It's Just Dirt

June 2021

Digging in Dollars

Common $ense Erosion & Sediment Control

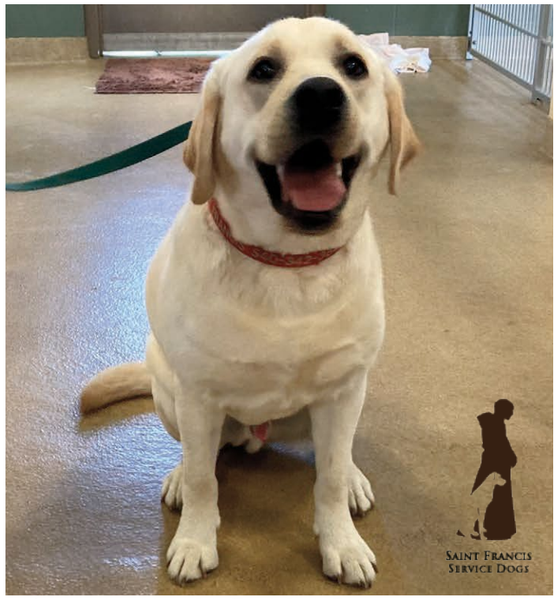
June 2021: Stormwater Clean Award / Rain Drop Erosion / Clean Stormwater / Rip-Rap Channels / 5th Edition

"Service Dogs" Earn Stormwater Clean Award

Roanoke County's Department of Development Services selected the Saint Francis Service Dogs Pavilion project, located at 8232 Enon Drive, Hollins, VA, as the latest recipient of the Stormwater Clean Award.

Stacey Lucas and Kim Roenberger of **Lionberger Construction** were proactive regarding the site's erosion and sediment control measures throughout the project. Any necessary corrections were swiftly executed. This made for a great project, and it also helped protect downstream waterways from receiving sediment-laden stormwater runoff from the site.

Land development in Roanoke County presents difficult challenges in the management of stormwater runoff due to the very steep slopes and highly erodible soils in the region. Because of these challenges, Roanoke County created the Contractor Appreciation Program to recognize land-disturbing contractors who conduct exemplary work within the County to protect its natural water resources.



A happy pup in training at Saint Francis Service Dogs.

Roanoke County inspectors submit candidate projects to a selection committee that meets monthly to evaluate the projects for recognition. Selected projects receive a permanent banner for display at the project site, and they are recognized in the department's newsletter and on the County's website. To learn more about this exciting program, please visit the County's website at *https://www.roanokecountyva.gov/1780/Stormwater-Contractor-Appreciation*

Or, even better, become the NEXT winner!

Alina Herron of Roanoke County presented the Stormwater Clean Award to David Underwood (President), Stacey Lucas, and Kim Roenberger of Lionberger Construction.

Doing Right for the Roanoke River

Pictures of the Saint Francis Service Dogs Pavilion Project tell the story: Early application of straw mulch to protect bare soils from rain drop erosion and proper installation of perimeter controls kept dirt on the project and out of nearby creeks!

Rip-Rap Channels For Long-Term Flow

Everyone wants stable property, to include well-vegetated lawns and ditches that don't erode or damage downstream properties. A rip-rap channel can be an attractive, effective stormwater conveyance device if it is properly designed and installed. However, rip-rap channels are often poorly constructed, despite the best design! This can result in the channel being undermined such that water flows beside or beneath it, or the channel being overtopped because it lacks sufficient capacity to carry the flow for which it was intended. In either case, the chance for erosion and subsequent off-site sedimentation is high. This article provides some guidance to install an aesthetically pleasing and fully functional rip-rap channel.

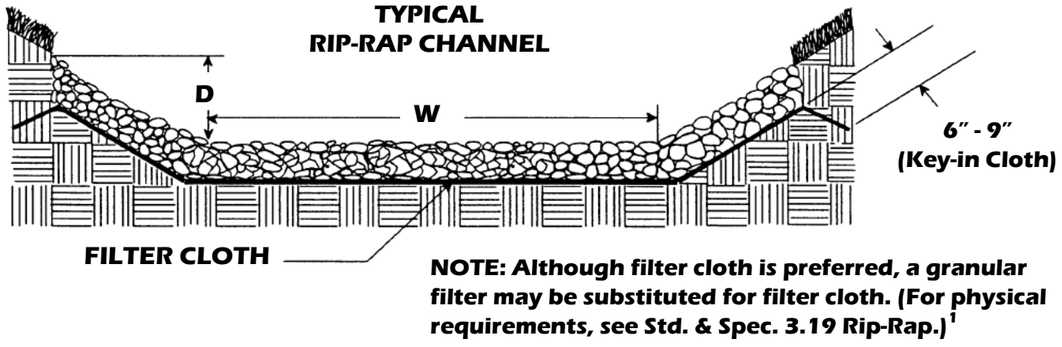
A well-graded rip-rap channel properly keyed in to existing grade.

