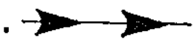
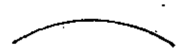
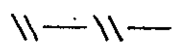
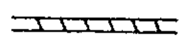
CHAPTER 9

EROSION CONTROL

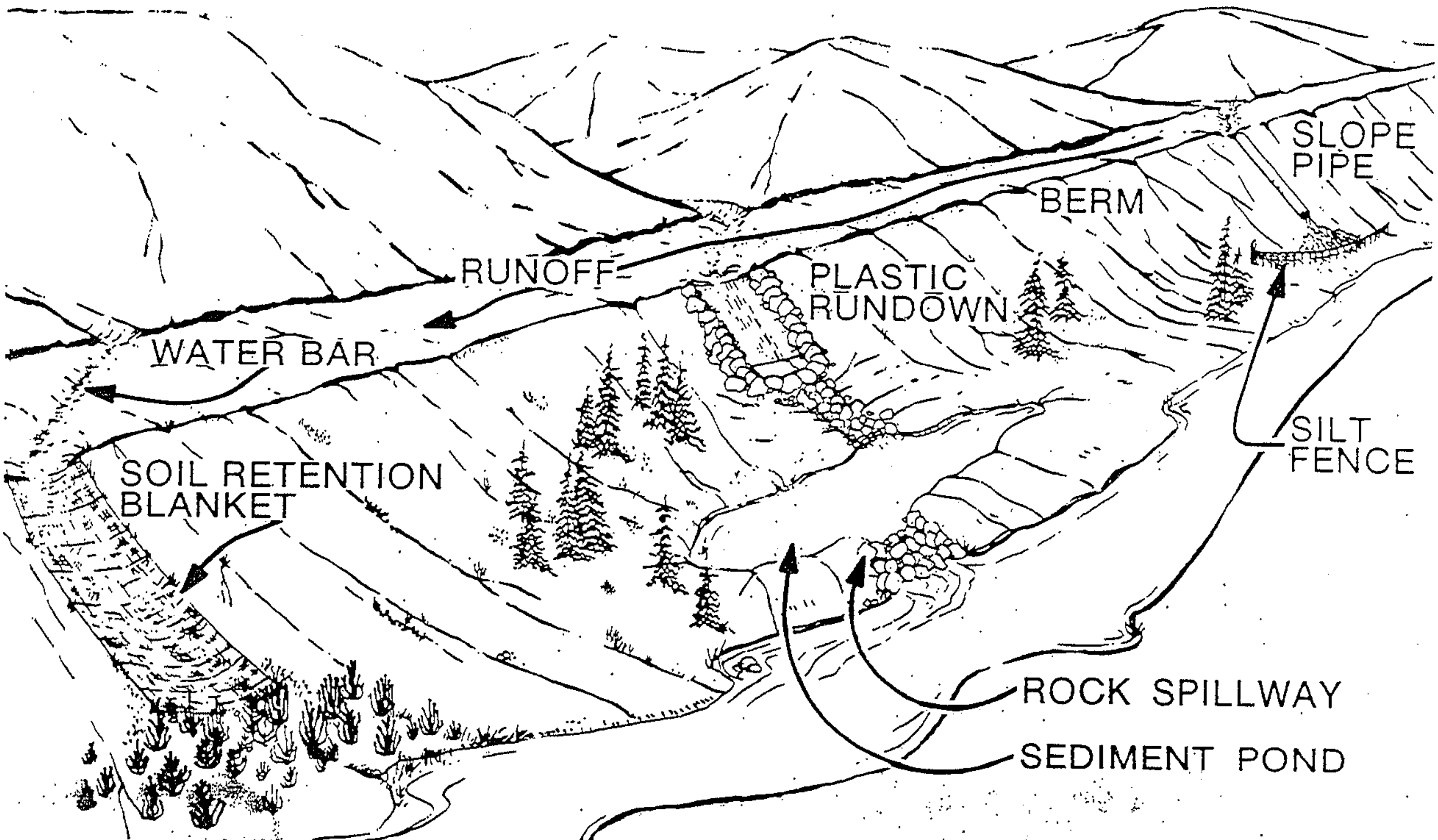
EROSION CONTROL SYMBOLS

A completed plan will incorporate many methods for controlling erosion.

The treatment of individual problems can require a number of methods, therefore numerous symbols are necessary for detailing a set of plans. The following series of symbols is recommended for use by designers in detailing temporary erosion control methods on the project plans.

INTERCEPTING DITCH	
DIVERSION DITCH OR STRUCTURE	
STRAW BALES	
CHECK DAMS	
SILT FENCE	
SANDBAGS	
SEDIMENT TRAP	
BERM	
CHEMICAL TREATMENT	
PUMP	

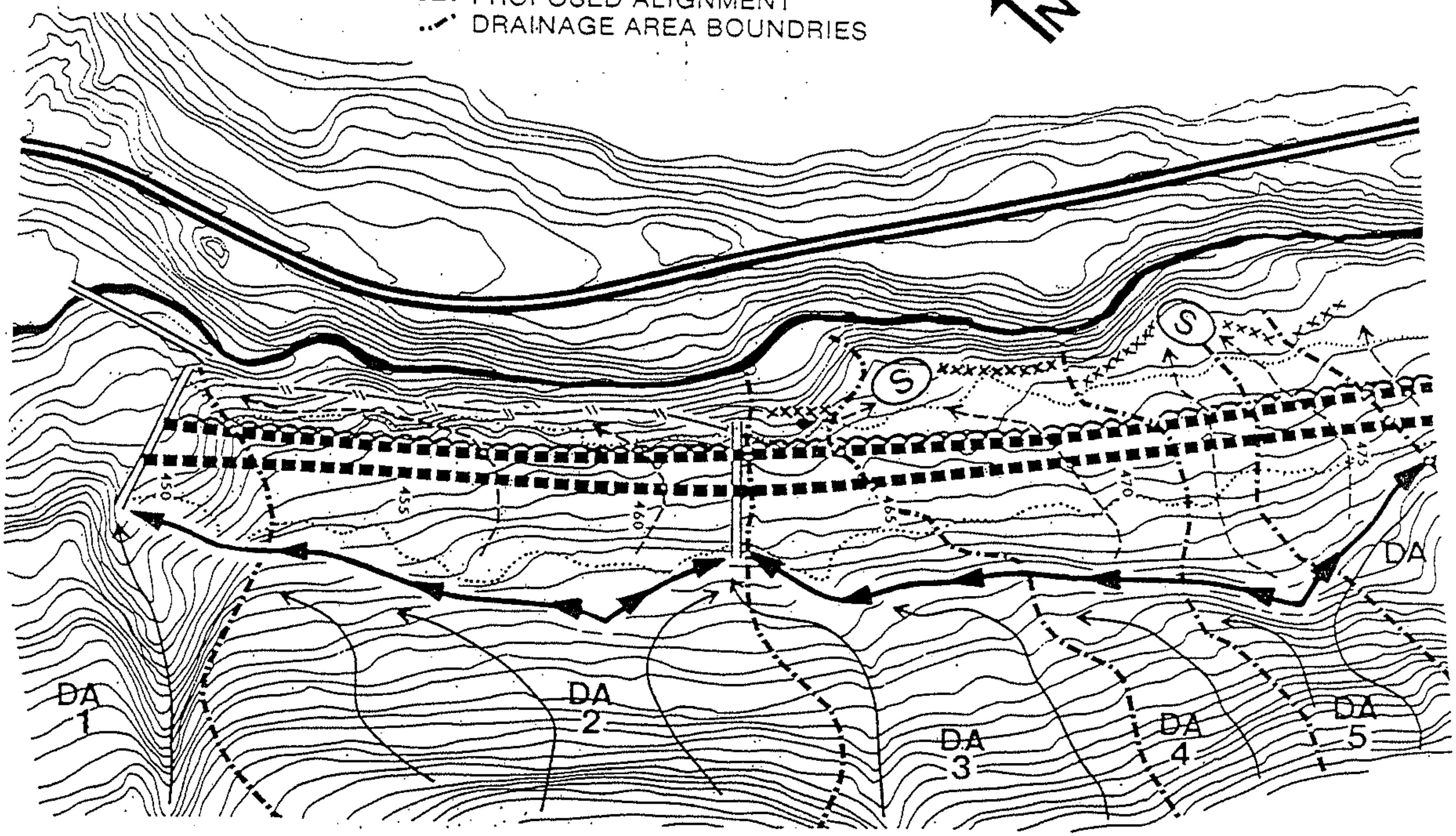
EROSION CONTROL SYSTEM



DETAIL ECS - 1

EROSION CONTROL SYSTEM
SAMPLE PLAN

- HIGHWAY
- STREAM
- PROPOSED ALIGNMENT
- DRAINAGE AREA BOUNDRIES



DETAIL ECS - 2

EROSION CONTROL DURING CONSTRUCTION

The techniques for minimizing erosion and sedimentation rely on a few simple principles, as outlined briefly below. They are the basis for the erosion control solutions presented later.

Shield soil from rainfall and runoff. Numerous mulches, blankets, and nettings are available to protect soil from raindrop impact and runoff. Chemical soil binders also provide similar protection.

Reduce soil exposure time. The interval between earthwork commencement and slope revegetation should be minimized, unless special grading of a slope is required to achieve a special effect.

Control runoff water. Whenever possible, natural or clear water runoff should be kept separated from project runoff and carried through the project uncontaminated. Normally, the volume of water from natural drainage is too great to allow mixing with project runoff in a contaminated water collection system.

Slowing runoff velocity will reduce its erosive force. Increased surface roughness or checks can be used for this purpose. Early construction of drainage structures maintains natural cross drainage and simplifies the separation of natural and construction runoff.

Trap sediment. Sediment laden water can be filtered using silt fences or erosion bales. Temporary or permanent basins can be used to trap sediment for removal at a later time. Retention time is based on the soil conditions and characteristics.

INTERCEPTING DITCH OR BARRIER

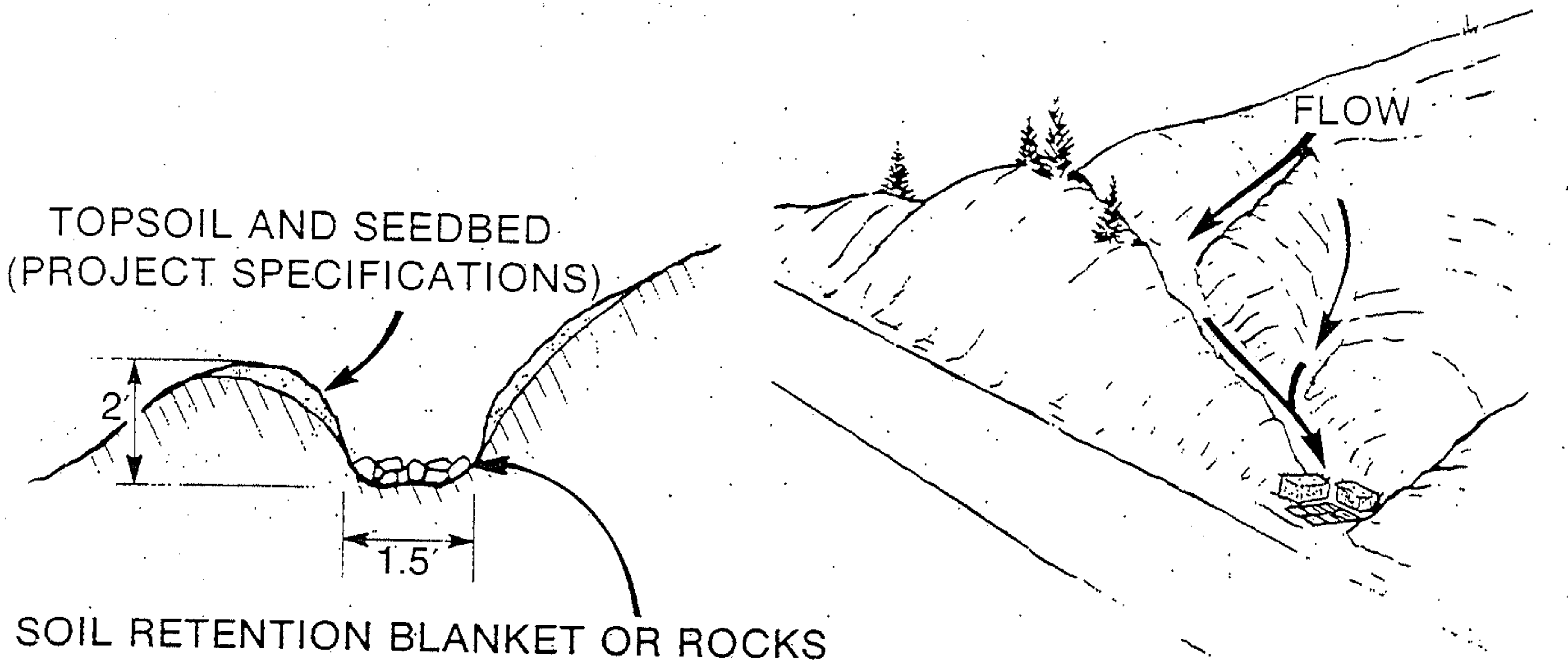
DESCRIPTION: When snowmelt runoff and groundwater springs are foreseen as potential erosion problems, an intercepting ditch or barrier may be constructed above future cut slopes to divert surface runoff to temporary or permanent cross culverts. Unless severe slope stability problems exist, interception of the natural drainage is to be used as a temporary measure until permanent ground covers (grasses) are established. If ditching is not practical, a temporary barrier of erosion bales with an entrenched plastic lining is a viable alternative which will not permanently disturb the natural watershed.

DESIGN: Intercepting ditches or barriers are to be used from cut-fill transition areas to the top of the cut slope behind the slope stakes. Intercepting ditches or barriers are to conform to STANDARD M-203-C (Ditches).

CONSTRUCTION: **Type 1.** Hand dug or trenched ditch with soil retention blanket or rock lining. **Type 2.** Barrier or erosion bales with entrenched plastic lining secured with rocks or logs.

MAINTENANCE: Periodic inspection of ditch or barrier for sediment accumulation and/or breaks in the system, which may need handwork and repair. When vegetative cover is established, ditches are to be filled and seeded.

INTERCEPTING DITCH



DETAIL ID - 1

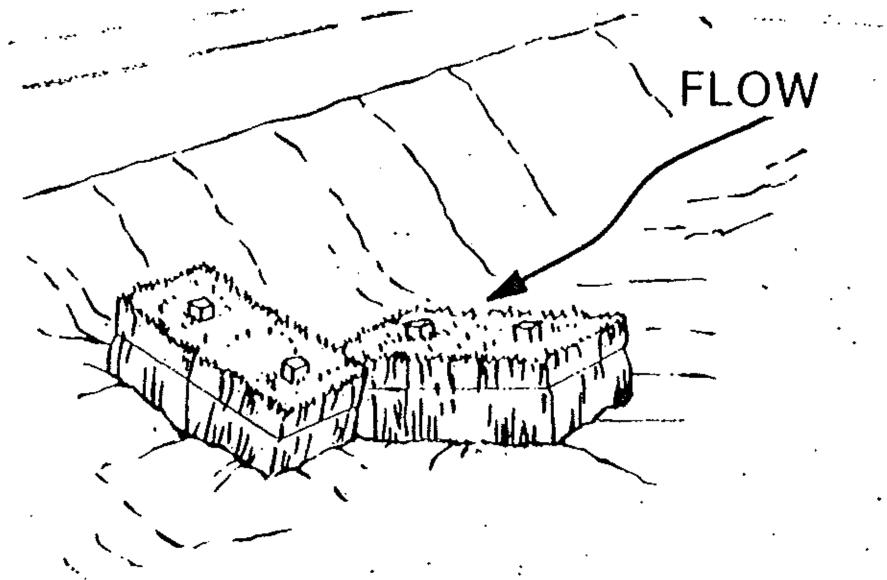
EROSION BALES

USAGE: Erosion bales are used as filters along the toe of fill, as erosion checks in ditches, and as diversions at unfinished drop inlets, culvert inlets and outlets. Erosion bales placed below new fill slopes protect streams or adjacent property from erosion until vegetation is established. When used as erosion checks in roadway ditches, bales reduce flow velocity thereby reducing erosion. Bales are often placed as a filter around drop inlets and culvert inlets and outlets to trap construction sediment until the project is completed.

CONSTRUCTION: The main consideration in placing erosion bales is to obtain tight joints. ERosion bales will not filter sediment out of the water if the water is allowed to flow between, around, or under the bales.

