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Southeast, LLC

Environmental, Health and Safety

The Ground Beneath Your Feet

How Geography Shapes Construction Site Management

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Storm Water Awareness Week 2026 | A WGR Southwest Affiliate Presentation

Mountains

Piedmont

Coast

Who We Are

WGR Southeast, LLC — A WGR Southwest Affiliate

WGR Southeast is an Environmental, Health, and Safety (EHS) firm focused on construction stormwater compliance, erosion and sediment control, and site environmental management.

- Qualified Stormwater Personnel (NCDOT Level II, QSP / QSD)
- Certified Professional in Erosion and Sediment Control (CPESC)
- Certified Erosion, Sediment and Stormwater Inspector (CESSWI)
- Construction Environmental Compliance Services
- E&SC Plan Development, Inspections, Training, and Monitoring



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The Core Idea

Geography and geology are not background information

SOIL

Soil Type Determines Pollutant Behavior

Clay, sand, silt, and organic soils each erode differently, absorb differently, and produce different runoff chemistry. A BMP designed for one soil type may fail completely in another.

SLOPE

Slope and Topography Drive Energy

Steeper terrain means faster, more erosive runoff. Flat terrain means longer contact time, ponding, and different pollutant loading patterns. Site design must account for both.

RAIN

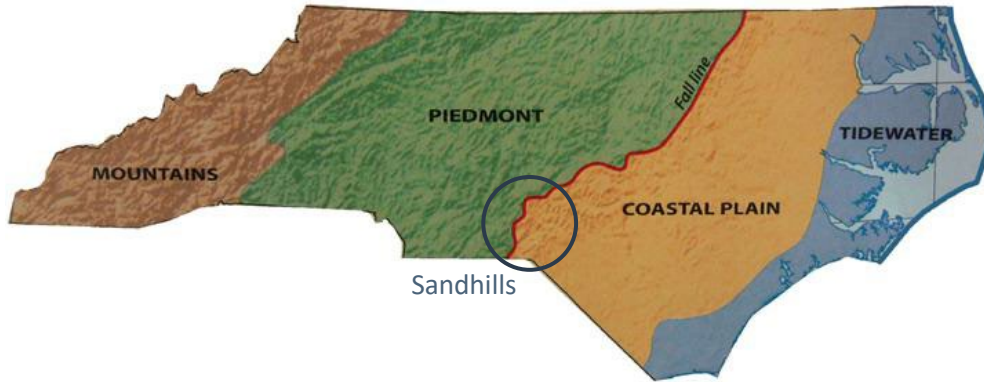
Rainfall Pattern Shapes Risk

A defined wet season produces predictable risk windows. Year-round rainfall with episodic high-intensity storms demands a fundamentally different management posture.

What works in one region may not work in another. Understanding the ground is the first step.

North Carolina as a Case Study

Three distinct regions — one regulatory framework



Mountains

Rugged terrain, steep slopes, thin soils, high-gradient streams. Trout waters and Outstanding Resource Waters with enhanced protections.

Piedmont

Rolling terrain, dense red clay soils, high development pressure. Fine suspended sediment that resists conventional controls.

Coastal Plain & Tidewater

Flat topography, sandy soils, high water tables, slow-moving waterways. Nutrient-sensitive receiving waters with specific basin rules.

Fall Line

The geologic boundary between the Piedmont and Coastal Plain. Rapid change in soil type, stream gradient, and BMP performance over short distances.

Sandhills

Deep sandy soils over clay hardpan at the Piedmont-Coastal Plain transition. Distinct infiltration and revegetation characteristics.