A common issue with channels is inadequate width of the channel section, which limits the overall carrying capacity. An undersized channel will result in water running outside of the conveyance, which creates erosion and has the potential to impact downstream properties. Another common issue is that channels are cut to the finished grade, and then the rip-rap is installed. This leaves the rip-rap too high, which not only limits the channel's ability to convey stormwater but also sets the stage for stormwater to start "digging" beside it such that it will eventually get under the channel.

A poorly constructed rip-rap channel, not properly keyed in to existing grade.

STEP 1: "Cut the channel to the subgrade." Critical areas include the upstream and downstream end of the channel. Many problems originate at the upstream end of channels when they are not cut deep enough. This means that the rip-rap essentially becomes a dam; because water cannot get into the channel, it bypasses it instead.

STEP 2: Once the channel is excavated to subgrade, install a filter cloth per the manufacturer's recommendations. This may include "trenching in" the upstream end of the fabric, overlapping upstream sections on top of the downstream sections, and using staples of a specified length. Take care in placing the rip-rap to ensure that the filter cloth is not damaged. You may want to add a layer of smaller washed stone, such as #57, on top of the liner to help the rip-rap "seat" better.



If the channel is properly excavated to subgrade, the finished rip-rap surface will be entirely below finished grade on either side of the channel. The channel section may be checked by pulling a string across the channel from finished grade on each side. The rip-rap should be entirely below the string, and the measurement from the string line to the flow line should equal the specified channel depth, labeled "D" in the schematic above (taken from the *Virginia Erosion & Sediment Control Handbook*, Std. & Spec. 3.17). If this process is followed, and the design parameters have been met, you should have a stable channel for the long-term.

[1] *Virginia Erosion & Sediment Control Handbook, Std. & Spec. 3.19.*

Digging in Dollars: Common Sense Erosion & Sediment Control

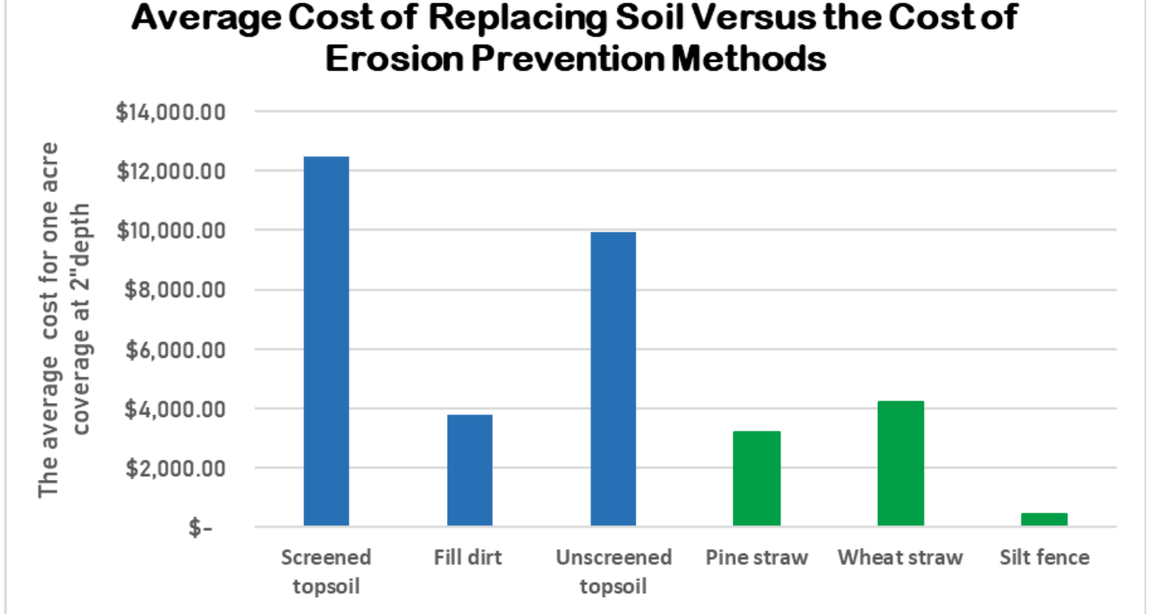
Land development is associated with a number of hazards including loss of vegetation, increased stormwater volume and velocity, and soil compaction. (Refer to Chapter II of the *Virginia Erosion and Sediment Control Handbook* for additional related issues.) These hazards not only negatively affect the natural environment, because they set the stage for erosion, but they will also affect your project. Uncontrolled erosion from bare soils and the resulting sedimentation it causes can mean significant soil loss from a jobsite and associated clean up costs to remove accumulated sediment from offsite, downstream properties and waterways. In addition, to achieve adequate permanent vegetation, you may have to import soil to replace what has been washed away from your site.