The erosion bales should be entrenched six inches and anchored with 2" x 2" x 4' stakes or #4 reinforcing bars.

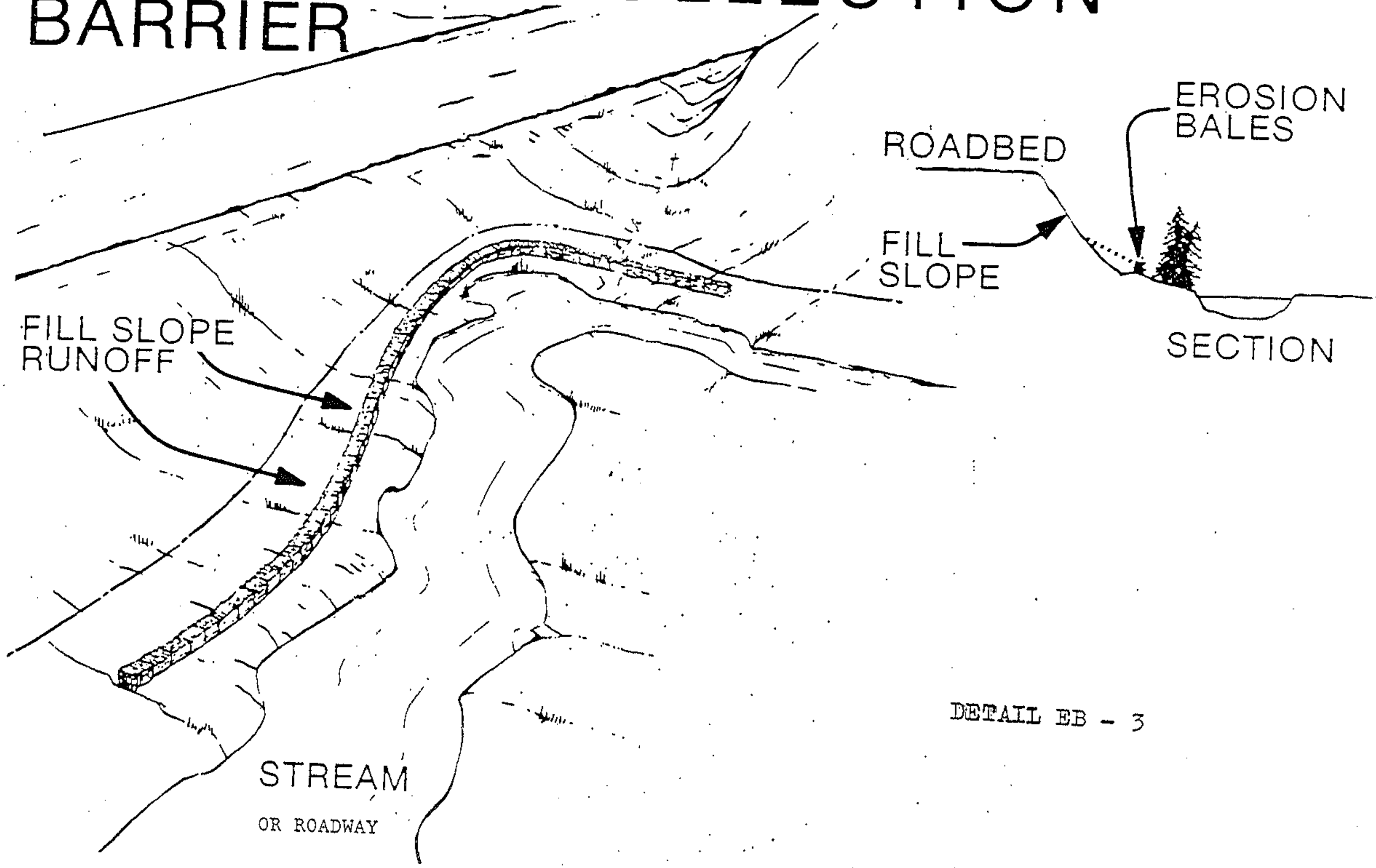
MAINTENANCE: Since erosion bales deteriorate quickly, they may require replacement during construction. When vegetation is established, the accumulated sediment may be spread, seeded, and then mulched with the erosion bales. Where not visually obtrusive, erosion bales may remain in place to decompose with grass seed spread on the sediment that has collected behind the barrier, e.g., where a steep fill is directly adjacent to a stream.



Erosion Bale Check Dams Used In Roadside Ditches To Trap Sediment

DETAIL CD - 2

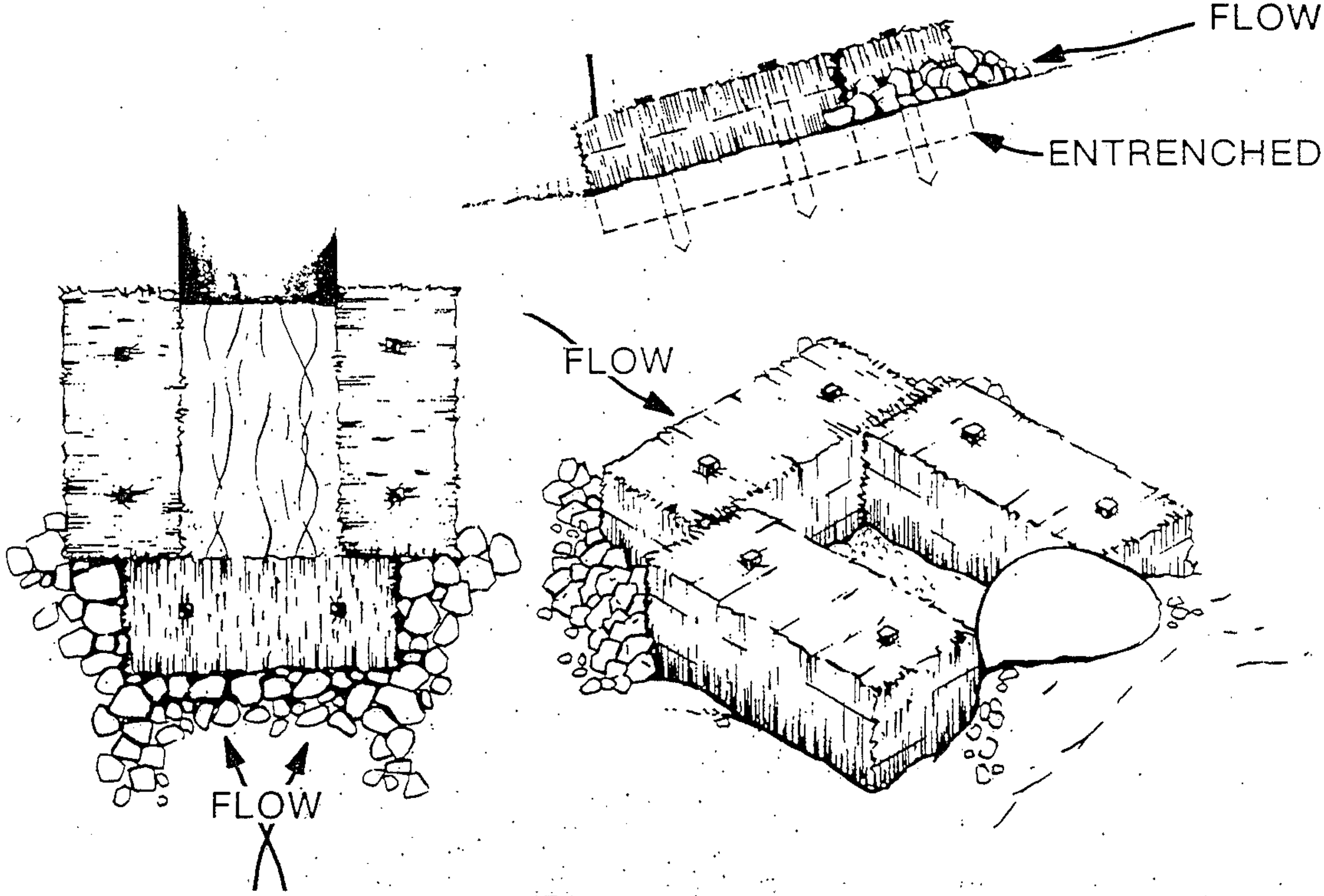
SEDIMENT COLLECTION BARRIER



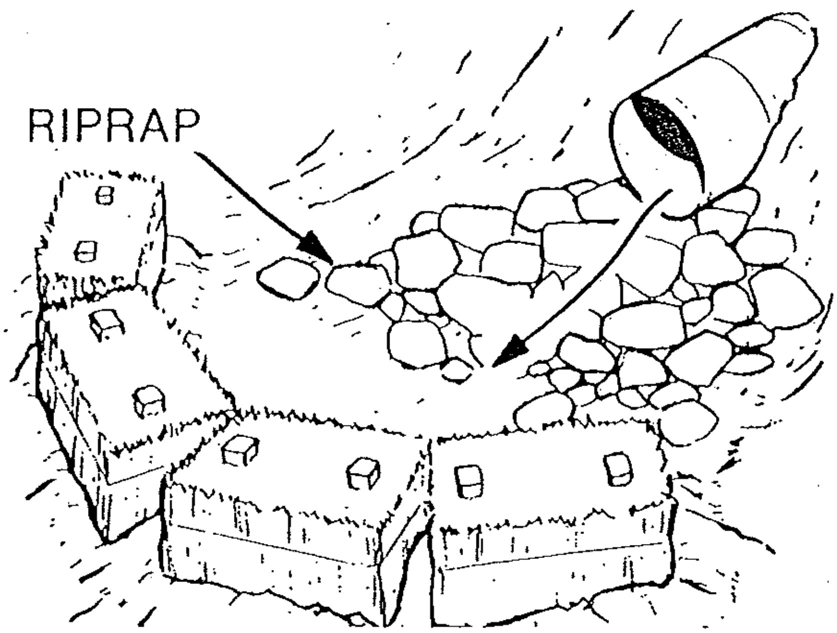
DETAIL EB - 3

ETAIL EB - 2

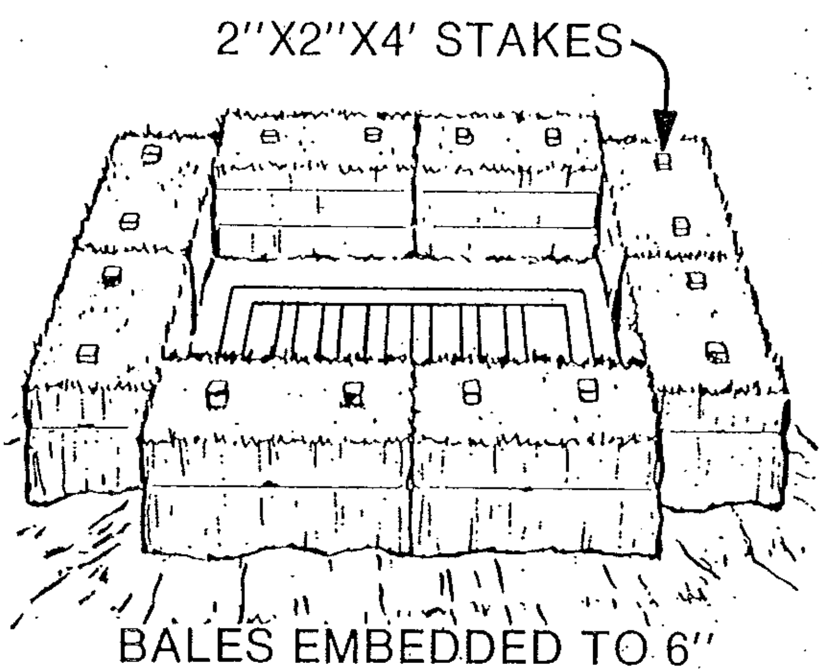
CULVERT INLET TRAP



DETAIL EB - 1



Erosion Bales Trap Sediment At Culvert Inlets And Prevent Erosion At Culvert Outlets Until Vegetation Is Established



DETAIL EB - 2

CHECK DAMS

DESCRIPTION: A check dam is simply a very small sediment trap made of erosion bales or rocks placed across a ditch or gully. Check dams decrease water flow velocities creating a tranquil water area behind the dam in order to deposit sediment loads. Generally, erosion bales and rock check dams are easily constructed and maintained.

DESIGN: Erosion bales with 10 mil plastic lining provide an economic check dam for a wide swale. Rock check dams are more suitable for narrow ditches and gullies. The flow across a check dam should remain concentrated near the center. Therefore, the ends of the check dam must be well above the center to prevent flow around the ends.

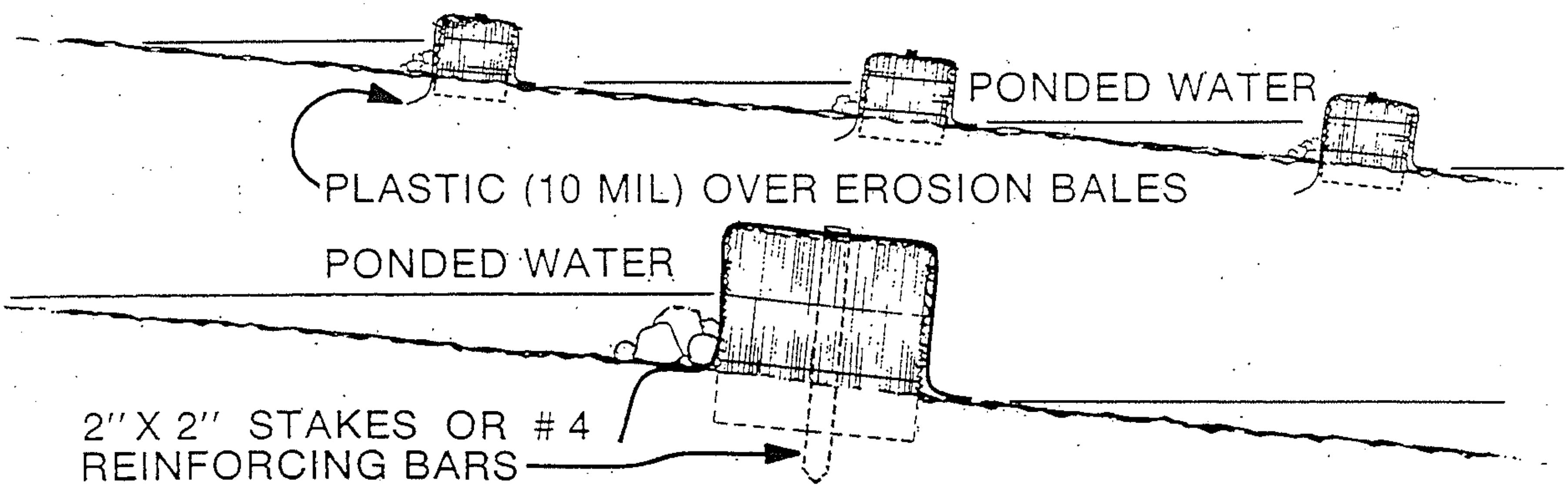
CONSTRUCTION: Several erosion bales configurations are possible solutions depending on the specific terrain conditions. Plastic lining is placed over the bale when high runoff flows are present or anticipated. This barrier is designed to be impervious and allow overflow when holding capacity is reached. However, entrenched bales alone may be used for sediment entrapment and low runoff flow filtering.

Rock check dams should be built with well graded rock. Enough gravel and cobbles are required to fill the voids between the larger rock and force water over the dam.

MAINTENANCE: Generally, it is not necessary to remove silt from a rock check dam. As sediment builds up to the top of the dam, the upstream ditch slope is flattened which reduces the ditch erosion. When erosion bale check dams are removed, the sediment shall be spread, seeded, and mulched with the removed bales.