The Mountains

Steep terrain, thin soils, and some of NC's most protected waters



The Mountains

Steep terrain, thin soils, and some of NC's most protected waters

Soils and Geology

- Thin, rocky soils over bedrock
- Limited infiltration capacity
- High organic content in upper horizons; highly erodible when disturbed
- Steep slopes amplify erosive energy of rainfall
- Landslide risk on steeper slopes when vegetation is removed
- High baseflow contribution from groundwater to streams

Receiving Waters and Regulatory Overlay

- Trout Waters designation triggers enhanced E&SC requirements
- Outstanding Resource Waters (ORW) provide highest level of protection
- High-gradient streams are highly sensitive to sediment
- Siltation smothers spawning substrate
- Cool water temperatures support sensitive macroinvertebrate communities
- Buffer requirements apply along designated trout streams

BMP Considerations

- Conventional sediment basins difficult to site on steep terrain
- Check dams and rock energy dissipators are primary conveyance controls
- Slope-length interruption is critical
- Benching and interceptor swales required
- Rapid revegetation is challenging here; cool temps, short growing windows at elevation
- Native species critical. Conventional fescue mixes underperform
- Straw wattles and erosion control blankets well-suited to steep slopes

Trout Waters and Outstanding Resource Waters

Two separate, often overlapping tiers of protection for the mountains' most sensitive streams

Trout Waters (Tr)

- Supplemental water quality classification for streams supporting natural trout propagation and stocked trout survival
- Set by the Environmental Management Commission, separate from NC Wildlife Resources Commission's public trout fishing waters
- The two designations often overlap but are not the same system
- Triggers a fixed 25-foot undisturbed buffer from top of bank, a hard floor other streams don't get
- Stormwater draining to trout waters cannot cause an increase in receiving water temperature
- All tributaries, named and unnamed, take on the trout classification once the main stem is designated

Outstanding Resource Waters (ORW)

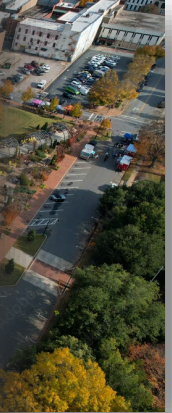
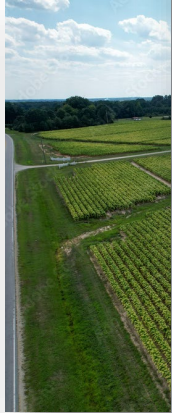
- Reserved for waters of exceptional recreational or ecological significance
- Must be rated Excellent by DWR, plus one outstanding value: scenic river status, park or refuge land, or rare species habitat
- Each segment is designated individually, hence named stretches like Class C Trout ORW
- Automatically a subset of High Quality Waters, the tier just below it
- No new wastewater discharges within a mile upstream; existing ones face tight limits
- 30-foot buffer minimum for development; new discharge permits require a public hearing

The Food Web Connection

- High-gradient streams stay too energetic for fine sediment to settle, keeping the gravel substrate open
- That open gravel is exactly what trout need to spawn; eggs need oxygenated water moving through it
- Fine sediment from a disturbed site fills the gravel and smothers both the eggs and the insect life underneath
- The same substrate supports EPT taxa: mayflies, stoneflies, caddisflies, roughly 90 percent of a trout's diet
- EPT taxa are also the standard bioindicator agencies use to score stream health
- Sediment control here protects the food chain, not just the fish directly
- Terrestrial insects falling from an intact vegetated buffer are a real food source too, another reason the buffer matters

The Piedmont

Red clay, rolling terrain, and the fine suspended sediment problem



The Piedmont

Red clay, rolling terrain, and the fine suspended sediment problem

Soils and Geology

- Residual red clay soils derived from weathered crystalline rock
- High clay content, can exceed 60% in some horizons
- Highly erodible when disturbed; forms a structural crust when dry that masks instability below
- Low infiltration rates when compacted; increases runoff volume
- Fine particles remain in suspension for extended periods after disturbance

The Fine Sediment Challenge

- Silt fence alone is largely ineffective against Piedmont clay fines; particles can pass through the fabric
- Sediment basins capture settleable fraction but not colloidal clay
- Turbid red water can travel miles from a site with minimal visible settling
- Polyacrylamide (PAM) or other flocculants may be necessary for effective treatment
- Receiving water impacts can persist long after visible erosion is controlled

Context and BMP Approach

- Most of NC's urban development and infrastructure construction occurs in the Piedmont
- High impervious cover increases runoff volume and velocity over time
- Phased clearing is the most effective first-line control
- Stabilized entrances must be maintained aggressively
- Temporary seeding with cereal rye (fall/winter) is critical
- Subsoiling on final grades recommended to restore infiltration