DID YOU KNOW?

- Straw mulch applied at the rate of 2 tons per acre reduces raindrop erosion by a whopping 80%
- Surface cover is the most important factor affecting how much erosion occurs

Have you ever heard the expression that "dirt ain't cheap?" It is expensive to buy soil, and it is even more expensive to go get it from the downstream areas where it has settled.

The graphic below shows the average cost to cover one acre at two inches in depth using different media. The average cost of dirt-to-topsoil ranges from $14 to $46.50 per cubic yard (an acre is roughly 268.86 cubic yards). Compare that to the straw prices, which range from $5.35 to $7 per bale (an acre requires around 600 bales for 2" depth). Silt fence runs about $34.98/100 ft. roll for the fabric and ~$9.08/12-stake bundle for the wooden stakes, assuming perimeter coverage of a perfectly square acre (834.8 feet). Note: these projected costs do not include delivery fees. Careful comparison of these various costs will reveal that it is substantially cheaper to install silt fence to "keep the dirt on the project" than it is to buy replacement dirt. And, the application of straw mulch to protect the dirt from erosion is a clear gain.



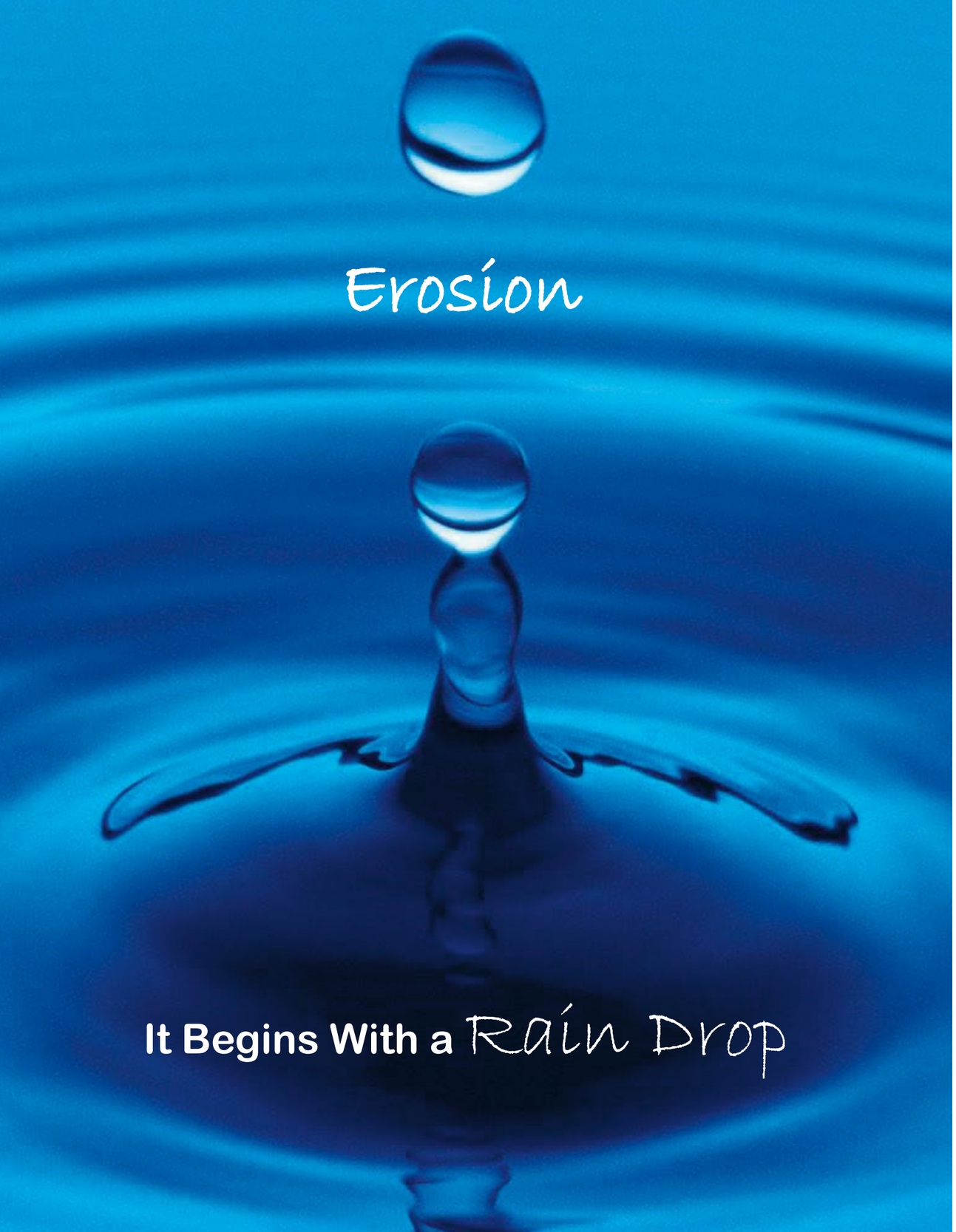
BOTTOM LINE: Temporarily stabilizing dormant areas, even with "just" straw mulch, is cheaper than replacing an acre's worth of soil, and it will significantly reduce the percentage of soil loss.

