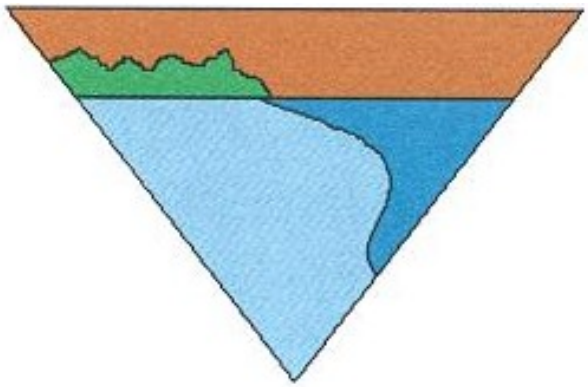
Vermont Better Backroads Pocket Guide

Clean Water You Can Afford



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Vermont Better Backroads Pocket Guide

The Better Backroads Pocket Guide is a summary of the *Vermont Better Backroads Manual*. Like the manual, the pocket guide shows examples of actions for maintaining roads while improving water quality. Preventing erosion and sedimentation saves money, especially in the long term and helps to preserve a precious natural resource—clean water!

The pocket guide is designed to be used as a quick reference. For a more detailed explanation of each topic, refer to the original *Vermont Better Backroads Manual*, other professional publications or call one of the Better Backroads program partners listed on page 39.

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Better Backroads Best Practices Checklist

- ☐ Crown roads to allow water to move quickly from the surface into the ditches.
- ☐ Stabilize all exposed soil with seed and mulch or erosion contol blankets as soon as possible.
- ☐ Line ditches with slopes greater than or equal to 5% with stone and fabric.
- ☐ Line ditches with slopes less than 5% with vegetation (seed and mulch).
- ☐ Direct runoff into vegetated areas, if possible.
- ☐ Avoid concentrating runoff and keep runoff velocities as low as possible.
- ☐ Install culverts with a minimum diameter of 18”.
- ☐ Install stone aprons at culvert outlets where erosion is occurring.
- ☐ Install headers and wingwalls on culverts where erosion is occurring.
- ☐ Schedule and perform regular inspection and maintenance on culverts and ditches.
- ☐ Stabilize eroding banks with vegetation or stone.
- ☐ Disturb in a day only an area that can be stablized that same day.
- ☐ After September 15th, stabilize soils by hydroseeding or covering with erosion control blankets, not seed and mulch.

Gravel Road Design

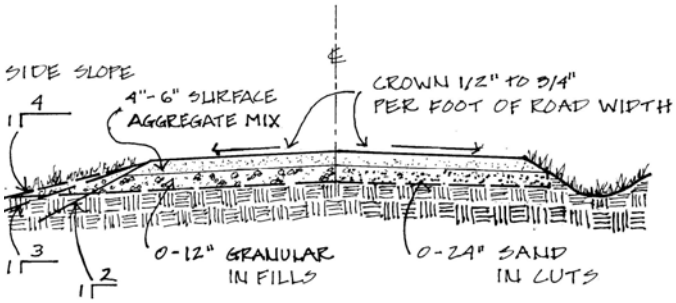
Crown of gravel roads should be ½ to ¾ inch for each foot of road width measured from the center of the road.

Depth of surface gravel: Eight inches or more.

Slope roads with over-the-bank drainage toward the ditched side of the road.

Soil for surface layer should be uniformly graded from course to fine. Vermont Agency of Transportation (VTrans) recommends:

Soil:	< .074 mm
Sand:	.074 to 2.0mm
Aggregate:	> 2.0 mm



Grading

It is recommended that roads be graded in the spring or after rain to minimize loss of materials as dust.

Regravel road surface every 4 to 5 years with 2-3 inches of new gravel.

Dust Control

- Dust is created when binder material is lost, which leads to rapid deterioration of the road.

- Calcium chloride can be applied to unpaved roads to reduce dust.

Recommended Chloride Rate

Spring: 0.5 gallons per square yard (liquid)
2.5 pounds/sq. yd. (flake)

Summer: 0.3-0.4 gallons per square yard (liquid)
1.5-2.0 pounds/sq. yd. (flake)

Disposing of Material

- Do not dispose of excess material (fill, ditch spoils, etc.) in wetlands, ditches, swales, near streams or lakes, on slopes greater than 2:1, or in other locations that could potentially cause water quality concerns.

- Areas downhill from disposal areas should be vegetated to trap sediments.

- Vegetate all bare soils as soon as possible.

Ditch Design

- Control and filter water through vegetated or stone lined ditches.

- Design and grade ditch and side slopes at a maximum 2 horizontal to 1 vertical ratio.

- Excavate ditch 1.5 to 2 feet deep but not so deep that water settles.

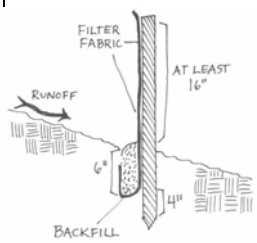
- All ditches need an outlet. Standing water weakens roads.

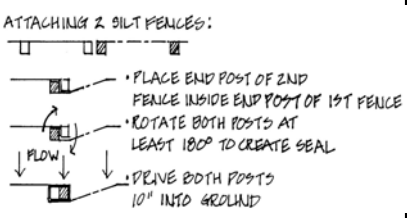
Temporary Erosion Control

It might be necessary to implement some temporary erosion control measures to reduce surface water pollution during the installation of your project or for a short period after the project is completed.

Silt Fence

- Use at the base of a slope to intercept overland flow and trap sediment.
- Place in 6” x 6” backfilled trench and drive 10 inches into ground.
- Use a “j-hook” at the ends to catch water trying to get around it.
- Place end post of second fence inside end post of first, rotate posts together to create a seal.
- Periodic removal of trapped sediment is necessary for optimum performance.
- Not recommended for use in running water (i.e., ditches, streams).





