Kentucky Division of Oil and Gas FIELD GUIDE

BEST MANAGEMENT PRACTICES FOR EROSION AND SEDIMENTATION CONTROL OF OIL AND GAS WELL SITES

PURPOSE OF THIS FIELD GUIDE

This Best Management Practices Field Guide has been designed as a general reference manual for erosion and sediment control required by wells permitted in the Commonwealth of Kentucky. Well operators and contractors should use this guide as a reference for access road and wellsite design, construction, maintenance and reclamation for oil and gas wells.

Additional reclamation requirements are also included in the Oil & Gas Well Operator's Manual found on the Division of Oil & Gas website: http://oilandgas.ky.gov

WELL SITE RECLAMATION REGULATORY BACKGROUND

The Kentucky Division of Oil and Gas established wellsite reclamation requirements for wells permitted on severed mineral tracts pursuant to KRS 353.5901 and 805 KAR 1:170 as a result of legislative action in 1994. The Kentucky legislature enacted additional reclamation requirements to include Best Management Practices for all surface disturbances associated with oil and gas well permits issued after June 24, 2015. Well permit applications require an Operations and Reclamation Plan (ED-10) identifying proposed construction activities required in building the well access road and wellsite. In addition, the Plan also requires operators to identify BMP's to be installed or utilized on the disturbed areas for erosion and sedimentation control and proposed reclamation of the wellsite along with seed mixtures for soil stabilization.

What are BMP's?

Best Management Practice's (BMP's) are vegetative, structural or managerial practices used to prevent erosion, and sedimentation from oil & gas construction sites and control water runoff from these sites which may adversely impact waters of the Commonwealth of Kentucky. Water runoff generated from rain and snowmelt flow over the surface; a certain portion of the water percolates into the ground. During rainstorms or excessive precipitation a large portion of water runoff from oil and gas construction sites may impact waters of the Commonwealth.

Best Management Practice Segments:

- ❑ **Erosion Prevention-Erosion** is defined as **the** wearing-away of soils by the action of water and wind. **Erosion Prevention BMP's** keep the sediment in place at the disturbed site while protecting exposed soils from the wearing away effects of water and wind resulting in topsoil and sediment loss.
  - ✓ Grading Techniques
  - ✓ Vegetative Filter Strips
  - ✓ Rock Check Dams
  - ✓ Silt Fences
- ❑ **Water Runoff Control-**Identify natural drainage patterns for surface water control by diverting or conveying runoff.
  - ✓ Diversion Ditches
  - ✓ Water Bars
  - ✓ Broad-Based Dips
  - ✓ Culverts
- **Sediment Control-**A process to trap dislodged sediment particles mobilized by water. **Sediment Control BMP's** are designed to trap sediment from a disturbed

area by retarding and filtering water runoff.

- ✓ Silt Fences
- ✓ Composite Filter Socks

Erosion & Sedimentation Control Principles:

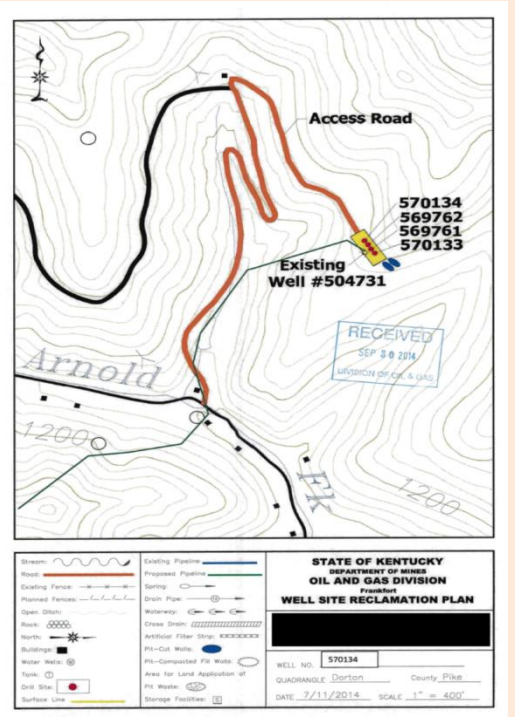
1. *Plan Erosion and Sediment Control BMP installation in conjunction with construction activities.*
2. *Controlling erosion is easier than controlling sediment.*
3. *Remember that BMPs work best when several are used in a treatment approach.*
4. *Sediment control BMPs need to have erosion control BMPs installed ahead of them or the sediment control BMPs will quickly fail.*
5. *Preserve existing vegetation wherever possible, especially trees.*
6. *Install BMP's before exposing soil and avoid exposing more soil than necessary.*
7. *Stabilize exposed soils with mulch or vegetation as soon as possible.*
8. *Reduce water velocities across well site to prevent erosive flows.*
9. *Divert runoff flowing onto your site around well site.*
10. *Monitoring and periodic maintenance of BMP's will insure compliance with reclamation requirements.*

INTRODUCTION

Each access road and wellsite has individual characteristics (e.g., topography, soils and vegetation) that must be considered in the development of **BMP's-Erosion and Sediment Control Plan**. Effective erosion and sediment control measures requires careful planning and design in addition to proper installation and proper maintenance of the best management practices. Operators should develop a **Site Specific Plan** with best management practices (BMP's) that are best suited for that proposed wellsite and area disturbed.

Considerations for the Plan include:

- Plan access road route from state or country roads to proposed well location, the route must be identified on a 1”=400’ scale map as represented below and included with the Operations and Reclamation Plan.



- Utilize existing topography to minimize erosion (Avoid steep slopes, minimize amount of disturbed area, utilize USGS 7.5’ topographic maps to determine water flow).
- Identification of all streams/waterways potentially impacted by access road and well site.
- Identify drainage patterns near access road and well site for location of culverts and ditches and determine surface water control by the location of ditches and outlets for runoff control.
- Identify locations for BMP’s installations for sediment and erosion control.

- Preserve existing vegetation wherever possible, especially trees.
- Identify karst features (i.e. sinkholes) which may be conduits to groundwater requiring BMP's installation around feature to prevent groundwater degradation.

All BMP's require routine monitoring and inspection. Periodic maintenance may be required to ensure continuous, effective operation.

This Field Guide includes:

- Erosion and sediment control practices Installation details for a wide range of Best Management Practices (BMP's)
- Photographic examples of correct and incorrect installations of BMP's
- Acceptable seed mixtures for Reclamation
- Division of Oil & Gas Inspector Contact Information

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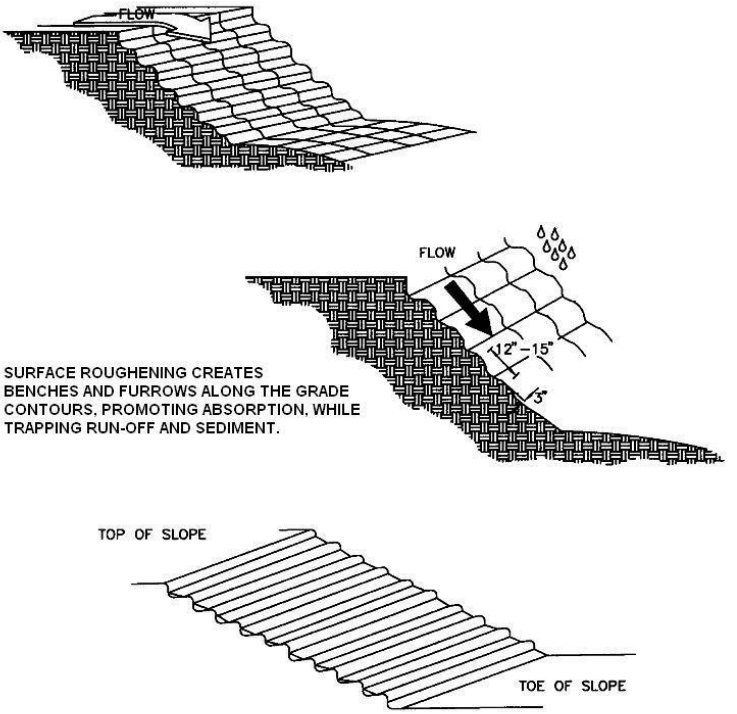
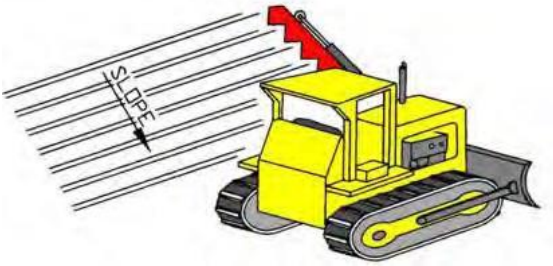
GRADING-SCARIFICATION

Surface Grading or Scarification of slope terrain is an effective erosion-grading control BMP, the process breaks up the ground and makes it more receptive to absorption. By mechanically ripping, disking, tracking, or scarifying the ground, the surface area is increased and the absorption of run-off is facilitated.