Clean Stormwater

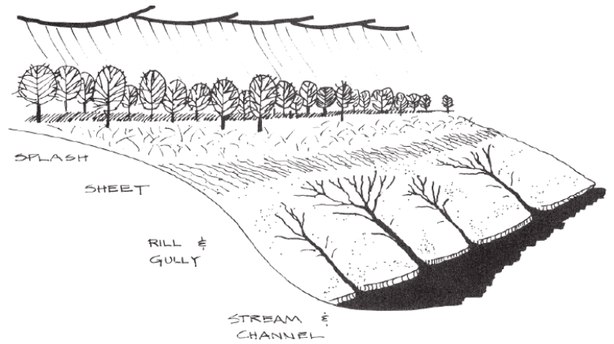
Starts right here, on YOUR project

Do Your Part . . . Be STORMWATER SMART:

- Leave existing vegetation in place for as long as possible
- Cover bare dirt as soon as possible
- Install sediment trapping devices FIRST
- Use proper inlet protection
- Disturb the least amount of area possible
- Entrench silt fence



Reining In Rain Drop Erosion



Rain drops hit bare soil like little bombs with tremendous energy. They cause loose soil particles to become dislodged and to splash up. According to Jason Warren, a Soil and Water Conservation Extension Specialist with the Oklahoma Cooperative Extension Service, as rain falls vertically on flat ground, *rain drop [or splash] erosion* is equal in all directions. However, as rain falls on a slope, more of the soil is splashed down the hill than up the hill. If the rain is being wind driven, the amount of erosion will be determined by the steepness of the slope.[1] Stormwater [i.e., rainfall] runoff carries the loose particles away in the form of *sheet erosion*.

Mr. Warren says "water does not really flow downhill in a smooth, level "sheet" as the name might imply, unless the soil surface is extremely smooth. Water detours around clods and spills out of small depressions. In general, it is a slow, but irregular flow. Sheet erosion is difficult to see, but its damage can be great. Erosion has a greater tendency to carry away the finest material (colloidal clay) than it does the coarsest material (the sand particles). But the problem is that most plant nutrients are attached to the fine, clay particles. So erosion, a selective process, steals the most valuable part of the soil, as well as important organic matter."[1]

Rill erosion occurs next. As a thin layer of water moves downhill, it tends to concentrate in tiny channels called "rills." These rills look like miniature rivers, bending and cutting through the soil. Raindrops continue to break apart the soil, but runoff also has built up enough momentum to break the particles loose. In addition, rills have an excellent ability to transport soil particles. The amount of destruction done by moving water depends on the length and steepness of slope.[1] It's a simple equation, really: The longer and steeper the slope = the faster the water moves = the more erosion occurs.

