter fabric.

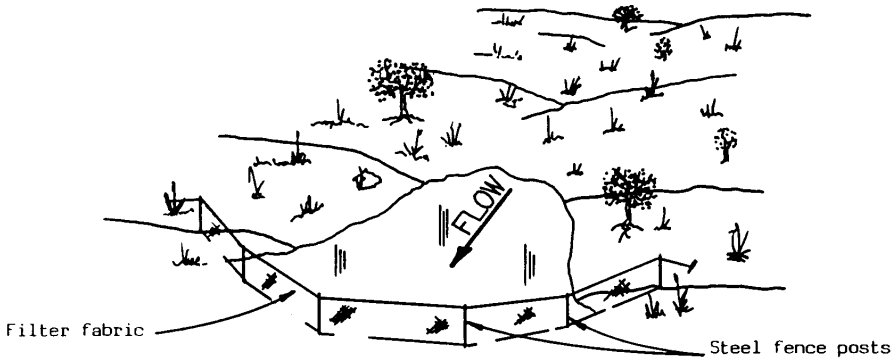
MAINTENANCE

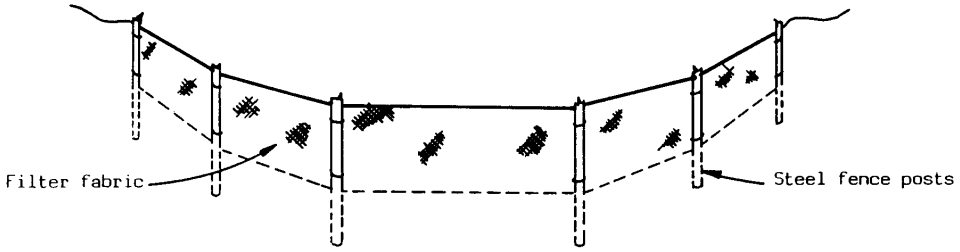
The filter or silt fence should be thoroughly inspected after each precipitation or storm event and immediately repaired. Sediment should be removed regularly to keep the barrier functional. Sediment should not be allowed to reach one-half the height of the fence. Excavated material must be disposed of properly, off site and never placed down slope.

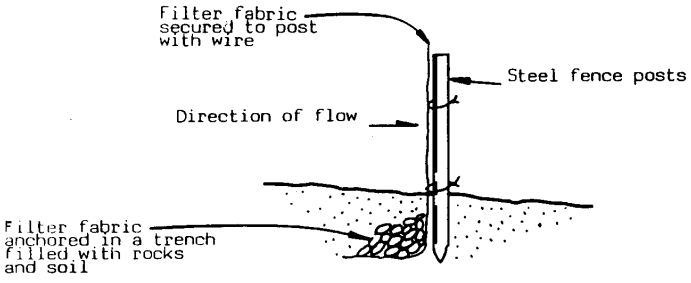
EFFECTIVENESS

The effectiveness of filter or silt fences is excellent if they are installed properly and maintained regularly. Fence barriers will last longer than straw bale lines due to their greater strength and durability.

SILT FENCE/FILTER FENCE
FIGURE 7







SECTION

SILT FENCE/FILTER FENCE

FILTER STRIPS

DEFINITION

Strips of close growing vegetation located to receive runoff from diffuse sources, waterways, drains and intermittent streams before the water enters a stream, drainage, pond or lake.

PURPOSE

To provide desilting areas to remove sediments from runoff waters before they enter streams, drainages, ponds or lakes.

APPLICABILITY

Applies to all land uses where topography, soils and moisture supplies are suitable for establishment of filter strips.

PLANNING CRITERIA

1. The runoff water should be spread as it enters the filter strip either by natural topography or by installation of level spreader ditches.

2. Use strips or areas of existing vegetation wherever possible.

3. Width of the filter strip should be adequate to allow settlement of the sediments. The width will vary depending on slope, type of vegetation and quantity of anticipated runoff water.

METHODS AND MATERIALS

1. In silviculture or rangeland brush management work, leave undisturbed strips of vegetation adjacent to streams, ponds and lakes.