Adapted from the City of Farmington, NM SWPPP

If constructed correctly, *Grading* will create furrows and small terraces that can slow down flows, promote infiltration and capture sediment.



***Surface Roughening or Scarification*, through Mechanical modification of the soil, can be facilitated with many, varying equipment attachments. The application is similar to the harrow technique farmers use to scarify their fields. The degree or aggressiveness of the technique implemented should correspond to the steepness of the grade and soil type.**

VEGETATIVE FILTER STRIPS

Vegetative Filter Strips reduce the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow. They can also be used as permanent water quality treatment features in areas of low pollutant generation. Vegetated strips may be used downslope of all disturbed areas. Vegetated strips are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to a sediment pond. The only circumstance in which overland flow can be treated solely by a strip, without use of additional treatment, is when the following slope and reach conditions apply:

Average Slope	Slope Percent	Flowpath Length
1.5H:1V or less	67% or less	100 feet
2H:1V or less	50% or less	115 feet
4H:1V or less	25% or less	150 feet
6H:1V or less	16.7% or less	200 feet
10H:1V or less	10% or less	250 feet

The vegetated strip should consist of a minimum of a 25-foot wide continuous strip of dense vegetation with permeable topsoil.

Grass-covered landscaped areas are generally not adequate because the volume of sediment overwhelms the grass. Ideally, vegetated strips should consist of undisturbed native growth with a well-developed soil that allows for infiltration of runoff. Areas of heavy clay soils that will not support good vegetative growth do not make suitable vegetated strips. When establishing new vegetative strips, or enhancing existing vegetated areas, it may be necessary to import good topsoil and till it into the existing soil.

DIVERSION DITCHES

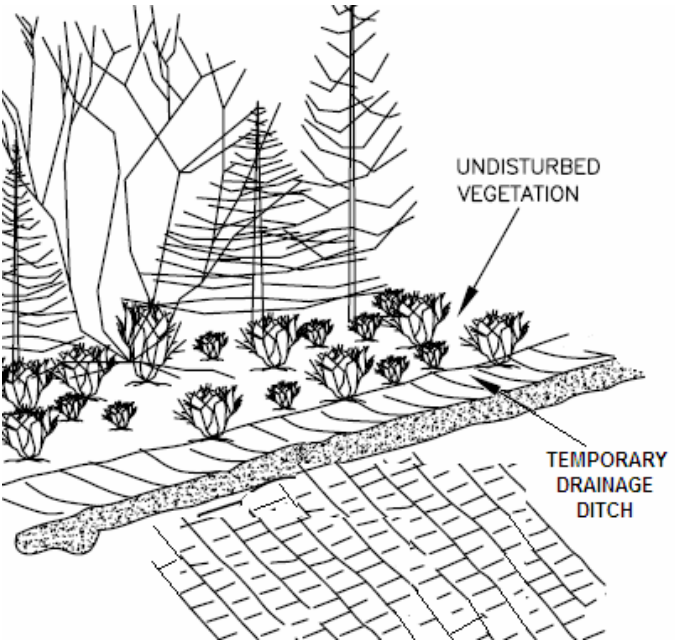
Diversion Ditches are channels constructed to divert flows around a wellsite and access road by directing flows away from areas of disturbance and into detention facilities. They function as conveyances, to direct runoff to a natural drainage area.

When diversions are constructed, they should have rounded or flat bottoms to avoid concentrating the flows at the bottom of the channel, which can lead to ditch cutting. Installation should also ensure positive drainage and include a well defined drainage system to incorporate natural drainage around the wellsite or along an access road.

Diversion Ditches should be routinely inspected to insure proper drainage of ditches. Periodic maintenance may be required to restore positive drainage especially after periods of excessive rainfall.

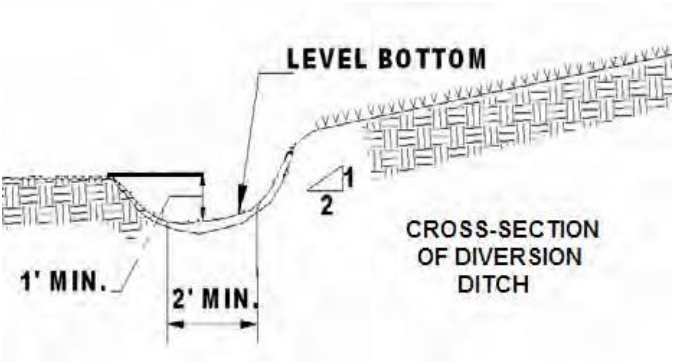
Diversion Ditches may be constructed in conjunction with an Earthen Berm. The addition of a compacted Earthen Berm will increase the capacity of the ditch and prevent the feature from being overwhelmed or by-passed.

Diversions installed during construction may transition to permanent roadside ditches or drainage swales. In this scenario, it may be advantageous to work the feature to completion, i.e. grass or rock lined swale, rip rap run down, concrete pan, etc. By working the feature to its final disposition, the operator will avoid implementing transitional BMP’s and the costs associated with their maintenance.



Adapted from Clean Water Services

Diversion Ditch **used to intercept run-on, above a graded slope.**



Adapted from Louisville MSD

A well constructed *Diversion Ditch* will convey flows within the feature without erosion.

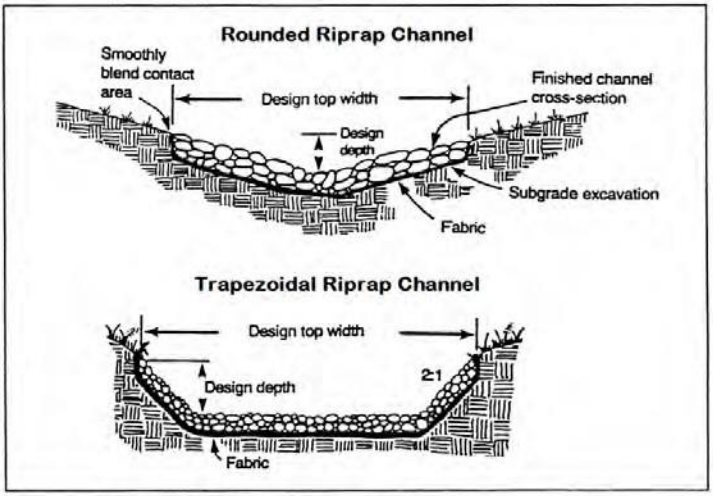
ROCK LINED SWALES

Diversion Ditches, Drainage Swales and Roadside Ditches are prone to erosion when carrying flows. It is a natural by-product of their function of carrying concentrated flows. Lining the conveyance with a rock layer can prove to be valuable for preventing erosion in the ditch bottom.

Rock will spread-out and diffuse the flow energy, thus controlling cutting in the swale. This is realized by forcing the flows higher, above the grade, and outward along the width of the swale. The volume of flows in the conveyance will help to determine rock size for optimal performance. The fabric layer will prevent scour under the rock.

Over time, every storm water conveyance will exhibit ditch cutting; damaging the feature and transporting sediment.

Rock is a good stabilizer for temporary or permanent run-downs, ditches, swales and channels.



Typical riprap-lined channel cross-sections.

Adapted from NC Dept. of Health and Natural Resources, BMP Field Manual

Channel armoring installation for defusing flows within the conveyance feature for erosion control.

SLOPE DRAINS

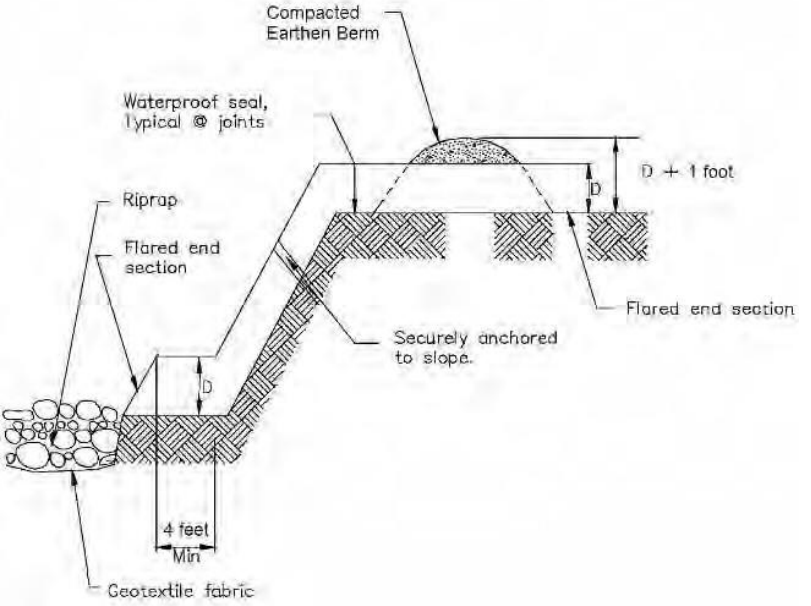
Managing site drainage on oil and gas sites that have steep grades can be challenging. With no controls in place, gravitational forces will concentrate runoff down these embankments, resulting in gully erosion. Subsequent storm events will quickly elevate the surface erosion to property damage.