Eventually, the rills will merge to form larger channels. These may form even larger channels and can become deep enough to be labeled as "gullies." In agricultural terms, channels are defined as gullies when they cannot be obliterated with normal tillage operations. *Gully erosion* is expensive to repair, as the gullies have to be filled and compacted and any off-site sediment deposits have to be reclaimed, if possible. And, gully erosion is deceiving. Although it is the most obvious form of erosion, it does not remove nearly as much soil as the more invisible forms of erosion. Rain drop (splash), sheet, and rill erosion are the forces behind the largest percentage of soil loss, as they occur on all unprotected surfaces, while gully erosion is a problem mainly on steep or long slopes.[1]

WHAT IS A RESPONSIBLE CONTRACTOR TO DO? **Absorb raindrop energy, and reduce the flow rate of stormwater runoff.** Both of these goals can be easily met by applying straw mulch to bare soils. **In fact, if it is applied at the rate of 2 tons per acre, rain drop erosion will be reduced by 80%.** That is huge.

Rain Drop Erosion becomes ... *Sheet Erosion becomes ...* *Rill Erosion becomes...* *Gully Erosion...*

The most effective way to minimize erosion is to keep bare soils protected from rain drop erosion.

[1]*Jason Warren. Oklahoma Cooperative Extension Service PSS-2252 Raindrops And Bombs: The Erosion Process.*

An Ounce of Prevention: Is It Worth It?

As the world took preventive measures to minimize the spread of COVID-19, so can you, as a developer, implement preventive measures to minimize erosion and sediment loss from your project. But just how much do erosion and sediment controls cost? And do they work? There is a prevailing misconception that such controls may be a waste of money, and something for which a developer cannot charge. In an industry where cost is a prime driver, this is a very compelling argument. But, before you make your opinion on the matter, let us explore the actual cost of employing these controls and evaluate their benefits.

PREVENTION

Erosion is defined as the wearing away of the soil surface by water, wind, ice, or gravity. As such, **erosion control** is the attempt to stop erosion before it ever starts. That sounds counterintuitive. But, the effort is focused on keeping the existing soil in place so that it does not become detached or transported elsewhere. How is this accomplished on a construction project? By leaving the existing vegetation in place, if possible, or by covering up the bare soils with *something*. **Vegetation is the best surface cover** because: it holds the soil in place, slows the flow of stormwater runoff, and filters sediment from the runoff. However, other techniques can be used to protect bare soils such as the application of straw mulch, soil stabilization blankets/matting, and even plastic tarps.

Often, a common goal for land development projects is to reshape the existing landscape. Because time and money are spent to clear, grade, and shape the existing topography into a more desirable finished product, it is wise to employ measures to keep the relocated soil in place once the work is complete. This is where erosion control comes into play. As noted, **the best erosion control is green**. Grass, or other dense vegetative cover offers the best protection for bare soils. Most developed properties are sold in their finished state with grass cover, as this is not only aesthetically pleasing but it also protects the underlying soils from erosion. Thus, if the finished product for a project needs to have grass, it makes sense to establish that grass as early as possible in the development process.

The most successful projects bring portions of the site to final grade, add topsoil if required, and immediately stabilize the areas with seed and mulch (or fabric). This is a "going-straight-to-the-finish line" approach. Any reputable grading contractor will tell you they don't want to move the soil twice, unless they get paid extra for doing so. Getting a site under grass cover keeps the soil in place - where it has been placed, and minimizes future re-work. In addition, fully-vegetated areas slow the flow of stormwater runoff, which effectively minimizes sediment loss.

Sedimentation is the deposition or settling out of eroded soil particles that were previously held in suspension by stormwater runoff. **Sediment control** is the effort to "keep eroded soils on the project." It is often the only real option on a construction site, because once the soils are denuded (bare), they will erode and be transported from the site via stormwater runoff. Unless, you employ prevention measures: Control (minimize) the erosion, then control (minimize) the runoff. If you do both of these, you will minimize sedimentation.