2. On grazing lands, fence areas adjacent to streams, ponds and lakes where runoff waters enter.

3. Plant strips of adapted grasses, legumes, and other vegetation along the lower edge of cropland fields as filter strips for irrigation drainage runoff.

4. On constructed ponds and reservoirs, plant filter strips of adapted grasses and legumes at the upper end of the storage area wherever the topography is suited to the use of filter strips. Use species that tolerate inundation and deposition of sediment such as reed canary grass, creeping foxtail, beardless wildrye and common reedgrass. Protect filter strips from grazing during establishment.

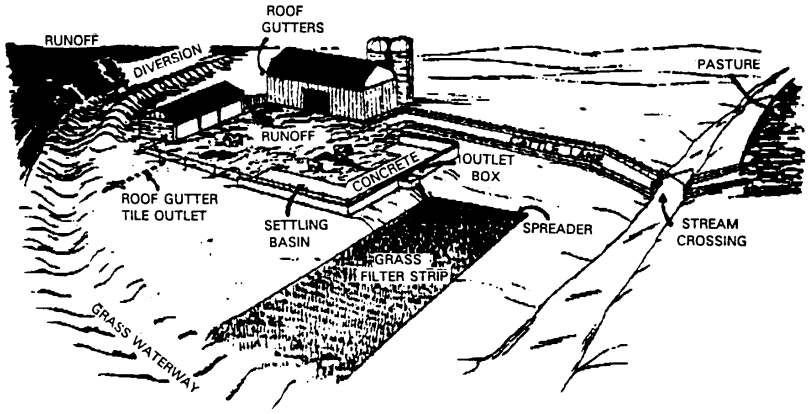
MAINTENANCE

Manage filter strips to maintain good vegetative cover. Protect filter strips from grazing or graze lightly after plants have matured seed. Where channels develop in the filter strips, install diversions to spread the water.

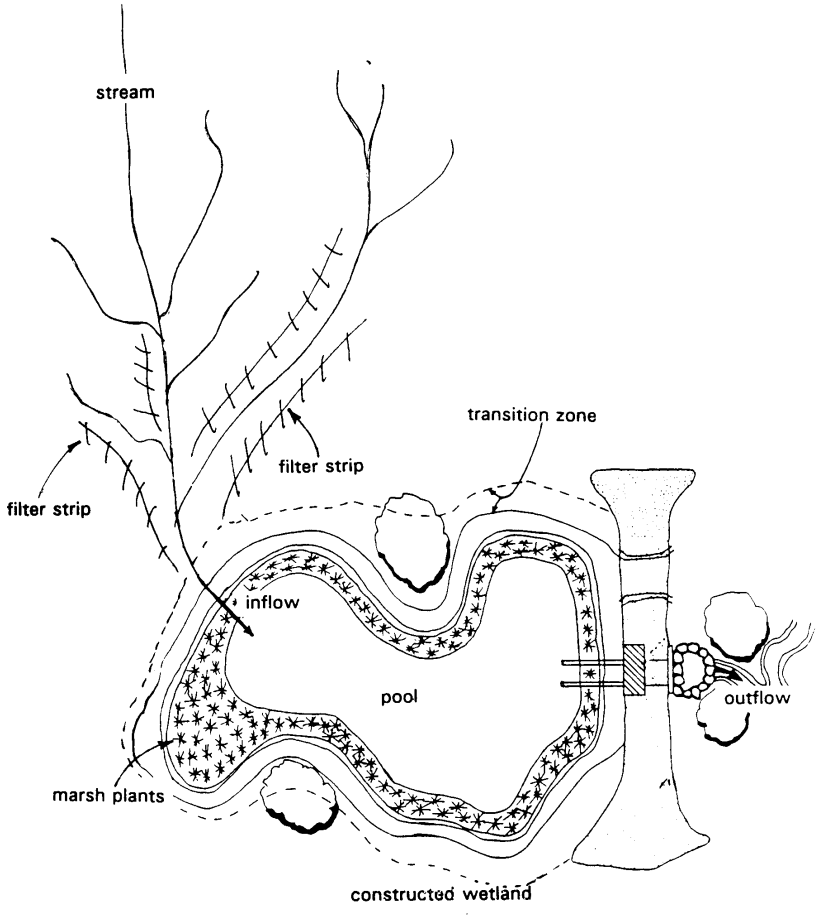
EFFECTIVENESS

Where installed and maintained properly, filter strips can significantly reduce sediment delivery into streams, ponds and lakes.