Installing temporary Slope Drains (also referred to as Embankment Protectors) allows the operator to determine where and how runoff will be conveyed down a grade. The Slope Drain is often a pipe, which functions as a conduit for storm water, to prevent erosion on the slope, whether the grade consists of exposed soils, is newly seeded or is blanketed.

Slope Drains are typically installed in conjunction with other drainage features, such as ditches, to direct the runoff to the pipe. This can help to complete the process of keeping runoff away from work areas and focusing it where the operator wants it to drain.

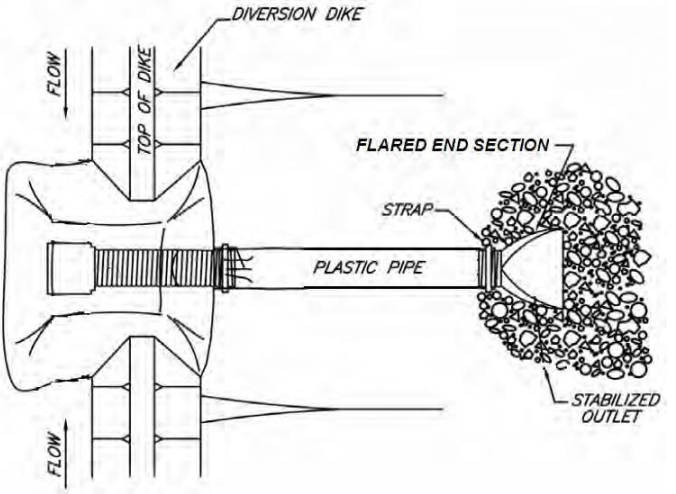
Installation for Slope Drains will include outfall protection to prevent scour, as there will be a concentrated flow with the point source discharge at the end of the feature. Outfall protection can be rip rap or a rolled erosion control product. If piping is used for the Slope Drain, the sections need to be tightly adjoined and adequately secured to prevent by-pass or displacement.

Inspections for Slope Drains should ensure on-going function: piping is intact and in place, run-off is being diverted to the feature, no accumulations of debris risk clogging the pipe, flows are being conveyed down the grade and there is no erosion at the outfall.



Adapted from Cal Trans Div of Construction

Slope Drain installation for safely conveying runoff down a grade without impacting the slope.



Adapted from Portland, OR Erosion Control Manual

Slope Drains can function effectively for conveying flows down an un-stabilized grade.

Adequate outfall protection is required at the termination point to prevent scouring.

ROCK CHECK DAMS

Ditches, channels and swales used to convey stormwater runoff can be impacted by erosive flows. Flows that are allowed to run unchecked in these features can rapidly erode the feature. If these features are not stabilized with a liner, or vegetation, **Rock Check Dams** can be installed to provide erosion control.

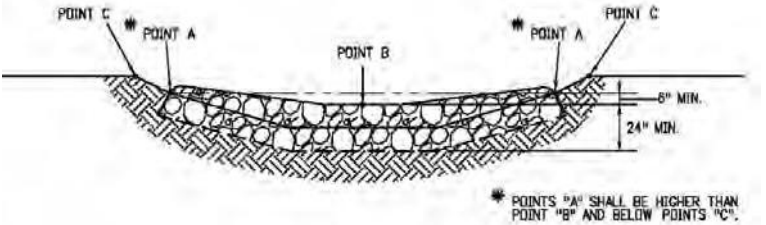
The function of the Rock Check Dam in a storm water conveyance is to slow and spread the flow out to prevent erosion. This is accomplished by spreading out and breaking up the erosive velocity of the flow, allowing the flows to pass through or over the feature at a slower rate. The contour of the conveyance is equally important. The ditch bottom should be flat or rounded to promote a thinner layered or more laminar flow.

Many styles of Check Dams (constructed or prefabricated) can perform adequately. Silt Fencing, and other BMP's that do not function in concentrated flows, cannot perform as Check Dams. Features that have a tendency to pond large volumes of runoff should also be avoided.

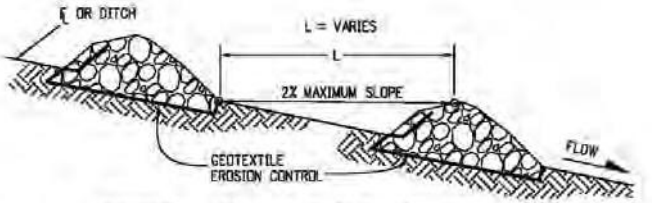
Installation of Check Dams will include trenching in the feature below grade (to prevent undermining), appropriate spacing (to prevent the flows from regaining erosive velocity) and keying into the adjoining grade/embankment (to prevent bypass around the ends).

Inspections should verify the Check Dam has not been damaged, or bypassed. Maintenance practices, including the removal of sediment and debris, should ensure on-going performance and allow flows to pass through and over the feature.

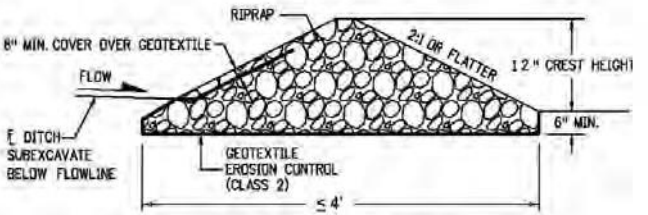
Rock Check Dams **may also include other sediment control features such as hay bales for water flow control as represented below.**



TYPICAL SECTION VIEW



SECTION VIEW ALONG DITCH FLOWLINE



SECTION DETAIL

NOTES:
1. RIPRAP SIZE D_{50} = 6" OR AS SHOWN ON THE PLANS.
2. THE ENDS OF RIPRAP CHECK DAM SHALL BE A MINIMUM OF 6 IN. HIGHER THAN CENTER OF CHECK DAM.

ROCK CHECK DAM

Adapted from Colorado DOT M-Standards

Rock *Check Dams* will intercept, spread out and slow flows in ditches and swales, preventing ditch cutting and scour. *Check Dams* are not recommended for larger drainage areas or steep grades.

Correctly installed rock *Check Dams* will allow flows through and over the feature without bypass or undermining.

SILT FENCES

Silt Fences are sediment barriers that allow water to pass through but trap soil and other debris. **Silt Fences** are composed of geotextile mesh material supported by stakes installed down-slope of disturbed areas on the contour and up-slope of streams or environmentally-sensitive areas.

Silt Fencing acts as a barrier and intercepts sediment-laden runoff and impounds it, until it infiltrates, evaporates or weeps through the fabric. Silt Fences are not designed or intended to function as a filter, because very little runoff will actually discharge through the fabric.

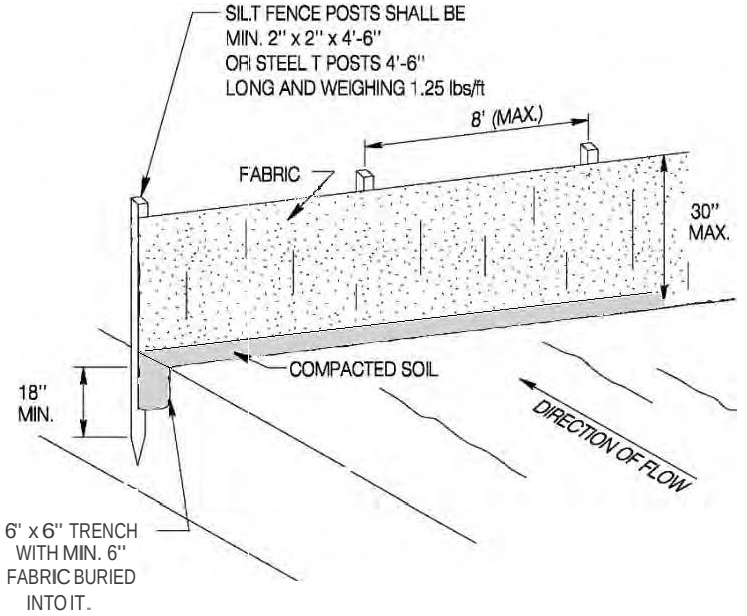
Silt Fencing has many limitations that must be carefully evaluated prior to installation. Understanding these limitations will help to determine if it is the appropriate BMP for the site conditions and ensure that it can be sited correctly for maximum performance.