How the Clay Forms, and What Actually Helps It

The geology behind the fine-sediment problem, and two amendments people often confuse

The Geologic Origin

- Piedmont bedrock is crystalline rock, granite, gneiss, schist, uplifted during ancient mountain-building
- NC's warm, humid climate has weathered that rock in place for millions of years, with no glaciation to scrape it away
- The product is saprolite: weathered rock that keeps its structure but is soft enough to dig, sometimes over a hundred feet deep near Charlotte
- Feldspar and other primary minerals convert directly into clay minerals, mainly kaolinite, as the rock weathers
- Iron-bearing minerals oxidize in the same process, essentially rusting, giving the clay its red color

Lime

- Exposed Piedmont subsoil and saprolite run acidic once the topsoil is stripped, often strongly to very strongly acid
- At that pH, aluminum can become soluble enough to damage root growth, and other nutrients become harder for plants to use
- Ground agricultural limestone neutralizes that acidity and raises pH into a range vegetation can actually use
- Dolomitic lime adds magnesium along with calcium; either form supplies calcium that helps clay particles bind into stable aggregates
- This is the reliable, general-purpose amendment for prepping raw Piedmont subsoil ahead of seeding

Gypsum

- Calcium sulfate, and unlike lime, it does not meaningfully change soil pH
- Its real, well-documented mechanism is calcium displacing sodium in sodic soils, which restores structure by letting dispersed clay particles reflocculate
- Typical Piedmont red clay is not a sodic soil; it's fine-grained because of its own mineralogy, not excess sodium
- A university extension source lists gypsum loosening ordinary compacted clay as a myth; it does not reliably decompact non-sodic soil on its own
- Worth reaching for when a soil test actually shows elevated sodium, or when calcium is needed without raising pH further
- Not a default pairing with lime for routine compaction relief; the evidence for that specific use is thin

The Coastal Plain

Sandy soils, flat terrain, high water tables, and nutrient-sensitive waterways



The Coastal Plain

Sandy soils, flat terrain, high water tables, and nutrient-sensitive waterways

Soils and Hydrology

- Sandy, low-cohesion soils which erode easily under flow but settle quickly
- High infiltration rates: runoff may be minimal but subsurface transport is significant
- Seasonally high water tables; sediment basins may intersect groundwater
- Flat topography means slow drainage and extended ponding after rain events
- Pocosins and wetland systems are prevalent; buffer requirements are common

Nutrient Sensitivity and Basin Rules

- Neuse River Basin Rules: nitrogen loading limits apply
- Tar-Pamlico Basin Rules: similar nutrient management strategy
- Fertilizer application during revegetation must be carefully managed in these basins
- Riparian buffer protections are extensive and strictly enforced
- Receiving waters feed the Albemarle-Pamlico estuary system

BMP Considerations

- Sediment control shifts: sand settles readily, nutrient control becomes the priority
- High water tables complicate basin design; liner or elevated outlet(s) may be needed
- Silt fence performs better on sandy soils than in the Piedmont
- Vegetation establishment faster due to warmer temps and longer growing season
- Native coastal plain species establish quickly and provide excellent groundcover
- Wetland impacts and buffers must be identified before any grading begins

Nutrient Sensitive Waters: The Neuse and Tar-Pamlico

Why two river basins carry their own regulatory layer on top of standard sediment control

What Triggered It

- Both basins were designated Nutrient Sensitive Waters after documented algal blooms and large-scale fish kills
- In 1989 the state's Division of Marine Fisheries declared the Pamlico River commercially dead
- Washington, NC held a funeral procession downtown, residents dressed in black, to mark the river's decline
- In 1996 the General Assembly set a goal: cut the average annual nitrogen load reaching the Neuse Estuary by 30 percent from 1991-1995 levels
- The Environmental Management Commission was directed to build a plan to hit that target; the Neuse and Tar-Pamlico strategies are the result