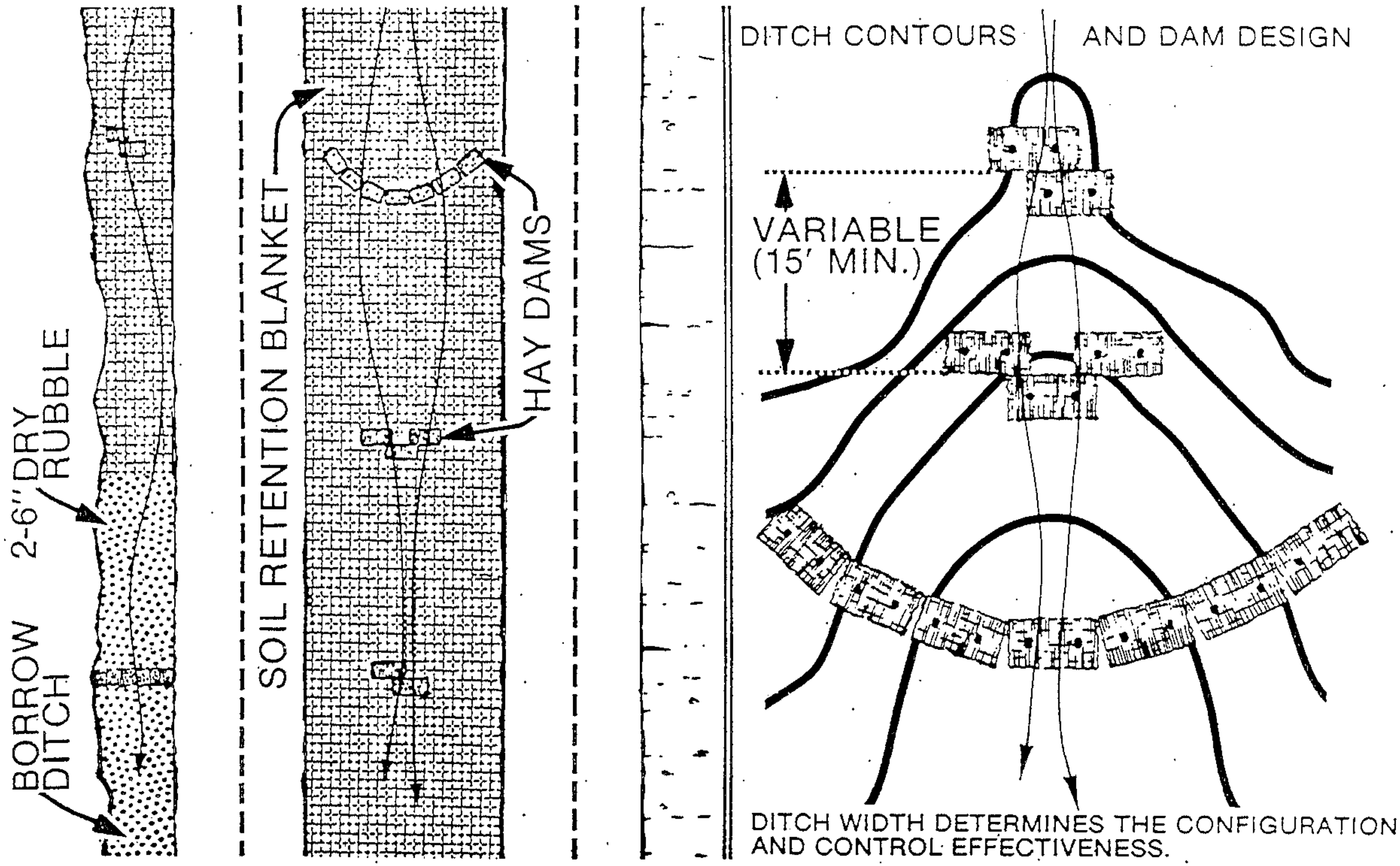
EROSION BALE CHECK DAMS WITH PLASTIC LINING

PROFILE VIEWS



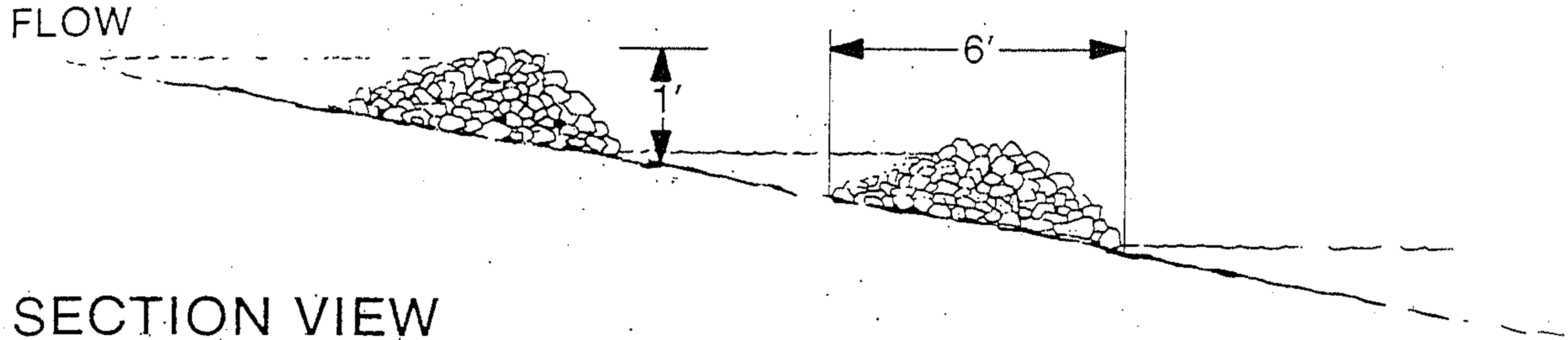
DETAIL CD - 1

EROSION BALE CHECK DAMS- ALTERNATIVE SOLUTIONS

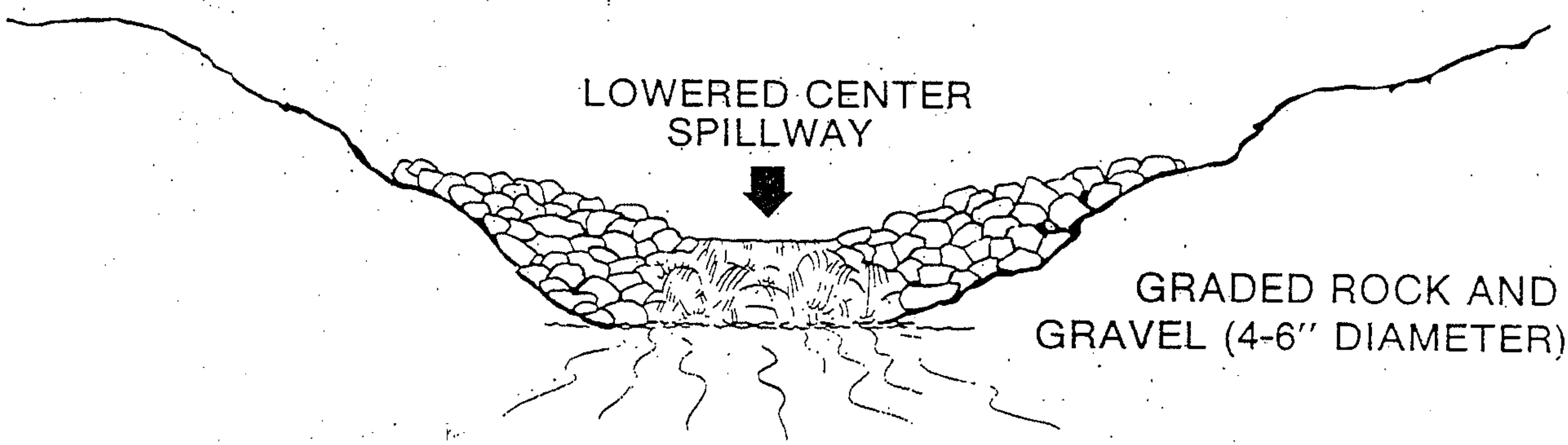


ROCK CHECK DAMS FOR DITCHES

PROFILE VIEW



SECTION VIEW



DETAIL CD - 4

TEMPORARY DIVERSIONS

USAGE: When permanent drainage structures must be constructed in flowing creeks, a temporary flow diversion around the work area is required. This keeps the work area dry and prevents siltation of the downstream channel. common practice is to excavate an unlined diversion channel around the site, whereas effective erosion control requires either a channel lining or a temporary culvert. Temporary culverts are often necessary for traffic maintenance.

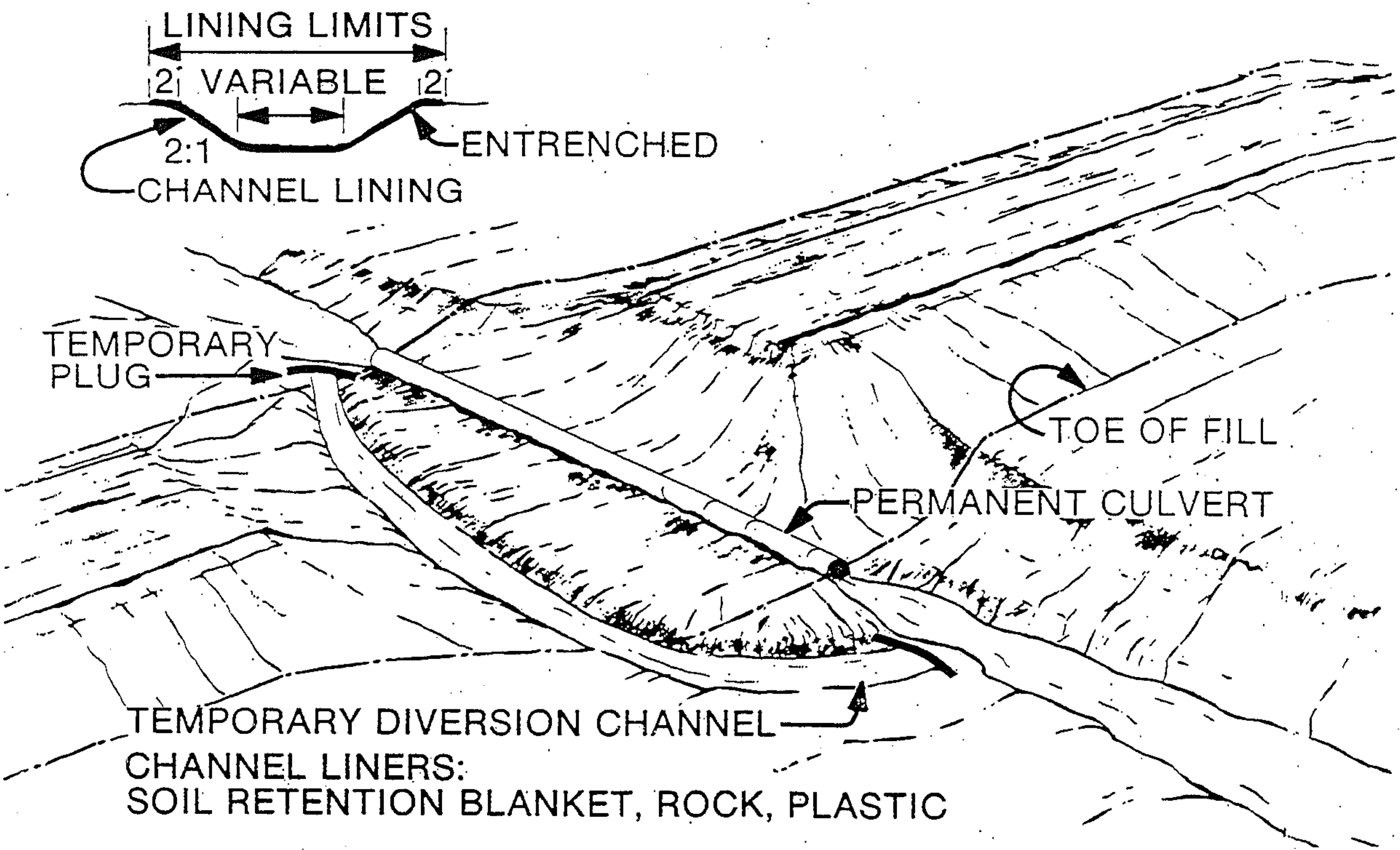
DESIGN AND CONSTRUCTION: Channel linings of jute or similar soil retention blankets will hold soil in place for trickle flows less than two cubic feet per second. Ten mil plastic lining will withstand flows up to five cubic feet per second. For higher flows, riprap and channel dimensions can be designed using Chapter 8 in the CDOH Design Manual. The following steps are necessary in construction and operation of a diversion channel:

Excavate the diversion channel to the proper dimensions, leaving plugs at each end.
Place channel lining and stabilize with rock.
Remove plugs and divert water.
Construct permanent drainage structure.
Divert water into finished structure.
Salvage channel lining and fill channel.

Where plastic lining or soil retention blankets are used as channel linings, the entire channel cross-section must be covered. Joints must run transversely and be overlapped two feet. The lining edges along the top of the channel should be weighted with rocks or dirt. The following figures show typical placement.

MAINTENANCE: The lining must be inspected frequently to ensure that it remains stable. For plastic lining or soil retention blanket, additional rocks may be needed on edges, joints, and bottom to prevent movement.

TEMPORARY DIVERSION



DETAIL TD - 1

SILT FENCE

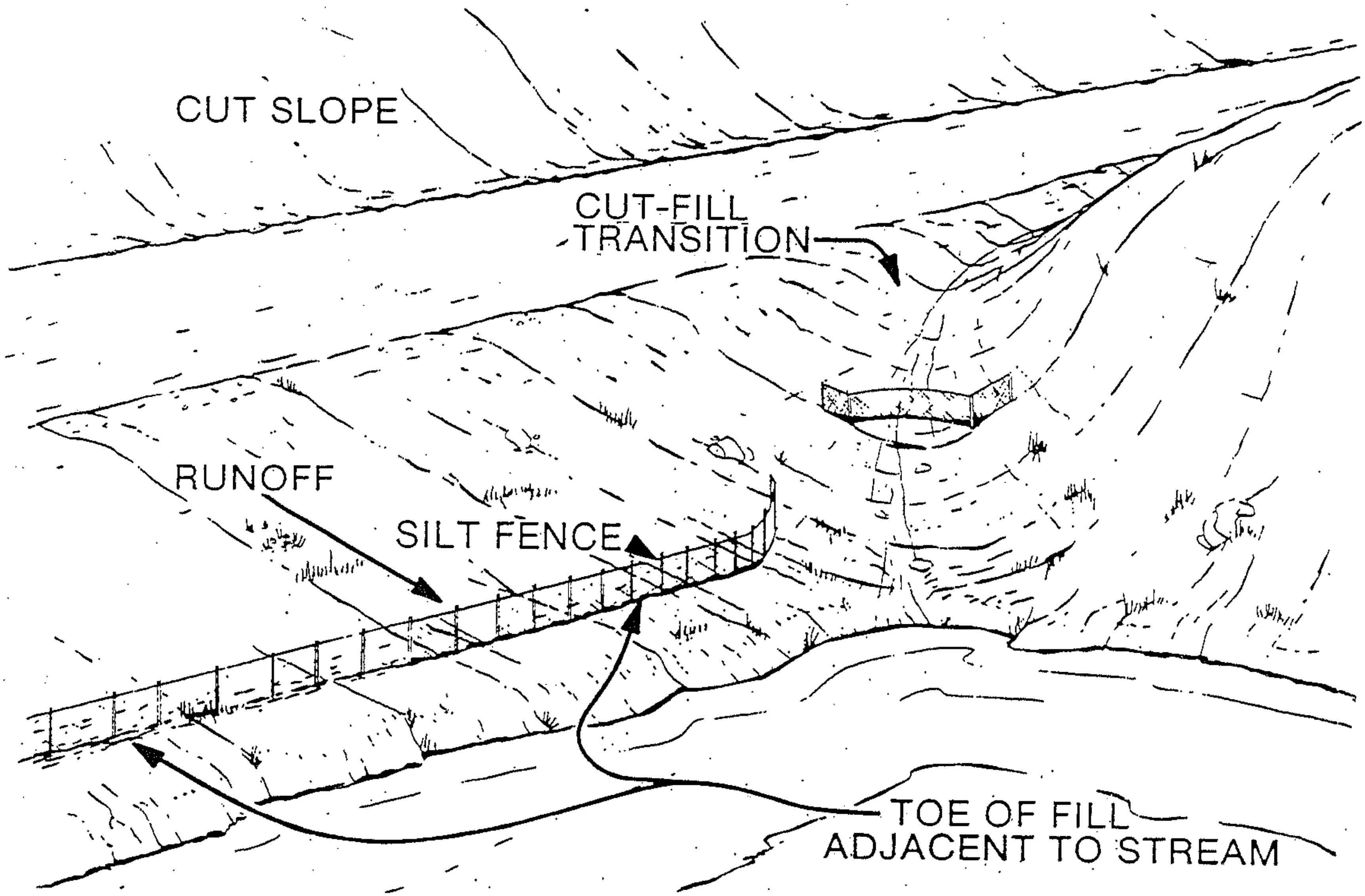
DESCRIPTION: A silt fence is a vertical barrier of filter cloth. The cloth is supported by a low, woven wire fence. Sediment laden water is diverted through the filter cloth which retains the sediment and allows the clean water to pass through.