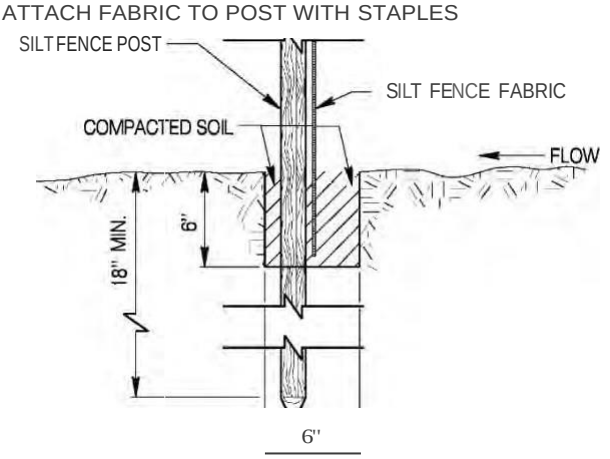
Silt Fencing can <u>not</u>:

- Function in concentrated flows
- Manage large drainage areas alone
- Perform unless installed along the grade contour
- Work well installed right at the toe of a slope

Silt Fence functions in limited drainage areas, typically no more that ¼ acre of disturbance discharging to 100 linear ft. of fencing (if Silt Fencing is the only BMP to manage the area).

Silt Fencing has several key installation details that must be followed. Once installed, it can be a high cost BMP to maintain in place. It performs best, when used in conjunction with other BMP's.





Adapted from WYDOT Temp. Erosion Control Measures

Silt fences **are typically located between access roads and streams for sediment barrier to streams and waterways.**

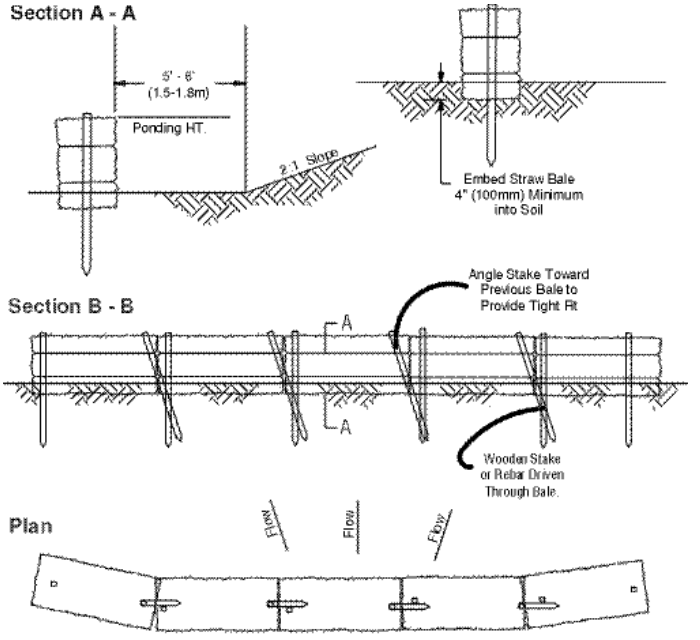
Silt Fencing must be properly anchored in the ground to function properly as a sediment barrier.

***Silt fences* cannot be located in an area of concentrated flow, the sediment typically overwhelms the fence when improperly located.**

A **Super Silt Fence** is a geotextile fabric barrier attached to a chain link fence with wire ties or staples and used to intercept sediment-laden runoff from areas too large for regular silt fences.

STRAW BALES

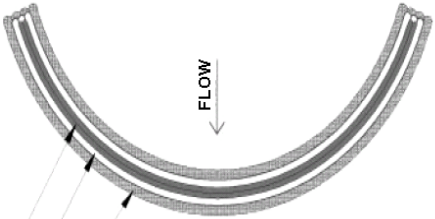
Straw Bales can function as a sediment control BMP for small drainage areas preventing sediment from leaving the site. Straw bales typically are used for short periods (less than 3 months) and work best for sheet flow and not in areas of concentrated flow such as channels or gullies. All bales shall be wirer-bound or string-tied lengthwise on the contour and entrenched and back-filled to maintain stability. Each bale shall be anchored with at least 2 stakes placed at a depth to secure the bales.



NOTES:
1. The straw bales shall be placed on slope contour.
2. Bales to be placed in a row with the ends tightly abutting.
3. Key in bales to prevent erosion or flow under bales.

COMPOSITE FILTER SOCKS

Composite Filter Socks are compost inserted into a flexible, permeable tube and placed perpendicular to sheet flow to control erosion, retain sediment and reduce runoff velocity. The filter components allow a portion of water to pass through while also trapping sediment.



12" DIAMETER SOCK

18" DIAMETER SOCK

24" DIAMETER SOCK

1. Compost Sock Sediment Trap shall be sized to provide 2,000 cubic feet of storage capacity for each acre tributary to the trap.
2. Minimum base width is equivalent to the height.
3. Sediment accumulation shall not exceed 1/3 the total height of the trap.
4. Socks shall be of larger diameter at the base of the trap and decrease in diameter for successive layers as indicated to the left.
5. Ends of the trap shall be a minimum of 1 foot higher in elevation than the mid-section, which shall be located at the point of discharge.

Composite socks can be placed along perimeter of sensitive properties or dwellings such as cemeteries:

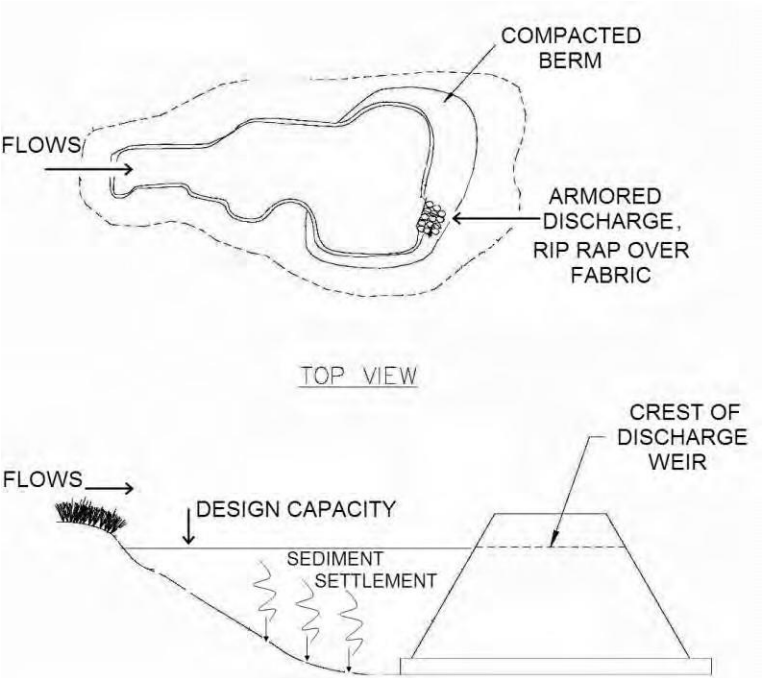
Filter socks **may also be placed along access roads for sediment and sheet runoff control.**

Straw waffles **are similar to filter socks and serve similar functions.**

SEDIMENT TRAPS AND BASINS

Sediment Traps are temporary or permanent dam or basin used to collect, trap, and store sediment produced by construction activities, or as a flow detention facility for reducing peak runoff rates. Sediment traps are used during site development to manage water quality as well as quantity, for drainage areas. The maximum acreage that a sediment trap is designed to handle is five (5) acres. Sediment traps can be designed to maintain a permanent pool or to drain completely dry. Either way, the trap detains sediment-laden runoff long enough to allow most of the sediment to settle out. A sediment basin can be constructed by excavation or by placing an earthen embankment across a low area or drainage swale. The pond has a riser and pipe outlet with a gravel outlet or spillway to slow the release of runoff and provide some sediment filtration. Functioning as sediment removal BMP's, traps will impound diverted flows and allow heavy particles to settle out.

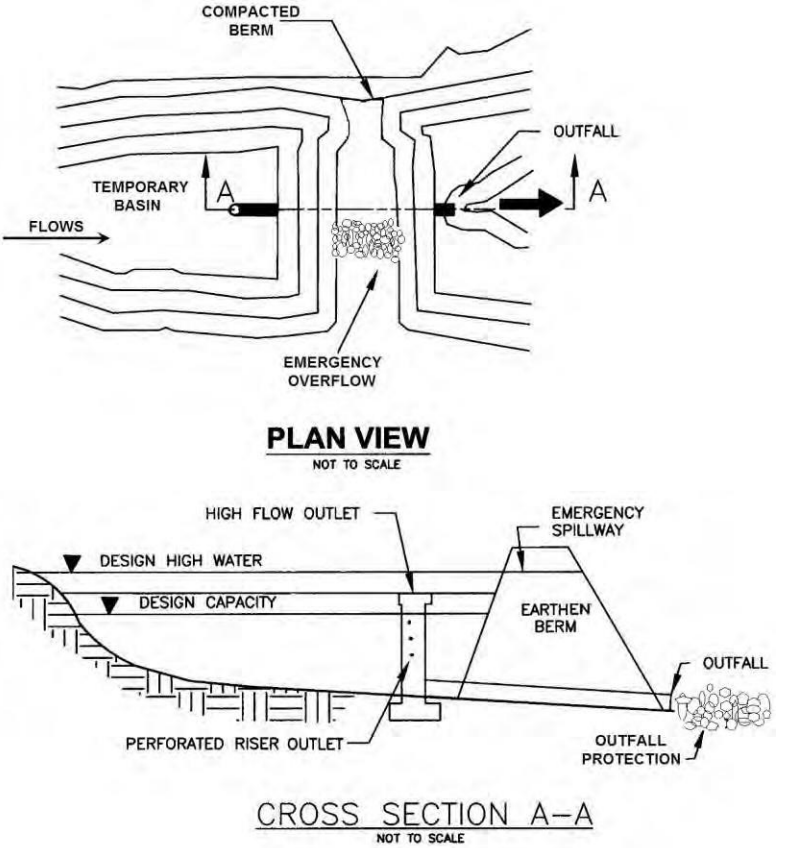
As entrapment facilities, traps can also help manage site drainage by providing temporary storage for run-on and run-off. Along with Sediment Basins, Sediment Traps are often the termination point for Diversions Ditches.