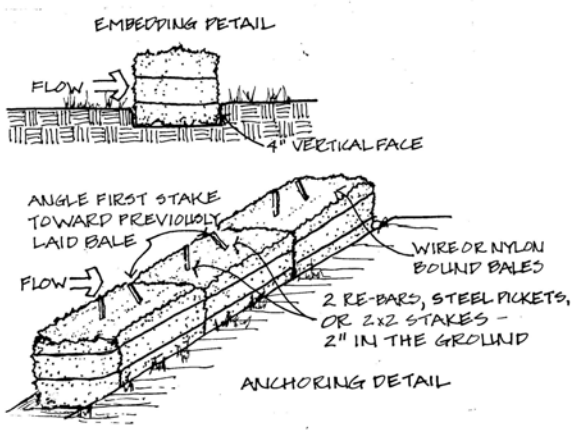
Rock Filters

- Use in conveyance channels to remove sediment.
- Require periodic maintenance to remove accumulated sediment to prevent clogging.
- Need to be removed and replaced if filter becomes clogged.

Hay Bales

Hay bale dikes are no longer a recommended erosion control device. They disintegrate rapidly and should never be counted on to provide more than one or two weeks of effective sediment control. If you do chose to use them, be sure to install them properly.

- Bury at least 4 inches into the soil.
- Make sure bales are staked and backfilled.
- Use at toe of slopes, at culvert outlets or to protect catch basin inlets.
- Never install in running water.
- Remove sediment periodically.

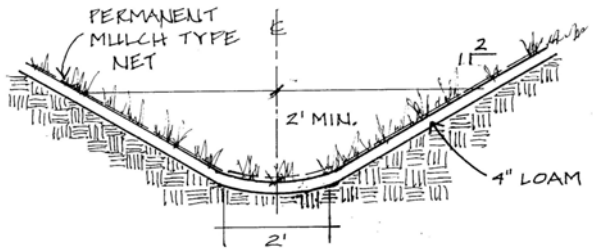


Sediment Trap

- Small temporary excavation or embankment designed to intercept, trap, and retain sediment.
- Handles larger flows than other controls.
- Should be at least twice as long as it is wide.

Ditches

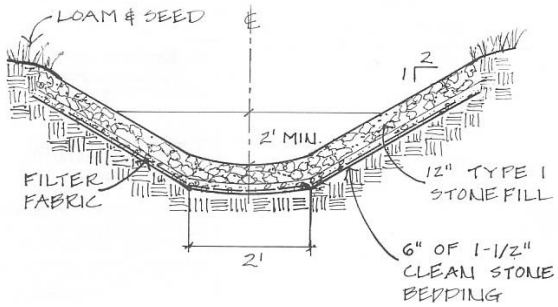
Grass: Line ditches that have less than 5% slope with grass in order to filter sediments. Use mulch or erosion control blankets to hold seed in place and allow it to become established.



Stone: Line ditches having 5% to 10% slope with stone.

- If slope is 5% to 10%, line ditches with stone 2 to 6 inches in diameter up to 7.5 inches thick.
- If slope is greater than 10%, line ditches with stone 3 to 12 inches in diameter up to 12 inches thick.

Use geotextile fabric (nonwoven) under stone in ditches to protect against erosion of underlying soil and provide a barrier between stones and soil.



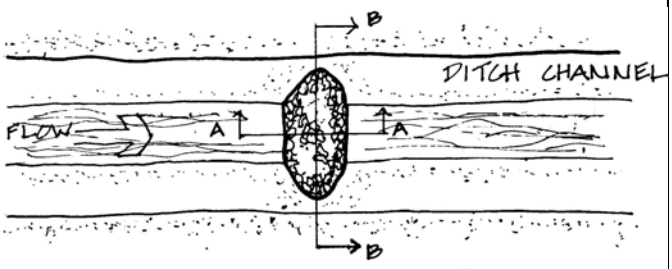
Velocity Controls and Energy Dissipaters

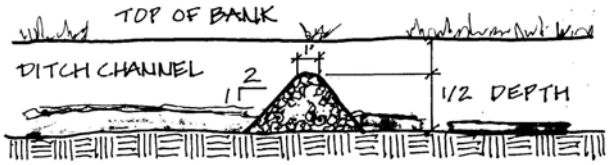
Locate in ditch channels and at culvert outlets to reduce scour and erosion, collect sediment, and help ground water recharge.

- Types of velocity controls and energy dissipaters include: stone dikes and log and brush check dams.

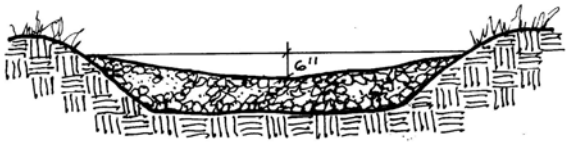
Stone Dikes

- Constructed of stone large enough to handle the expected velocity of water.
- More permanent than most other types of controls.





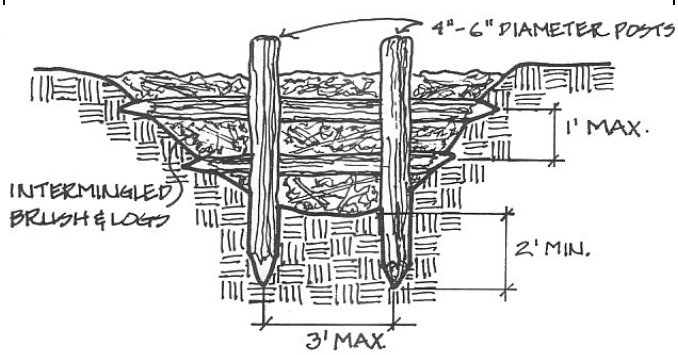
TYPICAL SECTION A-A

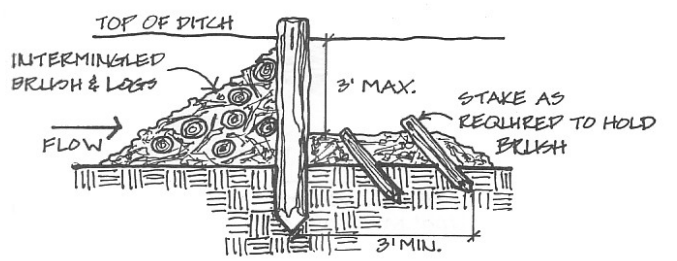


TYPICAL SECTION B-B

Log and Brush Check Dams

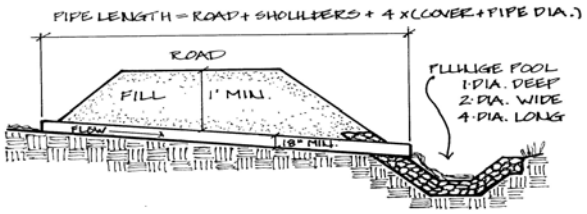
- Constructed of brush intermeshed with logs staked into the ground.
- Materials for these dams can be gathered on site making them convenient and inexpensive.
- Good emergency control.
- Installation technique is critical to performance.