USAGE: Silt fences are especially useful to trap sediment where access or right-of-way is limited beyond the toe of slope. A silt fence can be constructed and removed using only hand labor. Silt fences are typically used at the following locations:
Along the toe of fills
Transition areas between cut and fill
Adjacent to streams
Along private property

CONSTRUCTION: A silt fence is built along a terrain contour so that runoff can be filtered uniformly along the fence. Care must be taken to choose a stable area where increased soil moisture will not cause soil slumping. The ends of the fence are tapered uphill to contain the sediment buildup. concentrated flows to a small area of the fence must be avoided so that the filter cloth capacity is not exceeded. Five foot steel or wood posts are driven to a depth of 2 feet at 6 foot spacing. Woven wire fence, 36 inches high, is stretched along the posts and fastened with wire ties. The plastic filter cloth is secured to the top of the fence with wire ties or hog rings and the bottom is entrenched (6") along the base of the fence and stabilized with rock to prevent underflow.

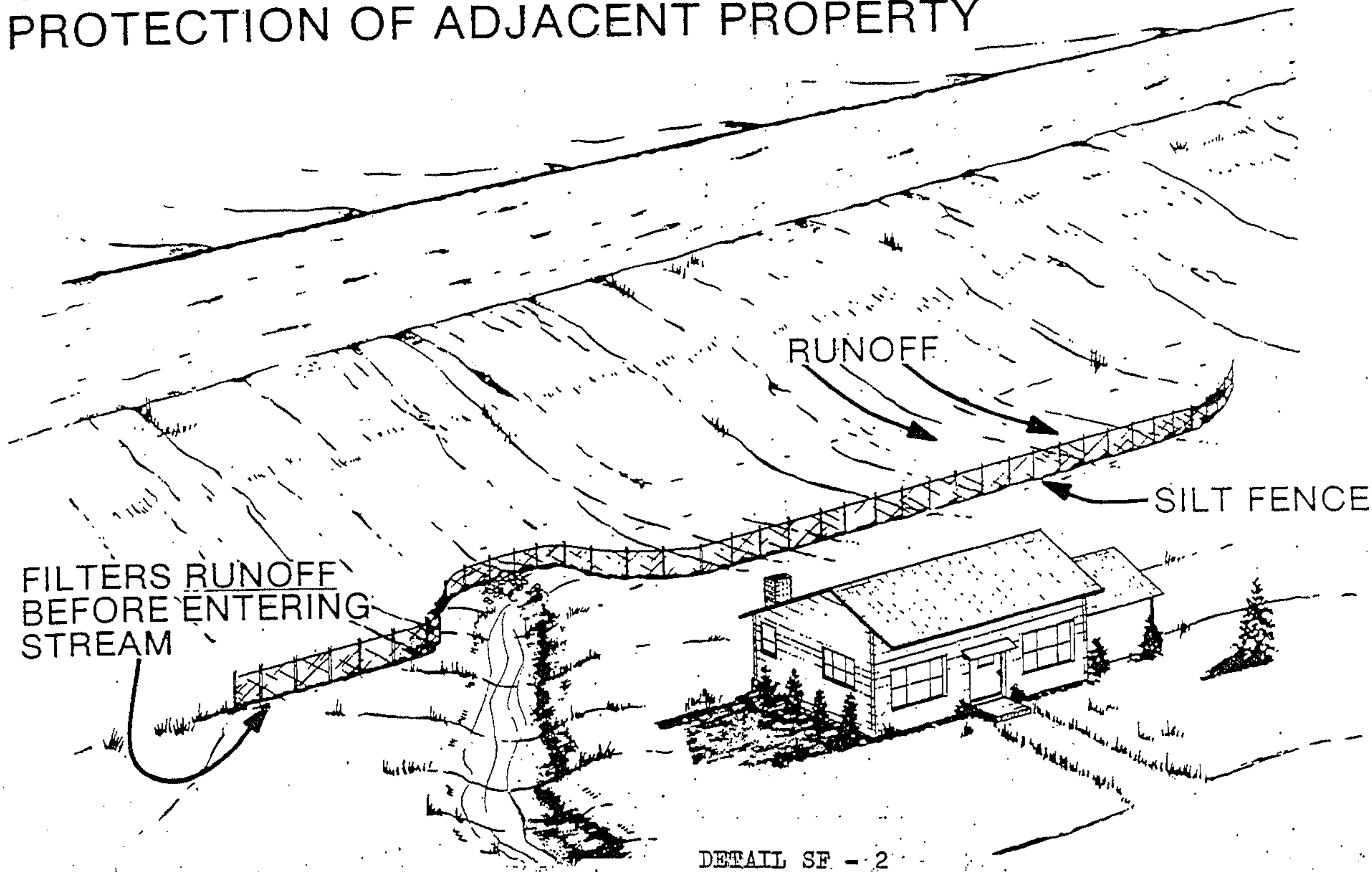
MAINTENANCE: Sediment should be removed when the accumulated depth reaches eighteen inches. Depending on accessibility, machinery or hand operations can be used. When slope vegetation is established and permanent erosion control measures are in place, the entire silt fence should be removed, and the sediment spread and seeded.

SILT FENCE APPLICATIONS



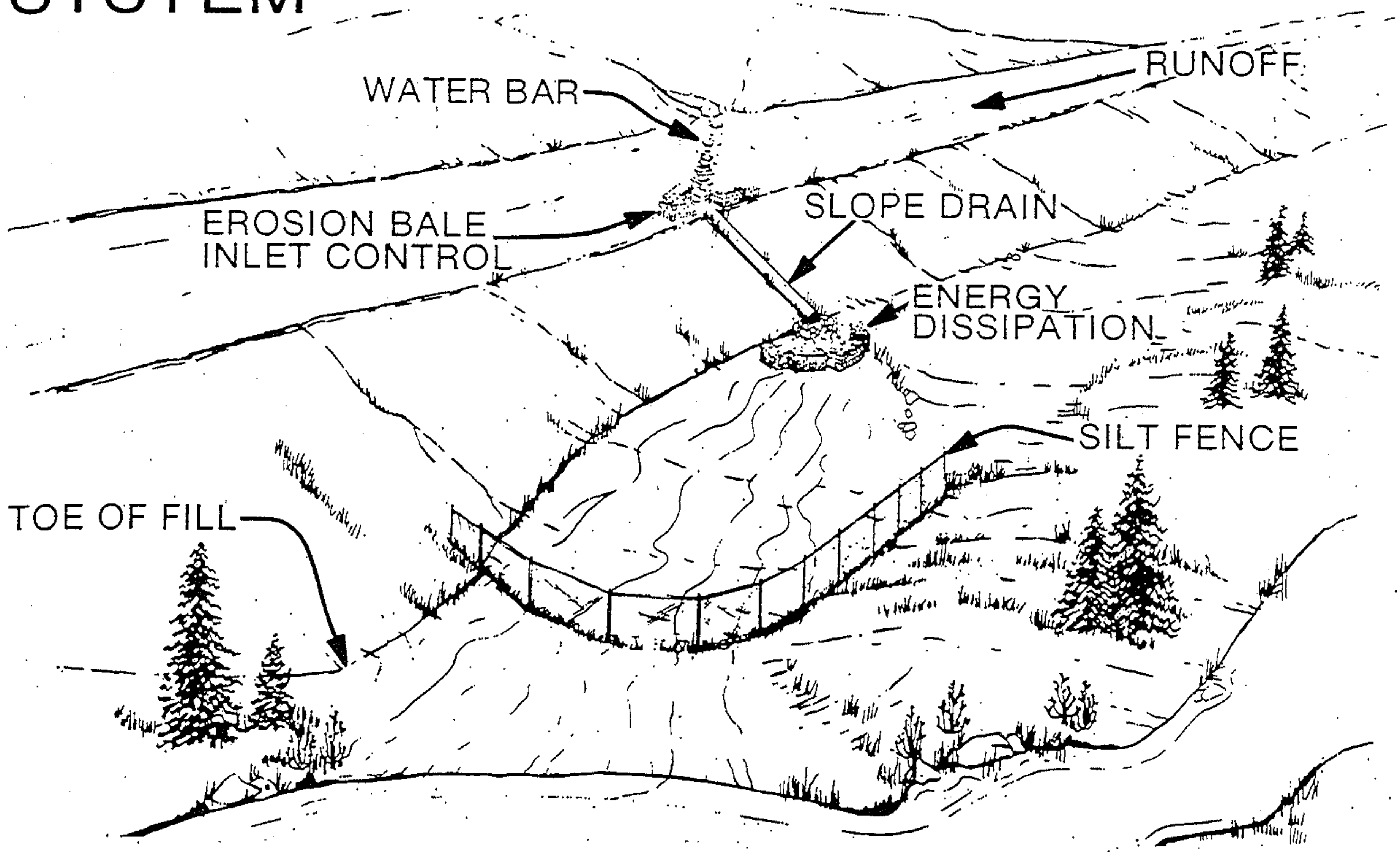
DETAIL SF - 1

SILT FENCE APPLICATIONS
PROTECTION OF ADJACENT PROPERTY



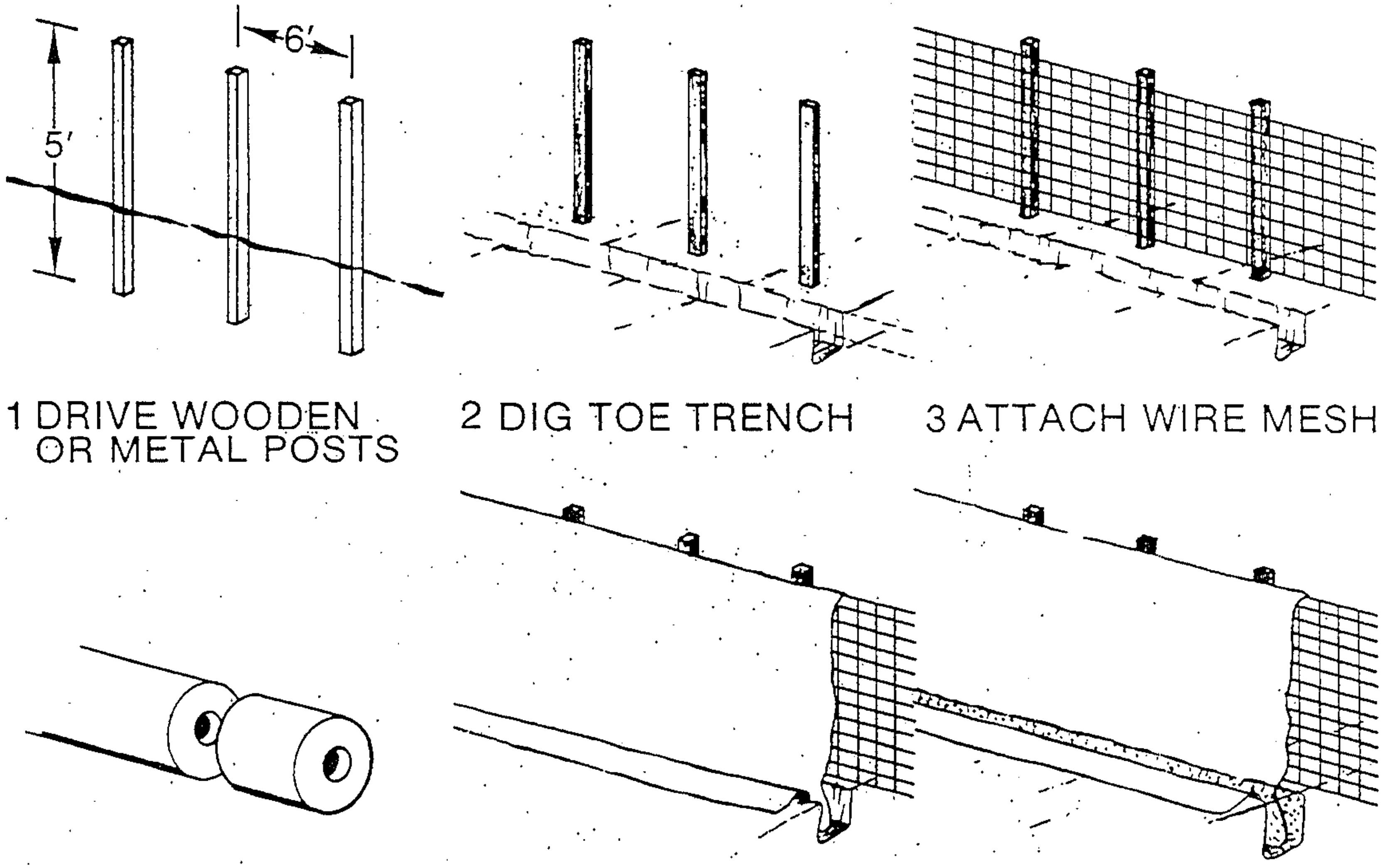
DETAIL SF – 2

DIRTY WATER TREATMENT SYSTEM



DETAIL SF - 3

SILT FENCE CONSTRUCTION



1 DRIVE WOODEN OR METAL POSTS

2 DIG TOE TRENCH

3 ATTACH WIRE MESH

4 CUT LENGTH OF FILTER FABRIC

5 ATTACH FILTER FABRIC

6 BACKFILL TRENCH

DETAIL SF - 4

SANDBAGS

USAGE: Sandbags may be temporarily used for diverting stream channels, for barrier walls for sedimentation ponds where inaccessible by large equipment, and for retaining walls between fill slopes and watercourses during construction. (For example, bridge abutments and pier construction areas.)

DESIGN: Sandbags are flexible design building blocks which can easily conform to the terrain of an area. Waterproofing can be achieved by covering with plastic lining. Sediment filtering may be accomplished by using filter cloth at toes of steep fills adjacent to streams.

CONSTRUCTION: Common burlap bags filled with soil material may be constructed on site. Sandbags can be stacked by using an alternately layered method for building the barrier wall.

MAINTENANCE: Periodic inspection for effectiveness will be necessary dredging sediment and repairing any breaks in the barrier wall. Removal will be required when roadway construction terminates.

TEMPORARY BERM

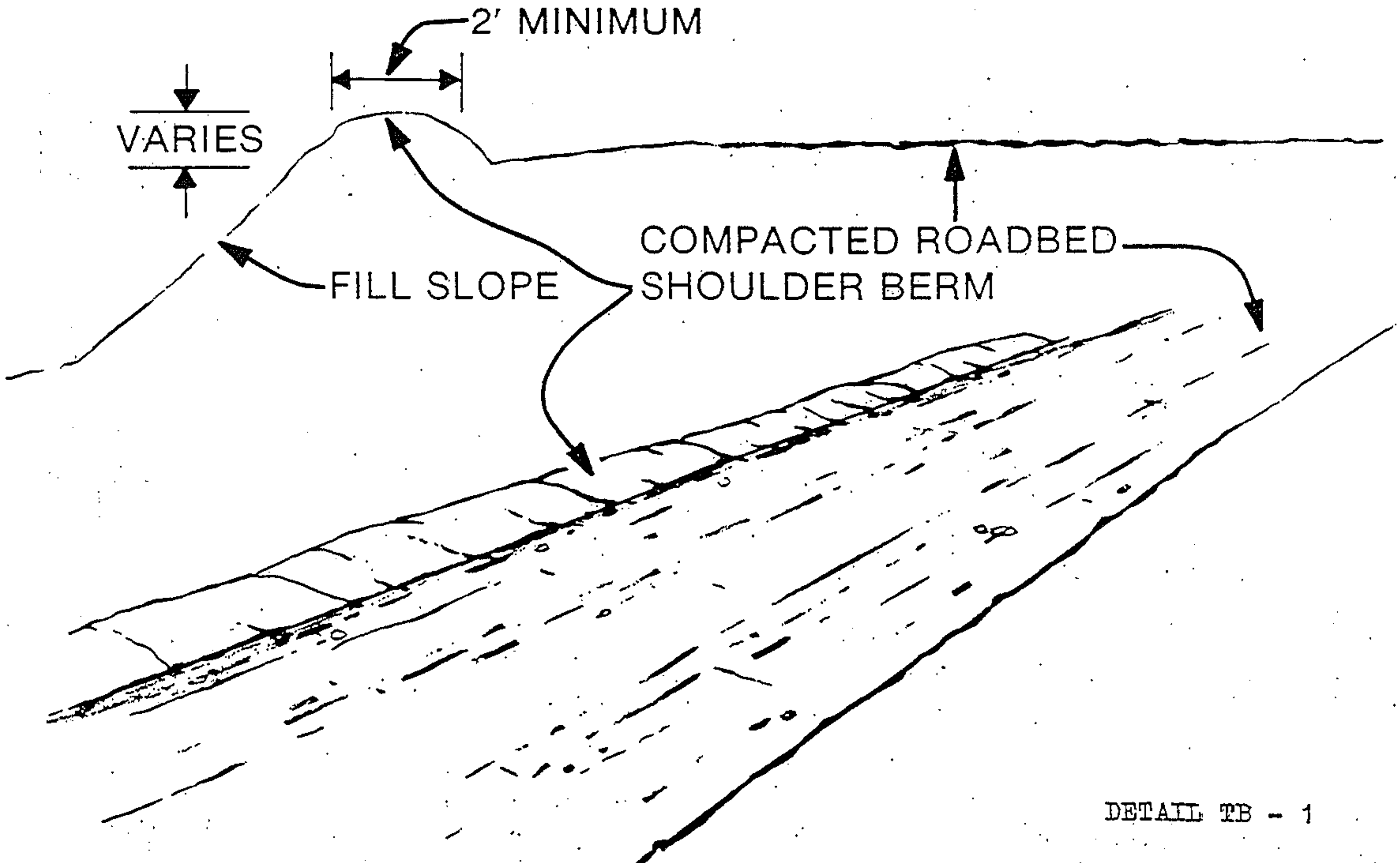
DESCRIPTION: A temporary shoulder berm is placed along the top edges of fills to prevent runoff water from eroding newly constructed slopes. The berm is made of compacted soil with or without a shallow ditch along the front edge.