Sediment trap Schematic Diagram
Adapted from Cal Trans Division of Construction

Sediment Basins are somewhat larger than traps, typically larger than five (5) acres but the construction approach is similar. Sediment basins usually have more spillway protection because of their larger flows.

Sediment basins typically have risers and outlet pipes rather than rock spillways to handle the larger flows.

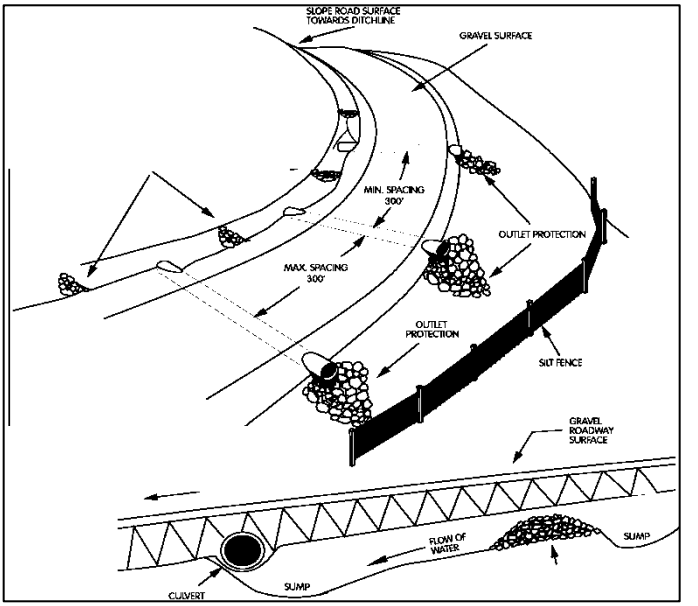


Sediment Basin Schematic Diagram
Adapted from: Farmington, NM Construction Standards

Adapted from: FLA Stormwater Manual

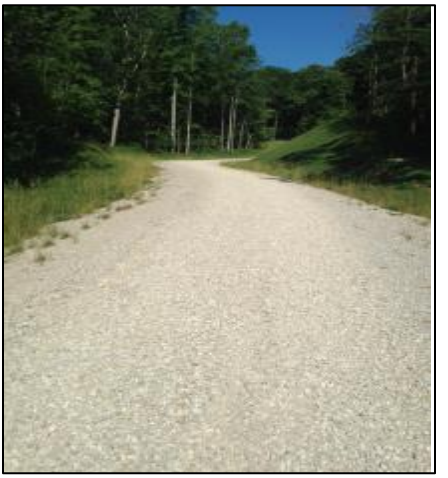
ACCESS ROAD CONSTRUCTION AND MAINTENANCE

The **Access Road** (including all disturbed areas) shall be graded and stabilized so that soil erosion, surface disturbances and stream sedimentation is minimized utilizing BMP's in accordance with the Operations and Reclamation Plan (ED-10).



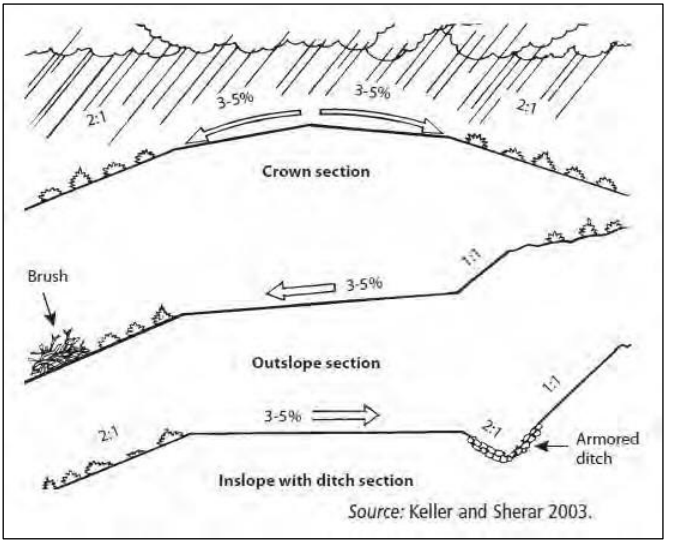
Adapted from WV Erosion Control Manual

The road shall be constructed and maintained in such a manner as to prevent settlement of the roadbed or slides of the cut slopes. Additionally, the road shall adequately provide traffic conveyances as well as storm water runoff conveyances. Temporary erosion control measures shall be implemented



during construction of the road to minimize sedimentation until permanent control measures including seeded and mulched road ditches can be established.

Access roads shall have surface drainage BMP's to accept runoff and prevent impacting surface owner's property, roads or farming operations and buildings. Access roads should be crowned with a minimum width of 12-14 feet and kept below 20% grade and stabilized with compacted soil, crushed stone, aggregate or gravel and include diagonal water bars, broad-based dips, side drainage ditches and culverts within natural drainage to control runoff and prevent erosion.



Source: Keller and Sherar 2003.

Poorly constructed and maintained *access road* with little or no runoff diversion results in access roads developing deep ruts or channels which will eventually make the road impassable.

If the well(s) are productive and the access road remains open for active use; the road must be maintained in accordance with the Operations and Reclamation Plan and perform remedial repairs following floods, landslides or excessive settlement.

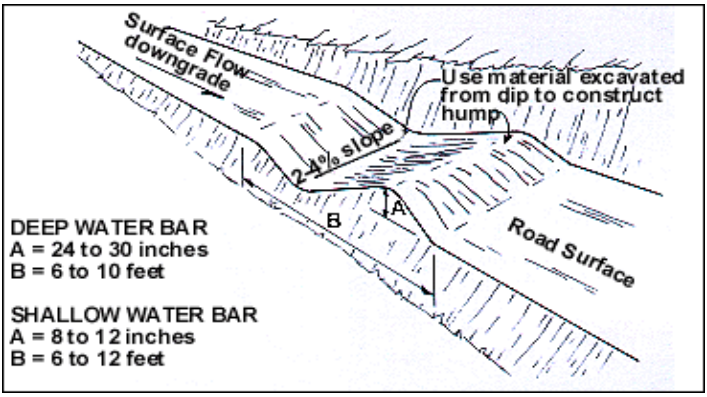
WATER BARS

Water Bars (cross drains) are a common practice to divert surface runoff water from the access road. Water bars are small open ditches about 8 inches deep and 2 feet wide cut across the roadway with a bulldozer blade.

Road Grade (%)	Distance Between Water Bars (ft.)
1	400
2	250
5	135
10	80
15	60
20	45

Water bars are typically spaced on the access road slope, see table to the left.

Water bars are channels constructed diagonally across access roads to divert water runoff.

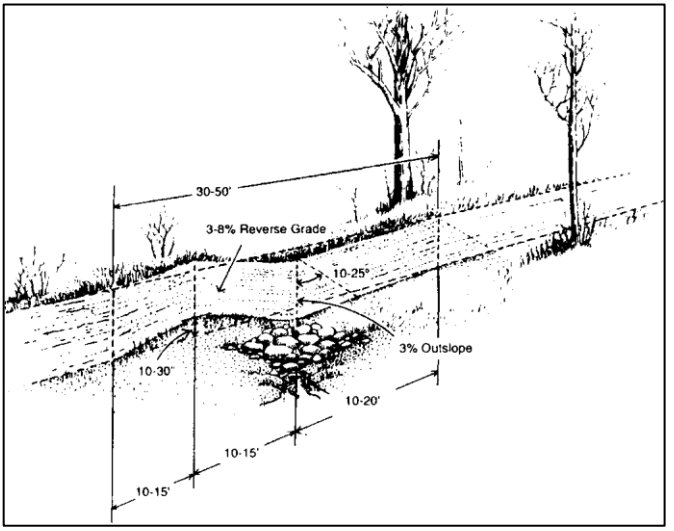


BROAD BASED DIPS

Broad-based dips are constructed dips across an access road sloped to the out-slope for drainage of the access road surface.