FILTER STRIPS
FIGURE 8



FILTER STRIPS B
FIGURE 9



SEDIMENT BARRIERS

DEFINITION

Barriers constructed to retain sediments.

PURPOSE

During periods of high runoff sediment barriers retain sediments by retarding flow and filtering.

APPLICABILITY

Usable in areas that have erosive soils and have a history of high sediment load during runoff. Sediment barriers are also applicable to development, mining, construction and reclamation sites.

PLANNING CRITERIA

Barriers are useful at storm drain inlets, across swales and ditches, drainages, as restraining dikes and berms, along property lines, and for other applications where the structure is of a temporary nature until permanent surface stabilization treatments are in place.

METHODS AND MATERIALS

1. Sandbag sediment barriers - berms to direct or divert runoff flows, or as barriers to collect and store runoff. The following information pertains to the installation of sandbag sediment barriers.

    a. Install so that flow under or between bags is prevented.
    b. The sandbags should be stacked in an interlocking fashion to provide additional strength for resisting the force of flowing water.
    c. Sandbags should not be stacked more than three high without broadening the foundation using additional sandbags or providing addition stability.
    d. Sandbag sediment barriers should store the expected runoff.

2. Straw Bale Sediment Barriers - The following information applies to the installation of straw bale sediment barriers.

a. The service life of the barrier can be prolonged by using wire or nylon-tied bales rather than those tied with twine.
b. Bales should be laid on their sides and staked in place. At least two metal stakes should be driven through each bale and into the ground at least one foot. The first stake should be angled toward the previously placed bale and driven through both the first and second bale.
c. Piping is a major cause of failure. The possibility of piping failure should be reduced by setting the straw bales in a trench excavated to a depth of at least six inches and by firmly tamping soil along the upstream face of the barrier.
d. The functionality of straw bales can be increased by incorporating filter fabric or utilized with a filter or silt fence.

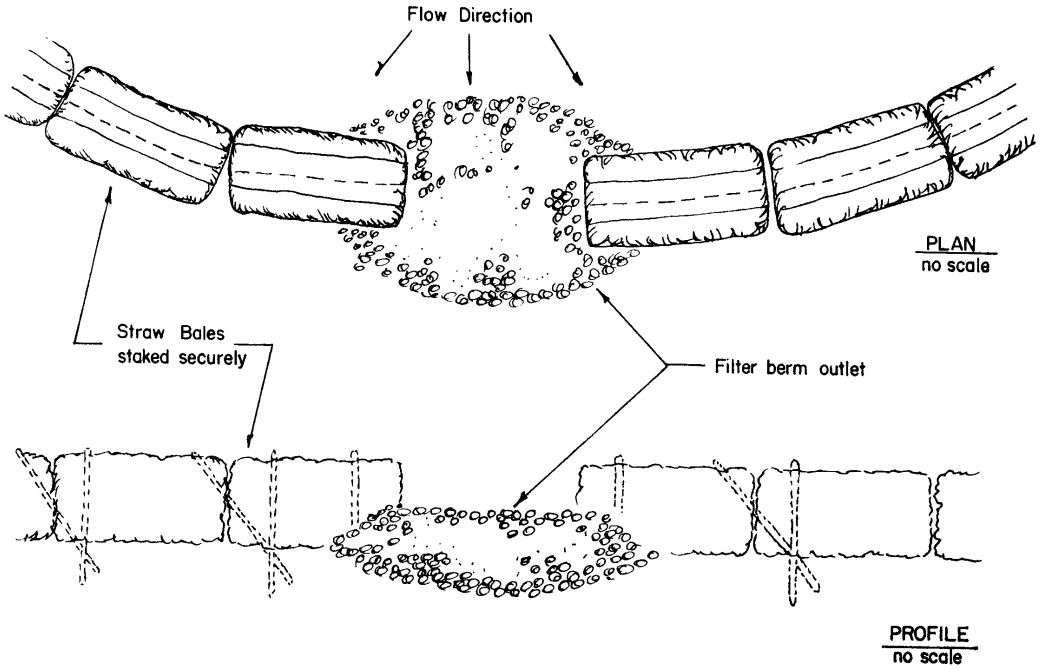
MAINTENANCE

Inspect sediment barriers after every precipitation or storm event and replace damaged bags or bales. Straw bales are often a target for vandals and frequent inspection is usually required. They should be replaced when rotten or disintegrating. Remove deposited sediment from structures after each precipitation or storm event and dispose of the sediment off site.