USAGE: Temporary berms are used to direct project runoff to slope drains. Runoff from slope and roadway work areas must be diverted from steep slopes to designated disposal areas. Two types of berms are used depending on the intended length of service. Temporary berms are constructed along fills at the end of each day's operation on embankments. Slope drains and berms are continually adjusted as the fill height increases. Berms for winter shutdown have a larger cross-section for stability over a longer period. They are used when embankment operations shut down for the winter season, when work is discontinued for at least two weeks on the embankment, or when roadway grades and embankments are completed but paving and final drainage structures are not yet placed.

DESIGN AND CONSTRUCTION: Temporary berms are intended to accommodate runoff only from small areas, e.g., less than five acres. If proper slope drain spacing is used, drainage areas will stay well within this limitation. Systematic channelization of runoff expedites effective treatment and reintroduction to natural streams. Temporary berms should be constructed to the dimensions shown on the typical drawing. Compaction is accomplished by several passes of a dozer track or grader wheel.

Berms must be properly graded to carry water to the slope drain. Ponding must be minimized to prevent soft spots in the embankment. Embankment lifts should be placed so that a gradual transverse slope is maintained. Temporary berms and slope drains then are required on only one side of the embankment.

TEMPORARY BERM



DETAIL TB - 1

SLOPE DRAINS

USAGE: Slope drains convey runoff water from the work area down unprotected fill slopes. They are used in conjunction with berms along the tope edge of newly constructed slopes to prevent erosion. Plastic lining, wooden flumes, metal, rigid or flexible plastic pipe, and half round pipe are commonly used.

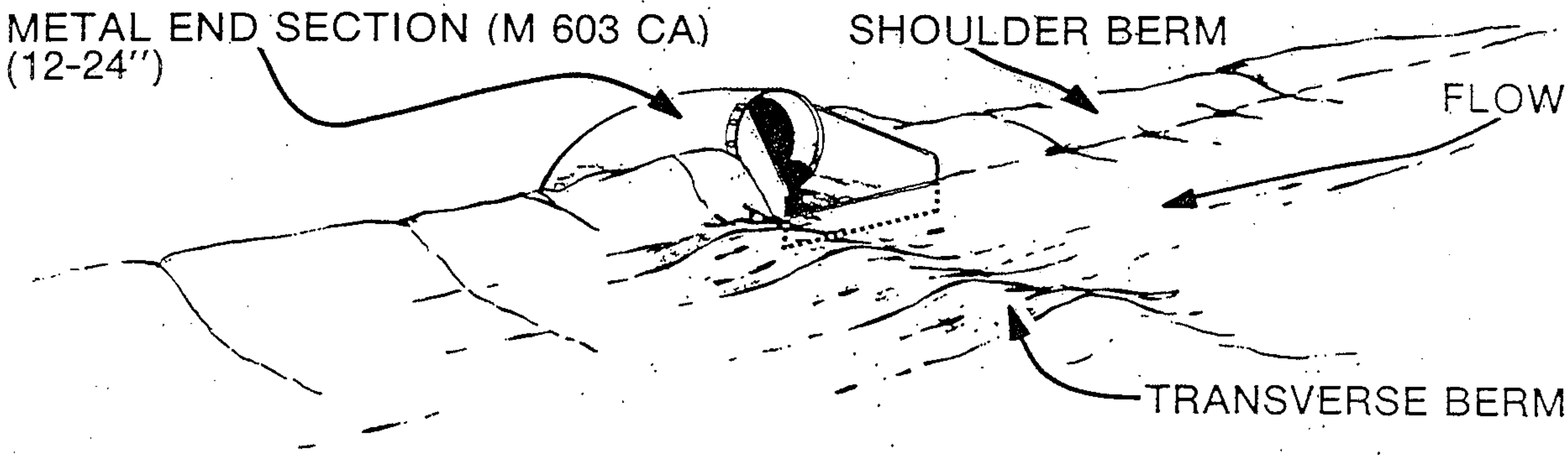
DESIGN AND CONSTRUCTION: Slope drains are required at frequent intervals along ocntinuous fill slopes and at low points in the roadway profile grade. Prior to paving, slope drains are required twice as often as given by the Embankment Protector Spacing Chart in the CDOH Design Manual.

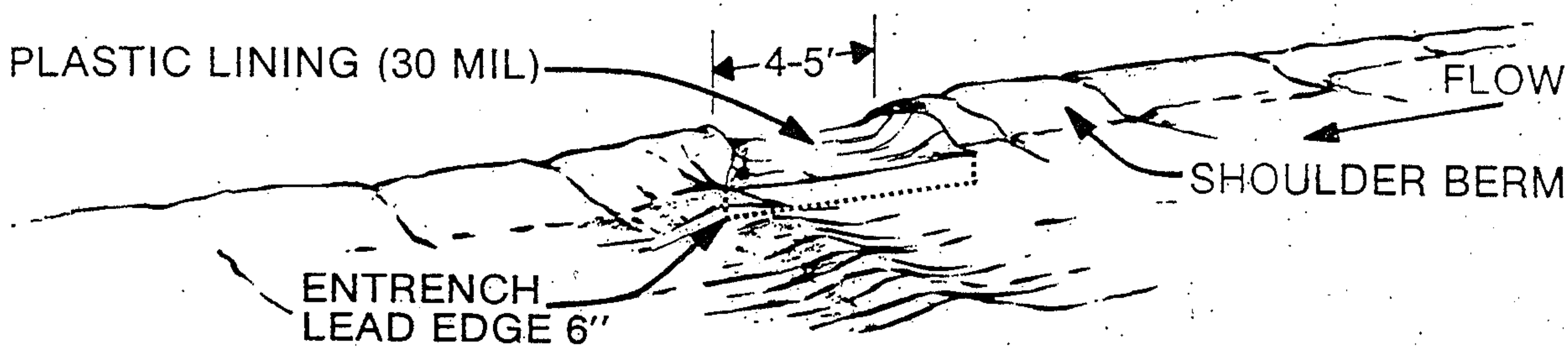
The surface of the slope must be dished somewhat to accommodate a slope drain. When plastic lining is used, a smooth, uniform ditch is required to prevent water from overflowing the sides. A small trench is needed to provide lateral stability for flumes or pipes. All drains must be staked or weighted down to withstand the force of the water.

Special care must be taken at the slope drain inlet to funnel water into it and to prevent piping failures around the sides. A metal end section witha short section of pipe through a berm creates the most satisfactory inlet. The toe plate of the end section combined with proper soil compaction on the sides gives an effective seal.

MAINTENANCE: Temporary slope drains require frequent modification as fills are constructed. Inlets must be relaid and drain section added as the fill height increases.

SLOPE DRAIN DETAILS (INLETS)