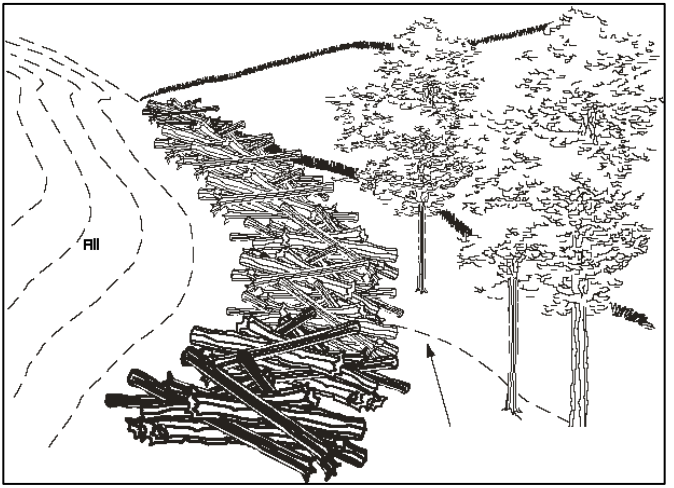
Road Grade (%)	Distance Between Dips (ft.)
2	300
4	200
5	180
6	165
8	150
10	140

Spacing of the broad-based dips is a function of the road grade; the steeper the slope, the shorter distance between dips. Refer to the table to the left for broad-based dip spacing based on road grade.


30-50'
3-8% Reverse Grade
10-25'
3% Outslope
10-30'
10-20'
10-15'
10-15'

BRUSH PILES-RIP RAP

Brush Pile-Rip Rap is stacked timber cut during site construction and stacked in an arranged layer for slope protection and dissipation from runoff as well as sediment control. The material can also be used for outlet protection reduces the speed of concentrated stormwater flows, thereby reducing erosion or scouring at stormwater outlets.

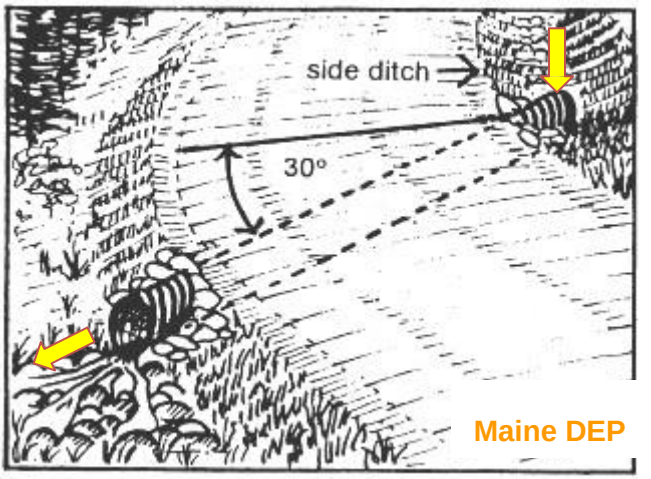


CULVERTS

Culverts are installed for surface water runoff management from ditches and under access roads at natural drainage or stream crossings. Culverts will limit the volume of flows conveyed down a ditch, thus controlling erosion within the road-side ditch.

Use Culverts when good point source discharge zones are available. Best case scenario, the discharge zone for culvert piping will be similar to that of the Ditch Turn-Out, relatively flat and vegetated. Vegetation is always important; however other BMP's can be implemented for conveying concentrated flows down steep slopes and over areas of poor vegetation. These would be the instances for considering a stabilized (rock or lined) run-down or Slope Drain.

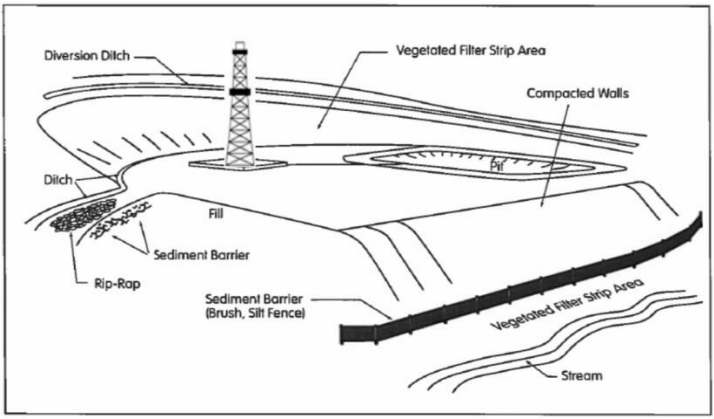
Maintenance should ensure good flow, no erosion at either end and no obstructions or blockage from debris or sediment accumulations.



Culverts should be set at an angle 30-35 degrees downslope from a line perpendicular to the road's centerline. Culverts set on an angle improve their hydraulic efficiency and lessen erosion at the inlet.

Culverts **that discharge to steep, un-vegetated areas require a lined or stabilized run-down (outlet) to dissipate water energy and preventing surface erosion.**

WELLSITE CONSTRUCTION



Well site design should be done to minimize the amount of area disturbed and size of the area to accommodate equipment and production facilities. A BMP approach should be formulated for the sequence of major site development activities. The wellsite shall be constructed on a stable base and all cuts and fills shall have side slopes that are stable for the soil or fill material. If possible, all topsoil present in the area to be disturbed

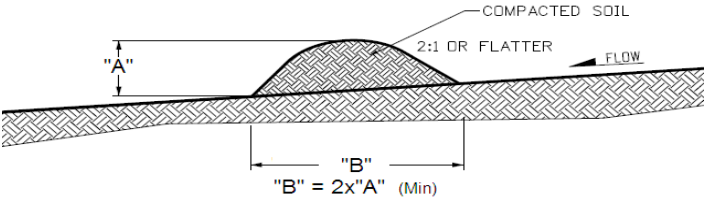
shall be removed and segregated for redistribution during reclamation. All trees greater than six (6) inches in diameter should be cut and logs stacked for use as rip rap or for use by the landowner. Earth moving and grading operations should be done in a manner to prevent impact of any streams down-slope of the wellsite.

Trenching or benching of high-walls shall be done to prevent excessive erosion from excavated areas. Surface water runoff control measures should be installed after well site has been prepared. Following well completion the well site shall be stabilized with native species vegetation, a listing of those seed mixtures are located on pages 49-51. Construct roadside and diversion ditches to control runoff from access roads, wellsite and other disturbed areas which may interfere with surface owner's property.

Although not required, a gate may be installed to at the entrance to the access road to prevent access to the well site from ATV and off-road vehicle traffic.

DIKES-BERMS

Earthen berms for produced fluid storage facilities should be constructed of compacted material and sufficient size to contain all contents of tanks inside the berm area.



TEMPORARY BERM

NOTES:

1. BASE WIDTH WILL BE DETERMINED BY HEIGHT. HEIGHT WILL BE DETERMINED BY SIZE OF DRAINAGE AREA.
2. BERMS WILL FUNCTION TO INTERCEPT FLOWS AND IMPOUND THEM
3. BERMS WILL BE USED FOR LIMITED DRAINAGE AREAS, NOT TO EXCEED 1/4 ACRE FOR EVERY 100 LINEAR FEET OF BERM

Adapted from Colorado DOT M-Standards

50 bbl. polyurethane tanks in *earthen berm*

Concrete dikes **are also an acceptable method of containment production facilities.**

DRILLING PITS

Drilling Pits shall be constructed on the cut, or high-wall side in a stable area (non-fill) of the well site and large enough to accommodate all drilling and completion fluids. The pit must allow for adequate freeboard (minimum 2 feet) during heavy rainfall. The pit should be lined with an impermeable liner of sufficient thickness to contain all fluids. Surface water must be diverted from the pit. Steel pits are an acceptable alternative to earthen pits.

Following completion the pits shall be closed in accordance with all state and federal regulations and the liner folded inward and backfilled.

Properly lined pit with anchored liner.

***Pits* are not to be used for trash disposal or discarded oil or grease containers.**

GATHERING LINE CONSTRUCTION

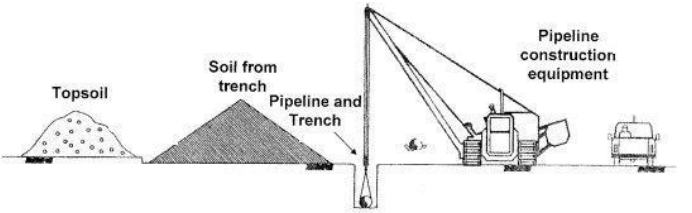
Gathering Line installation and reclamation of disturbed areas shall be conducted in accordance with the Operations and Reclamation Plan (ED-10) on file with the Division of Oil & Gas.