Culverts

- For less than 20 acre watersheds, add 8 to the acreage to estimate culvert diameter. Example: 15 acre watershed plus 8 = 23. Rounded to nearest culvert size: 24”.
- Place culverts no more than 500 feet apart. Steep slopes need more culverts.
- Discharge water from culverts to vegetated areas, never directly into a stream or surface water, if possible.
- Set grade of a culvert by existing channel or to where the outlet can discharge to the existing ground. Minimum slope for culverts is 0.5%.
- Culvert length equals width of the road and shoulders at angle crossing the road plus 4 times the culvert diameter + cover. Add extra length to accommodate headwalls.
- Protect culvert outlets from erosion and undermining by using rock aprons, plunge pools, or sediment basins.



Installing and Replacing Culverts

- Install culverts during periods of low stream flow or during dry weather.
- Lay pipe upstream, outlet end first.
- Compact backfill in six-inch lifts.
- Try to achieve at least 2 feet of cover.
- Seed and mulch all disturbed areas.

Culvert Inspection

Inspect culverts in spring, fall, and after storms (at a minimum).

- Mark all drainage structures.
- Mark outlet ends of underdrains.
- Check for deterioration/replacement needs.

Maintenance- Spring

- Inspect culvert condition.
- Remove obvious blockage.

Maintenance- Summer

- Clean and flush inside of pipe from outlet end.
- Repair or install headwalls, end sections, and splash pads.
- Mow, trim and remove brush from around culvert ends.
- Reestablish vegetation at culvert inlet/outlet to prevent erosion.
- Add cover material.
- Remove obvious blockage.

Maintenance- Fall

- Inspect culvert condition and mark culvert ends for winter.
- Remove obvious blockage.

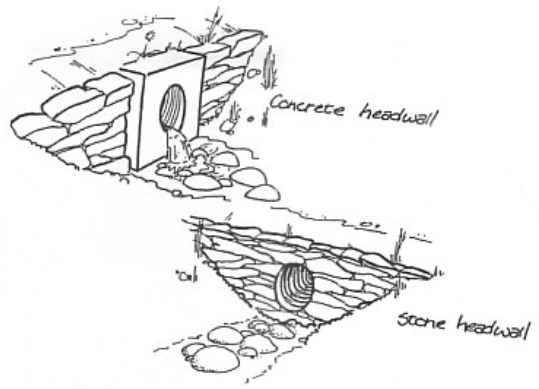
Maintenance- Winter

- Monitor for blockage and ice/snow.
- Thaw culverts with steam, high pressure water, ice augers, welders, or calcium chloride.

Headwalls (Stone or Concrete)

Headers increase hydraulic efficiency, prevent erosion around culvert inlets, and protect culvert ends from being damaged by traffic and equipment.

- Build headers flush with end of culverts.



Driveways and Side Roads

Protect public roads and ditches with adequately sized driveway culverts and headwalls. It is recommended for towns to adopt a driveway access policy. Contact the Better Backroads program for a copy of *Developing a Highway Access Policy* with model language for driveway culvert policies.

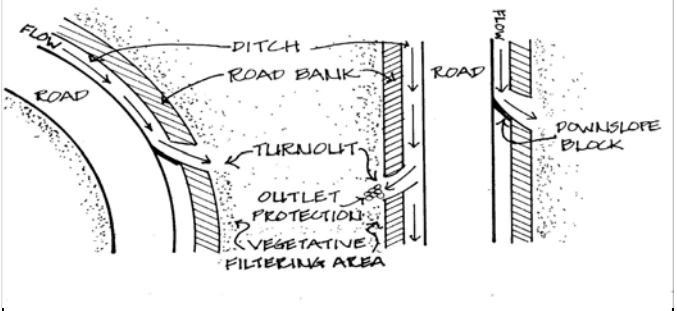
Outlet Structures

Outlet structures are used to discharge water from a ditch or culvert. Outlet structures reduce the velocity of water carried by road ditches and culverts, therefore helping to control sedimentation. There are a variety of types that can be used.

Turnouts

Turnouts are extensions of ditches which direct water away from the road edge to filtering areas. Use of turnouts will not only protect water quality, but will also save gravel for reuse.

- Follow culvert recommendations for spacing of turnouts (see p. 12).
- Use only in areas where the water will flow to a filtering area well away from the road and surface waters.

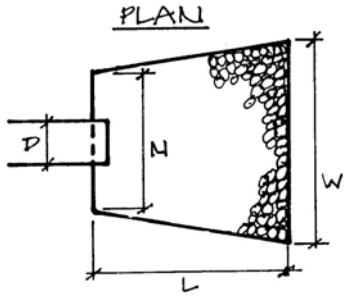


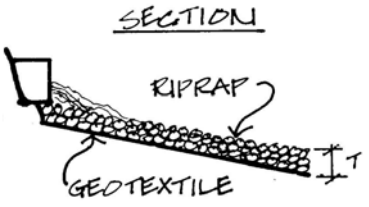
Rock Apron

A rock apron is an area lined with riprap used to discharge water from culverts to existing ground.

- Provide culvert outlet protection by reducing water velocity and promoting sheet flow.
- Size and placement of riprap in the apron is dependent upon the diameter of the culvert as well as on expected water flow through it.

Rock Apron Specifications					
Culvert Diameter (D)	Riprap Size	T (in.)	N (ft.)	W (ft.)	L (ft.)
18”	(3”-12”)	18	4.5	14.5	10.0
24”	(3”-12”)	18	6.0	20.0	14.0

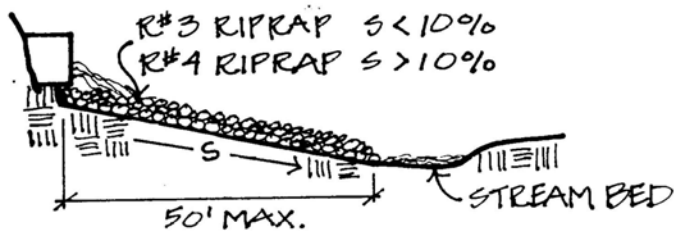




Riprap Conveyance Channel

A riprap channel is used to remove sediments and to keep the channel itself from eroding while carrying runoff from a culvert or ditch.