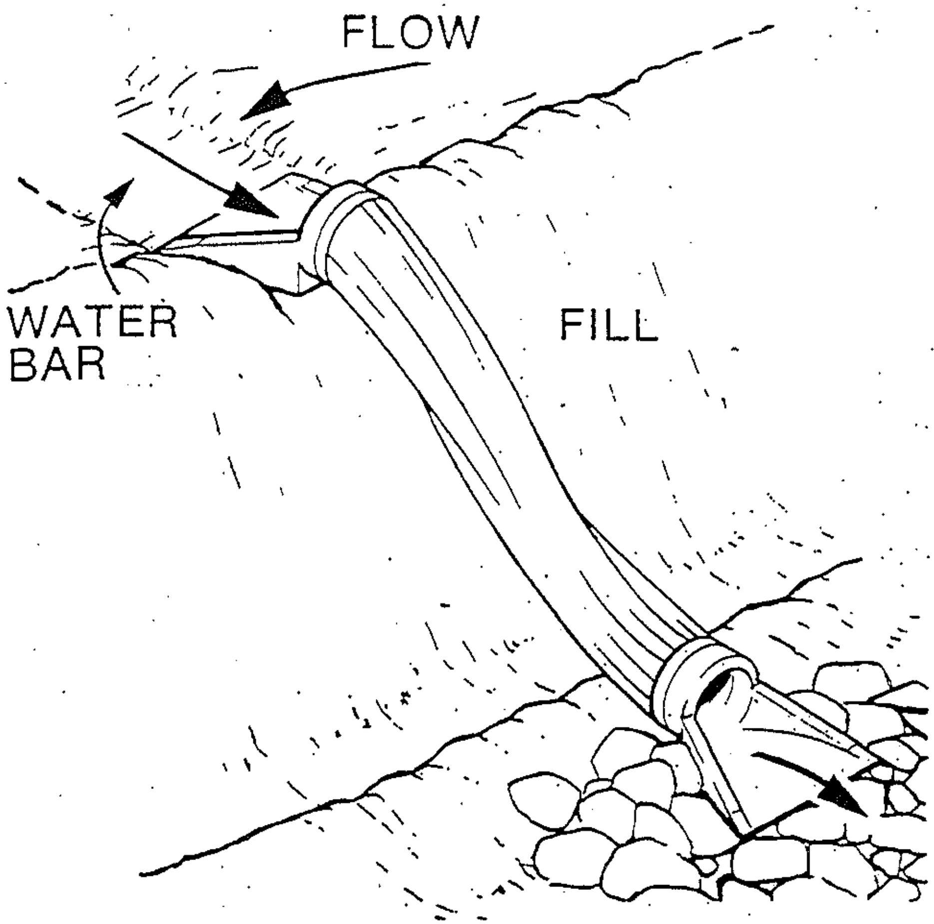




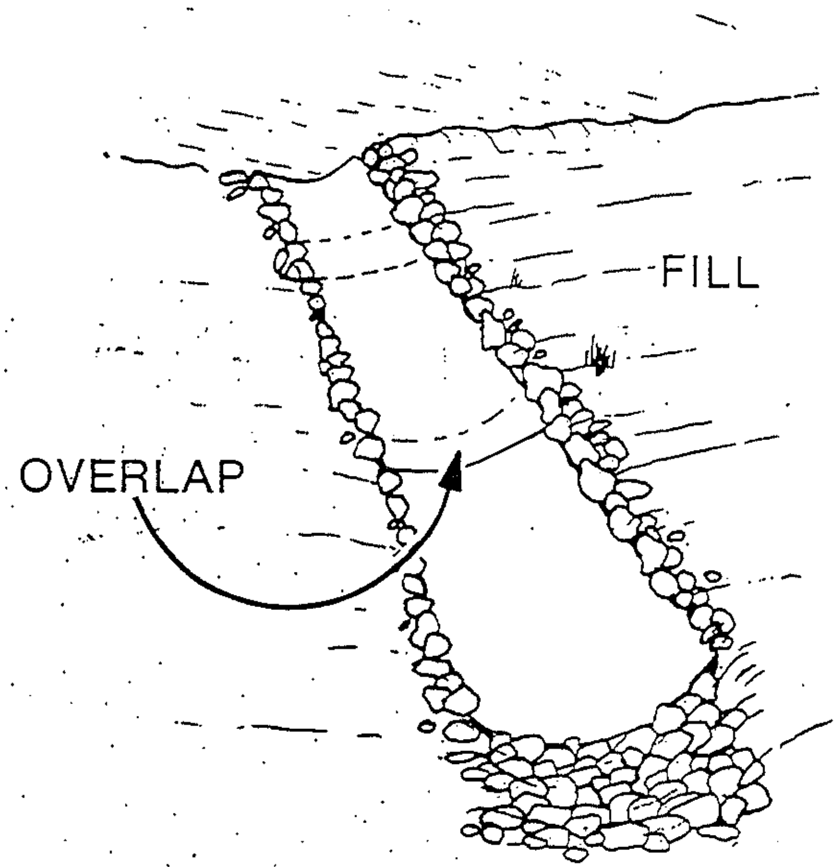
DETAIL SD - 1

SLOPE DRAINS

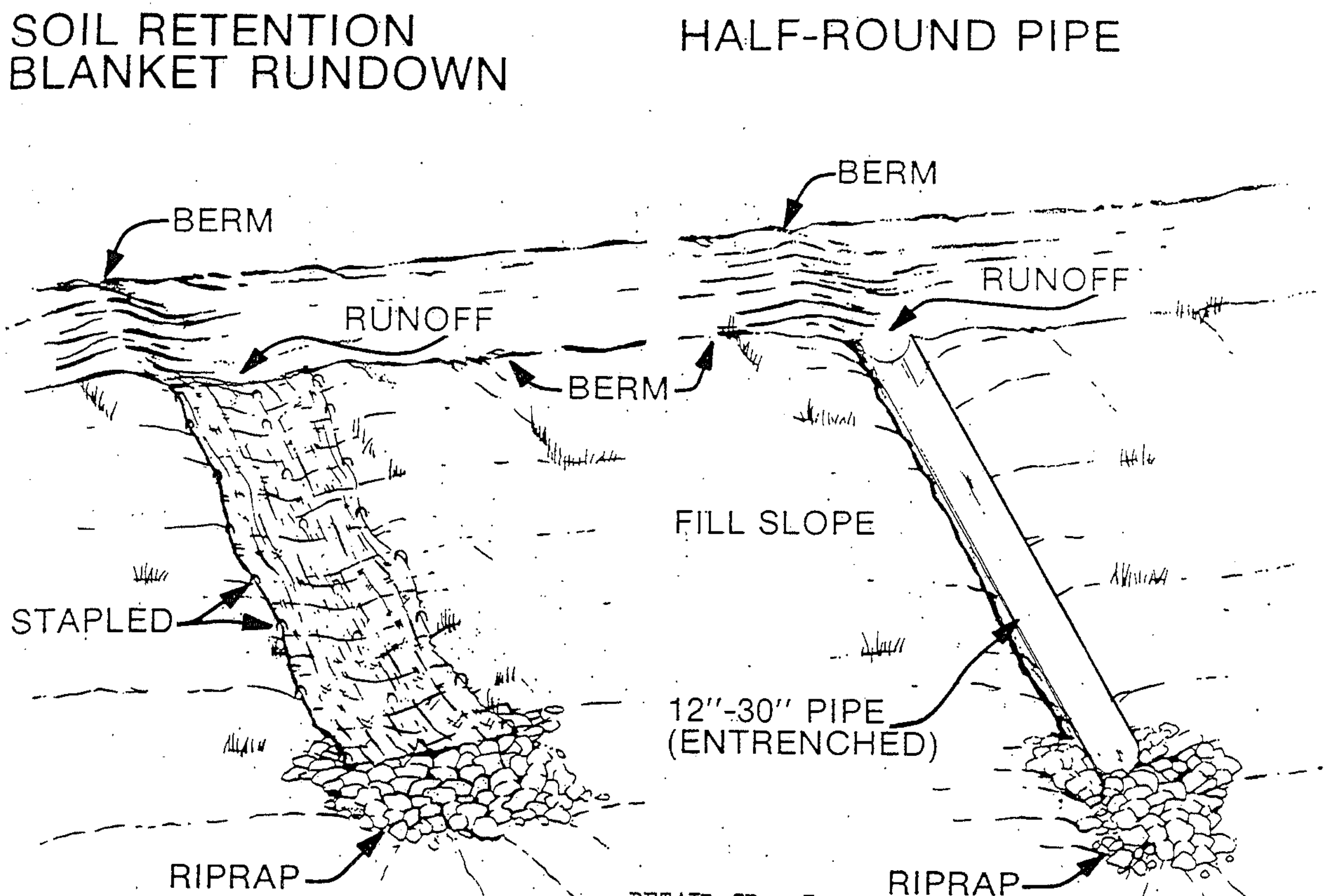
FLEXIBLE PIPE



DITCH LINER

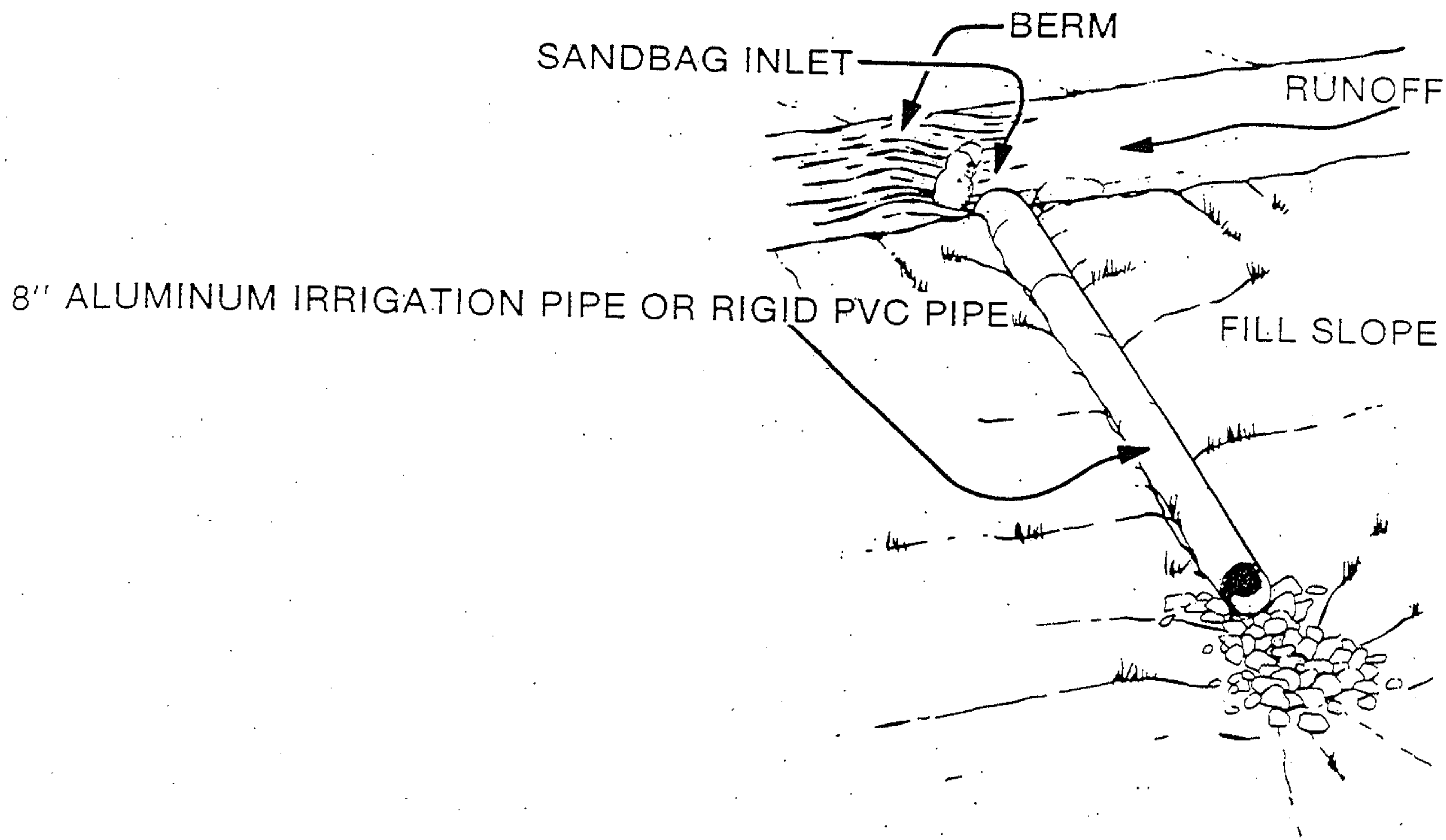


DETAIL SD - 2


SOIL RETENTION
BLANKET RUNDOWN
HALF-ROUND PIPE
BERM
RUNOFF
BERM
BERM
RUNOFF
FILL SLOPE
STAPLED
12"-30" PIPE
(ENTRENCHED)
RIPRAP
RIPRAP

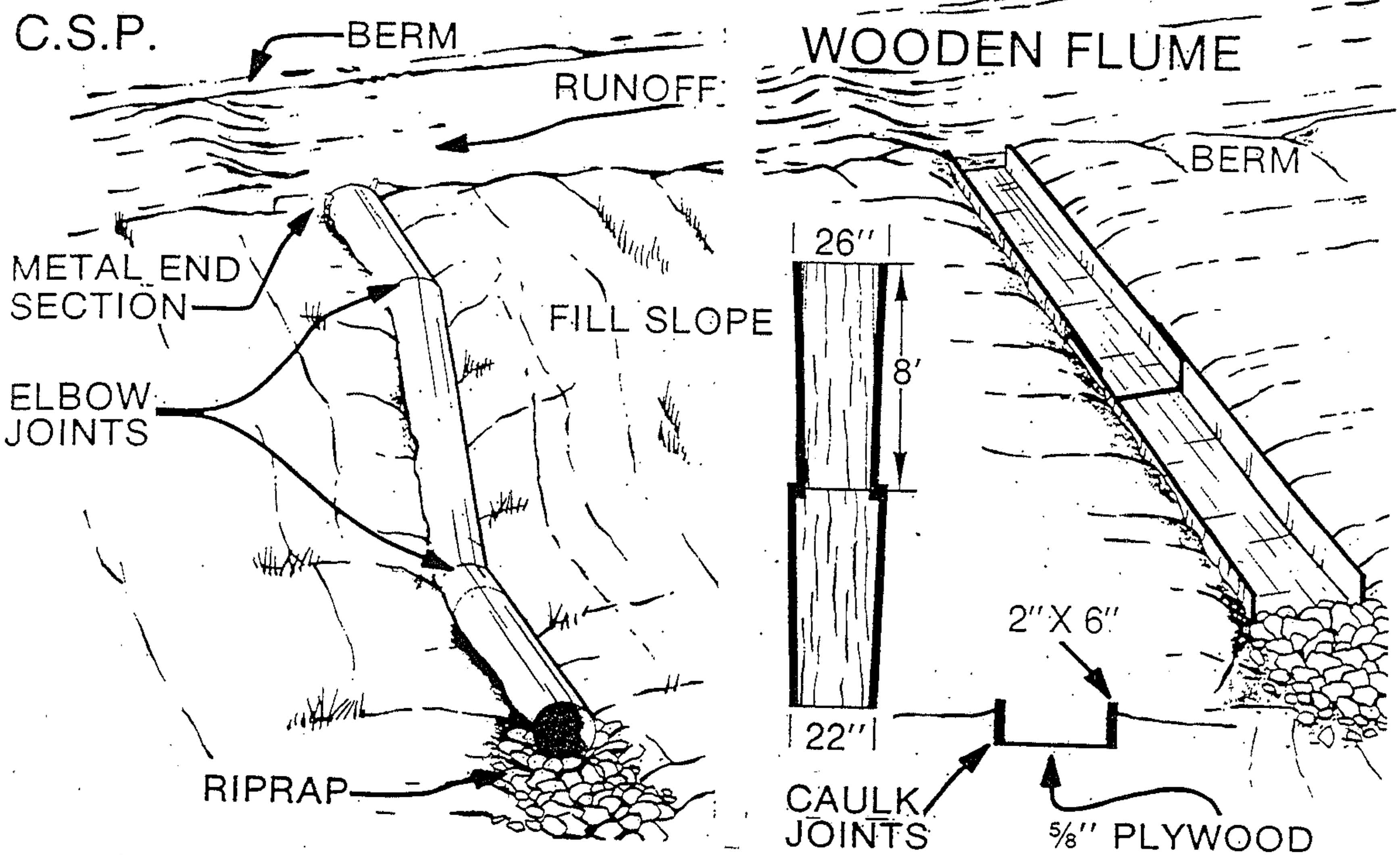
DETAIL SD - 3

SLOPE DRAINS



DETAIL SD - 4

ALTERNATIVE SLOPE DRAIN DETAILS



DETAIL SD - 5

SEDIMENT TRAP

DESCRIPTION: A sediment trap is a small water detention basin which allows sediment particles to settle out before the runoff continues to receiving waters. Sediment traps are used fro drainage raeas less than ten acres. By using small traps, a wide variation of side slopes and inlet and outlet controls may be safely utilized. Sediment traps are constructed by excavating a basin, by using a natural terrain depression, or by building a low dam embankment.

Large sediment traps for areas greater than ten acres should be avoided in favor of several smaller traps. When large structures are necessary they should be designed by the Hydraulics Squad and incorporated into the plans.

USAGE: Sediment traps may be used below embankments, below slope drains, at the lower end of waste areas and borrow pits, or at the downgrade end of a cut section. Before choosing a sediment trap as a control measure, the feasibility of eliminating the sdeiment supply upstream should be investigated.

A few guidelines will help clarify the propoer use of sediment traps:

1. Sediment traps are for treatment of on-site runoff only.
2. Traps should be built as close to the sediment supply as possible.
3. Never construct a sediment trap in a flowing stream. The sediment produced during construction and removal of the trap will surpass the amount trapped.
4. Normally, only sand size and larger particles are caught in the trap allowing most silt and clay particles to pass through. The bulk of the sediment remains in the trap, however, the turbidity of the outfall may not change significantly.

DESIGN: The location of the sediment trap is determined by the natural terrain, by the drainage pattern of the runoff, and by accessibility for maintenance and removal. Destroying valuable vegetation for a sediment trap site is undesirable. The additional land disruption of the site and the construction expense must be weighted against the damaging effects of sediment without the trap. The trap must be placed where runoff can be easily channeled into it. Changes in drainage pattern during construction must be considered in assessing the useful life of a trap. Almost all sediment traps will be used as temporary measures and therefore must be removed, unless a premanenet pond is the desired effect in special areas. The location must be accessible at project completion to remove accumulated sediment and regrade the area.

As runoff enters a sediment trap, the velocity and turbulence are greatly reduced. This allows sediment particles to settle to the bottom of the trap. Sand and gravel settle rapidly; silt and clay particles settle very slowly. Therefore the efficiency of a sediment trap depends on its geometry, the fall velocity of the sediment particles inw ater, and the retention time of the runoff.

The first step in sizing a sediment trap is to predict the inflow. This discharge should be a two-year design flow computed using the Rational Equation as explained in the Roadway Design Manual. Discharges typically will be less than five cubic feet per second.

The second step is to choose the size and percentage of sediment particles to be removed. it is generally acceptable to remove ninety percent of all particles alrger than very fine sand (diameter greater than 0.062 mm). Silt and clay sized particles require excessive retention time so that it is probably not feasible to design a trap to remove them unless chemical flocculents are added at the inlet to the pond.

Next, the required surface area of the trap is computed using Figure ________ The jorizontal axis show the percent of sediment load removed and the vertical axis gives the ratio of the required surface area divided by the discharge.

Example

Given:
1. Q_2 = 3 C.F.S.
2. Must remove 90% of particles larger than very fine sand.

Solution:
1. Read up from 90% removal to the coarse silt curve.
2. Read across to the ratio of surface area: Q = 280.
3. Use this number to compute the trap surface area.
   Surface area = 3 x 280 = 840 Sq. Ft.
4. The trap dimensions may be any combination which gives this surface area, 25 ft x 34 ft or 15 ft x 57 ft. The terrain generally controls these dimensions.

The depth of the trap from the spillway to the low point should be only two to three feet. Excessive depth is of little value as the sediment particles have a longer distance to settle. A rectangular, shallow basin is preferred.

After locating and sizing the sediment rap, the outlet type must be chosen. The basic types of outlets are shown. For small design flows (Q less than 3 C.F.S.) over a low dam, a plastic lined overflow channelis sufficient. Plastic lining is also acceptable on axcavated traps with the outlets onto natural ground. For larger flows over higher dam embankments a riprap lining is necessary. The plastic lining beneath the riprap prevents leaching of the embankment fines. Pipe outlets are more suitable than an overflow spillway. The pipe should convey a two-year frequency discharge while providing a suitable freeboard to the dam crest. Pipe diameters of 12" to 24" are adequate for most installations.

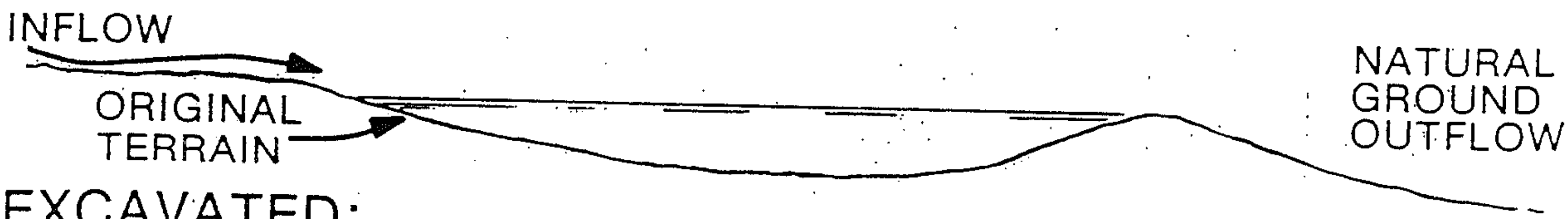
The efficiency of sediment traps can be increased if they are drained prior to each rainstorm. The runoff from small rainstorms can often be totally stored in theponding area. After allowing a few hours for the sediment to settle, the trap can be drained slowly in preparation for the next storm. Figure III-24 shows several types of drains which can be used in conjunction with the regular sediment trap outlets.

CONSTRUCTION: Vegetation within the trap area should be removed to allow periodic removal of accumulated sediment and keying in of the dam embankment. Embankment slopes should be 2:1 or flatter. The minimum embankment width is normally eight feet or as dictated by the equipment used. Embankment must be well compacted.

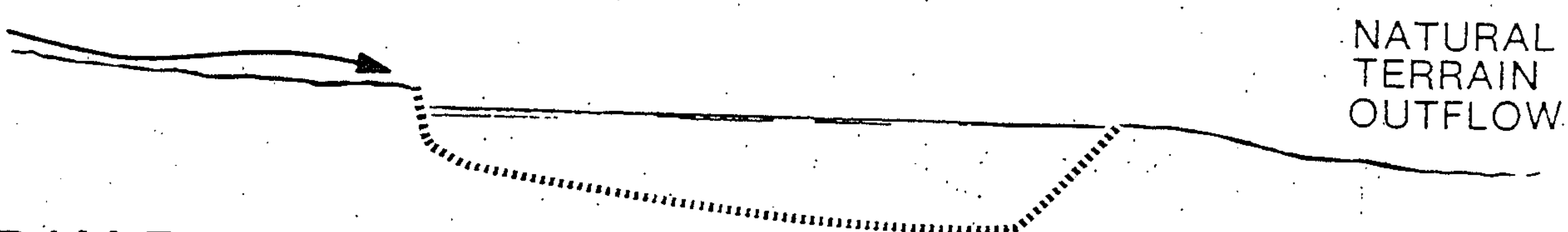
MAINTENANCE: Removal and disposal of accumulated sediment is necessary to maintain proper sediment trap operation. Disposal locations should be selected where the sediment will not erode back into the construction area or into natural water courses.

