GUIDANCE DOCUMENT
REASONABLE AND PRUDENT PRACTICES FOR STABILIZATION (RAPPS) OF OIL AND GAS CONSTRUCTION SITES
HJN 040027 IM

PROVIDED BY:

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PREPARED BY:

HORIZON ENVIRONMENTAL SERVICES, INC.

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1.0 INTRODUCTION

The purpose of this document is to compile the various operating practices utilized by reasonable and prudent operators in the oil and gas industry to control erosion and sedimentation associated with storm water runoff from areas disturbed by clearing, grading, and excavating activities related to site preparation associated with oil and gas exploration, production processing, treatment, and transmission activities. Site preparation activities associated with such oil and gas activities are referred to in this document, consistent with EPA's terminology, as "oil and gas construction activities" or "construction activities." The operating practices used to control erosion and sedimentation from oil and gas site construction activities are referred to in this document as "Reasonable and Prudent Practices for Stabilization" or "RAPPS."

In the preparation of this document, emphasis was placed on the selection and practical application of RAPPS, given a variety of basic physical circumstances. This document is provided as a tool to quickly evaluate which RAPPS may be useful at a given construction site. This document anticipates that the user will be prudent and exercise good judgment in evaluating site conditions and deciding which RAPPS or combination of RAPPS is to be used at a specific site. If the RAPPS selected are not effective to prevent discharges of potentially undesirable quantities of sediment to a regulated water body, different or additional RAPPS should be employed.

2.0 CONSTRUCTION SITE PHYSICAL CONSIDERATIONS

There are several physical conditions that can affect the decision about which RAPPS will be effective at a given construction site. Two primary factors that are emphasized within this document are the proximity to a regulated water body and the amount of vegetative cover between the construction site and the regulated water body. Other physical considerations include the slope of the terrain, rainfall, and soil erodibility. For purposes of this guidance document, each of these physical features may further be defined with respect to a designated rank (i.e., slope 0 to 10% or vegetative cover 25 to 75%).

Slope is defined as the amount of elevation gain over a given distance (vertical rise to horizontal run). A hill with 2 feet of elevation gain over 5 feet of horizontal distance has a slope of approximately 40%. A slope of 10% would require 2 feet of elevation gain per 20 feet of horizontal distance. The slope characteristic must be evaluated between the construction activity and the regulated water body.

Vegetative cover is defined as the percentage of ground covered with primarily low-growing, herbaceous vegetation (grasses, forbs, and wildflowers). Shrubs and trees may provide some erosion control and filtration, but the amount of filtration is significantly less than that provided by low-growing herbaceous cover. For the purposes of this document, therefore, percentage cover of shrubs and trees should not be factored into the estimate of vegetative cover.

3.0 GEOGRAPHIC LOCATIONS AND IDENTIFICATION OF RAPPS

The following sections describe general geographical categories across the continental United States as outlined on Figure 1. These categories were defined taking into consideration general slope, annual rainfall, major soil types, and vegetative cover.

"Do Not Scale This Drawing"

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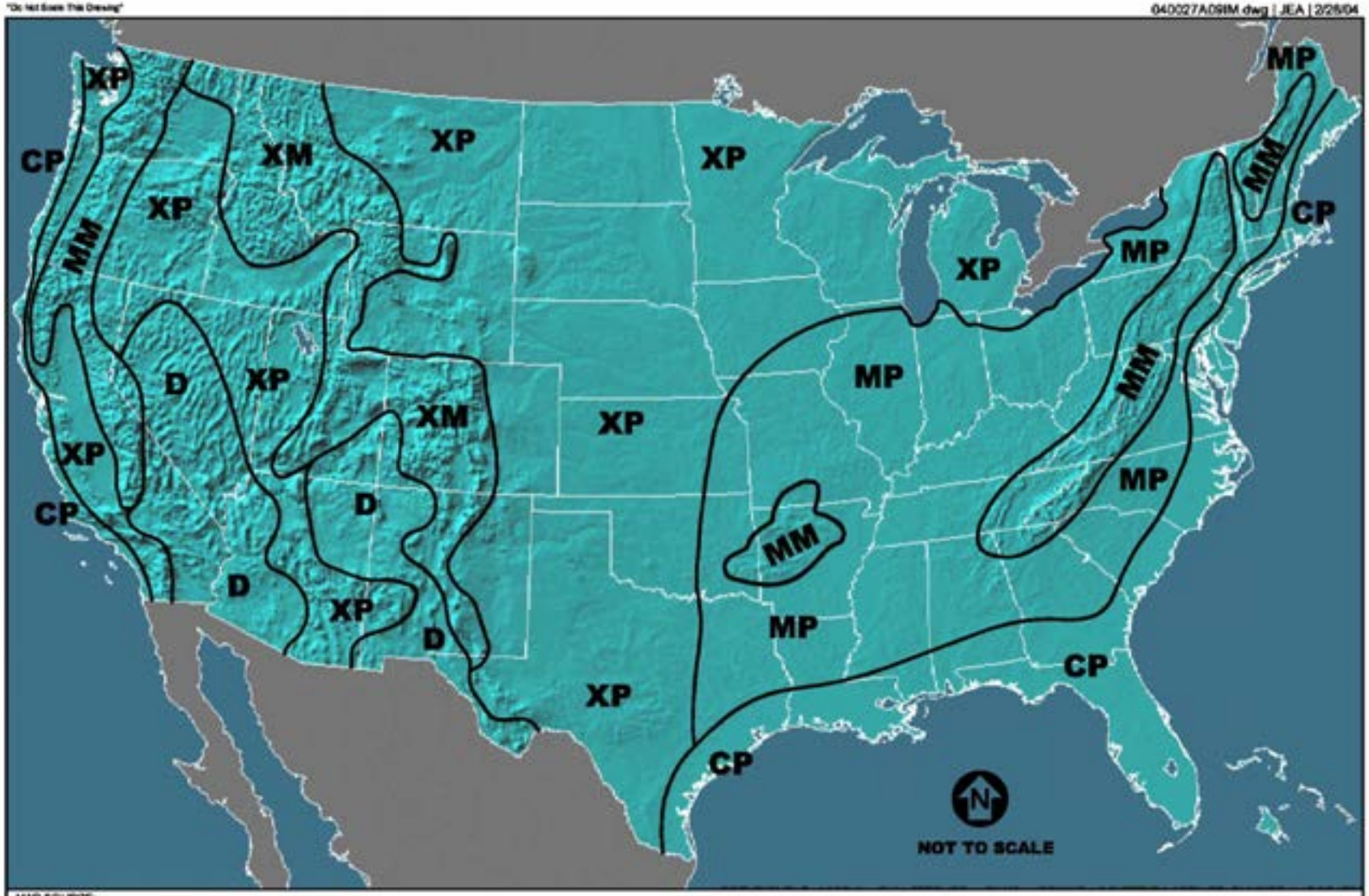


MAP SOURCE:
RAY STERNER, JOHN HOPKINS UNIVERSITY
APPLIED PHYSICS LABORATORY (1995)

Horizon
Environmental Services, Inc.

EXPLANATION

CP	COASTAL PLAINS	**MP**	MESIC PLAINS	**MM**	MESIC MOUNTAINS
D	DESERTS	**XP**	XERIC PLAINS	**XM**	XERIC MOUNTAINS

FIGURE 1

GENERAL GEOGRAPHICAL LOCATIONS
WITHIN THE CONTINENTAL UNITED STATES
REASONABLE AND PRUDENT PRACTICES
FOR STABILIZATION (RAPPS) GUIDANCE

The distance between a construction site and a regulated water body should be calculated from the closest boundary of land disturbance due to construction activity to the boundary of the regulated water body. Construction sites determined to be in excess of a minimum distance from a regulated water body for a particular geographical region will not typically require the implementation of any RAPPS. This identified minimum distance was determined using the assumed general physical characteristics for a particular geographical category but may differ within any given geographical category.

The user should first determine which geographical category the construction project falls within, utilizing both the provided map and good field judgment. If local conditions in the immediate area do not meet the conditions described for the geographical category that would be indicated by the provided map, select a decision tree from another geographical category that better meets local conditions. If local conditions do not meet any of the mapped geographical category descriptions, the user should use good judgment selecting RAPPS.

Once the geographical category is determined, the user can determine if the assumptions outlined within that category fit the construction site. One to several physical conditions may be assumed to be constant within any given geographical category. Physical conditions that may not be assumed to be constant include slope, vegetative cover, and distance to regulated water. The area between the construction site and regulated water should be reviewed to determine approximate slope and the percentage of vegetative cover. These values will be utilized within the decision tree to determine a list of RAPPS to consider for that particular construction site.

It should be noted that the list of RAPPS for any given pathway on the decision tree are simply suggestions of RAPPS alternatives, from which one or more of the listed techniques or practices may be selected for a given site under site-specific circumstances. Not all RAPPS listed will necessarily be required for any given project. In addition, the list of RAPPS for any given pathway on the decision tree may not exhaust all of the available RAPPS that may be effective for any given construction site. Other RAPPS, not listed in this document, may be beneficial for controlling surface water runoff from the construction site, in addition to or in lieu of the RAPPS listed in this document.

RAPPS generally considered effective to prevent potentially undesirable quantities of sediment in storm water runoff from construction activities within these geographical categories are referenced within Appendix A of this document. Specific information (e.g., text description, limitations, and conceptual drawing) for each RAPPS is provided in Appendix A. RAPPS presented in Appendix A were derived from both common industry references provided in Section 4.0 of this document and from practical field experience.

A summary of the steps to follow when using this guidance document are below.

1. Determine geographical category that best fits local conditions using Figure 1 and field judgment.
2. Assure that assumptions for geographical category fit construction location. If local conditions do not meet assumptions, use good judgment to select RAPPS.
3. Review area between construction activity and regulated water body to determine distance to the regulated water body, approximate slope, and approximate vegetative cover.
4. Work through decision tree utilizing information from step 3.
5. Select RAPPS from the alternatives listed as being effective for a construction site under similar conditions of distance, slope, and vegetative cover (Note: not all RAPPS alternatives listed will necessarily be required for effective storm water control).
6. Implement RAPPS in appropriate locations.
7. Begin construction.
8. Stabilize disturbed areas following completion of construction.

3.1 COASTAL PLAINS

Description

Generally flat plains along coastal areas with a slope less than 10%; deep erodible soils; highly variable vegetation cover; and relatively high annual precipitation.

Selection of RAPPS

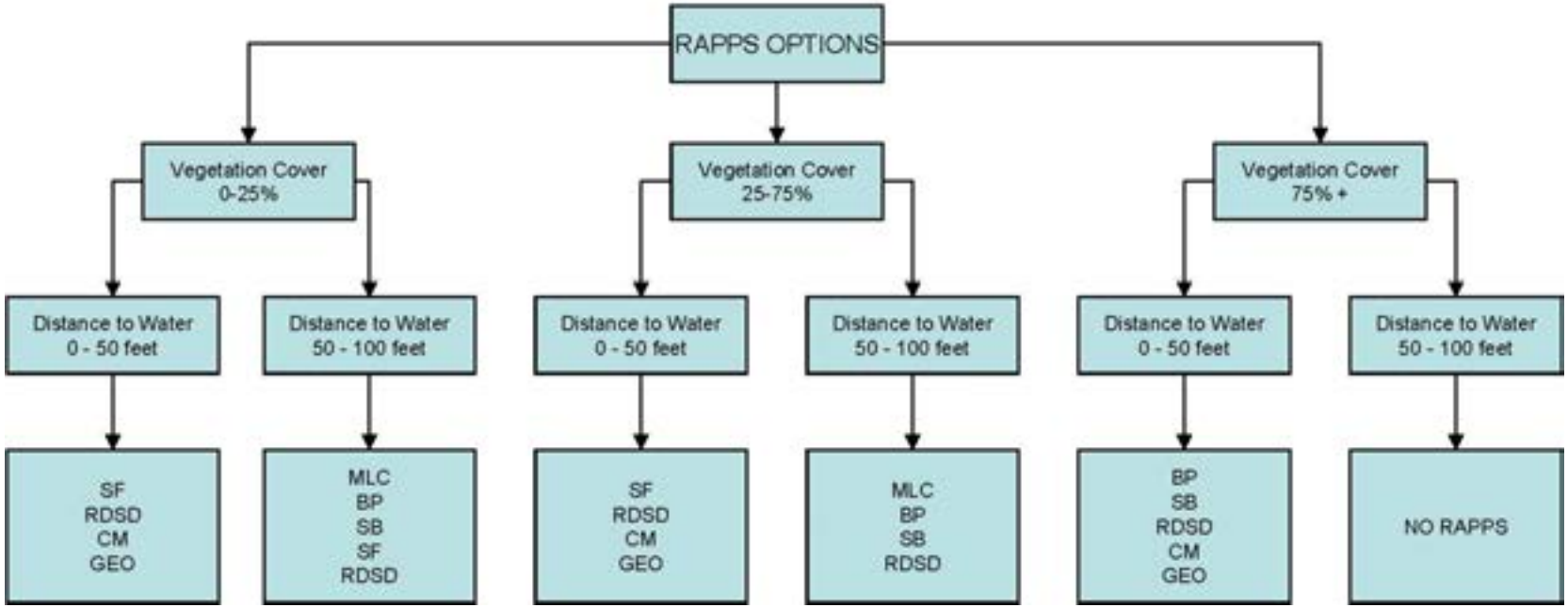
The flat topography of this region along with primarily herbaceous vegetation generally limits the opportunity for potentially undesirable quantities of sediment in storm water discharges to occur. Therefore, construction at oil and gas sites will not require the installation of RAPPS if one of the following exists:

1. The construction site is located in excess of 100 feet from a regulated water body.

2. The area between the construction site and a regulated water body has a vegetative cover in excess of 75% AND the site is located in excess of 50 feet from a regulated water body.

If neither of these two conditions is met, the decision tree in Table 3.1-1 will be useful in determining which RAPPS would be effective under the given circumstances. The decision tree process for this geographical category assumes that slopes are flat (0 to 10%); annual rainfall is high (50 inches and above); and soils are generally highly erodible.

Table 3.1-1 Decision Tree for Coastal Plains Geographical Region



Coastal Plains Assumptions:
1. Slopes are less than 10%
2. Annual precipitation is greater than 50 inches
3. Soils are loams or silts and highly erodable

No RAPPS needed:
1. When construction site is in excess of 100 feet from a regulated water body OR
2. When vegetative cover exceeds 75% AND the site is in excess of 50 feet from a regulated water body.