- Use in areas with fill slopes or with steep slopes where erosion would otherwise occur.
- Use in areas without adequate vegetative filter strips, and where an outlet must go directly into surface waters.
- Follow installation recommendations for stone lined ditch (see p. 9).

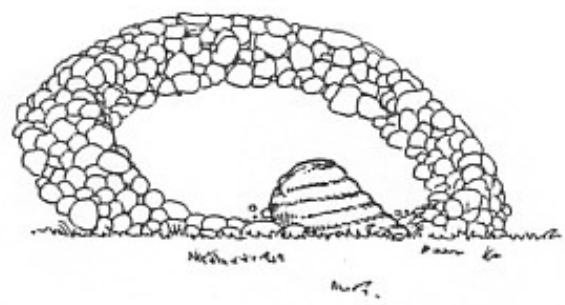


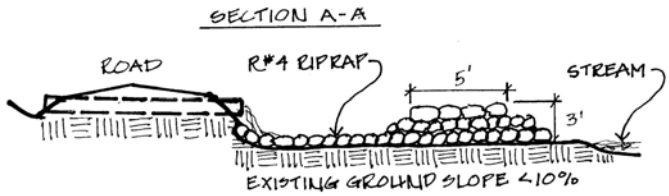
Splash/Plunge Pools

A splash/plunge pool is a riprap basin at the outlet of a culvert pipe used to remove sediments.

- Absorbs water energy and allows sediments to settle.
- Limited to areas with less than 10% slope.
- Clean pool when it is one third (1/3) filled with sediment.

Splash/Plunge Pool Capacity Requirements		
Distance Between Culverts (ft.)	Pool Capacity (cu. ft.)	
	Crowned road	Banked road
500	230	460
400	180	360
350	160	320
300	140	280
250	120	240
200	100	200





Bank Stabilization

Bank stabilization is the vegetative or structural means used to prevent erosion or failure of any slope.

Seeding & Mulching

- Use in areas with a maximum 1:1 slope.
- Rake fertilizer and lime into the top two inches of soil.
- Cover seed with hay, straw, wood waste to hold in place until germination occurs.
- Anchor mulch to soil with disk harrow or sheepsfoot roller.
- A hydroseeder may be used in place of hand seeding and manually mulching with hay.
- Erosion control mats/blankets can be used in place of mulch to cover seed on steeper slopes or in the fall when germination is uncertain.

Grading Techniques

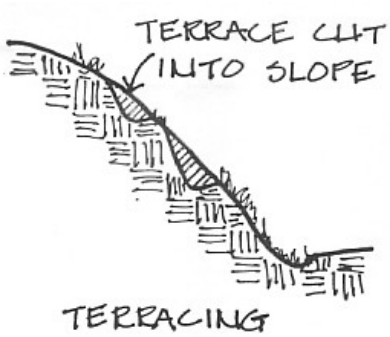
Proper grading or regrading of slopes can often stabilize banks without the use of structures.

- Grading or regrading slopes to a maximum 2:1 slope will help to stabilize the bank.
- Types of grading that can help stabilize banks are terracing, counterweight, cut and/or fill, and notching or keying.

Terracing

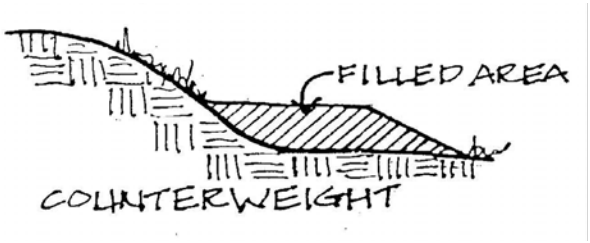
Terracing breaks a long slope into many flat surfaces where vegetation can be established.

- Reduces runoff velocity and increases infiltration.



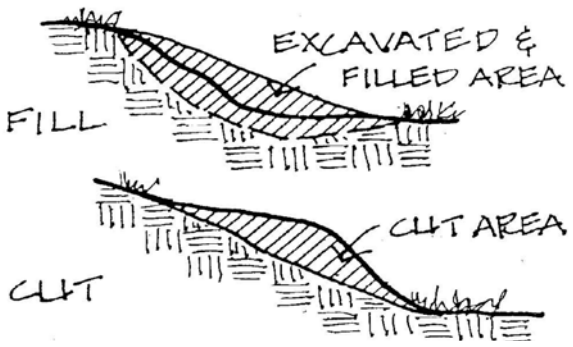
Counterweight

A one level bench and slope that can be added next to a steep failing bank to hold the bank up and prevent continued sliding.



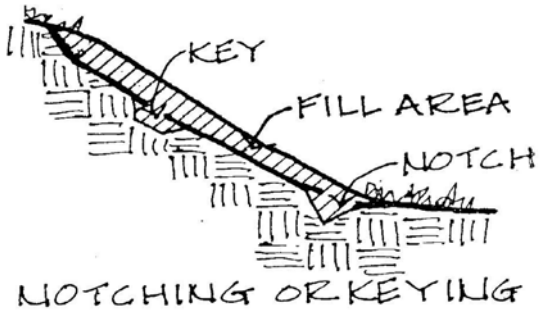
Cut and/or Fill

The removal or addition of soil to the bank to create the desired 2:1 or flatter slope, often times removing less stable soils and replacing them in the process of regarding the slope.



Notching or Keying

A “V” or trapezoid shaped cut made in the existing ground to help further stabilize the slope.



Vegetation – Shrubs and Trees

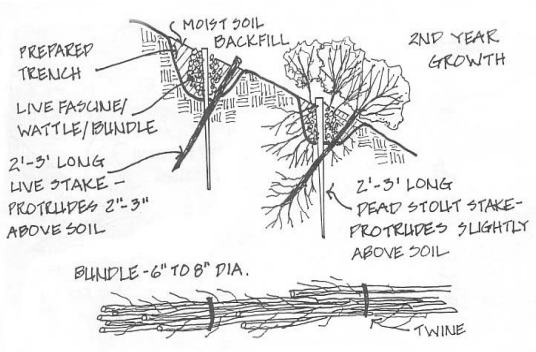
Shrubs and trees can be used to stabilize steep slopes and stream banks, and create a good vegetative filter strip.