EFFECTIVENESS

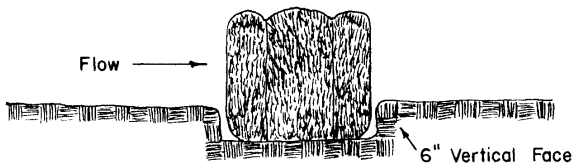
Sandbag or strawbale barriers are effective for temporary structures but require proper installation, regular maintenance and frequent repair.

STRAW BAIL SEDIMENT BARRIER
FIGURE 10

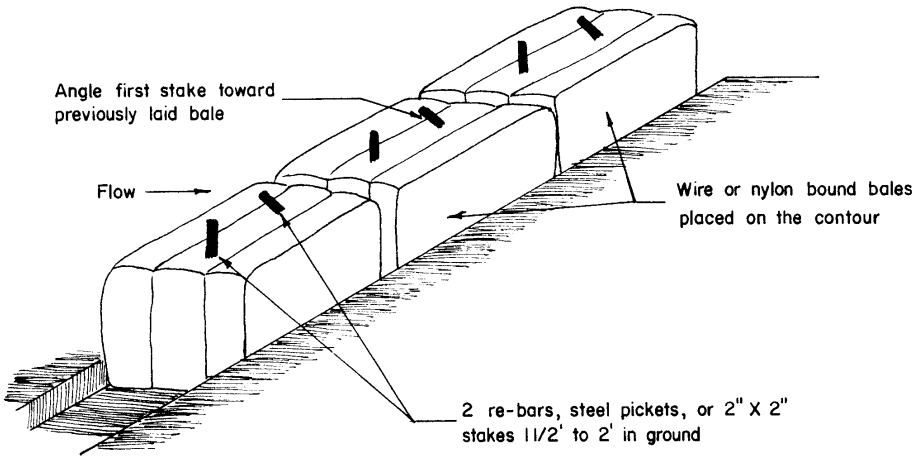


Semi-pervious barrier of straw bales with more pervious embankmen of sand and gravel for spillway

STRAW BAILS
FIGURE 11



EMBEDDING DETAIL



ANCHORING DETAIL

SEDIMENT BASINS

DEFINITION

A barrier or dam constructed across a waterway or other suitable location to form a silt or sediment basin.

PURPOSE

To preserve the capacity of reservoirs, ditches, canals, diversions, waterways, and streams; to prevent undesirable deposition on bottom lands and developed areas; to trap sediment originating from mining operations, gravel pits and construction sites; and to reduce or abate water pollution by providing basins for deposition and storage of silt, sand, gravel, stone, agricultural wastes, and other debris.

APPLICABILITY

This practice applies where the physical conditions, soils, topography and disturbance area merit basin installation. Sediment basins may be utilized in conjunction with erosion control measures installed at the source of the sediment or where a sediment basin offers the most practical solution to the problem. Development, mine, construction and any surface disturbing activity may utilize sediment basins to control the transport of sediment.

PLANNING CRITERIA

A qualified engineer should be utilized to design the size, capacity, length and location of the sediment basin.

The capability of a sediment or debris basin should equal the volume of sediment expected to be trapped at the site during the planned useful life of the structure or the improvements it is designed to protect. Where it is determined that periodic removal of debris will be practicable, the capacity may be proportionately reduced.

The design of dams, spillways and drainage facilities should be in accordance with the standard engineering principles as appropriate for the class and kind of structure being considered. Less conservative requirements may be used for small, temporary basins that will be in place only during a short development or construction period and conditions so warrant.

In urban and built-up areas, the means of draining and maintaining a dry pool between periods of use should be incorporated in the plans.