Index

BP = Brush Pile
CM = Construction Mat
CULV = Cross-Drain Culvert
DD = Diversion Dike
DIP = Drainage Dip
GEO = Geotextiles
MLC = Mulch
RB = Rock Berm
RDSD = Road-Side Ditch
RDSS = Road Surface Slope
RGHN = Roughening
SB = Straw Bale
SF = Silt Fence
ST = Sediment Trap
TO = Turnout

The list of RAPPS for any given pathway on the decision tree are suggestions of RAPPS alternatives, from which one or more of the listed techniques or practices may be selected for a given site under site-specific circumstances. Not all RAPPS listed will necessarily be required for any given project.

The list of RAPPS for any given pathway on the decision may not exhaust all of the available RAPPS that may be effective for any given construction site. Other RAPPS, not listed in this flowchart, may be beneficial for controlling surface water runoff from the construction site, in addition to or in lieu of the RAPPS listed in this document.

3.2 XERIC PLAINS

Description

Generally inland flat plains within the western portions of the US; slopes less than 40%; low soil erodibility; highly variable vegetation cover; and relatively low annual precipitation.

Selection of RAPPS

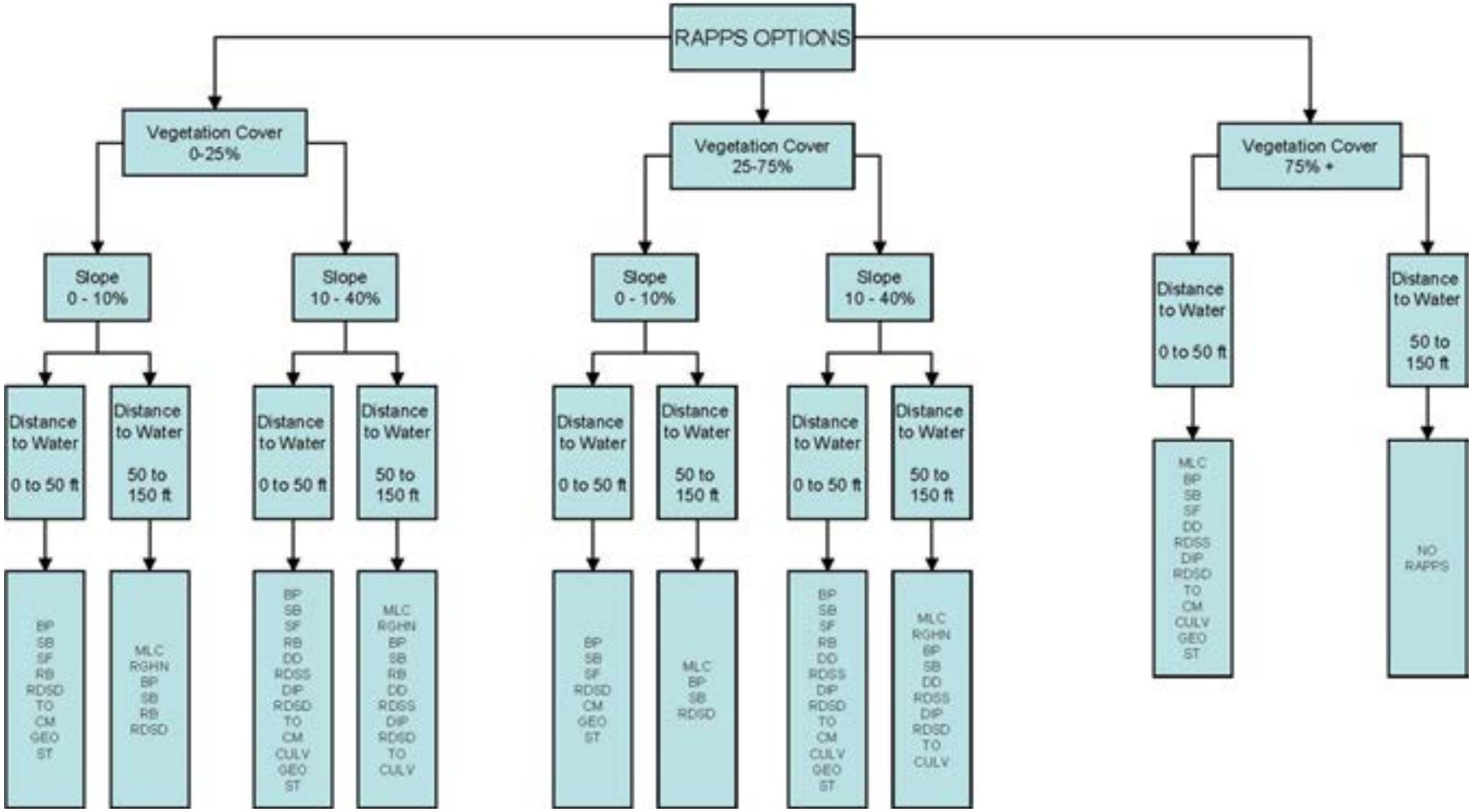
This region typically has fewer rainfall events with lower total annual precipitation than does the Mesic Plains. Dominant soils are sand and rock. These factors reduce the opportunity for potentially undesirable quantities of sediment in storm water discharges to occur. Therefore, construction at oil and gas sites will not require the installation of RAPPS if one of the following exists:

1. The construction site is located in excess of 150 feet from a regulated water body.

2. The area between the construction site and a regulated water body has a vegetative cover in excess of 75% AND the site is located in excess of 50 feet from a regulated water body.

If neither of these two conditions is met, the decision tree in Table 3.2-1 will be useful in determining which RAPPS would be effective under the given circumstances. The decision tree process for this geographical category assumes that annual precipitation is low (less than 35 inches) and soils have generally low erodibility.

Table 3.2-1 Decision Tree for Xeric Plains Geographical Region



Interior Xeric Plains Assumptions:
1. Annual precipitation is less than 35 inches
2. Soils are primarily sandy with low erodability

No RAPPS needed:
1. When construction site is in excess of 150 feet from a regulated water body OR
2. When vegetative cover exceeds 75% AND the site is in excess of 50 feet from a regulated water body.

Index

BP = Brush Pile
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3.3 MESIC PLAINS

Description

Generally inland flat plains within the eastern portions of the US; slopes less than 40%; moderately erodible soils including clays and loams; highly variable vegetation cover; and moderate annual precipitation.

Selection of RAPPS

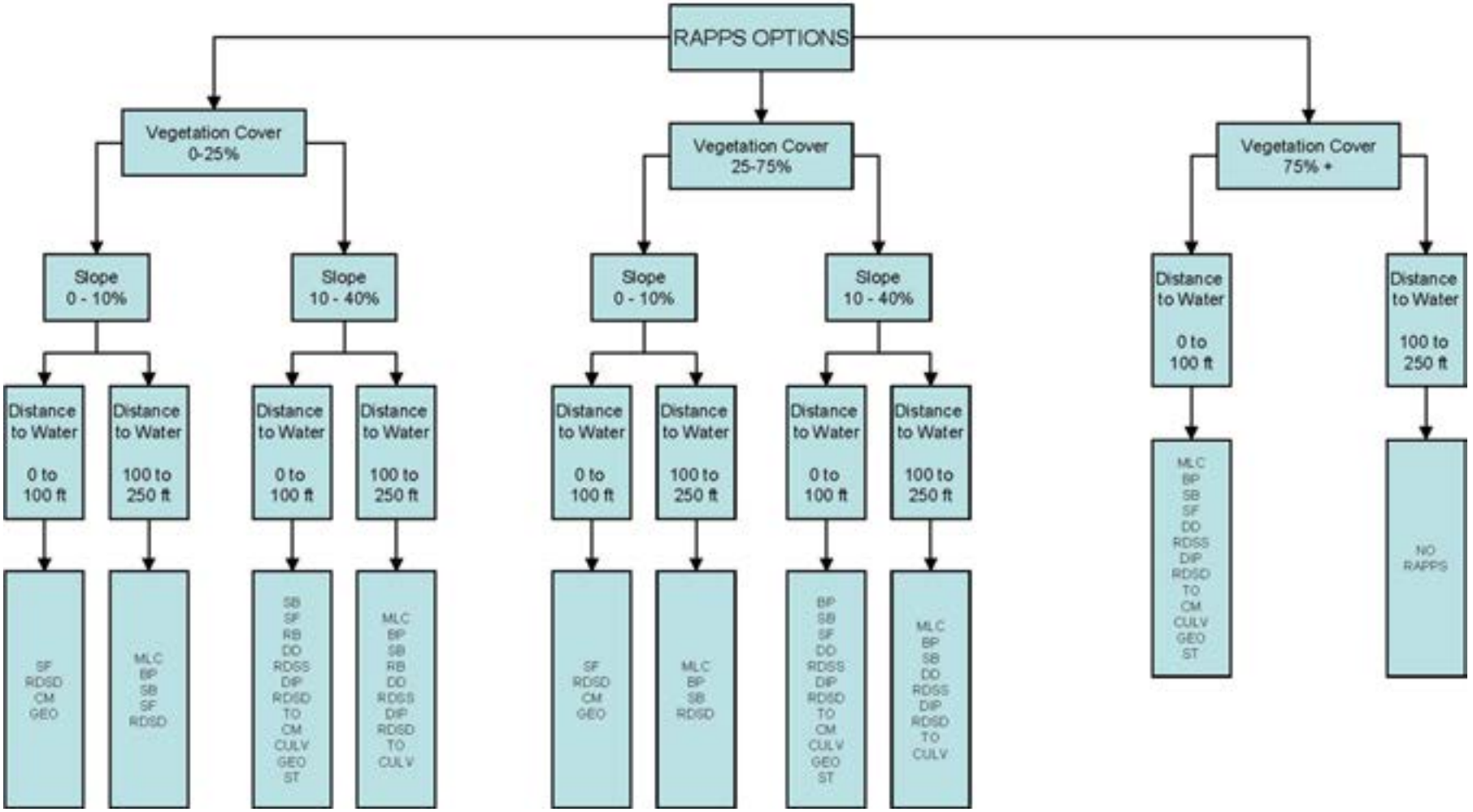
Since this region tends to have moderate annual precipitation, regular rainfall events, and clay-and-loam-dominated soils that are somewhat erodible, the opportunity for potentially undesirable quantities of sediment to be found in uncontrolled storm water discharges from an oil and gas construction site is increased over the Xeric Plains. Therefore, distance and slope are adjusted accordingly. Construction at oil and gas sites will not require the installation of RAPPS if one of the following exists:

1. The construction site is located in excess of 250 feet from a regulated water body.

2. The area between the construction site and a regulated water body has a vegetative cover in excess of 75% AND the site is located in excess of 100 feet from a regulated water body.

If neither of these two conditions is met, the decision tree in Table 3.3-1 will be useful in determining which RAPPS would be effective under the given circumstances. The decision tree process for this geographical category assumes that annual precipitation is moderate (35 inches and above) and soils have moderate erodibility.

Table 3.3-1 Decision Tree for Mesic Plains Geographical Region



Interior Mesic Plains Assumptions:
1. Annual precipitation is greater than 35 inches
2. Soils are moderately erodable

No RAPPS needed:
1. When construction site is in excess of 250 feet from a regulated water body OR
2. When vegetative cover exceeds 75% AND the site is in excess of 100 feet from a regulated water body.

Index

BP = Brush Pile
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3.4 DESERTS

Description

Lowlands of the southwestern US; slopes from 0 to 40%, but can be greater then 40%; shallow rocky or sandy soils with low erodibility; low to no vegetation cover; and low annual precipitation.

Selection of RAPPS

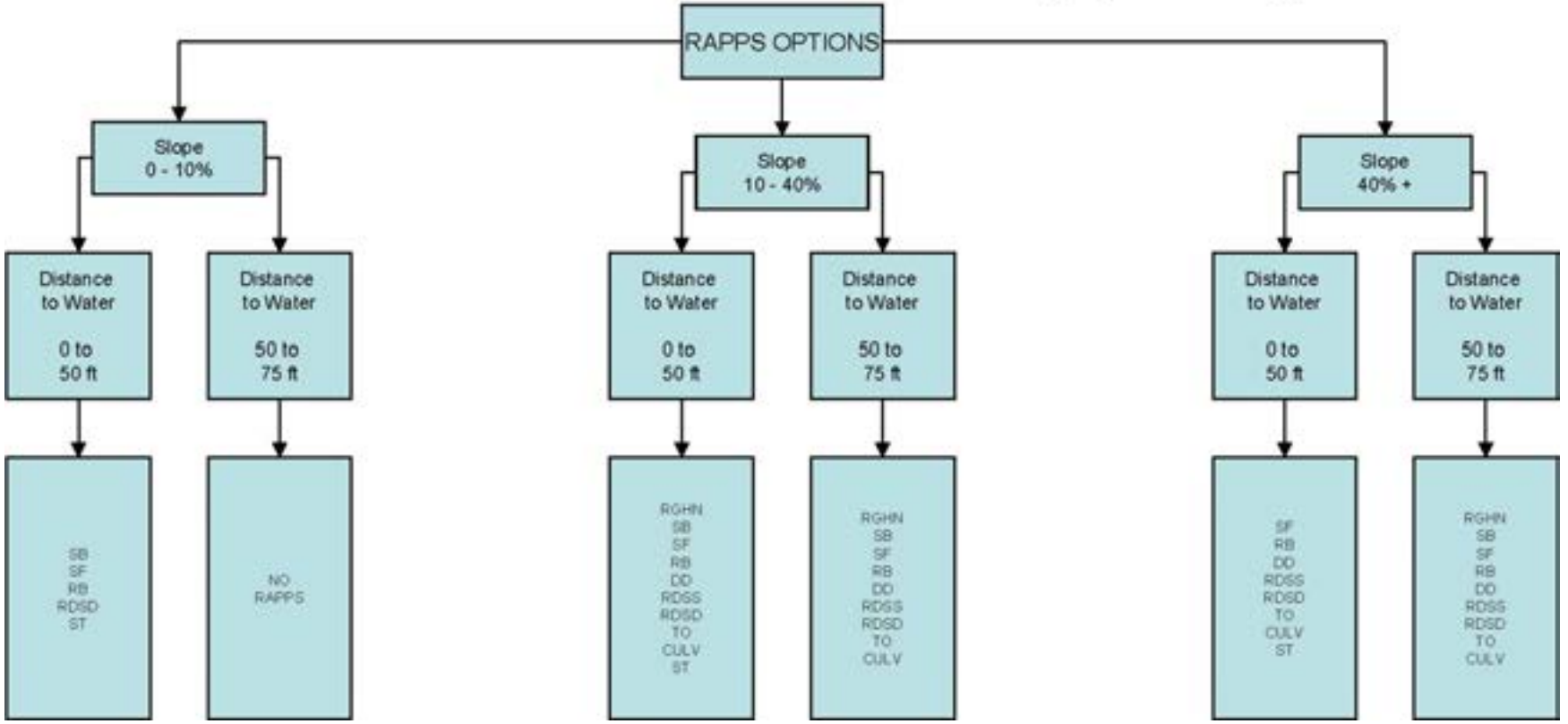
The lack of significant annual rainfall and the infrequency of rainfall events along with sand-and-rock-dominated soils limit the amount of sediment in storm water discharges from an oil and gas construction site in this type of geographical region. Therefore, construction at oil and gas sites will not require the installation of RAPPS if one of the following exists:

1. The construction site is located in excess of 75 feet from a regulated water body.

2. The area between the construction site and a regulated water body has a slope of less than 10% AND the site is in excess of 50 feet from a regulated water body.