THE CURE

Minimum Standard 19 of the Virginia Erosion and Sediment Control Regulations requires that "properties and waterways downstream from development sites . . . be protected from sediment deposition, erosion, and damage due to increases in volume, velocity, and peak flow rate of stormwater runoff." Thus, transported soil that ends up where it doesn't belong has to be cleaned up by the responsible party. That's the Cure part of the discussion. In fact, this misplaced soil may need to be immediately cleaned up, especially if it ended up in a nearby creek or stream. Sediment is a water pollutant, and it damages aquatic life, smothers fish eggs, and destroys aquatic habitat. The removal of accumulated sediment, i.e, "The Cure," can be expensive. It usually involves messy labor, equipment, and disposal costs, or at least putting the soil back where it belongs. All of this costs money, and yet you still have to get the site green to sell it and, hopefully, realize a profit. Also, if you dispose of the sediment offsite, you probably have to vegetate that too, which means more money.

In addition to the costs associated with cleaning up offsite sedimentation, you may be required to obtain a permit from the Virginia Department of Environmental Quality (DEQ) or the U. S. Army Corps of Engineers (USACE) to actually do the work, depending upon the extent of damage to the waterway and the specific jurisdiction of the two agencies. And, you may be subject to enforcement action, such as fines or civil penalties, due to your project's negative impact on waters of the United States and the Commonwealth.

The unexpected costs associated with remediation work, permitting, and enforcement may be hard to absorb. And, it is unlikely that these costs can be passed on to the customer. The Cure is Expensive. So, the question is raised, again: Would prevention have been worth it? Probably.

What follows are some comparative costs to employ erosion and sediment controls (The Prevention) on a site versus some possible repair costs associated with the same site (The Cure) where erosion and sediment controls have not been used or have not been properly used and/or maintained.

"Prevention" Costs				
Construction Entrance	1	Each	$1,200/Each	$1,200
Silt Fence	200	L. F.	$4.00/L.F.	$800
Temporary Diversion	50	L. F.	$5.00/L.F.	$250
Topsoil 3" depth	40,000	S.F.	$0.15/S.F.	$6,000
Permanent Seeding	40,000	S.F.	$0.05/S.F.	$2,000
Straw Mulch	40,000	S.F.	$0.05/S.F.	$2,000
TOTAL				**$12,250**

"Cure" Costs				
Sediment Cleanup (skid steer & dump truck crew)	1	Day	$1,200/Day	$1,200
Sediment Haul & Disposal	$17.50	C.Y.	50/C.Y.*	$875
Landfill Costs (if any, in addition to haul/disposal)	$100	Load	5 Loads*	$500
Re-seed	40,000	S.F.	$0.05/S.F.	$2,000
Re-apply Straw Mulch	40,000	S.F.	$0.05/S.F.	$2,000
Civil Penalty (County)	1	Ea.	$1,000*	$1,000
Permit (DEQ or USACE)	1	Ea.	Variable *($100 to $2,400*)*	$2,400
Fine (DEQ or USACE)	1	Ea.	$32,500*	$32,500
TOTAL				**$42,475**

**Assumed for illustration purposes. For DEQ permit fees, refer to https://law.lis.virginia.gov/admincode/title9/agency25/chapter20/section110/ For USACE permit fees, refer to https://www.lrl.usace.army.mil/Portals/64/docs/regulatory/Permitting/PermittingProcessInformation.pdf*

NOTES:

- Cure Costs are in addition to Prevention Costs, as they are associated with retrieval of offsite sedimentation and re-stabilization of the original site. For every dollar spent on Prevention, there is a possible savings of $3 for The Cure.
- All costs shown above are hypothetical and for illustration purposes only. However, it is fairly obvious to see from this comparison that Cure Costs significantly add to the initial Prevention Costs of "doing it right the first time."

Thus, the old saying is still true: *"An ounce of prevention is worth a pound of cure."*

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This publication is a public service message brought to you by Roanoke County, Department of Development Services. As regulated by federal and state laws, the County's Stormwater Management Program must include public information strategies to encourage the prevention of stormwater pollution. For more brochures or information on ways to prevent stormwater pollution, please call Cynthia S. Linkenhoker, Stormwater Program Manager, at 540-772-2036.

Top 10 Techniques to Keep YOUR Dirt on YOUR Site

1. Keep bare soils covered.
2. Keep existing vegetation in place, if possible.
3. Apply straw mulch at the rate of 2 tons per acre.
4. Cover or vegetate soil stockpiles.
5. Bury toe of silt fence in a 4" deep x 4" wide trench.
6. Routinely apply dust control measures to bare areas.
7. Install sediment controls before any upslope land disturbances begin.
8. Minimize land disturbance.
9. Maintain sediment traps.
10. Remove sediment from behind silt fence when it reaches 1/2 the height of the fabric.