Pursuant to 805 KAR 1:190

(1) If a gathering line crosses agricultural lands, the operator shall segregate topsoil while trenching, and trenches shall be backfilled so that the soils are returned to their original relative positions and contour, unless waived by the surface owner. This requirement to segregate and backfill topsoil shall not apply to trenches that are twelve (12) inches or less in width.

(2) On agricultural lands and nonagricultural lands, gathering line trenches shall be maintained in order to correct trench subsidence and reasonably minimize erosion. Interim and final reclamation, including re-vegetation, shall be performed in accordance with the Operations and Reclamation Plan.

In non-agricultural areas, or if conditions prevent burial the line may be ran on the surface.



VEGETATION

Vegetative cover for all disturbed areas is vital to deter surface erosion and maintain a stable wellsite during the productive life of a well.is regarded as the most powerful deterrent for surface erosion. The well operator must establish vegetation using approved seed mixtures found on subsequent pages. Focusing on this aspect of erosion control strategy of quickly establishing vegetative growth on disturbed areas is a powerful planning BMP.

Permanent seeding should be implemented on areas of disturbance as soon as they are completed and can be made available. It is not economically wise to wait until the end of development to implement the seeding program. More revenue can be expended installing and managing BMP's in areas with no work, then implementing final stabilization.

Many factors will impact the planning and execution of *Seeding*. Important considerations:

- Native to the region/elevation
- Soil type, grade and access
- Time of year, weather patterns
- Drainage patterns (concentrated or sheet)

Temporary Seeding

Areas that will be dormant, or that may not be fully readied for final stabilization, may be candidates for *Temporary Seeding* applications. This technique can provide interim erosion control and control costs associated with repairing grades damaged by surface erosion. Choices for Temporary Seeding may include the use of annual or perennial seed mixes and full mulch cover.

EROSION CONTROL BLANKETS

The function of **Erosion Control Blankets** is to provide cover and moisture for newly seeded areas. If some means of cover is not provided, seed beds will be vulnerable to wind and surface erosion. Moisture retention in the blankets will also promote germination.

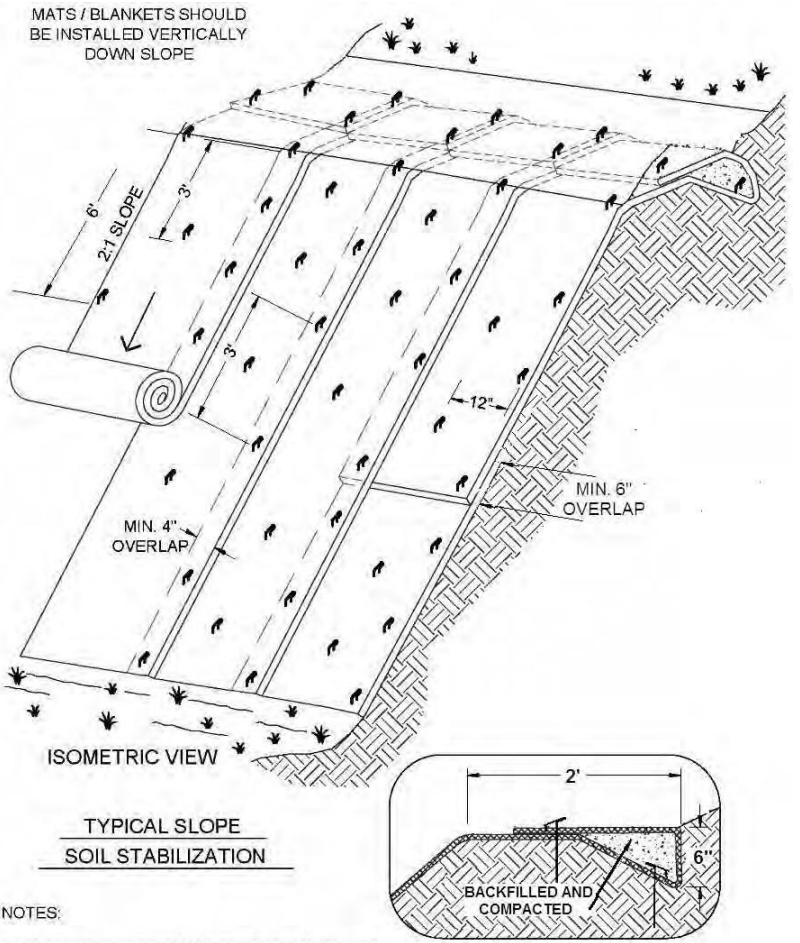
Blankets are routinely selected for applications that require more resilient and longer term protection than may be expected from other, mechanically installed applications (such as straw or hydro-mulch).

A wide-range of styles, composition and thicknesses are available for the installer to choose from. In order to determine the correct grade of blanket, site conditions/characteristics must be evaluated. These include the “Five S’s”:

- Soil type
- Slope steepness and length
- Seed type, and number of years to yield established growth
- Season; projected precipitation or irrigated
- Sheet flow application, or concentrated flow

Correct installation will include; soil preparation, good soil contact, proper staking/pinning, overlapping, anchor slot, check slots and correct orientation.

Blanket maintenance can be relatively minor, if the correct grade of blanket has been selected for the application and it is installed correctly. However, they still require routine inspections to verify they demonstrate integrity, are intact and can continue to function until vegetative cover is established.



TYPICAL SLOPE
SOIL STABILIZATION

NOTES:

1. SLOPE SURFACE SHALL BE FREE OF ROCKS CLODS, STICKS AND GRASS. MATS / BLANKETS SHALL HAVE GOOD SOIL CONTACT.
2. APPLY PERMANENT SEEDING BEFORE PLACING BLANKETS.
3. LAY BLANKETS LOOSELY AND STAKE OR STAPLE TO MAINTAIN DIRECT CONTACT WITH THE SOIL. DO NOT STRETCH.

Adapted from Oklahoma City, OK SWQ Standards

Erosion Control Blankets **must be installed running in the direction of the flow and adequately secured down. Good soil preparation, prior to placement, will prevent tenting or voids under the blanket.**

A good Erosion Control Blanket installation can provide long-term erosion control, seed-bed protection and promote germination.

WELLSITE CLOSURE & FINAL RECLAMATION

The Division of Oil & Gas shall consider the wellsite to be closed **only** after:

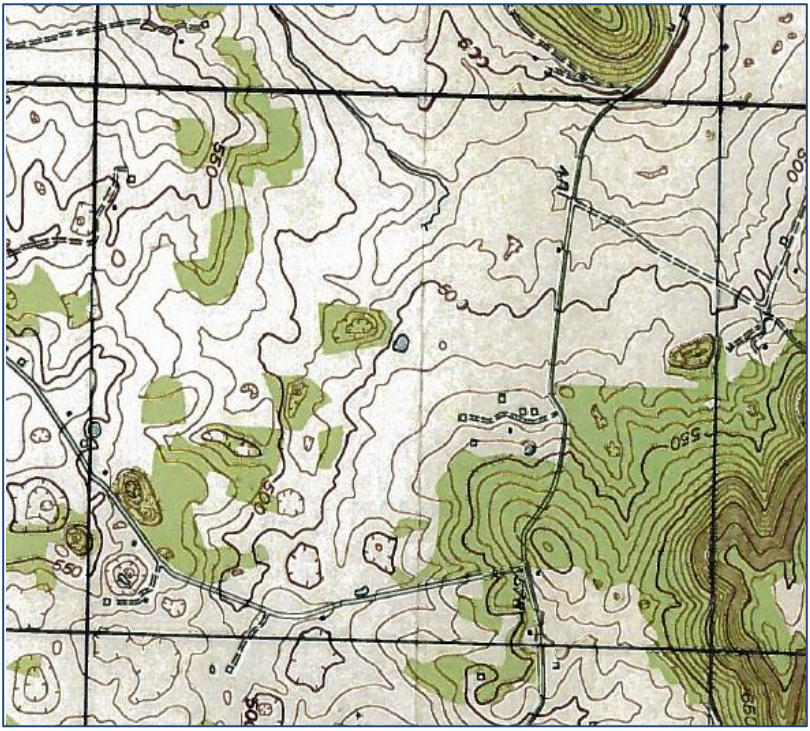
- ❑ All surface production facilities have been removed
- ❑ The well(s) have been plugged under the direction of a Division inspector, a listing of inspectors is included on pages 52-53.
- ❑ Written notice has been provided by the well operator to the Division that final reclamation and site closure has been completed and final reclamation conforms to the Operations and Reclamation Plan.

The Division inspector will then inspect all disturbed areas one (1) year after receipt of the letter of notification from the operator. The inspector will document that all disturbed areas have been secured in a manner to prevent runoff, sedimentation or settlement of the access road or sliding of cut slopes or any fill material.