If neither of these two conditions is met, the decision tree in Table 3.4-1 will be useful in determining which RAPPS would be effective under the given circumstances. The decision tree process for this geographical category assumes vegetation cover is low (0 to 25% coverage); annual precipitation is low (less than 15 inches); and soils are primarily sand and rock.

Table 3.4-1 Decision Tree for Deserts Geographical Region



Desert Assumptions:
1. Vegetation cover is below 25%
2. Annual precipitation is less than 15 inches
3. Soils are primarily sand and/or rock

No RAPPS needed:
1. When construction site is in excess of 75 feet from a regulated water body OR
2. When construction site has a slope of less than 10% AND is in excess of 50 feet from a regulated water body.

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3.5 XERIC MOUNTAINS

Description

Generally mountainous areas within the western US; slopes exceeding 10%; variable vegetation cover; shallow rocky soils with low erodibility; and low to moderate annual precipitation.

Selection of RAPPS

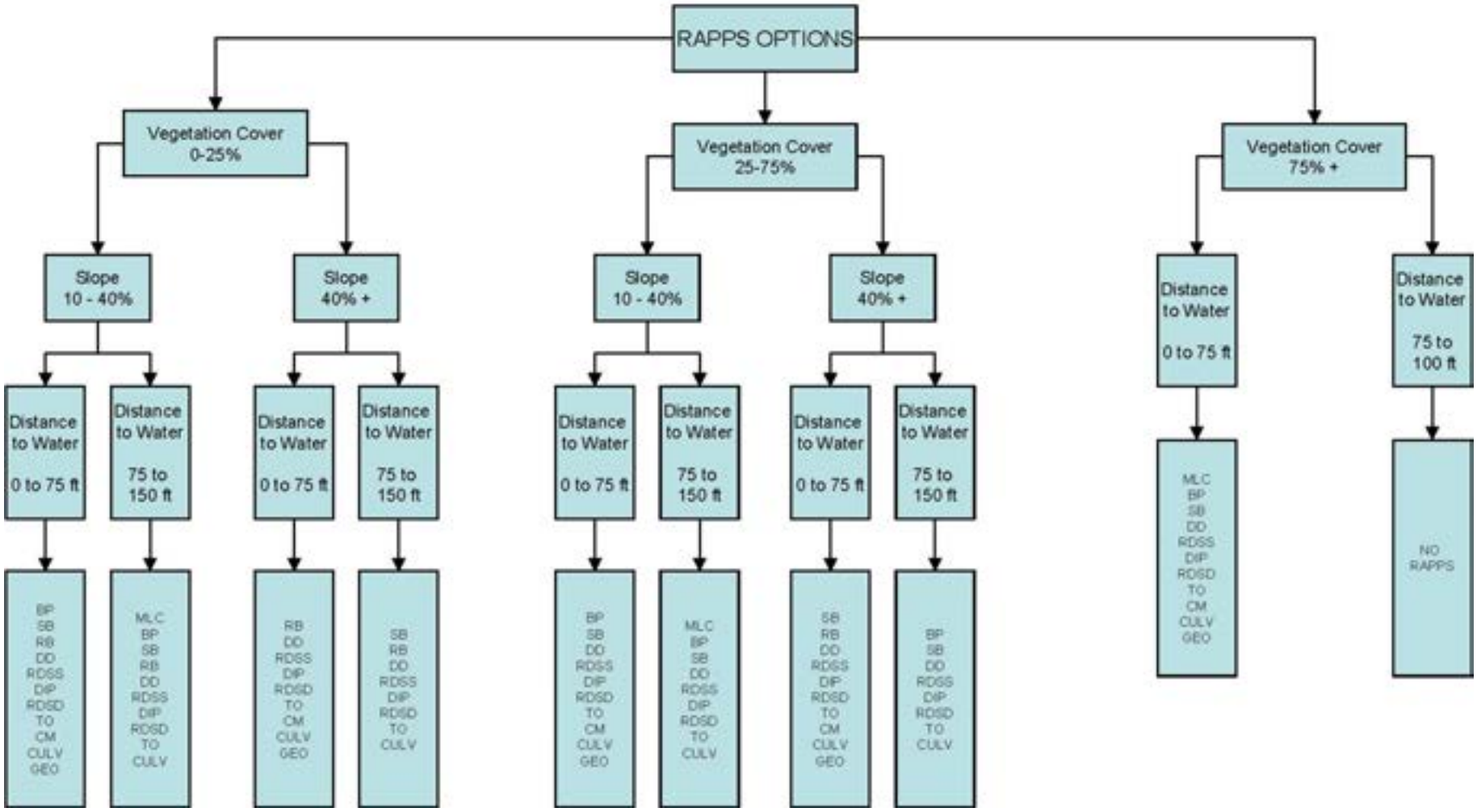
This region is dominated by very rocky, low-erodibility soils and typically only experiences rainfall events during warmer months. Snowmelt can cause erosion, but the opportunity for sediment in storm water runoff to be discharged to a regulated water body in undesirable quantities is low in comparison to the Mesic Mountains, and distance and slope are adjusted accordingly compared to the Mesic Mountains. Therefore, construction at oil and gas sites will not require the installation of RAPPS if one of the following exists:

1. The construction site is located in excess of 150 feet from a regulated water body.

2. The area between the construction site and a regulated water body has vegetative cover in excess of 75% AND the site is in excess of 75 feet from a regulated water body.

If neither of these two conditions is met, the decision tree in Table 3.5-1 will be useful in determining which RAPPS would be effective under the given circumstances. The decision tree process for this geographical category assumes annual precipitation is low to moderate (from 10 to 50 inches) and soils are primarily rock.

Table 3.5-1 Decision Tree for Xeric Mountains Geographical Region



Xeric Mountains Assumptions:
1. Annual precipitation is between 10 and 50 inches
2. Soils are rocky with low erodability

No RAPPS needed:
1. When construction site is in excess of 150 feet from a regulated water body OR
2. When vegetative cover exceeds 75% AND the site is in excess of 75 feet from a regulated water body.

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3.6 MESIC MOUNTAINS

Description

Rolling highlands and steep mountains within the eastern and northwestern portions of the US; slopes exceeding 10%; variable vegetative cover; loamy soils with moderate erodibility; and very high annual precipitation.

Selection of RAPPS

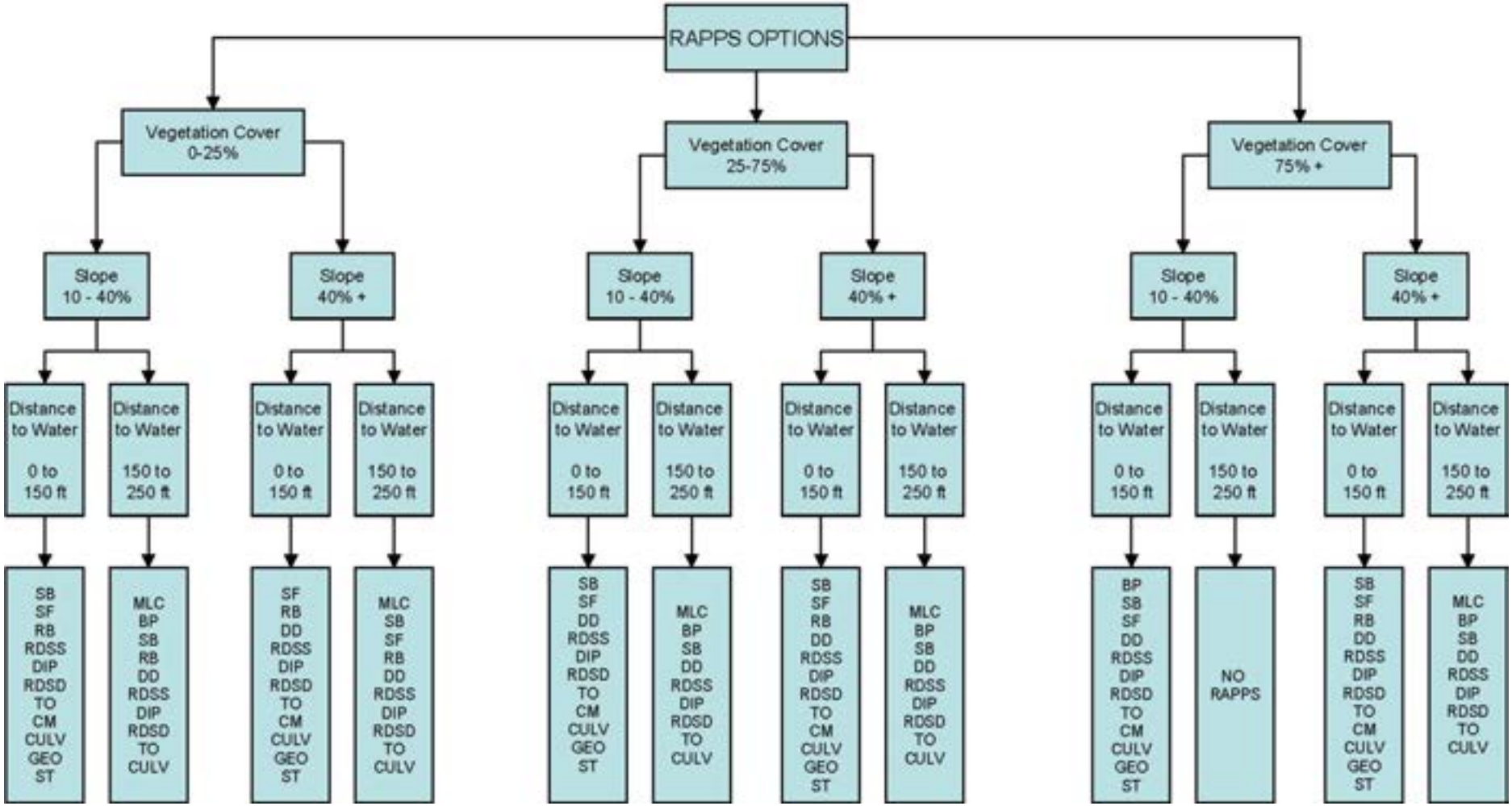
This region has high annual precipitation with frequent rainfall events. Additionally, vegetative cover tends to be dominated by forest, slopes are steep, and soils are dominated by loams. The opportunity for sediment to be discharged to a regulated water body in potentially undesirable quantities is increased over the Xeric and Mesic Plains and Xeric Mountains, and distance and slope for the Mesic Moutains are adjusted accordingly. Therefore, construction sites will not require the installation of RAPPS in the Mesic Mountains if one of the following exists:

1. The construction site is located in excess of 250 feet from a regulated water body.

2. The area between the construction site and a regulated water body has vegetative cover in excess of 75%; the slope is less than 40%; AND the site is in excess of 150 feet from a regulated water body.

If neither of these two conditions is met, the decision tree in Table 3.6-1 will be useful in determining which RAPPS would be effective under the given circumstances. The decision tree process for this geographical category assumes annual precipitation is high (in excess of 60 inches) and loamy soils are moderately erodible.

Table 3.6-1 Decision Tree for Mesic Mountains Geographical Region



Mesic Mountains Assumptions:
1. Annual precipitation is in excess 60 inches
2. Soils are loamy with moderate erodability

No RAPPS needed:
1. When construction site is in excess of 250 feet from a regulated water body OR
2. When vegetative cover exceeds 75%; the slope is less than 40%; AND the site is in excess of 150 feet from a regulated water body.

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4.0 CONSTRUCTION CROSSING A REGULATED WATER BODY

Construction of crossing at regulated water bodies increases the opportunity for pollution entering these areas. Several listed RAPPS will likely be necessary for water protection given the particular circumstances. Appendix B includes some general diagrams indicating RAPPS used effectively to protect regulated waters during oil and gas construction activity. The general recommendations listed below should also be considered to help control discharges of sediment to the regulated water in undesirable quantities during construction at regulated water bodies.

- Bore under regulated water body to prevent disturbance.
- Generally, construction activities should be limited to the extent practicable within regulated waters.
- Locate staging areas and spoil storage areas a minimum of 10 feet from the water's edge. Additionally, good vegetative cover and/or sediment barriers will be needed between the stored spoil and regulated water.
- Operate tracked equipment on construction mats within regulated waters to limit soil compaction or disturbance within these areas.
- Refuel equipment a minimum of 100 feet from the regulated water body.
- Cut vegetation at ground level and limit removal of root zones and stumps where possible.
- Maintain the maximum amount of vegetative ground cover as possible.
- Install temporary equipment crossings after initial clearing to allow for equipment access during construction. Flume pipe will be necessary at flowing streams.
- Stream flows at crossings should be flumed or dammed and pumped past the construction area.
- Dewater trench in a manner to prevent sediment-laden water from entering the regulated water. Trench water should be pumped into an area with good vegetative cover or into a filter bag and dewatering structure.
- Water body banks should be stabilized following construction to prevent sloughing or erosion.

5.0 STABILIZATION

5.1 ACTIVELY DISTURBED

Area of land disturbed during preparation of oil and gas sites or portion thereof is considered “actively disturbed” during the time period starting with the commencement of land disturbing activities (such as clearing, grading, or excavating activities) until the area of land disturbed is in a state suitable for the use and capacity for which it was intended and RAPPS have been implemented, if necessary.

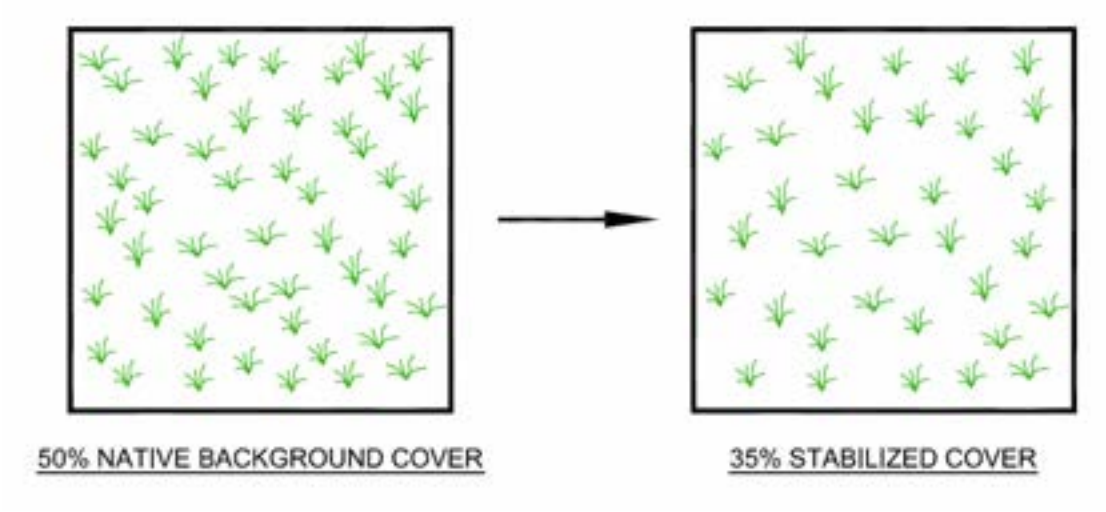
5.2 FINAL STABILIZATION

RAPPS should be maintained in good condition for the area disturbed during and after the period of active disturbance until final stabilization of the area disturbed. Final stabilization will limit and/or prevent potentially undesirable quantities of sediment from leaving the site in storm water runoff and entering a regulated water body. Final stabilization can be achieved in several different fashions.