- Commonly used stabilization plants include: willows, alders, and dogwoods.
- Techniques for stabilizing banks with woody plants include live fascines/wattles/bundles, live stakes, brushlayering, and sprigs/plugs.

Live Fascines/Wattles/Bundles

Bundles of live branches tied together.

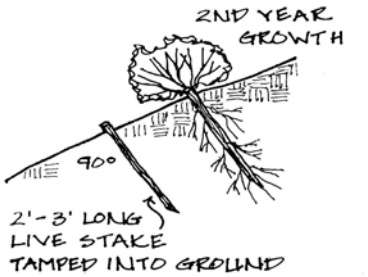
- To make your own bundles, orient growing tips in same direction with tops evenly distributed through length of bundle.
- To install, place in 12 to 18 inch trench dug along contour of the slope. Plant from the base of the slope upward.
- Secure with live stakes and dead stout stakes. Backfill with moist soil.
- Install bundles the same day as cut during dormant periods (spring, fall or winter).
- Can be used on steep slopes (1:1) and to protect slopes from shallow slides.



Live Stakes

Cuttings of live branches ½ to 1-½ inches in diameter and 2 to 3 feet long.

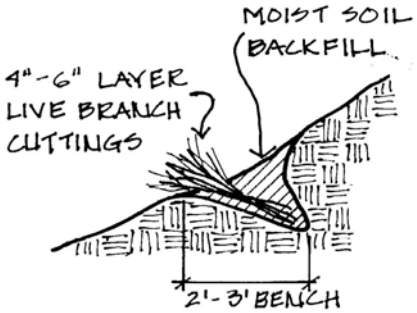
- Drive stakes into ground at right angle to the slope, 2 to 4 stakes per square yard, in alternating grid pattern (see p. 24).
- Plant stakes the same day as cut during spring, fall and winter.



Brush Layering

Live branches, 3 to 4 feet long, placed in excavated benches perpendicular to the slope with growing tips outward.

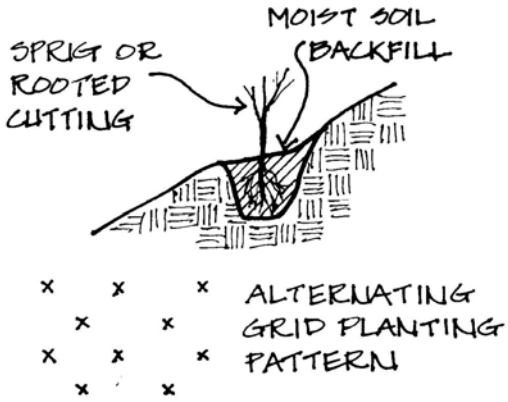
- Backfill on top of branches and compact.
- Plant the same day as cut during dormant periods.



Sprigs/Plugs

Individual plant stems with roots. They can be seedlings or rooted cuttings.

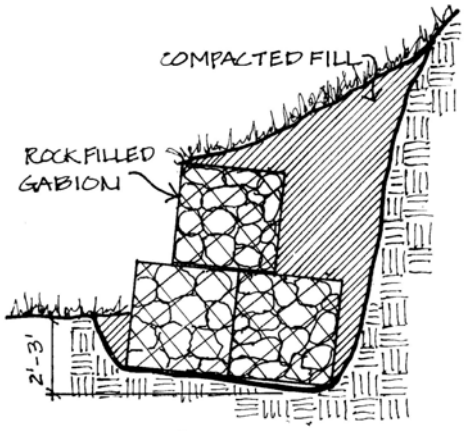
- Place in hole that is dug large enough to accommodate the roots and tamp soil down around the plant.
- Plant in alternating grids with plants ½ to 1 yard or meter apart.

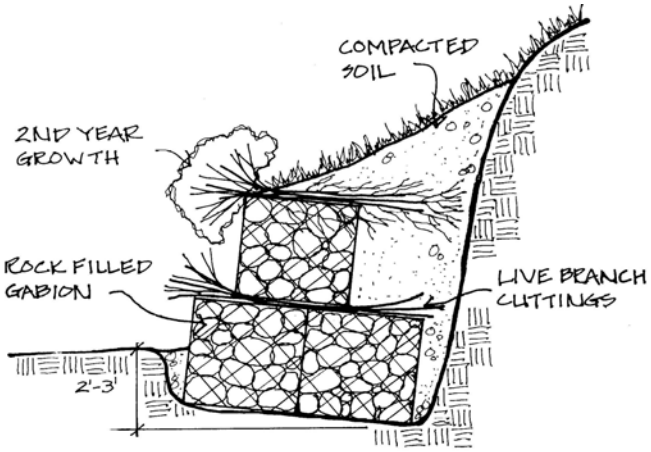


Gabions

Wire mesh rectangular baskets filled with stone. Can be combined with woody vegetation to stabilize soils.

- Gabions can be stacked or terraced.
- Gabions can be combined with woody vegetative stabilizers for increased strength.
- Use filter fabric between soil and gabions to prevent soil from washing out.

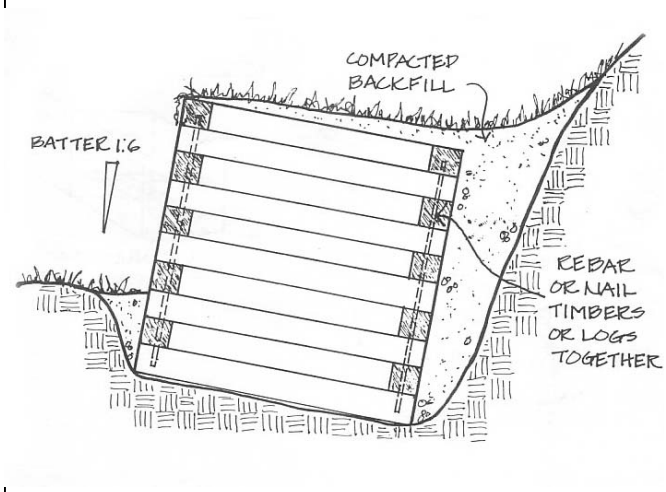


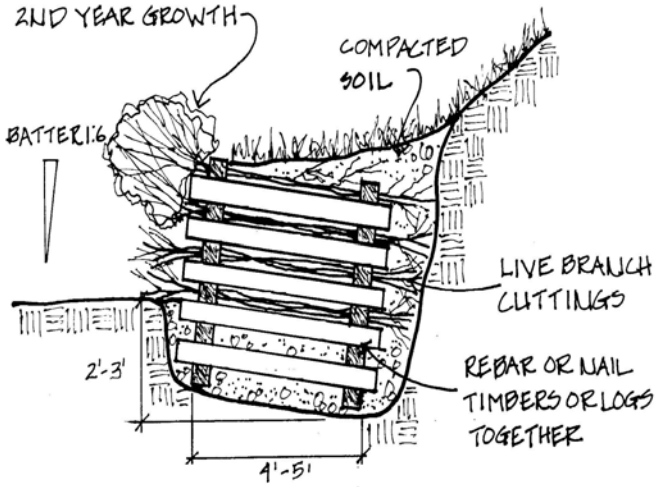


Log or Timber Cribs

A structure made of logs or treated timber and filled with soil used as a retaining wall.