Safety measures to protect the public from the hazards of soft sediment and floodwater are to be established as conditions dictate. Installations must consider water rights and comply with State statutes and regulations.

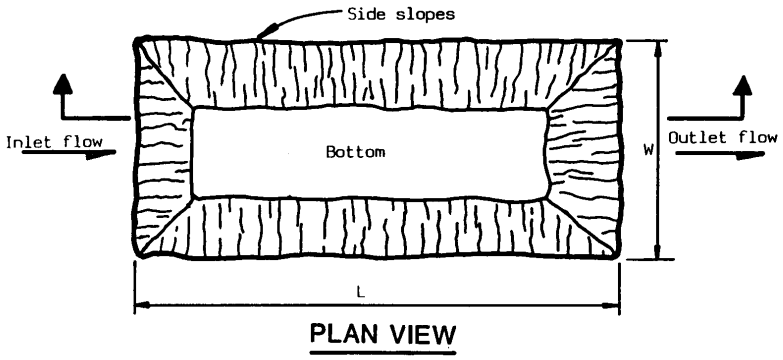
MAINTENANCE

Sediment basins should be regularly cleaned to retain their storage capacity and to maintain their effectiveness. Maintenance requirements should be based upon the specifics of the site.

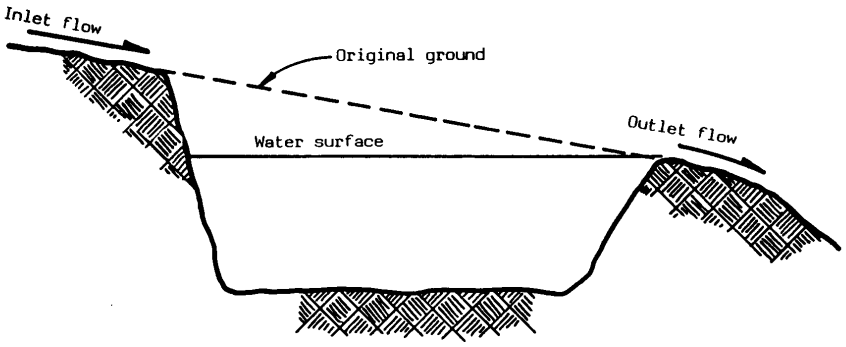
EFFECTIVENESS

Sediment basins are effective in reducing water pollution from silt, sand, gravel, and other debris. The proper design, construction and maintenance is critical to the effectiveness of the basin.

SEDIMENT TRAPS OR CATCH BASINS
FIGURE 12



PLAN VIEW



SECTION

SEDIMENT TRAPS OR CATCH BASINS

CONVEYANCE

GRASSED WATERWAYS AND OUTLETS

DEFINITION

A natural or constructed waterway or outlet with a vegetative cover of adapted grasses for safe disposal of runoff water without erosion.

PURPOSE

Grassed waterways are established to provide economical disposal channels for excess runoff waters for desilting and erosion control.

APPLICABILITY

This practice applies to all land uses where site specific conditions warrant and where soil and site conditions are suitable for establishing adequate grass cover. May be used for disposal of runoff water from diversions.

PLANNING CRITERIA

1. Grassed waterways and outlets must be installed in accordance with plans and designs specific for the site.

2. Moisture from natural precipitation or irrigation must be adequate to establish and maintain good grass cover.

3. Select grass species adapted to the area.

METHOD AND MATERIALS

1. Channels should be constructed with minimum side slope, 3:1 or flatter.

2. Fills and embankments must be firmly compacted.

3. The capacity of the waterway should be adequate.

4. Install grade control structures in waterways where grades are too steep for erosion control by vegetative cover alone.

5. It may be necessary to temporarily divert water from the area while grass cover is being established.

6. Protect grass seeding from erosion during establishment.

MAINTENANCE

1. Protect waterways from excessive grazing and vehicle use.

2. Keep waterways clear of debris, brush and excess growth.

3. Fertilize as needed to maintain grass stand and plant vigor.

4. Reseed any damaged or open areas in the grass cover.

EFFECTIVENESS

Properly designed, installed and maintained grassed waterways and outlets will effectively reduce sediment delivery from runoff waters.