After construction of roads and/or well or equipment pads is completed, the area covered by the road and/or equipment pad considered immediately and finally stabilized because of the placement of a base material on these areas, such as asphalt, caliche, rock, or just compaction of existing dirt in place. Once the base material is stabilized sufficiently for use in the use and capacity intended, it is considered finally stabilized.

In disturbed areas within Coastal Plains, Mesic Plains, Mesic Mountains, and Xeric Mountains where no base material will be placed, the area disturbed is considered finally stabilized when a uniform perennial vegetative cover with a density of 70% of the native background vegetative cover is established. When background native vegetation cover is less than 100%, the amount of vegetative cover needed to meet stabilization criteria needs to be determined. For example (see diagram below), if the native background vegetative cover is estimated at 50%, then 70% of the original 50% vegetative cover must be established. This would mean the area disturbed would need 35% vegetative cover to be considered finally stabilized (0.70 x 0.50 = 0.35 or 35%).

Alternatively, for sites located within the Desert and Xeric Plains in disturbed areas where no base material will be placed, the area disturbed may be considered finally stabilized prior to obtaining 70% of the native background vegetative cover as long as the following alternative final stabilization criteria are met: (1) Active disturbance of the land area to be considered stabilized has been completed, (2) RAPPS have been selected and installed appropriately, and (3) native seed has been dispersed in such a fashion as to be expected to achieve 70% background vegetative cover within 3 years under normal climate conditions for the region.



6.0 DEFINITIONS

Concentrated Flow – water run-off with increased volume and velocity

Construction Activity – construction activity including clearing, grading, and excavating operations that disturb land area, including construction of access roads, flow/gathering pipelines, well/tank battery pads, equipment/facility pads, regulated water body crossings

Construction Site – area of land disturbance

RAPPS – Reasonable and Prudent Practices for Stabilization – device, method, or procedure used to prevent or reduce sediment from oil and gas construction activity from entering a regulated water body in undesirable quantities

Regulated Water Body – A water body that is subject to the U.S. Environmental Protection Agency's (EPA's) jurisdiction under the Clean Water Act. EPA's jurisdiction extends over "waters of the U.S." EPA's definition of "waters of the U.S." is set out in Appendix C of this document.

NOTE: If there is a water body in the vicinity of your construction site and you are not sure whether it is a "regulated water body," you should contact an environmental professional or attorney to help you make this evaluation. The definition of the phrase "waters of the U.S." has been extensively litigated, and there is a large body of case law interpreting it. The definition of "regulated water body" may, therefore, vary between different areas of the country, because the courts in different parts of the country have reached different conclusions about the extent of EPA's jurisdiction.

Vegetative Cover – existing or planted low-growing, herbaceous plant species

7.0 REFERENCES

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Pennsylvania Department of Environmental Protection – Chapter 4, Oil and Gas Management Practices. http://www.dep.state.pa.us/eps/default.asp?P=fldr200149e0051190%5Cfldr200149e10561a8%5Cfldr20026f8082801d (12 Feb. 2004).

West Virginia Department of Environmental Protection – Office of Oil and Gas. http://www.dep.state.wv.us/publications.cfm?ssid=23 (12 Feb. 2004).

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APPENDIX A

DESCRIPTION OF RAPPS

(RAPPS presented were derived from both common industry references provided in Section 4.0 of this document and from practical field experience)

1. VEGETATIVE COVER

Vegetative cover is an effective natural means of filtering runoff and preventing erosion. Preservation of existing vegetation to the maximum extent practicable keeps soils stabilized and provides a natural filter. The most effective vegetative cover consists of low-growing, herbaceous species with a high percentage of ground coverage. Shrubs and trees provide some means of preventing erosion; however, the filtering ability is greatly reduced.

Limitations:

- Primarily filters sheet flow
- Minimum width of vegetative strip dependent on slope (greater slope requires wider strip)
- Vegetation must be established
- High percentage of ground cover

Installation:

- Limit vegetation clearing to the extent practicable during construction
- Plant fast-growing annual grasses for temporary controls
- Plant perennial seed mixes recommended by the local soil conservation office

Construction Activities:

Access roads, well/tank battery pads, and flow/gathering pipelines

15% COVER 50% COVER 85% COVER

2. MULCH (MLC)

Mulching is the use of vegetative fibers (e.g., straw, wood chips) to minimize rainfall impact, reduce suspended solids from runoff, protect seeds from erosion, prevent moisture loss from soil, and reduce predation of seeds by birds.

Limitations:

- Gradual slopes only
- Not for use immediately adjacent to wetlands or streams
- Can be lost with sheet flow runoff

Installation:

- Chop or chip wood, straw, or cellulose
- Mulch should be anchored by crimping or other technique
- Incorporate seed mix for permanent stabilization
- Hydro-mulch can be applied by spraying

Construction Activity:

Flow/gathering pipelines

3. ROUGHENING (RGHN)

This technique uses the horizontal grooves created by tracks of construction equipment to reduce runoff flow velocities. Tracks are established on the slopes perpendicular to water flow.

Limitations:

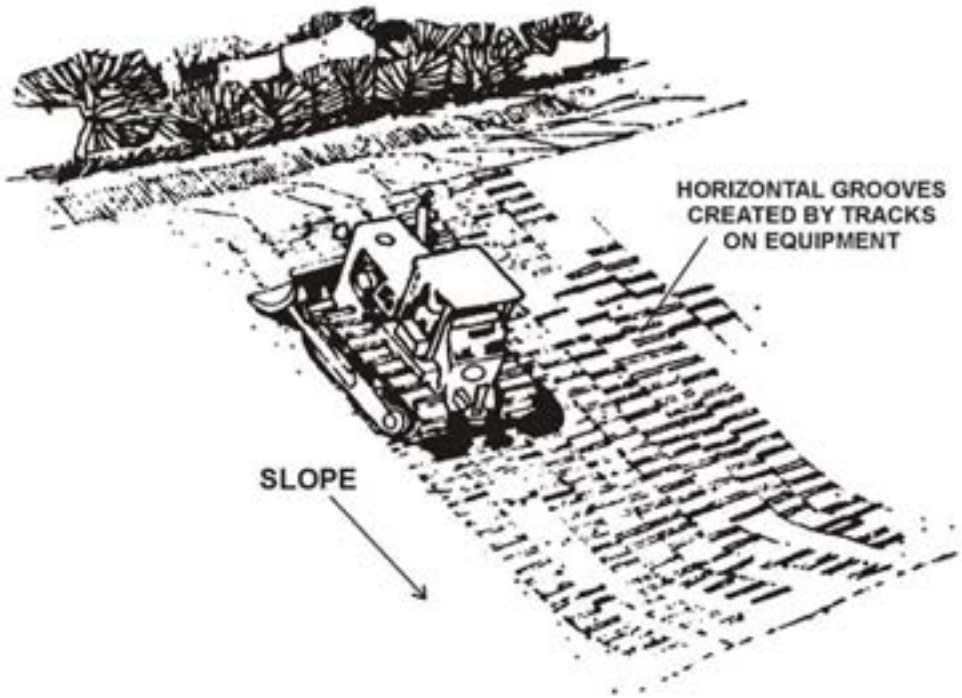
- Not for use on rocky slopes
- May cause soil compaction which limits vegetation re-growth
- Roughening may have to be re-established if lost due to heavy sheet flow runoff

Installation:

- Operate tracked equipment in a direction parallel to water flow as so to create tracks perpendicular to water flow

Construction Activity:

Access Roads, Well/Tank Battery Pads, and Flow/Gathering Pipelines



Source: Pennsylvania Department of Environmental Quality, 2004.

4. BRUSH PILES (BP)

Brush piles can be used to filter sediment from runoff of construction sites with small drainage areas on gradual slopes.

Limitations:

- Not effective on concentrated flows
- Large amounts of brush are typically needed
- Removal may be necessary after stabilization is complete

Installation:

- Cut up brush into small pieces and compact tightly
- Avoid bulky material
- Eliminate large voids within pile
- Pile brush up to 3 feet high with a minimum width of 5 feet at base
- Anchor brush piles
- The brush may be secured with photodegradable liner fabric

Construction Activities:

Access roads, well/tank battery pads, and flow/gathering pipelines

5. STRAW (HAY) BALES (SB)

This technique utilizes bound straw bales to filter sediment from runoff of small areas.

Limitations:

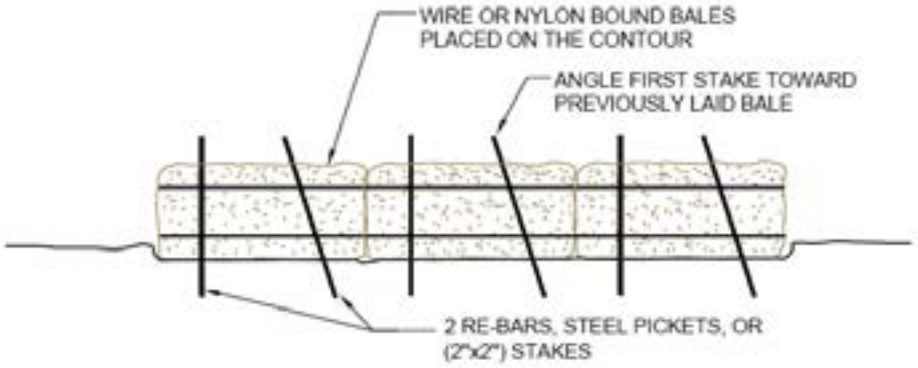
- Filters sheet flow from small drainage areas
- Short-term use
- Decomposes
- Consumed by livestock
- Removal of anchor stakes will be necessary after stabilization is complete

Installation:

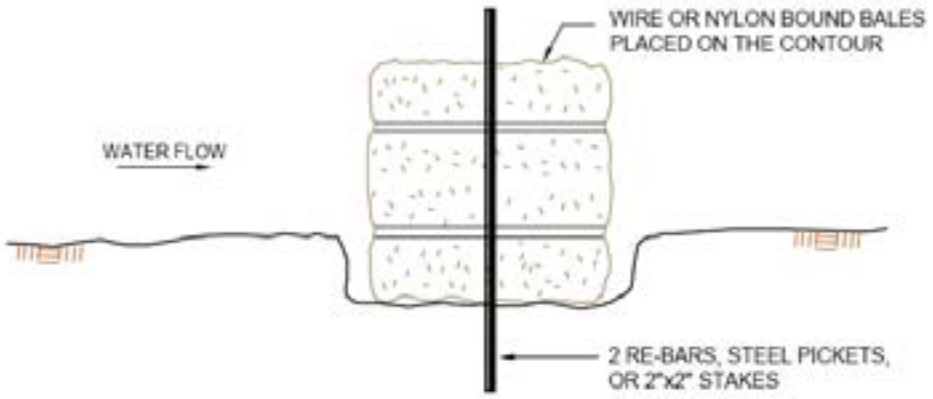
- Embed into trench
- Anchor with 2 support stakes
- Compact backfill on upgradient side
- Straw bales should extend across grade and upslope for short distance
- Use at outfall points from diversion dikes, turnouts, etc.

Construction Activities:

Access roads, well/tank battery pads, and flow/gathering pipelines



ANCHORING DETAIL



EMBEDDING DETAIL

6. SILT FENCE/FABRIC (SF)

Silt fence/fabric is utilized to filter sediment from runoff of small areas. Silt fence/fabric may also be utilized as a perimeter control around the construction site when the site is relatively small.

Limitations:

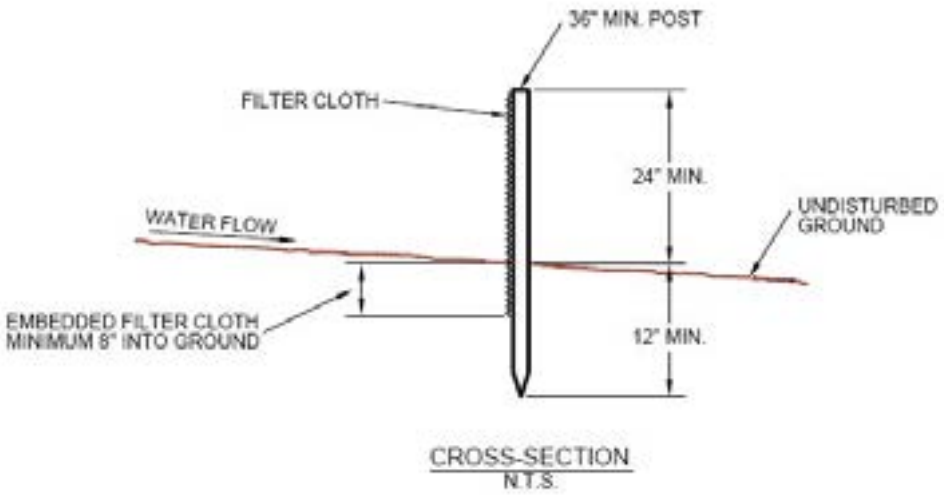
- Not for concentrated flows
- Not for use in rocky situations
- Removal will be necessary after stabilization is complete
- Not for large watersheds

Installation:

- Embed bottom of fabric into soil
- Support posts spaced no greater than 10 feet apart
- Compact backfill at base of fabric
- Extend silt fence across grade and upslope for short distance
- Use at outfall points where concentrated flows are not expected

Construction Activities:

Access roads, well/tank battery pads, and flow/gathering pipelines



CROSS-SECTION
N.T.S.

7. ROCK BERM (RB)

This technique is useful to filter sediment from concentrated flows and/or runoff of moderate grades and larger drainage areas. Additionally, rock berms may be utilized to reduce velocity of flows within constructed channels.