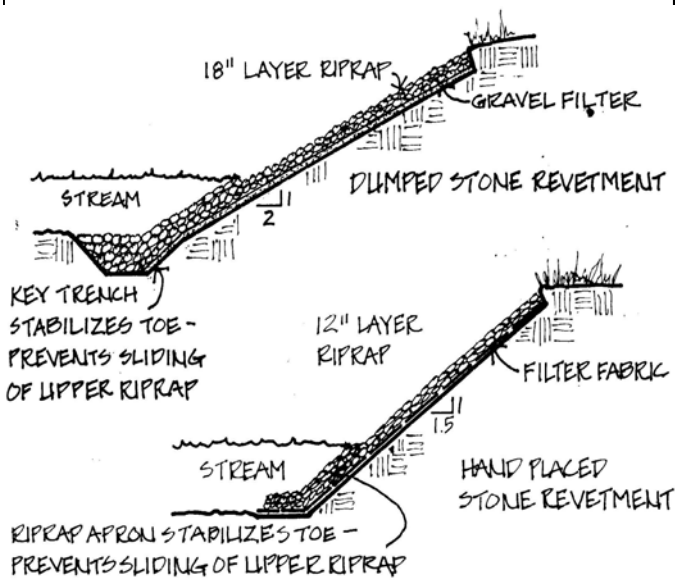
- Live branches can be planted in the crib to assist with stabilization.





Revetment Systems

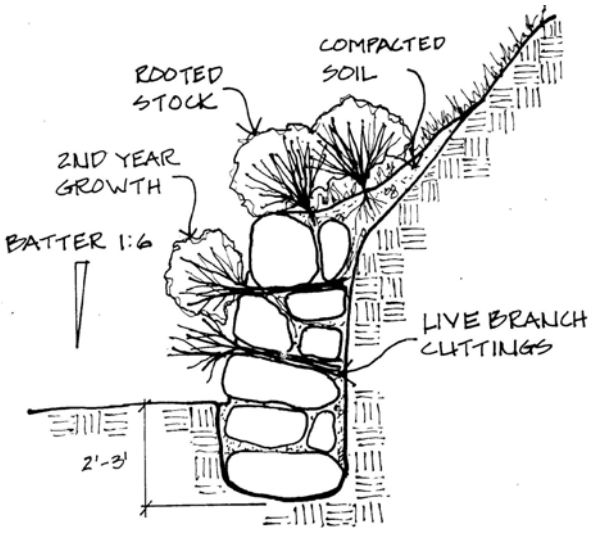
- Rock carefully placed on bank slopes and stream edges. Size of rock depends on quantity and velocity of water flow.
- Can be used on steep slopes, at sharp turns in streams, and where a bridge or culvert restricts water flow.
- This technique is likely to require a permit when installed on a streambank or lake shore. See pg. 37 for permit information.



Vegetated Rock Wall

A combination of rocks and live branches, as used in brush layering.

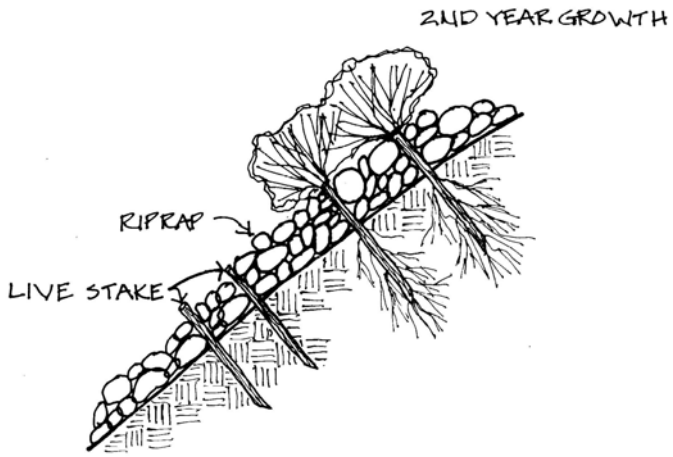
- Place rocks with long axis slanting inward toward the slope.
- Backfill between each layer of rocks and place live branch cuttings on backfill. Cover with soil and compact.
- Use at the base of a slope where a low wall not higher than 5 feet is required.



Vegetated Riprap/Joint Planting

Combines riprap revetment with the tamping of live stakes between the joints or open spaces in the rocks.

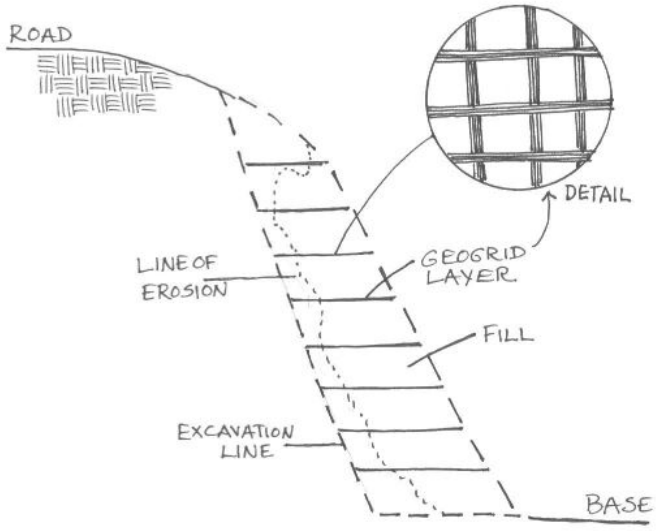
- Live stakes must be long enough to extend well into soil below rock surface.
- Roots improve drainage and create a mat that binds and reinforces the soil, preventing washouts and loss of fines between and below the rocks.