ROCK LINED DITCH OR SWALE

DEFINITION

A rock lined ditch or swale is an excavated ditch or swale lined with rock.

PURPOSE

A rock lined ditch or swale conveys surface runoff from other erosion control structures to an off-site drainage, stream, pond or lake. It can also be utilized between and in conjunction with other erosion control structures conveying runoff down slope.

APPLICABILITY

This type of conveyance can be utilized anywhere site conditions warrant. Typical applications include development, mine, and construction sites.

PLANNING CRITERIA

1. Determine through topographical mapping the length and degree of slope, contributing watershed and associated drainage ways.

2. **Depending on the magnitude of the project and the expertise of the proponent, utilize a qualified engineer to design the size, capacity, length and location of the rock lined ditch or swale.**

3. Identify and include in the design adequate erosion control and discharge areas to receive the surface runoff conveyed by the ditch or swale.

METHODS AND MATERIALS

Construct the rock lined ditch or swale along the slope contour per the site specifics of the project design including a stabilized discharge. Excavated materials should be placed on the downslope side of the ditch or swale and spread to conform with the natural slope. The ditch or swale is then lined with rock per design specifications. (NOTE: Angular rock is better than rounded rock due to it being more stable.) Depending on the design specifics, a fabric base is sometimes required to prevent under cutting of the rock. The fabric is laid into the ditch, anchored along the top edge, "toe in", then the rock placed on top. The rock should be applied thick enough to completely cover the ditch. The surrounding disturbance area should be stabilized and revegetated immediately after construction.

MAINTENANCE

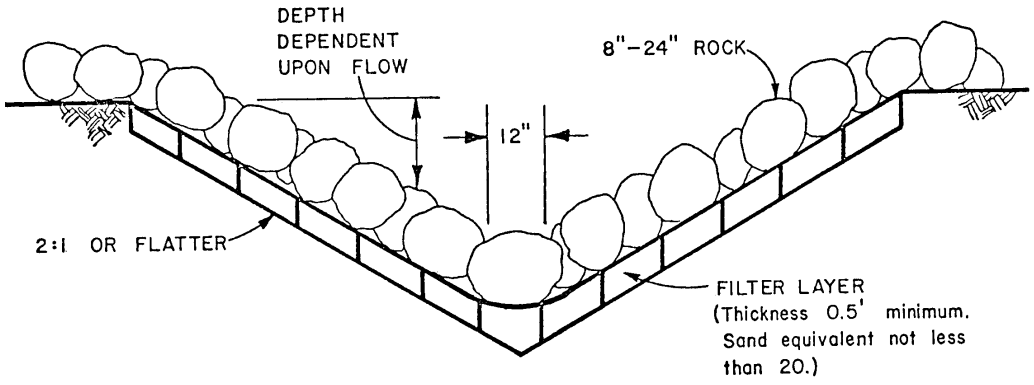
Inspections should be conducted for damage after each major precipitation or runoff event. Repair damage immediately as required.

EFFECTIVENESS

Properly designed, installed and maintained a rock lined ditch or swale will effectively convey surface runoff.

ROCK LINED CHANNEL
FIGURE 13

ROCK LINED CHANNEL



TYPICAL SECTION
no scale

WATERSPREADING

DEFINITION

Diverting runoff from natural channels or gullies by means of a system of dams, dikes, or ditches and spreading it over relatively flat areas.

PURPOSE

To provide extra moisture for improved cover and forage production on rangeland, pastureland, native hayland and reclamation projects and to disperse floodwaters to reduce sediment and damage to watershed areas.

APPLICABILITY

Applies to locations where climate, topography, soils and runoff conditions are suitable for installation and operation of a water spreading system.

PLANNING CRITERIA

All applicable state laws or water rights must be complied with in design, layout, construction and operation of the system.

The topography of the spreading area should be relatively flat, smooth and free of gullies or channels that would tend to concentrate the spread waters. Soils should have a moderate to high water holding capacity. The combination of soils, slopes and plant cover should be such that spreading of floodwaters will not create erosion problems. Sites without adequate plant cover should be properly revegetated.

The diversions and conveyance systems should ordinarily be designed to operate automatically during runoff periods. Where runoff periods extend for a day or more, some manual controls may be used. The works must be capable of safely bypassing peak flood flows.