Limitations:

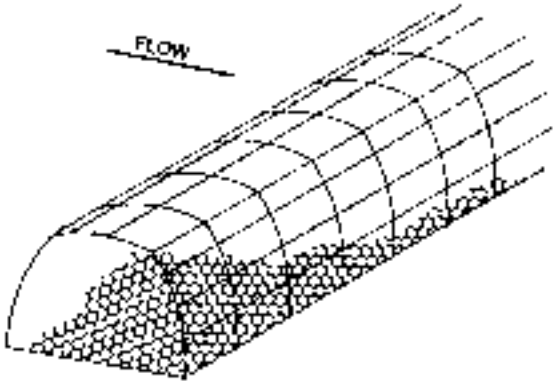
- Availability of rock
- Anchor rock into soil
- Difficult to remove after construction
- Require regular maintenance due to sediment build-up

Installation:

- Use medium to large diameter rock
- May secure rock within woven wire sheathing but not required
- Berm side slopes should be 3:1 or flatter
- Top of berm should be a minimum of 2 feet wide

Construction Activities:

Access roads, well/tank battery pads, and flow/gathering pipelines



ROCK BERM
NTS

CROSS SECTION
N.T.S.

8. DIVERSION/EARTHEN DIKES (WATER BARS) (DD)

This technique may be used to collect runoff from undisturbed areas and divert around construction activity. Additionally, dikes are used to limit the accumulation of water volume by diverting runoff from construction area into a stabilized outlet or well-vegetated area.

Limitations:

- Not for use on concentrated flows
- May cause concentrated flows from sheet flow
- Requires vegetative cover or other filter at discharge point

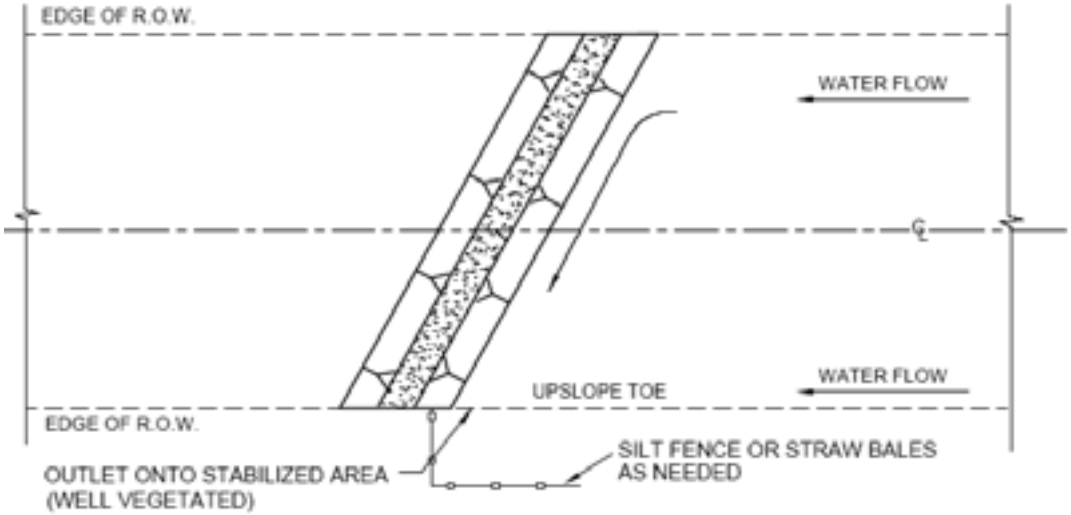
Installation:

- Pile and compact soil
- Dike sideslopes should be 2:1 or flatter
- Angle dike at approximately 30^{o} to slope
- Increase frequency with increased slope
- Outlet dike into well-vegetated area or install secondary control such as rock filter or straw bales

Construction Activities:

Access roads, well/tank battery pads, and flow/gathering pipelines

CROSS SECTION
N.T.S.



PLAN VIEW
N.T.S.

9. ROAD SURFACE SLOPE (RDSS)

This technique sheds runoff water from road surface into stabilized ditches or vegetation. Roads may be crowned, in-sloped, or out-sloped.

Limitations:

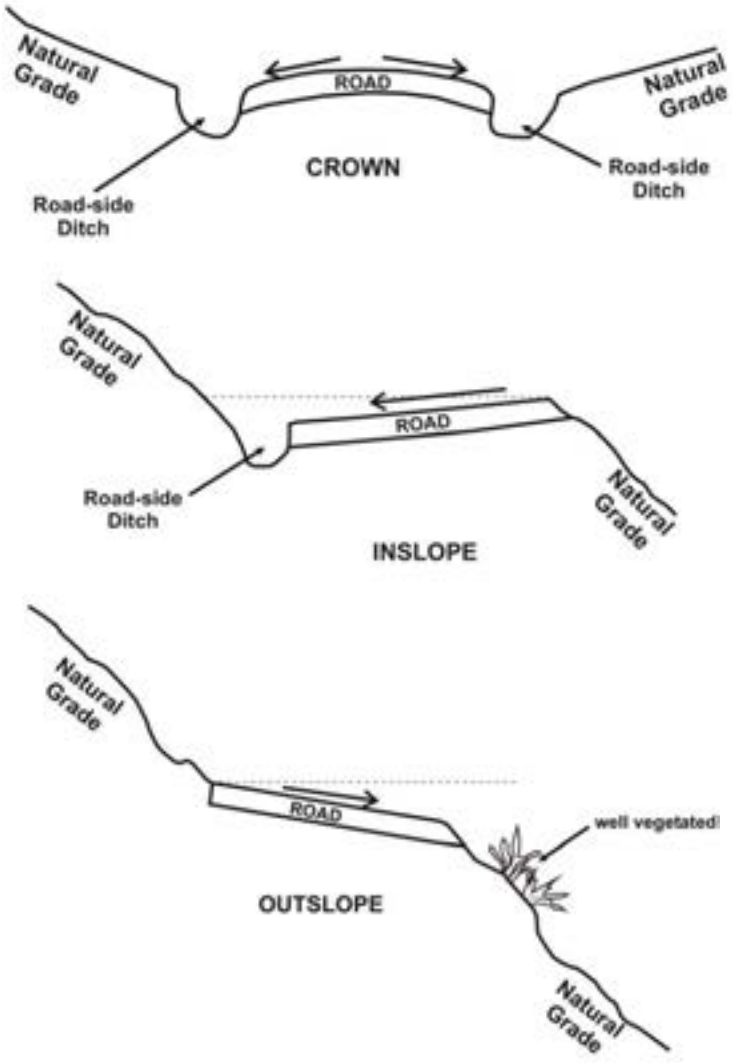
- Only sheds runoff collected from surface of road
- May cause concentrated flows from sheet flow
- Require vegetative ditches, turnouts, and/or cross-drains

Installation:

- Compact soil or road base material to direct runoff
- Crowning design directs runoff to both sides of the road requiring 2 road-side ditches
- Inslope design directs runoff toward the hillside and requires cross-drain installation
- Outslope design is most effective on moderate slopes with dense vegetative cover

Construction Activity:

Access roads



10. DRAINAGE DIPS (DIP)

This technique captures and directs runoff from the road into vegetative filter strips or other filter system. Ridges and associated dips are constructed diagonally across and as part of the road surface.

Limitations:

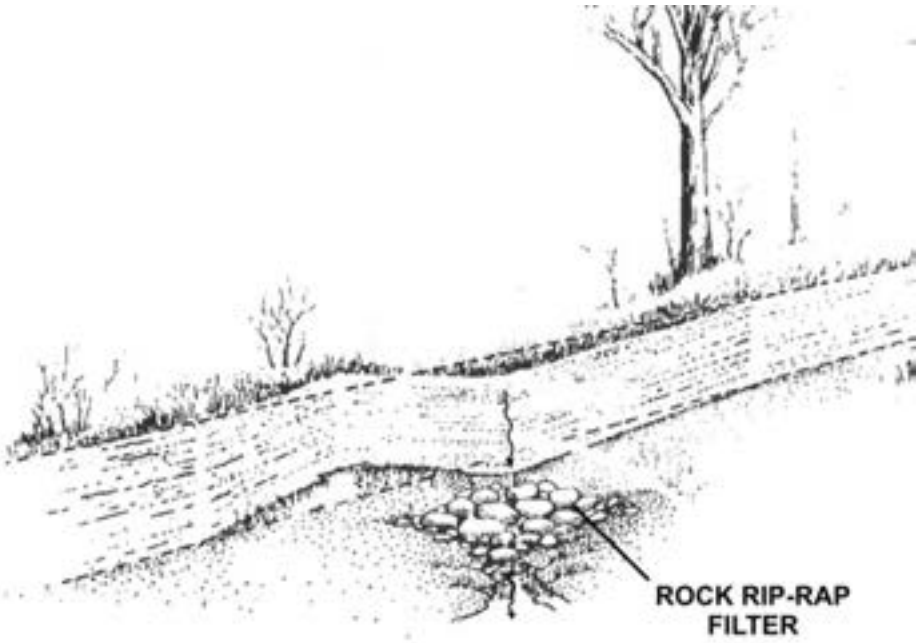
- Size limited by the safe passage of trucks and equipment
- May cause concentrated flows from sheet flows
- Require vegetative cover or other filter at discharge point

Installation:

- Need to be deep enough to carry expected flow
- Need to be wide enough to allow traffic to pass
- Increase frequency with increase slope
- Pile and compact soil
- Angle dips up to 25^{o} to slope
- Place rock at outlet

Construction Activity:

Access roads



PLAN VIEW
N.T.S.

Source: Cooperative Extension Service, 2002.

11. STABILIZED CONSTRUCTION ENTRANCE

Stabilized construction entrances limit the amount of tracked materials (mud and dust) from leaving the construction site. Mud and sediment are removed from vehicle tires when leaving the site as tires pass over rock pad.

Limitations:

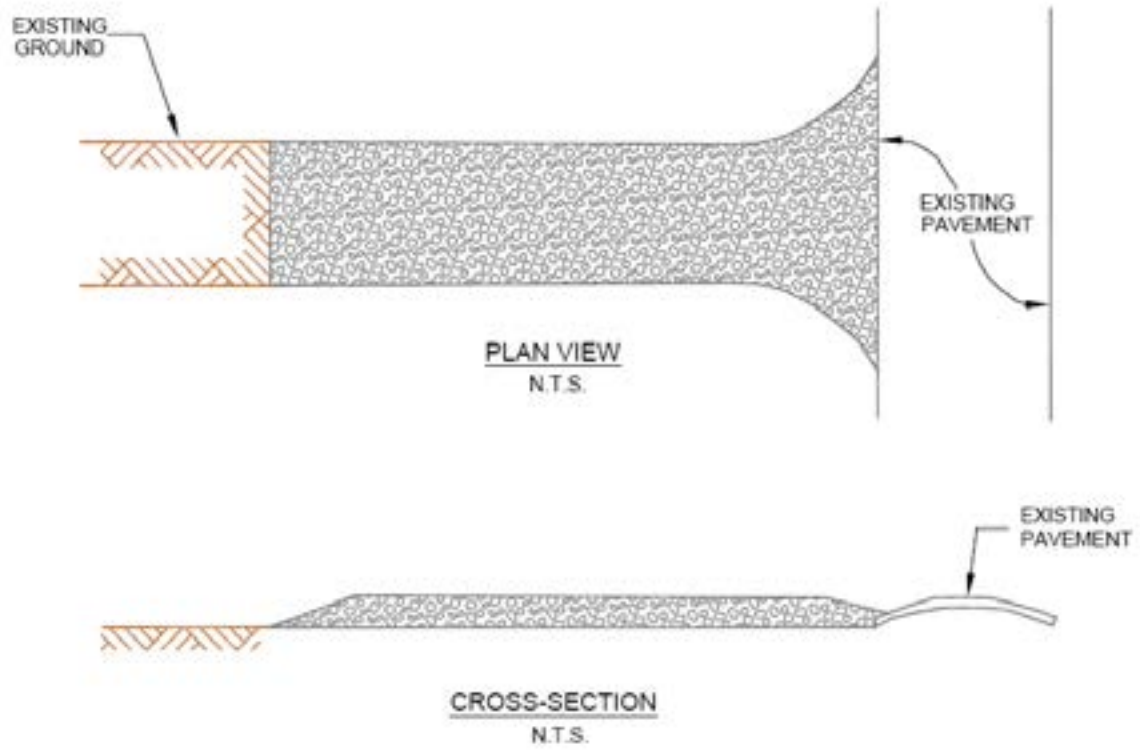
- Less effective with increased rain and mud
- Additional sweeping of paved road will be necessary
- Removal necessary after completion of construction
- Availability of rock

Installation:

- Install at entrances/exits to paved roads
- Place geotextile filter fabric under medium to large diameter crushed rock
- Length and width of entrance should be adequate to allow large vehicles to access site

Construction Activities:

Access roads, well/tank battery pads, and flow/gathering pipelines



12. ROAD-SIDE DITCHES (RDSD)

This technique requires constructing channels parallel to roads. The ditches convey concentrated runoff of surface water from roads and surrounding areas to a stabilized area.

Limitations:

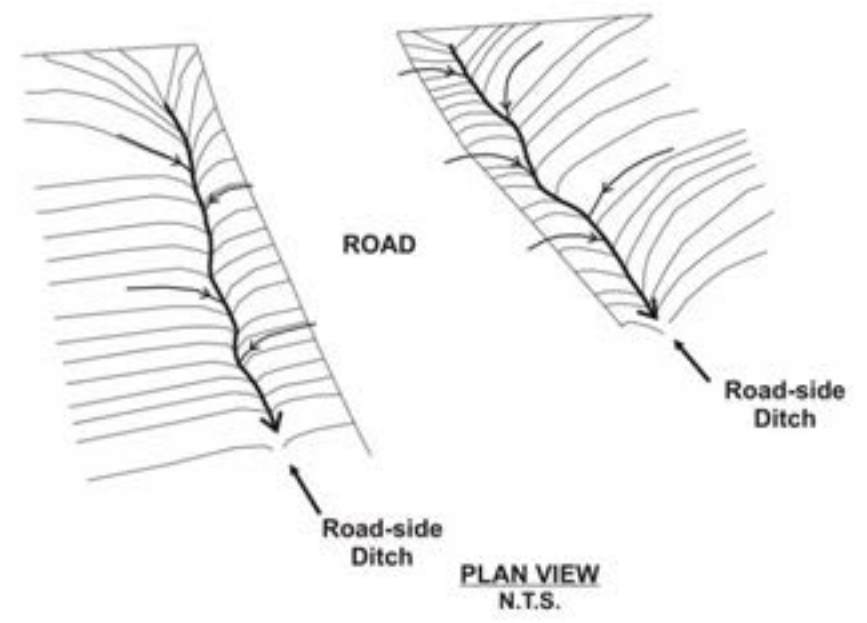
- Erosion occurs within channel
- Channel does not necessarily filter sediment from runoff

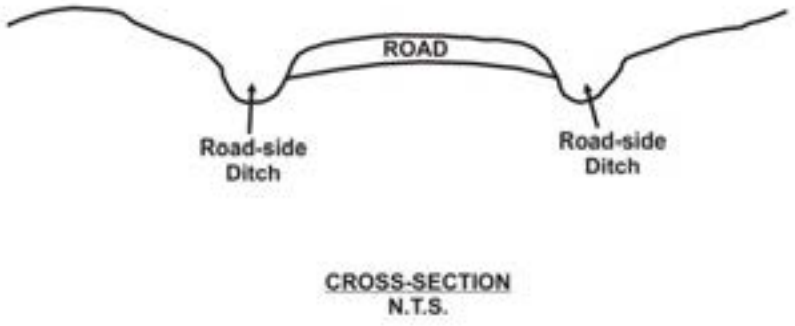
Installation:

- Excavate channel along roadside to a width and depth that can handle expected flows
- Slope channels so that water velocities do not cause excessive erosion
- Shape and level channel removing excess spoil so water can flow
- Vegetate or line channel with material to prevent erosion

Construction Activity:

Access roads





13. TURNOUTS OR WING DITCHES (TO)

These structures are extensions of road-side ditches and will effectively remove run-off water from the ditch into well-stabilized areas.