TYPES OF SEDIMENT TRAPS

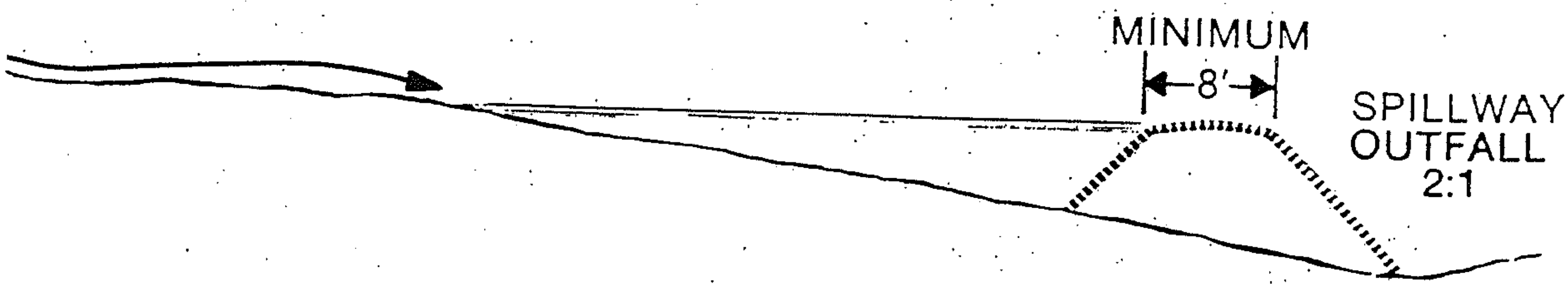
NATURAL DEPRESSION:



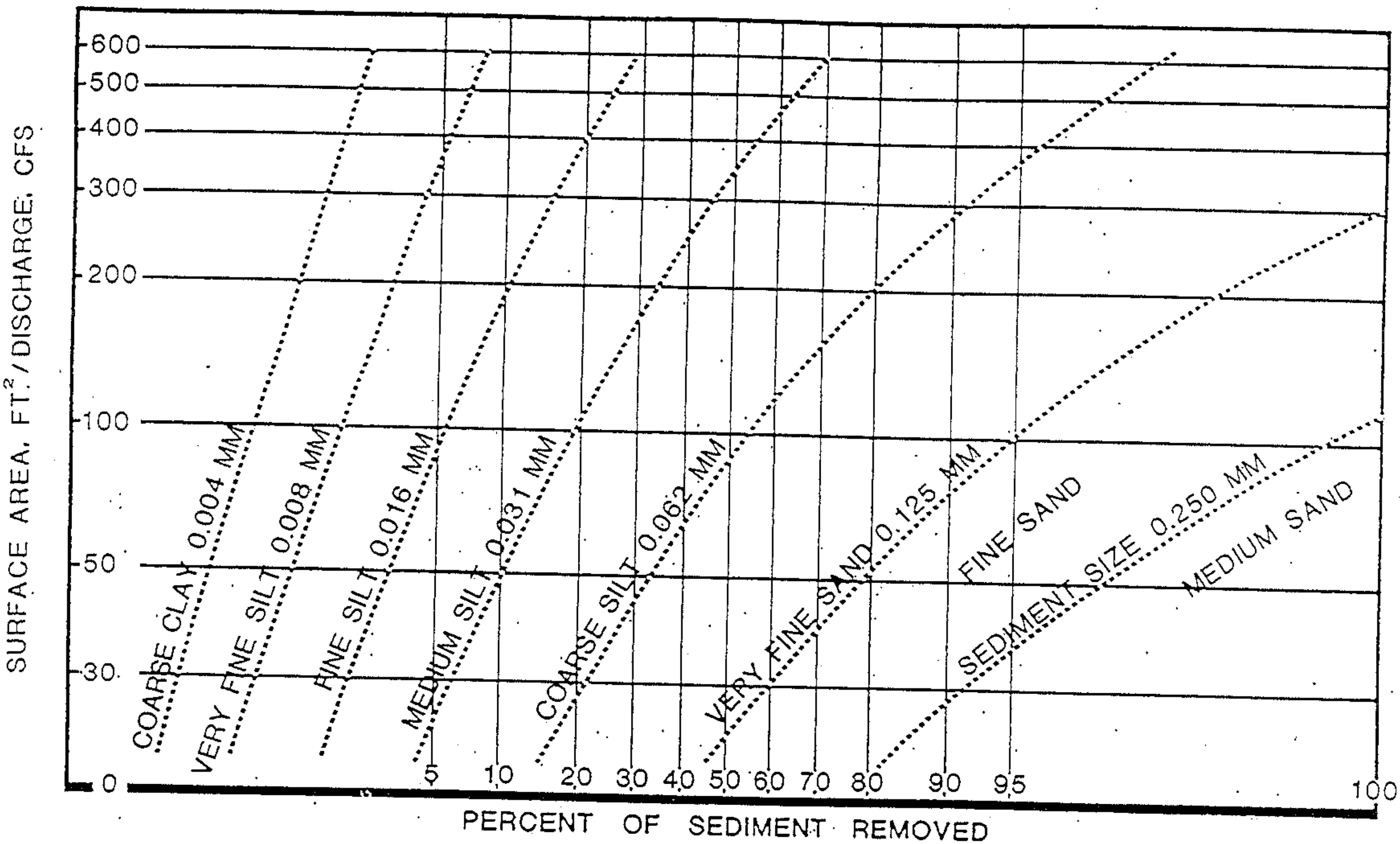
EXCAVATED:



DAM EMBANKMENT:



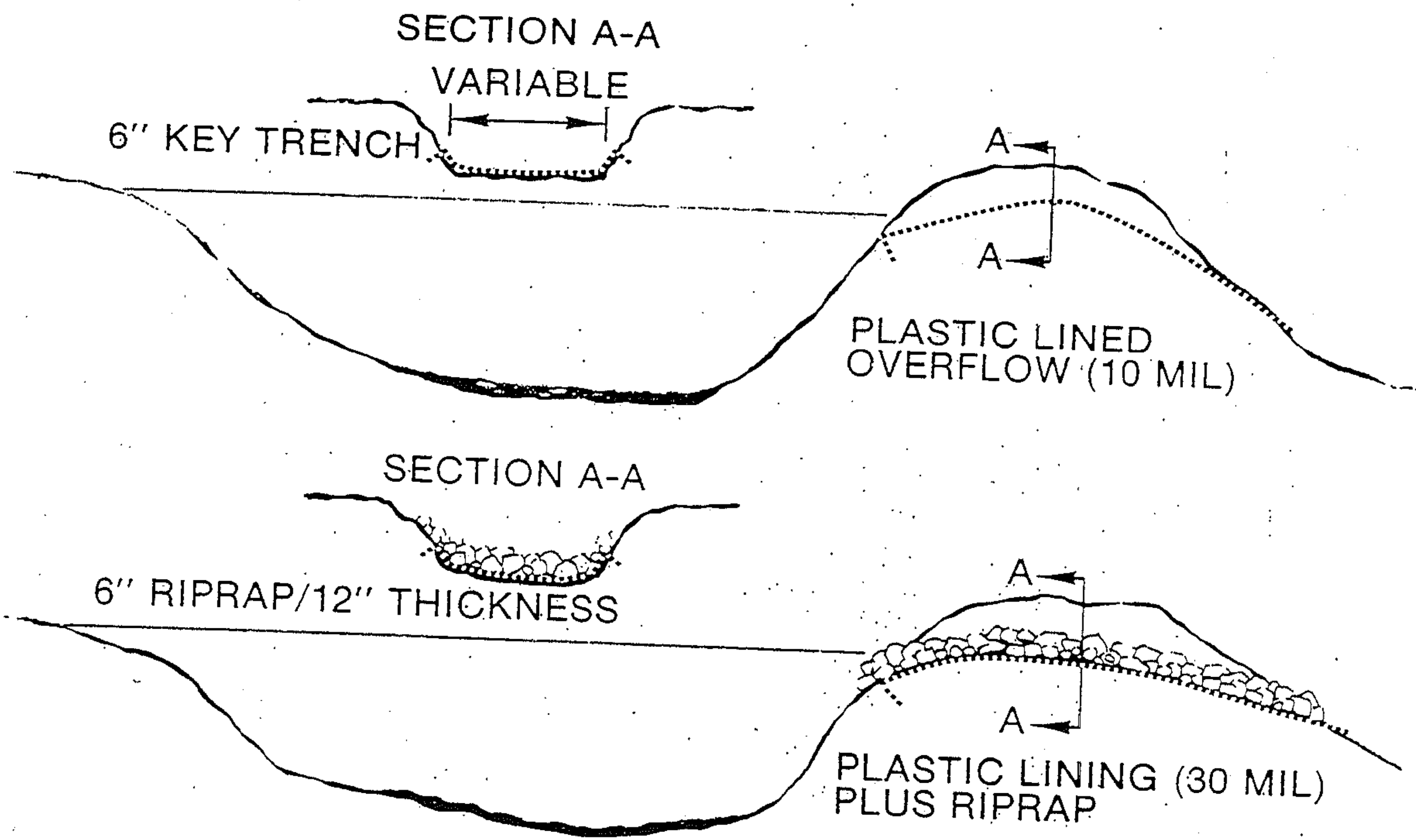
DETAIL ST - 1



PERCENT OF SEDIMENT REMOVED FOR DIFFERENT BASIN SIZES, SEDIMENT SIZES, AND DISCHARGES.