METHODS AND MATERIALS

Ditches, dike diversions and water control structures such as drops, checks and outlet gates are used as needed for installation of the system.

MAINTENANCE

Ditches, dikes and diversion works should be inspected after each precipitation or storm runoff period and repaired as needed. The entire system should be inspected prior to the runoff season and repaired as needed for proper function.

EFFECTIVENESS

Properly installed water spreading systems will reduce sediment delivery by trapping sediments in the spreading area and are highly effective in improving vegetative cover and forage production.

PERMANENT WATERWAYS

DEFINITION

A permanent waterway is a man-made drainage channel designed, engineered and constructed to convey surface runoff.

PURPOSE

To convert sheet flow to channel flow, to convert pipe flow to channel flow, and to convey concentrated runoff water at non-erosive velocities to permanent storm drainage systems or natural streams without causing erosion.

APPLICABILITY

Applicable to all drainage systems which collect, concentrate, and convey surface runoff at the ground surface. Can be used to convey runoff both to and from permanent underground storm drainage systems. Permanent vegetated waterways can provide the entire stormwater conveyance system where space and steep slopes are not a problem.

PLANNING CRITERIA

Permanent waterways are man-made channels designed to convey surface runoff for many years. They are also referred to as drainageways. The term diversion is sometimes used to describe temporary drainageways installed during the construction period. Permanent waterways lined with concrete or asphalt are commonly referred to as paved swales while those lined with rock are called rock-lined ditches or riprap channels. Permanent waterways can be lined with grass. Grass-lined waterways offer several advantages over paved or rock structures, but they do require more space and are not suitable on steep slopes.

A qualified engineer should be utilized to design the size, capacity, length, location and construction of the permanent waterway. Permanent waterways must be designed in accordance with two primary criteria. First, the channel must have sufficient capacity to convey the peak flow from the design storm event. Second, the channel must be resistant to erosion at the design peak flow. Permanent waterways must always be lined or vegetated regardless of slope. Channel linings have several secondary functions that influence the choice of lining material. Permeable lining materials permit infiltration of water into the soil, and that encourages plant growth. On the other hand, impermeable materials prevent infiltration, and that would be desirable on unstable cut and fill slopes. A smooth lining increases flow velocities. A lining that slows velocity reduces peak flows by spreading the flow over a longer time period. Thus, the choice of lining material must be evaluated in terms of flow velocities, cost, aesthetics, slope, desirability of infiltration, and maintenance.

The permeable lining materials include grass and rock, used separately or together. Impermeable materials include grouted riprap, concrete, gunite, and asphalt. Grass lined waterways are the most aesthetically pleasing and probably do the best job of filtering sediments and nutrients. Sediment traps, if needed, can be incorporated into waterway design by installation of small check dams at regular intervals. These drop structures can trap sediment at locations where cleanout is possible and thus keep the riprap channel relatively clean.

METHODS AND MATERIALS

Permanent waterways must be designed and installed by qualified professionals. Small riprap channels can be installed as follows:

1. Size the channel to hold the peak flow for the design storm.

2. Place a layer of filter fabric in the channel and up to at least 0.5 feet above the designed waterline.

3. Place a layer of riprap on top of the filter fabric.

4. **The proper rock size must be determined by qualified professionals in order to provide surface protection from erosion during the peak design velocities**. The rocks must be large enough so that they are not moved during the peak flow.

MAINTENANCE

If properly installed in accordance with the design criteria, maintenance will not be a problem because design velocities should keep the waterways clean. However, waterways, especially rock-lined ditches, can fill up with sediment very rapidly if located adjacent to roadsides or in flat areas. The cleaning of riprap channels is labor intensive unless specialized vacuum equipment is available. Paved swales require little maintenance other than regular sweeping. Grass-lined ditches adjacent to roadways can be cut if vegetation gets too high.

EFFECTIVENESS

Permanent waterways are very effective in conveying storm water runoff if properly designed and installed as part of a drainage system. High maintenance costs can reduce the cost-effectiveness of riprap channels. Grass-lined ditches are the most effective in trapping sediment and nutrients and are the most aesthetically pleasing.