Limitations:

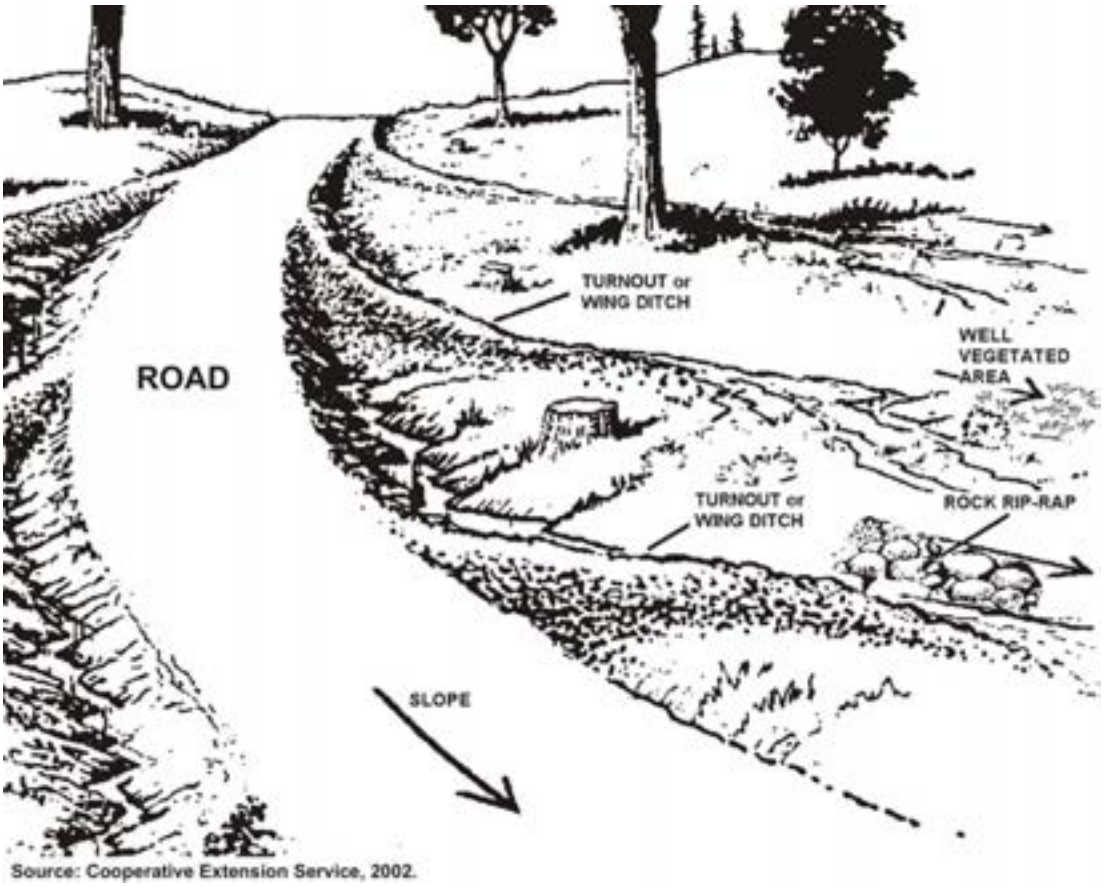
- Gradual slopes only
- Require vegetative cover or other filter at discharge point

Installation:

- Slope turnout gradually down from bottom of road ditch
- Angle turnout at approximately 30^{o} to road ditch
- Discharge turnout into well-vegetated area or install secondary control such as rock filter or straw bales
- Space turnouts according to slope

Construction Activities:

Access roads



Source: Cooperative Extension Service, 2002.

14. CONSTRUCTION MATS (CM)

This technique spreads the weight of construction equipment over a broad area to help prevent soil compaction and soil exposure.

Limitations:

- Useful on wet, soggy, and/or inundated soils
- Mats are bulky and difficult to move
- Does not filter sediment from runoff

Installation:

- Mats are constructed of large timber tied together
- Mats are placed ahead of operating equipment to provide stable work area

Construction Activities:

Flow/gathering pipelines

15. CROSS-DRAIN CULVERTS (CULV)

This technique can be used to direct road-side ditch flow across road or may be used to direct stream flow under road or construction area. Culverts passing construction sites will allow for continued flow of stream with minimal siltation.

Limitations:

- Culverts may become clogged
- Not a sediment filter

Installation:

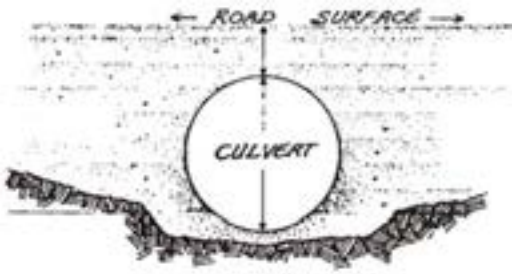
- Culverts may be steel, aluminum, or concrete
- Culverts should be placed at surface grades to allow normal low-flow water to be conveyed
- Soil or road base should be compacted over culverts to a minimum of 12 inches
- Culvert size should be adequate to convey anticipated flow
- Ditch plug will be needed within road-side ditch to direct water into culvert
- Culvert drop grade should be adequate to convey flows
- Increase frequency of culverts with increased slope
- Rock rip-rap often needed at outlet

Construction Activities:

Access roads and flow/gathering pipelines

PLAN VIEW
N.T.S.

Source: Cooperative Extension Service, 2002.



CROSS SECTION
N.T.S.

Source: Cooperative Extension Service, 2002.

16. GEOTEXTILES/EROSION BLANKETS (GEO)

Geotextiles are typically a porous fabric constructed of woven fibers. They are useful for stabilizing and preventing erosion on slopes, especially adjacent to streams.

Limitations:

- Decompose
- Effectiveness depends on proper installation
- Expensive

Installation:

- Select appropriate fabric type for necessary purpose
- Smooth soil prior to installation
- Fabric needs to be in continuous contact with exposed soil
- Anchor fabric securely
- Apply seed prior to fabric installation for final stabilization of construction sites

Construction Activities:

Well/tank battery pads and flow/gathering pipelines

17. SEDIMENT TRAPS (ST)

This technique uses a basin or pond to hold sediment-laden water so that sediment can settle and water is absorbed into the soil. Sediment traps are useful for construction sites where excessive runoff will need to be captured and filtered and other RAPPS are insufficient.

Limitations:

- Not for use in rocky situations
- Larger drainage areas require larger traps
- Overflow can result during large rainfall events
- Water will remain in trap for extended periods

Installation:

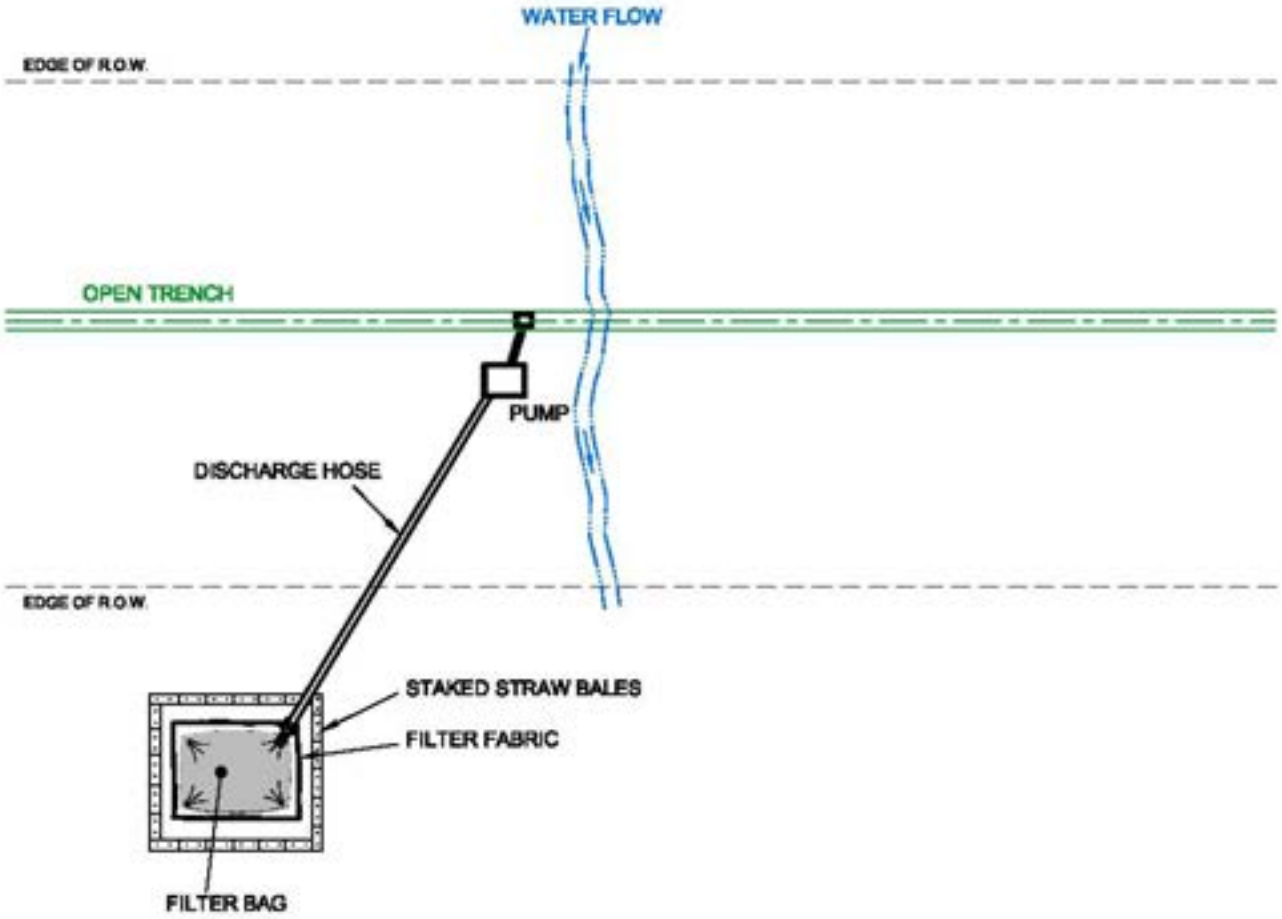
- Excavate trap or basin within area where runoff may be directed toward
- Sideslopes should be machine compacted
- Sideslopes should be 2:1 or flatter
- Volume of trap should handle runoff from 2-year storm events
- Soil within trap should allow for water absorption, no bedrock
- Construct spillway or outfall structure with rock rip-rap at outlet

Construction Activities:

Access roads, well/tank battery pads, and flow/gathering pipelines

APPENDIX B

DIAGRAMS OF TYPICAL REGULATED WATER BODY CROSSINGS



PLAN VIEW
N.T.S.

CONSTRUCTION NOTES:

1. DISCHARGE ONTO STABILIZED AREA (i.e. HEAVILY VEGETATED)
2. DISCHARGE LOCATION MUST BE A MINIMUM OF 25' FROM OPEN WATER BODY OR INTO DISCHARGE STRUCTURE.

TRENCH DEWATERING & DISCHARGE

Horizon
Environmental Services, Inc.

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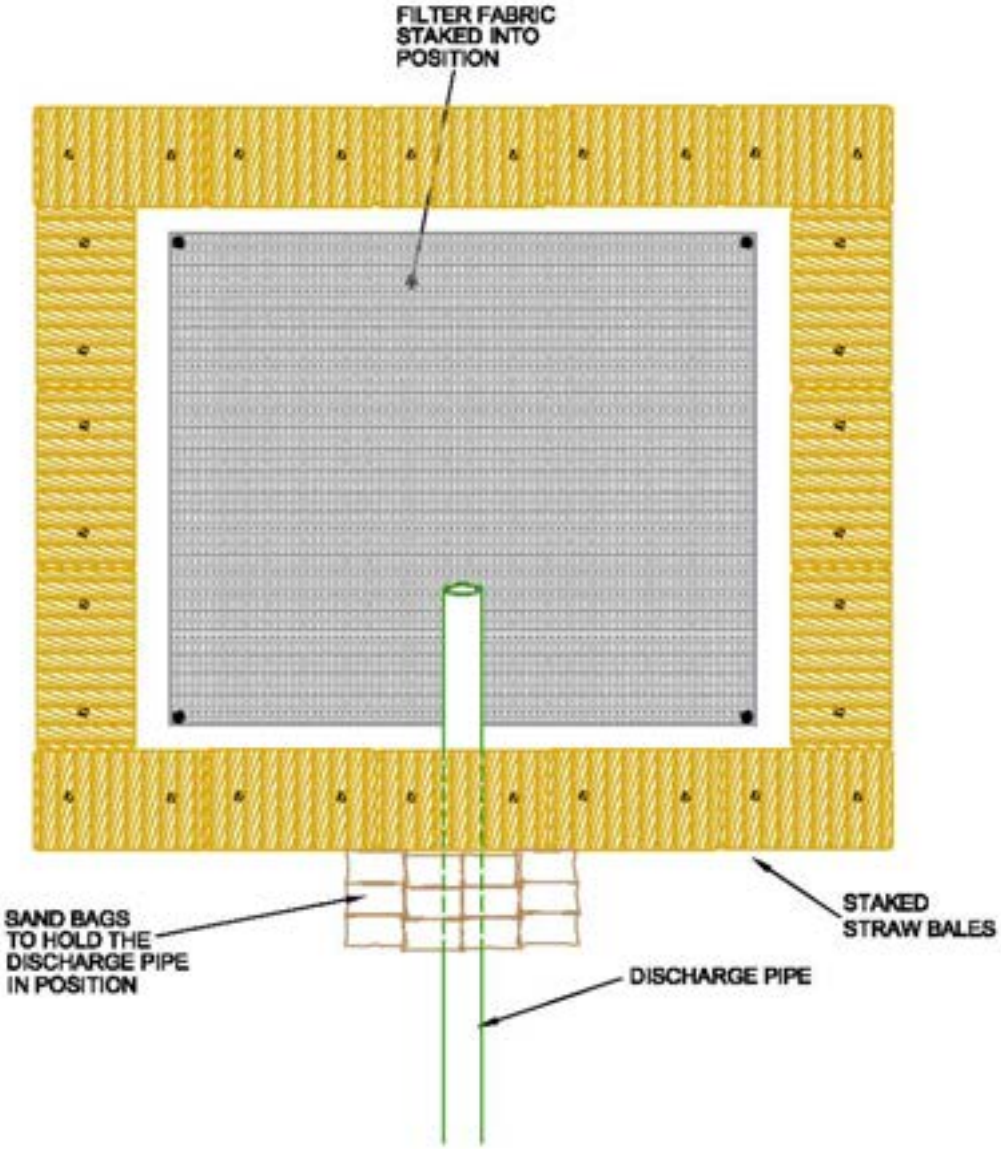


PLAN VIEW
N.T.S.