Geogrids

Geogrids are extremely durable woven materials with a polymer coating that can be used for soil reinforcement. Geogrids have a high tensile strength and are ideal for use on steep slopes and in areas with a narrow right-of-way.

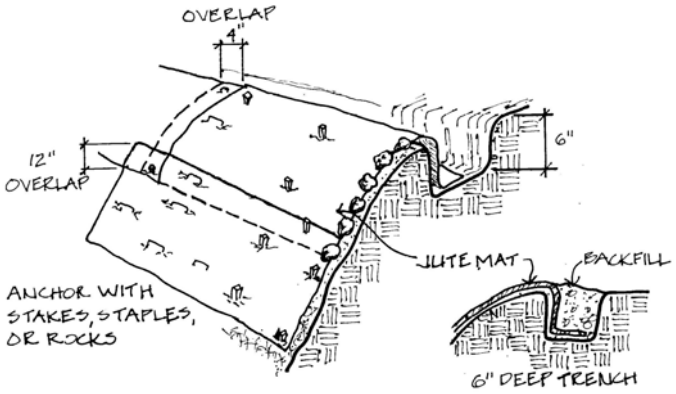
- Can be used as an alternative to riprap or a concrete retaining wall.
- Can be planted over with vegetation for additional strength and aesthetics.
- Resists degradation by water and chemicals normally found in soils.
- Check with product manufacturer for specific installation details.



Erosion Control Mats/Blankets

Erosion control mats and blankets are manufactured products used to cover seed until it germinates and prevent erosion on slopes and in ditches. Types of mats and blankets include jute matting, wood excelsior blanket, and mulch blanket.

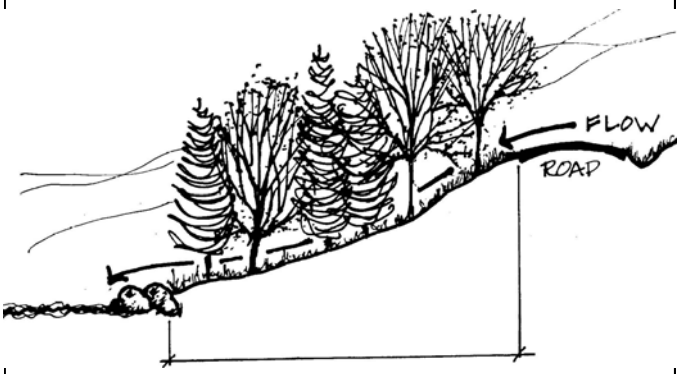
- Use in areas where it is difficult to hold mulch in place and there is erosion potential.
- Place after area has been seeded.
- Place lengthwise along direction of the slope and secure with stakes or staples.
- Overlap side-by-side sections about 4 inches.
- Overlap up slope sections by 12 inches.



Buffer Zones

Buffer zones are undisturbed areas of heavy vegetation separating roads or construction sites from sensitive areas such as streams, wetlands, and lakes. They slow water and act as a natural sediment filter.

- Maintain a minimum of 50 feet between roads and streams; 100 feet for lake shores. Plant trees, shrubs, and other woody vegetation to stabilize soils.

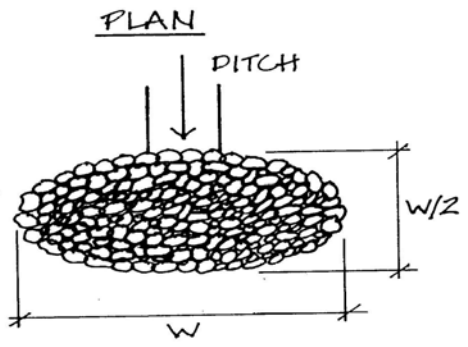


50' min for streambanks
100' min for lake shores

Level Spreaders

Bermed trench used to intercept and discharge water flow over a wide linear area.

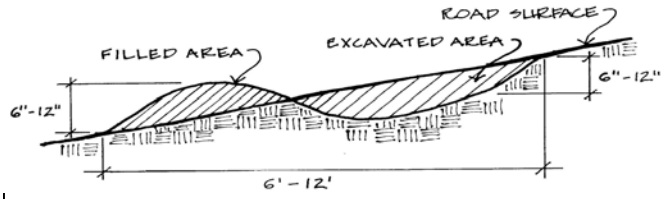
- Prevents gullies by discharging over a wide linear area.
- Generally used at the toe of a slope.
- Construct a long, level bermed trench. Water will discharge evenly over berm when trench is full.



Waterbars

Berm or open culvert constructed across a road used to divert water flowing down the road.

- Use only on very low traffic volume roads.
- Construct low enough for traffic to pass over and angle at approximately 30° across road (not perpendicular).



Beavers

Beavers can create problems for road crews by building dams that block culverts and impound water that can be released during a flood, washing out roads and bridges and releasing massive amounts of sediment. Here are some options when dealing with beavers:

- **Ignore the problem.** Evaluate the real threat to the road. Perhaps a "live and let live" approach would be easiest on all involved.

- Hang a 36"x36" **white flag** attached to two poles near the culvert when beavers begin to construct a new dam. The color and motion cause the beavers to leave and not come back.

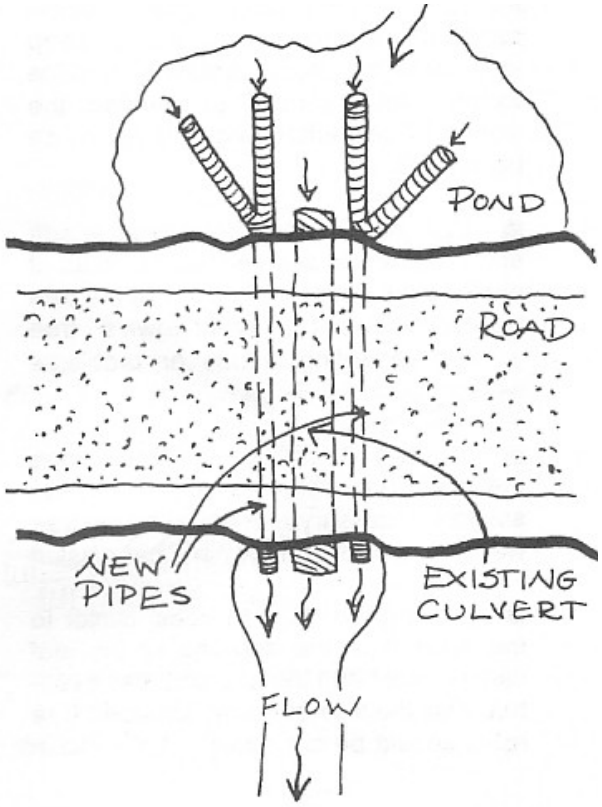
- **Avoid sudden destruction** of a dam. The resulting release of water and accumulated sediment from behind the dam can cause massive turbidity and flooding problems downstream and may result in a violation of VT Water Quality Standards. If a dam must be removed, do so gradually.