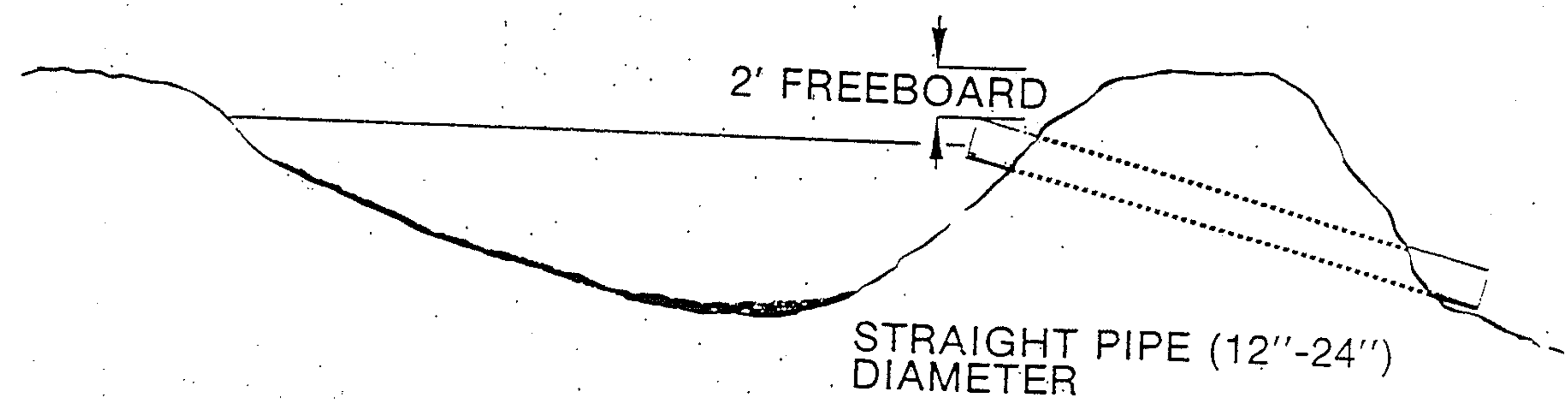
DETAIL ST - 2

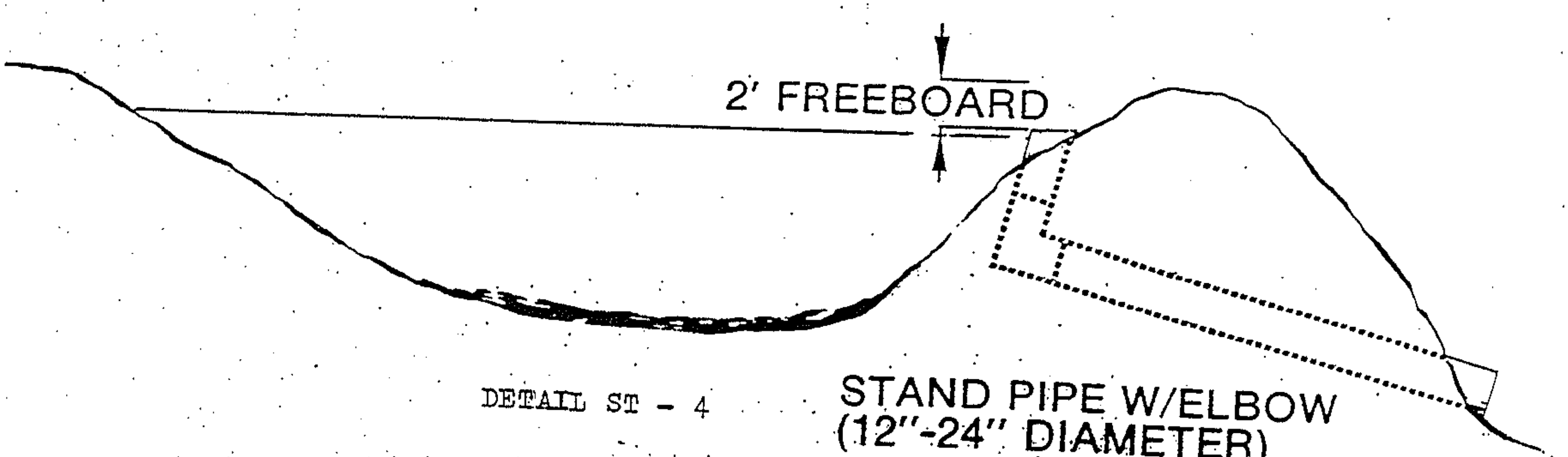
SEDIMENT TRAP OUTLETS



DETAIL ST - 3

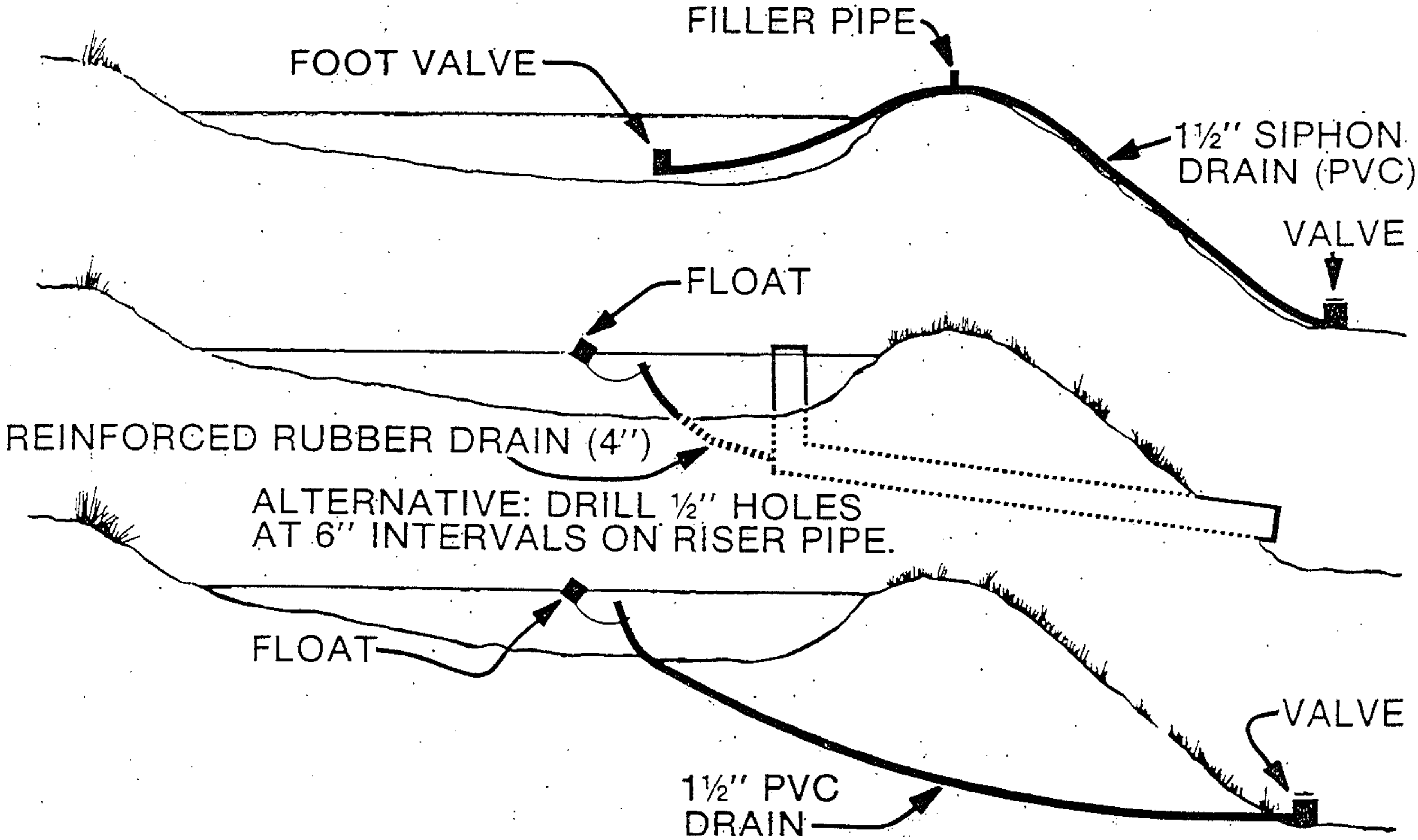
SEDIMENT TRAP OUTLETS





DETAIL ST - 4

ALTERNATIVE SEDIMENT TRAP DRAINS



DETAIL ST - 5

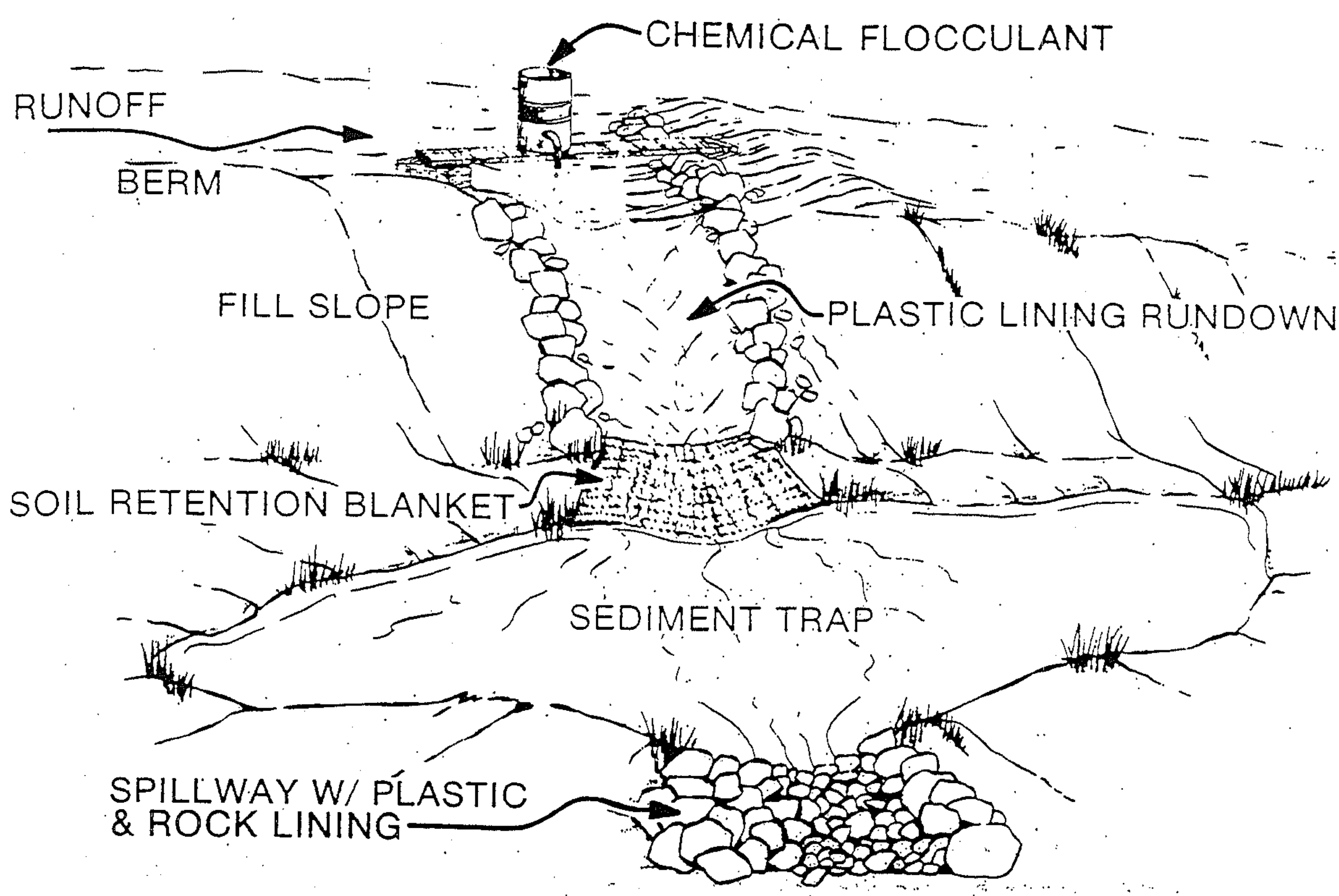
CHEMICAL TREATMENT

The sediment collected in a sediment trap consists mainly of sand size particleds and airger. The fine silts and clays which do not settle out rapidly are held in suspension and are carried on through the trap. By trapping the larger particles, damaging sediment deposits downstream are eliminated, however, the fine particles may still cause excessive turbidity. In situations where turbidity cannot be toleerated, chemical settling agents may be warranted.

Chemical settling agents form a nucleus which attracts small soil particles, a process called flocculation. A heavier conglomerate of particles if formed which settle out in the sediment trap. Chemicals are effectiveonly in the tranquil water of a sediment trap. However, in order to expedite uniform mixing of the flocculant in the pond, the chemical is to be added at the top end of the slope rundown or at the inelt to sedimentation pond.

Only non-toxic settling agents may be used as flocculation aids in sediment traps. Typically, the acceptable chemicals are those used as clarifying agents for domestic water supplies. Injection methods, conentration, and effectiveness should be discussed with the Town Engineer before usage.

CHEMICAL TREATMENT



DETAIL CT - 1

PUMPING

An alternate to chemical treatment is pumping contaminated water to suitable disposal sites.

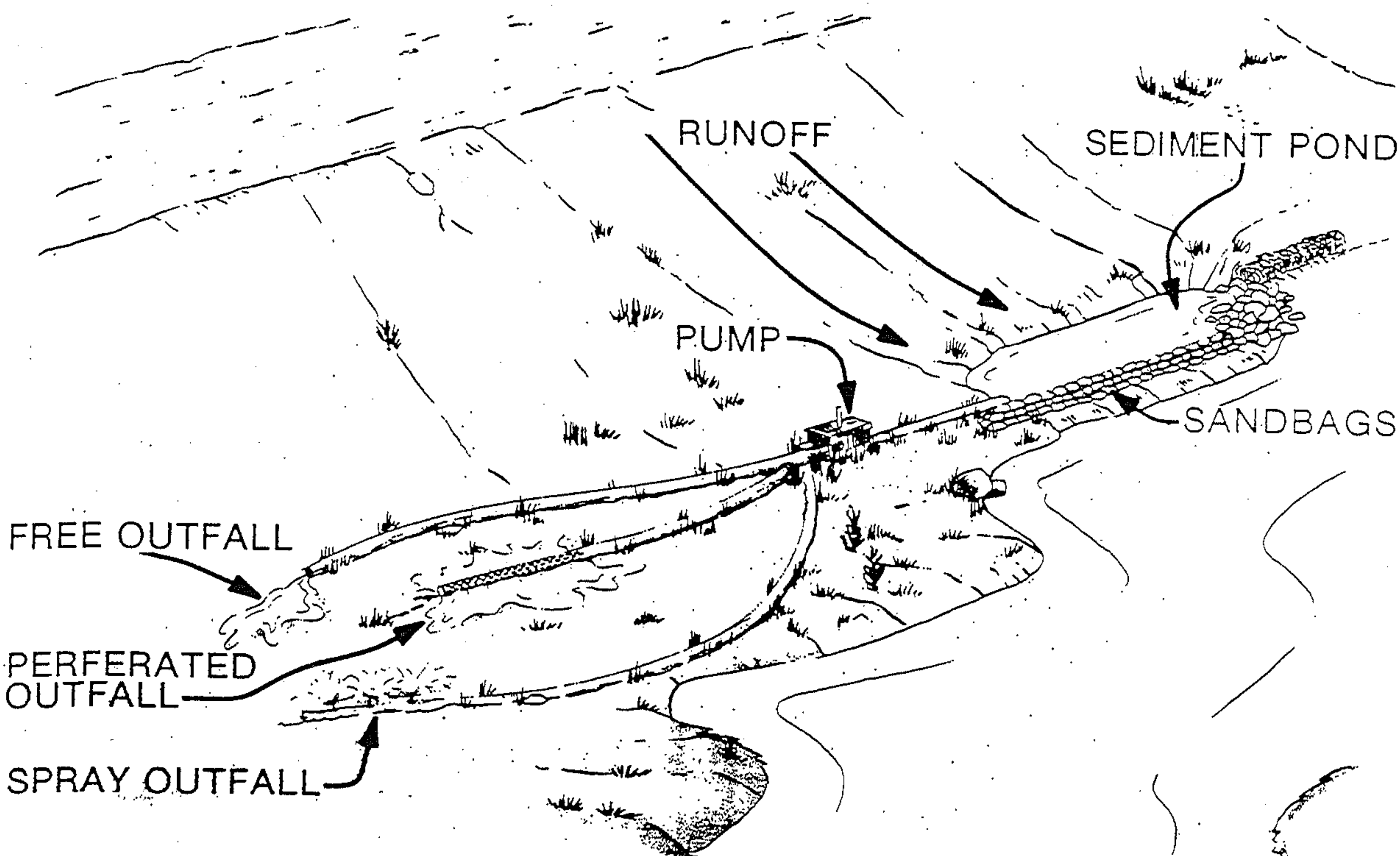
The pump is set next to a sediment trap or water collection sump. Water is pumped to a well-vegetated area where it will disperse and soak into the ground. aluminum irrigation pipe or fire hose is used as the supply line.

The supply line outlet may be modified as conditions warrant. Where the terrain will spread the flow naturally, an uncontrolled outlet is acceptable. To avoid a concentrated outlfow, perforated pipe may be laid horizontally on ground to act as a dissipater. Ten to thirty feet of perforated pipe should be used. Maximum idspersal of turbid water is obtained by using impact sprinklers to spray the water over the vegetation.

A sludge-type pump is desirable. High efficiency pumps with close tolerance impellers are likely to be damaged by sediment laden water.

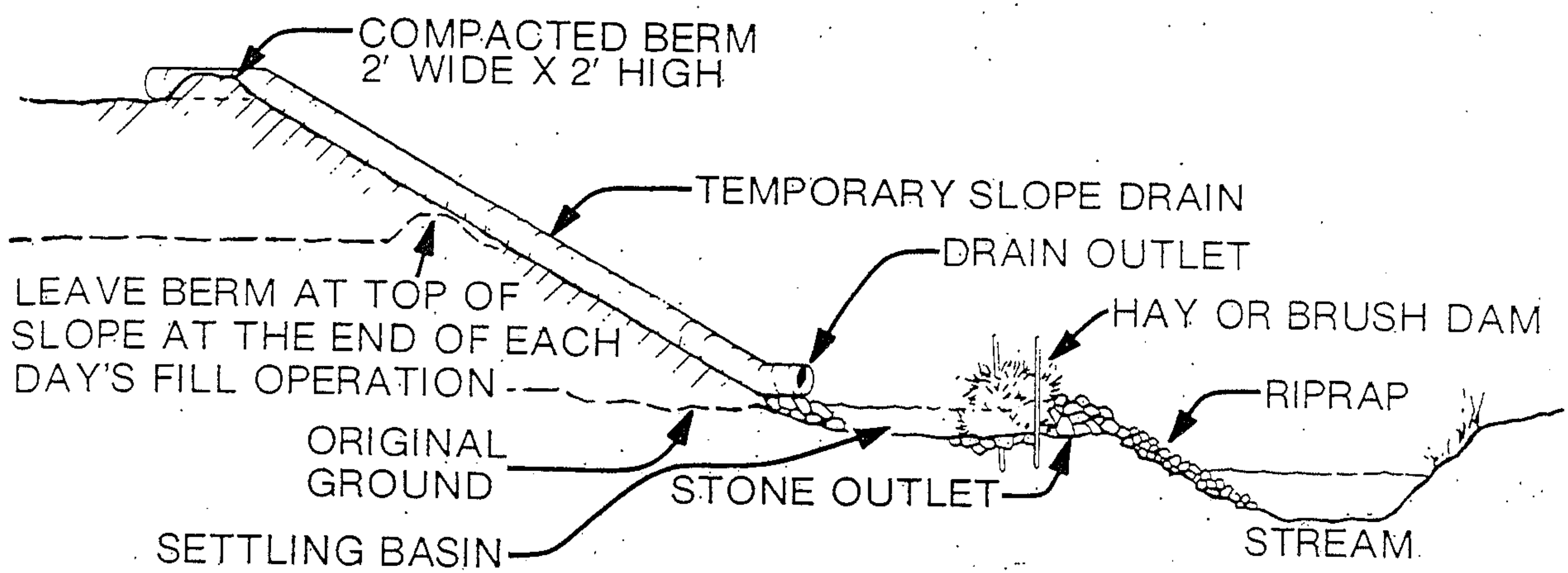
The disadvantages of a pumping system are that it is expensive and requires an operator. When rainfall occurs during off-work hoursor on weekends, no one will be available to operate the pump. Much of the time a pumping system will be ineffective. A gravity type system which operates without constant attention is more desirable.

PUMP OUTFALL ALTERNATIVES



DETAIL P - 1

RUNOFF TREATMENT



DETAIL RT - 1

SLOPE TREATMENT

INTRODUCTION: All the text to this point has dealt with temporary (short term) erosion control problems and solutions. However, this chapter serves as a transition between short term and long term (permanent) erosion control techniques. Sinch landscaping applications such as mulching, and soil retention blankets are considered temporary erosion control in aiding the long term establishment of grass stands, some seeding recommendations are thus included as a part of the text.

In order to adequately protect slopes from erosion, exposed slopes should have minimum acreage requirements before revegetation efforts and landscpae applications are implemented. This insures that erosion potentials are checked as construction acitvities progress. For example, not more than three acres of newly exposed slope shall be permitted before topsoiling, seeding, mulching, fertilizing, and soil retention blanket are applied to the slopes. These applications hsall be completed within ten days of completion of any section of newly exposed slope. Landscape watering shall be provided to establish healthy grass stands, except when fall plantings do not require seed germination until spring.

Soil Preparation: After nutrient rich topsoil is graded on the slope to the specified depth, rubble and other debris are then removed. If sloeps are wet, allow topsoil to dry before soil preparation. The slope seedbed is best prepared by discing or scarifying the topsoil parallel to the contours of the slope. This provides an excellent habitat for seed germination and viorous growth. Hand-raking, special chaining, and various other types of equipment are available for soil preparation of a slope.

Seeding: Soil types, elevation, and precipitation are the major site determinates for the seed selection design. A combination of grass species native to the area and other historically successful dryland species are recommended as seed mixtures.

The seeding operation is accomplished by either hand-broadcasting, drilling, or hydraulic spraying. For slopes 3:1 or flatter, drill seeding is the best known method since the soil will act as a protective layer until germination occurs. Hand-broadcasting or hydraulic seeding is effective on steeper slopes, which are inaccessible to drill seeding equipment. Hydraulic seeding equipment is applicable for cut or fill slopes which do not exceed 200 feet in height. Hand-raking seeds into the topsoil for hydraulically seeded areas will benefit the overall grass stand coverage.

Proper seeding techniques are important in establishing long term erosion control of slopes through healthy grass stands. Questionable situations may be directed to the staff or district landscape architects to assist revegatation efforts.

Mulching: This operation adds needed biomass and seedbed protection to disturbed slopes before vegetation becomes established. Normally hay or straw is spread at a rate of 2 tons per acres. Native hay is preferred since it provides additional grass seed. Hay and straw mulch is crimped into the soil by mechanical (or hand) methods. Chemical tacifiers have been effective in holding mulch to steep slopes where crimping machines are not accessible. Hydraulic application of mulch fiber, or hydromulch, may be used at a rate of 1 tone per acre. This method is commonly used on steep inaccessible slopes, but may also be used on flatter slopes that have been drill seeded. Special tacifiers are recommended to help adhere the application to the slope. Normally hydromulch is not used on dry sites.

Mulch Netting and Soil Retention Blanket: Mulch netting may be used to hold hay or straw mulch on steep slopes.

Soil retention blankets are quite effective in controlling erosion on steep slopes and in ditches. Blankets are especially advantageous on high altitude projects where growing seasons are very short and soil erosion potential is high.

The basic objective of mulch netting is to provide a stable seedbed for one or two growing seasons, then biodegrade as vegetal matter builds up to produce a healthy cover crop.