CONSTRUCTION NOTES:

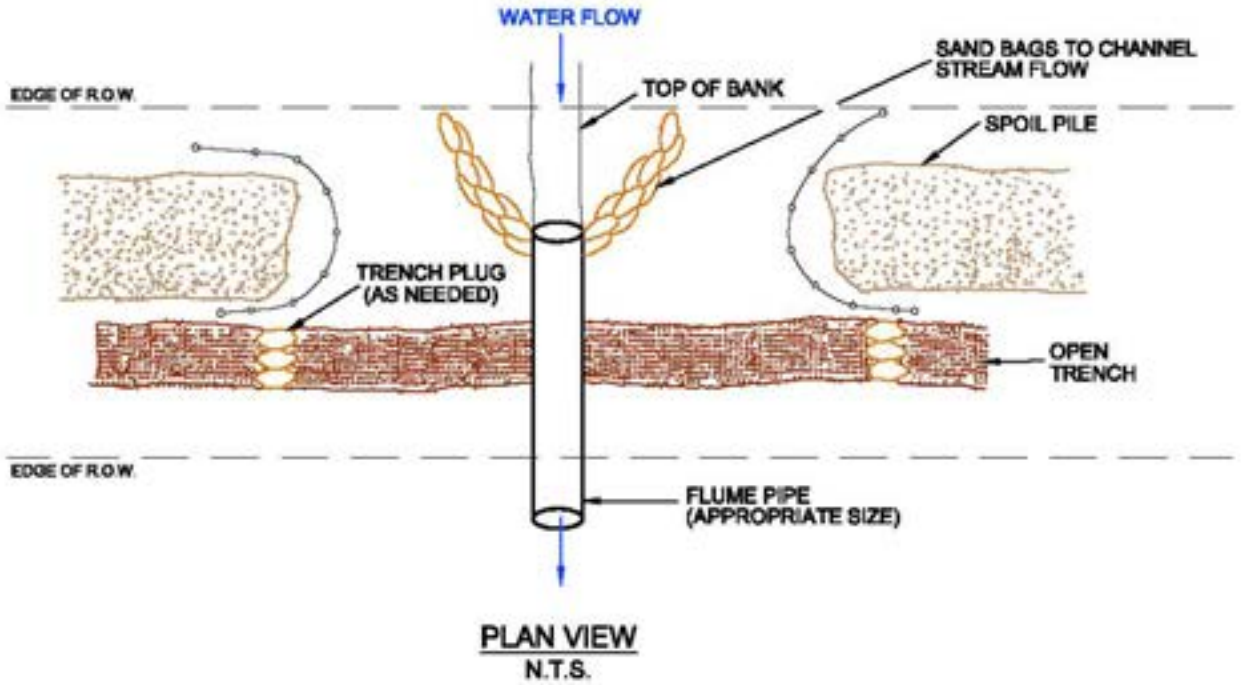
1. THIS DESIGN FOR FLAT OR RELATIVELY FLAT GROUND.
2. THIS DESIGN FOR SMALL DISCHARGES.

THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.

DEWATERING STRUCTURE

"Do Not Scale This Drawing"

Horizon
Environmental Services, Inc.



PLAN VIEW
N.T.S.

CONSTRUCTION NOTES:

1. TRENCH SPOIL SHOULD BE PLACED APPROXIMATELY 10' FROM THE TOP OF THE BANK.
2. RAPPS NEEDED BETWEEN SPOIL AND WATERBODY.
3. FLUME PIPE SHOULD ADEQUATELY CONVEY NORMAL STREAM FLOWS.

THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.

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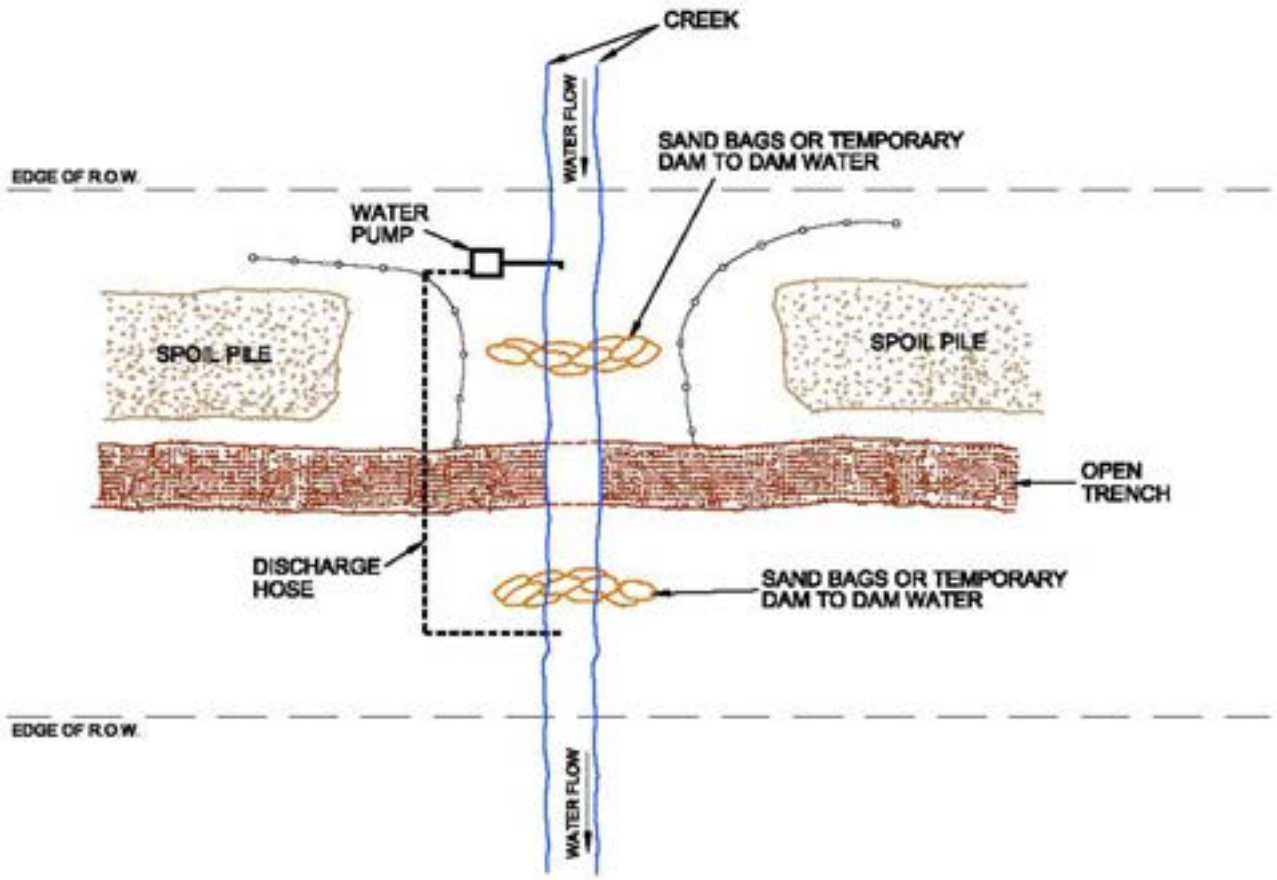
Environmental Services, Inc.

TYPICAL OPEN CUT FLOWING STREAM CROSSING FLUME PIPE



CONSTRUCTION NOTES:

1. REROUTE WATER VIA DAM AND PUMP.
2. EXCAVATE TRENCH.
3. TRENCH SPOIL SHOULD BE PLACED APPROXIMATELY 10' FROM THE TOP OF BANK.
4. RAPPS NEEDED BETWEEN SPOIL AND WATERBODY.
5. MONITOR PUMP(S) - REFUELING IN SPILL CONTAINMENT DEVICE.

TYPICAL OPEN CUT MINOR FLOWING STREAM CROSSING DAM AND PUMP

THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.

Horizon Environmental Services, Inc.

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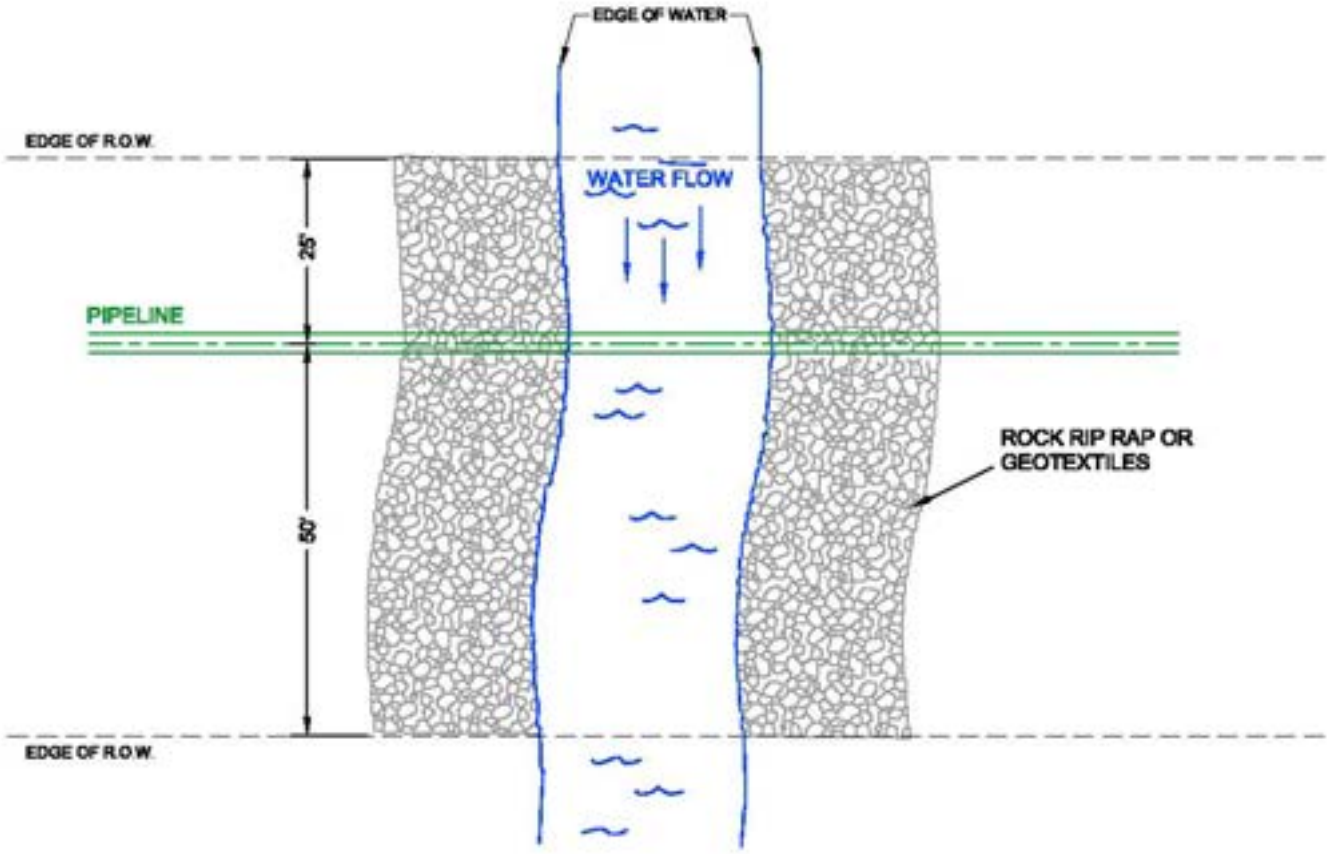
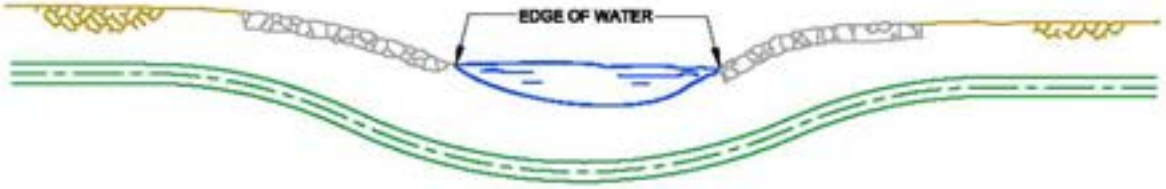


PLAN VIEW
N.T.S.



CROSS-SECTION
N.T.S.

NOTES:

1. GEOTEXTILES MUST BE SECURED.

THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.