- **Weld an elbow onto the culvert.** A 90 degree angle pointing downward below water level results in continual drainage, and the beavers won't be able to plug the inverted culvert end.

- **Try some of these new water level control ideas** in use around the country. The designs on the next 2 pages seek to limit the depth of the water behind a dam, but do not remove the dam itself.

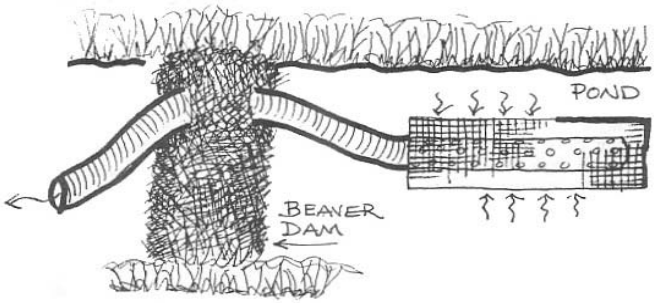
“Beaver Reliever”

Designed by the US Forest Service, this installation features additional perforated pipes parallel to the culvert. These extra perforated pipes help maintain the water level in the pond below the level of a culvert.



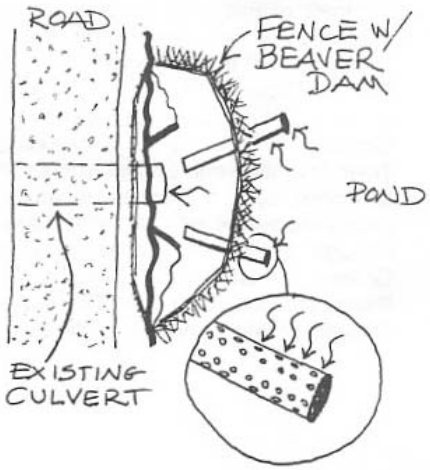
Beaver Baffle

A baffle system is a drain for the dam itself, creating an outlet for water straight through the dam. It requires only shallow digging into the dam.



Build A Fence

Build a horseshoe shaped fence (heavy gauge wire) around the upstream side of a culvert to keep beavers from plugging the culvert. For persistent problems, install perforated pipes through the fence into the pond.



Permits

For some erosion control projects, it may be necessary to obtain a permit for your activities. See below for information on permits that may be required and contact information.

Lakes and Ponds Shoreland Encroachment Permits

Vermont Water Quality Division
Shoreland Encroachment Program
103 South Main Street
Building 10 North
Waterbury, Vermont 05671-0408
(802) 241-3777

Stream Alteration Permits

Northwestern and Central Vermont
Vermont Water Quality Division
111 West Street
Essex Junction, VT 05452
(802) 879-5631

Northeastern and Central Vermont
Vermont Water Quality Division
5 Perry St., Suite 80
Barre, VT 05641-4268
(802) 476-2679

Southern Vermont
Vermont Water Quality Division
450 Asa Bloomer State Office Building
88 Merchants Row
Rutland, Vermont 05701-5903
(802) 786-5906

Wetlands Permits

Vermont Water Quality Division
Wetlands Section
103 South Main Street
Building 10 North
Waterbury, Vermont 05671-0408
(802) 241-3777 or (802) 241-3770

Stormwater Permits

Vermont Water Quality Division
Stormwater Section
103 South Main Street
Building 10 North
Waterbury, Vermont 05671-0408
(802) 241-3777 or (802) 241-3770

Federal Permit for Work in Rivers, Streams, Lakes and Ponds

U.S. Army Corps of Engineers
8 Carmichael Street, Suite 205
Essex, VT 05452
(802) 872-2893

Vermont Better Backroads
Staff & Partners

For more information or questions about the Better Backroads program, please feel free to contact us or one of our partners.

Linda Boudette, Better Backroads Technician, Northern Vermont Resource Conservation & Development (RC&D) Council, (802) 793-7816, backroadstech@yahoo.com

Jarrod Becker, Business Manager, Northern Vermont Resource Conservation & Development (RC&D) Council, (802) 828-4583, rcdbizmanager@yahoo.com

Susan Warren, Aquatic Biologist, Vermont Agency of Natural Resources, (802) 241-3794

Sally Collopy, Director, Vermont Local Roads Program, (802) 654-2652

Beth Ann Finlay, Coordinator, Northern Vermont Resource Conservation & Development (RC&D) Council, (802) 828-4595

Ken Hafner, Coordinator, George D. Aiken Resource Conservation & Development (RC&D) Council, (802) 728-9526

Chris Brunelle, Stream Alteration Engineer, Vermont Agency of Natural Resources, (802) 879-5631

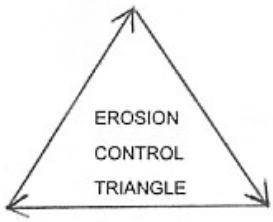
Dave Pelletier, Acting Director, Lamoille County Planning Commission, (802) 888-4548

Ernie Englehardt, District Transportation Administrator, Vermont Agency of Transportation, (802) 828-2691

Erosion Control Triangle

There are three sides to effective erosion control:

Long Term Maintenance
(Periodic checks, reseeding)



Temporary Control
(Before & during construction and maintenance work)

Permanent Control
(Long term controls)

Temporary	Silt fence, hay bales Rock filter Sediment trap Seeding, straw mulching
Permanent	Revetment systems Grass and stone lined ditches Retaining walls, terraces, berms Erosion control blankets on slopes Turnouts Underdrains, catch basins Woody plantings Hydroseeding
Long Term Maintenance	Occasional reseeding Clean catch basins and culverts Correct weak points immediately Replacement schedule for culverts