In addition, the inspector will verify diverse and effective permanent vegetative cover has also been established on the disturbed areas in accordance with the Operations and Reclamation Plan.

BMP'S IN KARST REGIONS

South-central Kentucky surface geology consists of Mississippian-age limestone. The limestone is subject to interaction with water creating instability in the limestone creating karst topography. Common karst features include sink holes which can be conduits to groundwater. Consequently sinkholes need to be identified prior to site construction and isolated from disturbed areas by installing silt fences around the sink hole. *Sinkholes* are identified on topographic maps as closed contours with hachures as evident on the map below**.**



RECOMMENDED HERBACEOUS MIXTURES FOR REVEGETATION OF OIL AND GAS WELLSITES IN KENTUCKY	
Perennial ryegrass	10
Annual ryegrass	5
Weeping lovegrass (after April 1)	2
Summer-May 15 to August 1	
Orchardgrass	10
Kobe lespedeza	15
Red clover	4
White clover (Birdsfoot trefoil)	1 (6)
Alfalfa	12
Add one (1) of the following quick cover species to the permanent summer seeding mixture:	
Sorghum	20
Foxtail (German) millet	12
Japanese millet	15
Soybeans	40
Cowpeas	40
Pearl millet	10
31 Tall Fescue	20
Fall – August 1 to October 1	
1. Orchardgrass	10
White or Ladino clover	2
Red clover	6
2. Orchardgrass	10
Alfalfa (Birdsfoot trefoil)	15 (8)
Red clover	6
3. 31 Tall fescue	20

RECOMMENDED HERBACEOUS MIXTURES FOR REVEGETATION OF OIL AND GAS WELLSITES IN KENTUCKY (cont.)	
4. Deertongue	12
Birdsfoot trefoil	8
Red clover	6
Add one (1) of the following quick cover species to the selected permanent fall seeding mixture:	
Winter wheat	30
Balbo rye or Winter rye	30
Winter oats	32
Perennial ryegrass	10
Annual ryegrass	5
Mixtures for West or Poorly Drained Areas and Pond Borders:	
Spring-February 15 to May 15	
Japanese millet	10
Redtop (Reed canarygrass)	3 (15)
Alsike clover	4
31 Tall fescue	20
Common annual lespedeza (quick cover species)	10
Fall – August 1 to October 1	
Redtop	3
Reed Canarygrass	15
Alsike clover	6
31 Tall fescue	20
Common annual lespedeza (quick cover species)	10

RECOMMENDED HERBACEOUS MIXTURES FOR REVEGETATION OF OIL AND GAS WELLSITES IN KENTUCKY (cont.)	
Mixture for Areas to be Stocked With Woody Plants:	
Spring or Fall Seeding	
Redtop	3
Perennial ryegrass	5
Birdsfoot trefoil (Appalow lespedeza)	10 (20)
Foxtail millet (quick cover species)	5
If both Appalow lespedeza and birdsfoot trefoil are used, cut their seeding rates in half.	

KENTUCKY DIVISION OF OIL & GAS INSPECTOR CONTACT INFORMATION		
Pikeville District		
Inspector	**Phone** **Email**	**Counties**
Richard McCown-Supervisor	Cell_ 606-312-7127 Richard.mccown@ky.gov	Boyd, Carter, Elliot, Greenup, Johnson, Lawrence, Menifee, Morgan
James Goble	Cell: 606-312-7126 Jamesd.goble@ky.gov	Floyd, Knott, Martin, Pike
Barbourville District		
Inspector	**Phone** **Email**	**Counties**
Jerry Finley-Supervisor	Cell: 606-521-1734 Jerry.finley@ky.gov	Bell, Jackson, Knox, Laurel, Rockcastle, Whitley
Kerry Morgan	Cell: 606-521-2183 Kerry.morgan@ky.gov	Clay, Harlan, Leslie, Letcher, Perry
Justin Turner	Cell: 606-312-7128 Justin.turner@ky.gov	Breathitt, Estill, Lee, Magoffin, Owsley, Powell
Matthew Adkins	Cell: 606-312-7130 Matthew.adkins@ky.gov	Casey, Lincoln, McCreary, Pulaski, Russell, Wayne
Glasgow District		
Inspector	**Phone** **Email**	**Counties**
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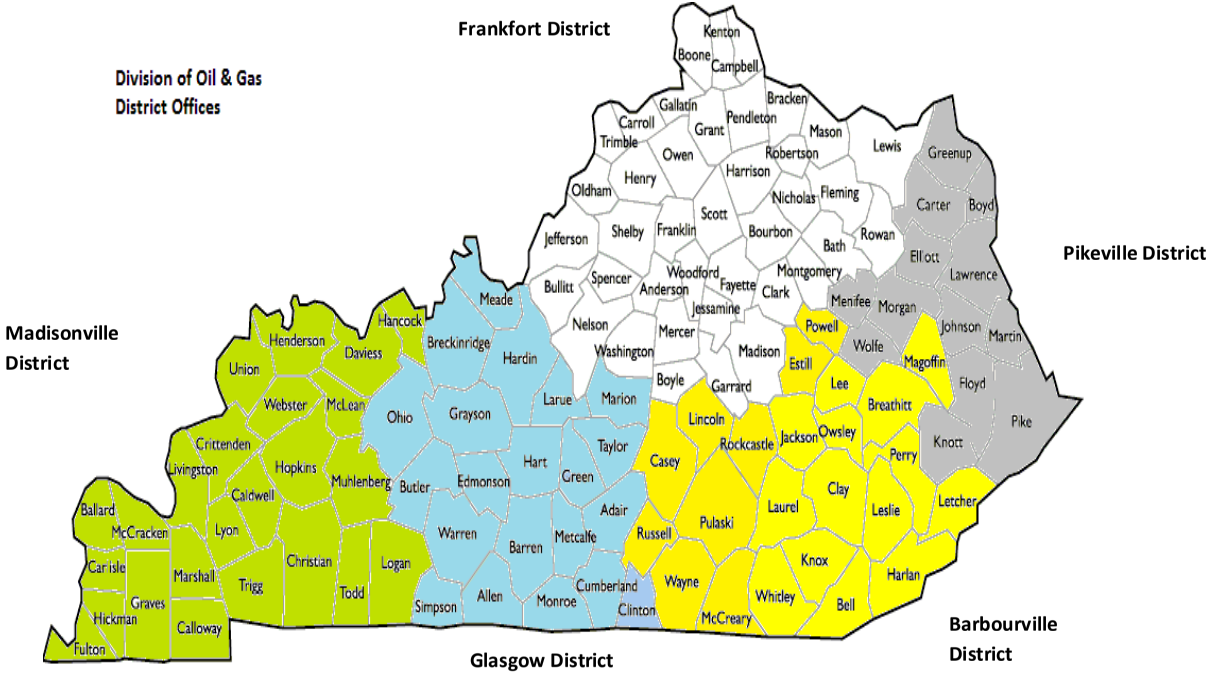
Greg Welsh	Cell: 270-871-4336 Greg.welsh@ky.gov	Breckinridge, Butler, Grayson, Meade, Ohio
Seth Parrish	Cell: 270-688-2115 Seth.parrish@ky.gov	Clinton, Cumberland, Monroe

Justin Watt	Cell: 270-312-7129 Justin.watt@ky.gov	Allen, Edmonson, Simpson, Warren
Brian Yager	Cell: 606-312-7131 Brian.yager@ky.gov	Adair, Green, Mario, Taylor
Madisonville District		
Inspector	**Phone** **Email**	**Counties**
Cy Britt-Supervisor	Cell: 270-871-8465 Cy.britt@ky.gov	Ballard, Calloway, Carlisle, Crittenden, Fulton, Graves, Hopkins, Hickman, Livingston, Lyon, Marshall, McCracken
Bert Combs	Cell: 270-871-4316 Bert.combs@ky.gov	Henderson, McLean, Union, Webster
Stephen Sloan	Cell: 270-302-4888 Stephen.sloan@ky.gov	Daviess, Hancock
Chris Ashby	Cell: 270-836-6176 Chris.ashby@ky.gov	Caldwell, Christian, Logan, Muhlenburg, Todd, Trigg
Frankfort District		
Inspector	**Phone** **Email**	**Counties**
Marvin Combs-Assistant Director	Cell: 606-454-6046 Office: 502-782-6925 Marvin.combs@ky.gov	Anderson, Bath, Boone, Boyle, Bourbon, Bracken, Bullitt, Campbell, Carroll, Clark, Fayette, Fleming, Franklin, Gallatin, Jefferson, Jessamine, Garrard, Grant, Harrison, Henry, Kenton, Lewis, Madison, Mason, Mercer, Montgomery, Nelson, Nicholas, Oldham, Pendleton, Owen, Roberson, Rowan, Scott, Shelby, Spencer, Trimble, Washington, Woodford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Lewis
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Henry
Harrison
Oldham
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Fleming
Carter
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Scott
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