POST CONSTRUCTION
STREAM BANK STABILIZATION

"Do Not Scale This Drawing"

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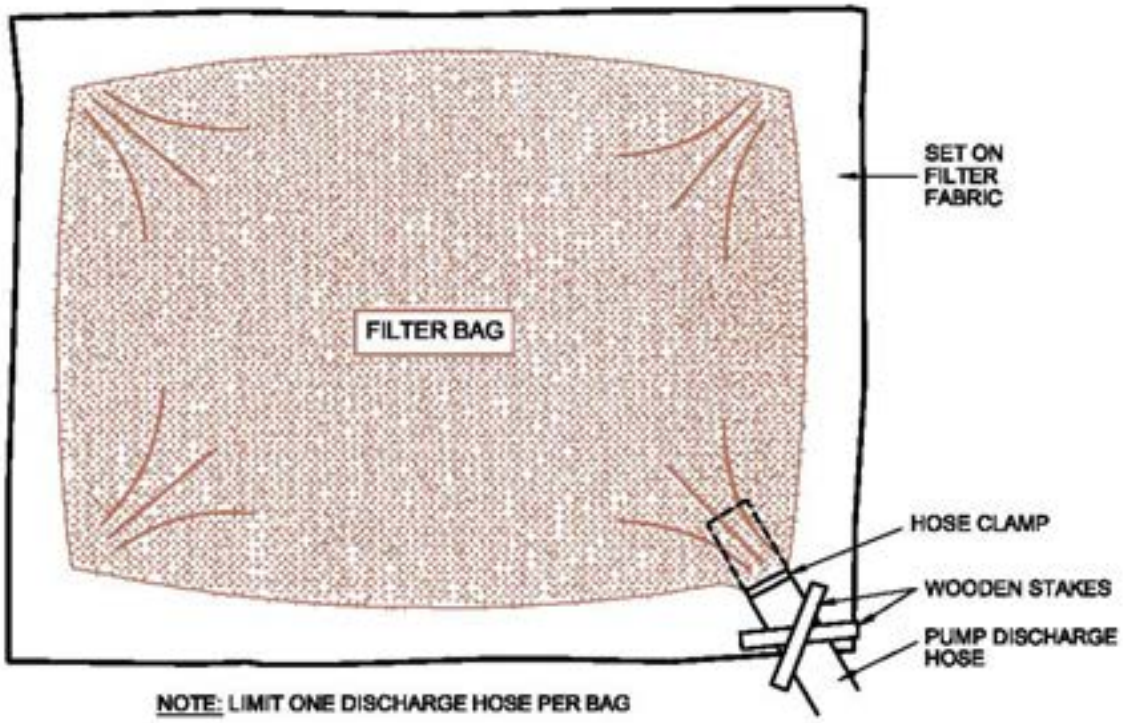
Environmental Services, Inc.



NOTE: LIMIT ONE DISCHARGE HOSE PER BAG

PLAN VIEW
N.T.S.

CROSS-SECTION
N.T.S.

CONSTRUCTION NOTES:

1. FILTER BAG SHOULD BE REPLACED WHEN SEDIMENT BUILD-UP OCCURS.

THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.

FILTER BAG DETAIL

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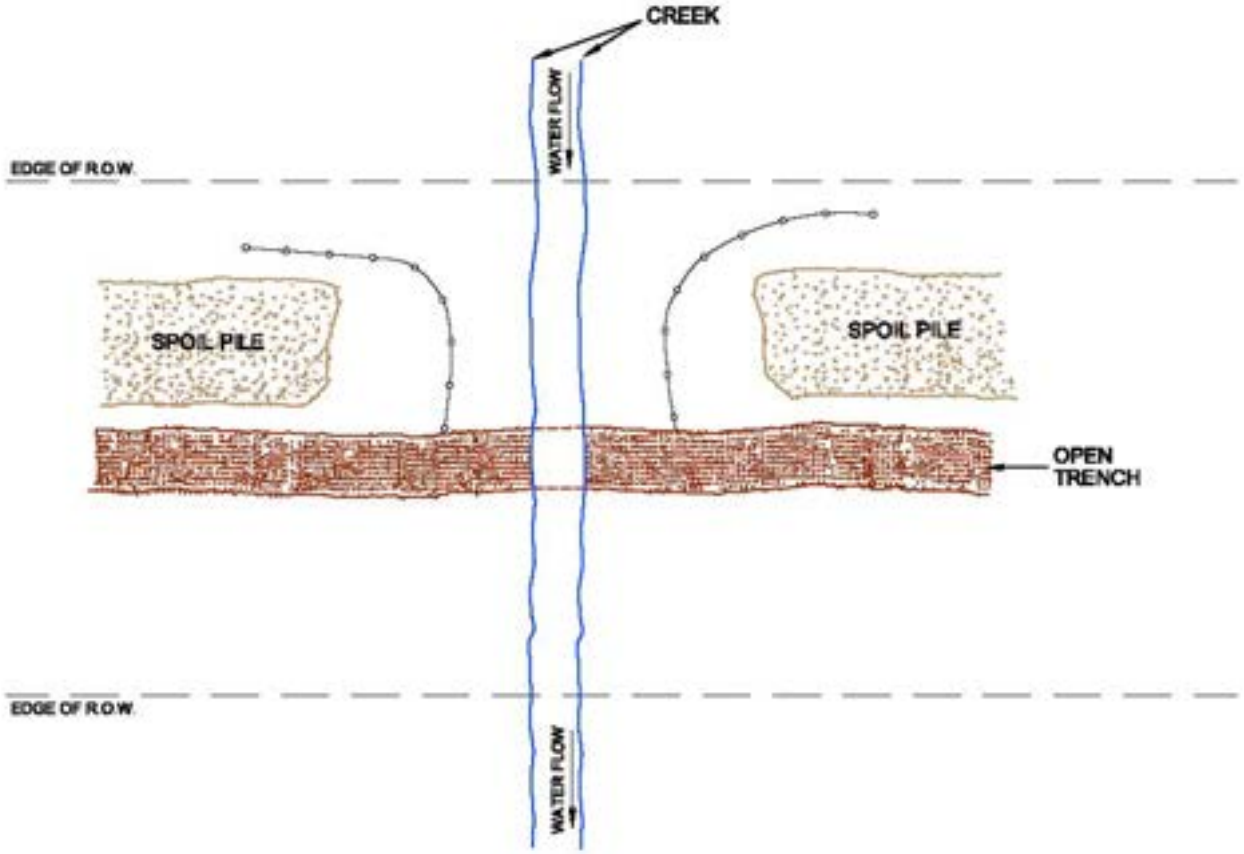
Environmental Services, Inc.



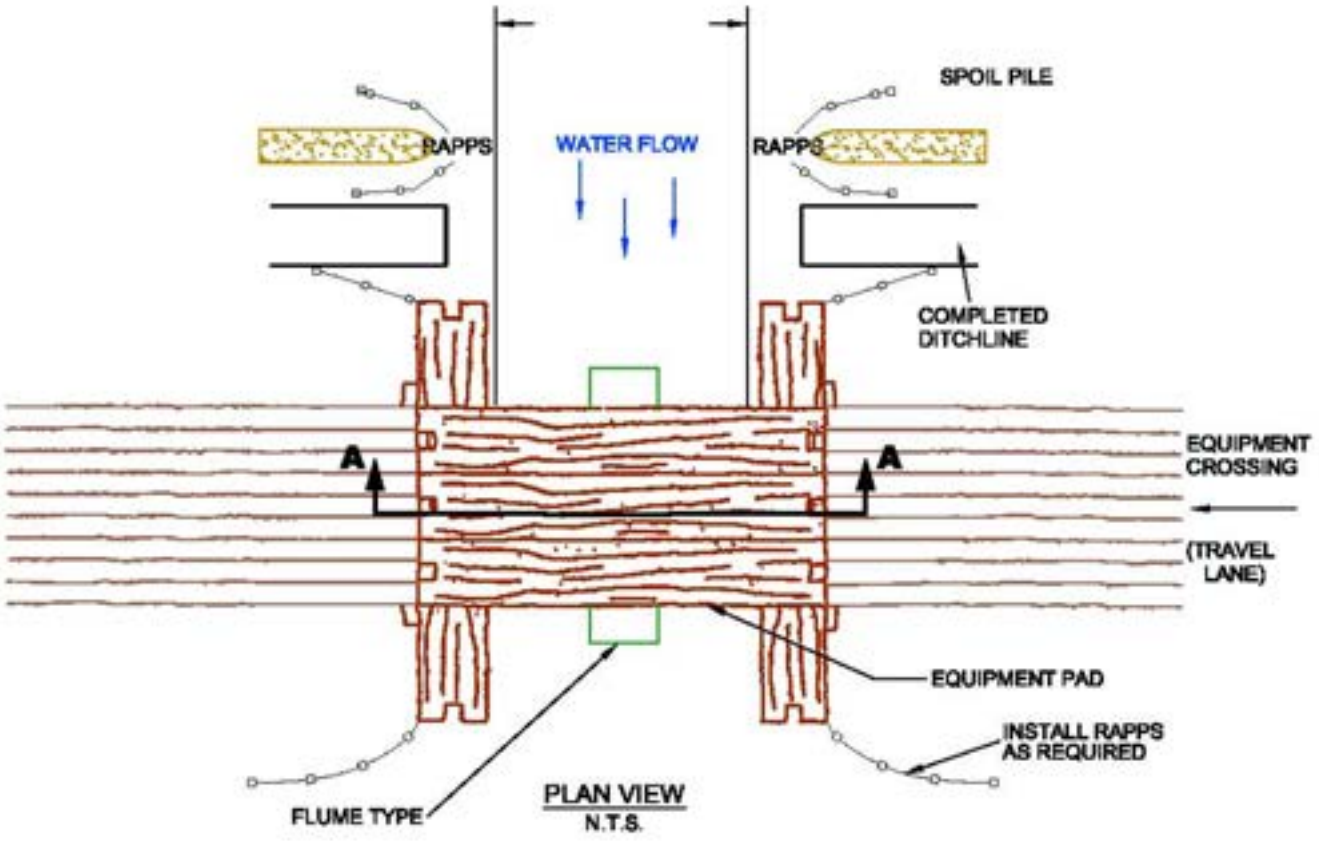
CONSTRUCTION NOTES:

1. EXCAVATE TRENCH.
2. TRENCH SPOIL SHOULD BE PLACED APPROXIMATELY 10' FROM THE TOP OF BANK.
3. RAPPS NEEDED BETWEEN SPOIL AND WATERBODY.
4. INSTALL FLUME PIPE TO CONVEY WATER FLOW, IF STREAM BEGINS TO FLOW DURING CONSTRUCTION.

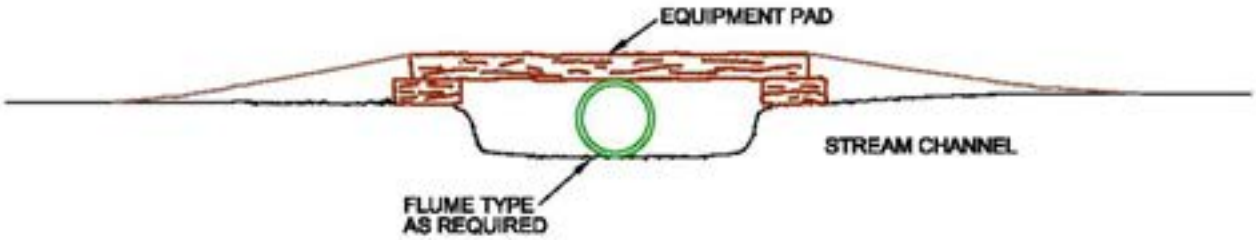
TYPICAL OPEN CUT DRY STREAM CROSSING

THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.

Horizon Environmental Services, Inc.



PLAN VIEW
N.T.S.



SECTION A-A
N.T.S.

CONSTRUCTION NOTES:

1. UTILIZE CULVERT PIPE(S) IF ADDITIONAL SUPPORT IS NEEDED.
2. ADDITIONAL EQUIPMENT PADS CAN BE PUT SIDE BY SIDE IF EXTRA WIDTH IS NEEDED.
3. EQUIPMENT PAD TYPICALLY CONSTRUCTED OF HARDWOOD. SHOULD ACCOMMODATE THE LARGEST EQUIPMENT USED.

THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.

TEMPORARY EQUIPMENT CROSSING OF FLOWING CREEK (BRIDGED)

Horizon Environmental Services, Inc.

APPENDIX C

EPA'S DEFINITION OF "WATERS OF THE US" FROM 40 C.F.R. 122.2

[Code of Federal Regulations]
[Title 40, Volume 19]
[Revised as of July 1, 2003]
From the U.S. Government Printing Office via GPO Access
[**CITE**: **40CFR122.2**]

[Page 134-141]

TITLE 40--PROTECTION OF ENVIRONMENT

CHAPTER I--ENVIRONMENTAL PROTECTION AGENCY (CONTINUED)

PART 122--EPA ADMINISTERED PERMIT PROGRAMS: THE NATIONAL POLLUTANT DISCHARGE
ELIMINATION SYSTEM--Table of Contents

Subpart A--Definitions and General Program Requirements

Sec. 122.2 Definitions.

The following definitions apply to parts 122, 123, and 124. Terms not defined in this section have the meaning given by CWA. When a defined term appears in a definition, the defined term is sometimes placed in quotation marks as an aid to readers.

Waters of the United States or waters of the U.S. means:
(a) All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;
(b) All interstate waters, including interstate ``wetlands;''
(c) All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, ``wetlands,'' sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce including any such waters:
(1) Which are or could be used by interstate or foreign travelers for recreational or other purposes;
(2) From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or
(3) Which are used or could be used for industrial purposes by industries in interstate commerce;
(d) All impoundments of waters otherwise defined as waters of the United States under this definition;
(e) Tributaries of waters identified in paragraphs (a) through (d) of this definition;
(f) The territorial sea; and
(g) ``Wetlands'' adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (a) through (f) of this definition.

Waste treatment systems, including treatment ponds or lagoons designed

to meet the requirements of CWA (other than cooling ponds as defined in 40 CFR 423.11(m) which also meet the criteria of this definition) are not waters of the United States. This exclusion applies only to manmade bodies of water which neither were originally created in waters of the United States (such as disposal area in wetlands) nor resulted from the impoundment of waters of the United States. [See Note 1 of this section.] Waters of the United States do not include prior converted cropland. Notwithstanding the determination of an area's status as prior converted cropland by any other federal agency, for the purposes of the Clean Water Act, the final authority regarding

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Clean Water Act jurisdiction remains with EPA.

Wetlands means those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Whole effluent toxicity means the aggregate toxic effect of an effluent measured directly by a toxicity test.

Note: At 45 FR 48620, July 21, 1980, the Environmental Protection Agency suspended until further notice in Sec. 122.**2**, the last sentence, beginning ``This exclusion applies . . .'' in the definition of ``Waters of the United States.'' This revision continues that suspension.\1\

\1\ Editorial Note: The words ``This revision'' refer to the document published at 48 FR 14153, Apr. 1, 1983.

(Clean Water Act (33 U.S.C. 1251 et seq.), Safe Drinking Water Act (42 U.S.C. 300f et seq.), Clean Air Act (42 U.S.C. 7401 et seq.), Resource

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Conservation and Recovery Act (42 U.S.C. 6901 et seq.))

[48 FR 14153, Apr. 1, 1983, as amended at 48 FR 39619, Sept. 1, 1983; 50 FR 6940, 6941, Feb. 19, 1985; 54 FR 254, Jan. 4, 1989; 54 FR 18781, May **2**, 1989; 54 FR 23895, June **2**, 1989; 58 FR 45039, Aug. 25, 1993; 58 FR 67980, Dec. 22, 1993; 64 FR 42462, Aug. 4, 1999; 65 FR 30905, May 15, 2000]