The Riparian Buffer Rule

- A 50-foot buffer measured from the top of the bank, on both sides, covering most surface waters in the basin
- Zone 1, the 30 feet nearest the water, has to stay completely undisturbed
- Zone 2, the outer 20 feet, has to stay a stable vegetated area, though some limited uses are allowed there
- Every proposed use gets sorted into one of four tiers: exempt, allowable, allowable with mitigation, or prohibited without a variance
- No new building permit can be issued in violation of the rule; it has real teeth

Who Enforces It

- The rule is set by the Environmental Management Commission; day-to-day enforcement sits with NCDEQ's Division of Water Resources
- That authority can be delegated to local governments with land use authority who apply for it, and a number of counties administer it themselves
- DWR typically learns of violations through complaints or referrals, from the NC Forest Service for example, not routine inspection
- Civil penalties can run up to \$25,000 per violation, though timber-removal violations are now capped differently under a 2023 change
- This is a separate track from both the sediment program and NCG010000; a project can satisfy both of those and still violate this rule

Managing Fertilizer in Nutrient-Sensitive Basins

The Four Rs

Nitrogen leaches. Phosphorus erodes. The 4Rs address both.

Nitrogen dissolves and moves through the ground. Phosphorus binds to soil and moves with sediment. Different pathways need different controls.

1 Right Rate	2 Right Timing	3 Right Source	4 Right Placement
Soil test before applying anything. A lot of NC land, including former farmland, already carries a phosphorus bank from decades of past application; a test can show none is needed at all. NC's Phosphorus Loss Assessment Tool flags fields that exceed recommended rates or drain to impaired waters.	Avoid application within a day or two of forecast rain, and avoid frozen ground or dormant periods with no active plant uptake. Leaching risk is highest on coarse, sandy, low-organic soil, exactly Coastal Plain conditions.	Favor gradual-release forms over fast-release nitrogen that outpaces what a newly seeded stand can actually take up before the next rain event.	Incorporate fertilizer into the seedbed rather than broadcasting it on the surface, and keep it entirely out of the riparian buffer, especially Zone 1.

This is the same nitrogen and phosphorus already covered on the Coastal Plain, applied to the one thing on a site that gets fertilized on purpose: revegetation.

Pocosins: The Coastal Plain's Distinctive Wetland

A swamp on a hill, and what it means for a nearby site

What a Pocosin Is

- A palustrine wetland with deep, acidic peat soil, sitting on flat upland ground between stream valleys, not in a floodplain
- The name comes from an Algonquian word meaning roughly “swamp on a hill”
- Rainfall driven rather than stream fed, with a perched water table holding it wet despite the higher ground
- The peat itself built up over thousands of years from plant material that couldn't fully decompose in saturated, low-oxygen conditions
- Dominated by dense evergreen shrubs: pond pine, titi, zenobia, and greenbrier at the margins

A Fire-Dependent Ecosystem

- Pond pine cones are serotinous, sealed shut until a fire's heat opens them to release seed
- Fire frequency shapes the whole system: roughly decade-scale fire favors pond pine with a cane understory
- More frequent fire produces the dense pyrophytic shrub layer pocosins are known for
- Annual fire prevents shrub growth entirely, creating an open grass and sedge savanna instead
- A burning peat fire can go deep enough to leave small lakes where the ground itself burned away

What It Means for Your Site

- North Carolina holds the majority of all pocosin acreage on the Atlantic Coastal Plain
- Roughly a third of what once existed has been drained or cleared since the mid-20th century, mostly for agriculture and pine plantation
- A standard upland seed mix is not suited to a pocosin's acidic, saturated, nutrient-poor edge; the transition zone needs its own species
- A pocosin is a federally jurisdictional wetland under the Clean Water Act
- Disturbance reaching into it triggers separate Section 404 permitting through the Army Corps of Engineers
- On a Coastal Plain site near a pocosin, that's a fourth regulatory layer alongside sediment control, NPDES, and the NSW buffer rule

The Albemarle-Pamlico Estuary

Where everything we've covered today actually ends up

2nd

largest estuary in the continental US

~28,000 sq mi

watershed draining into it

6

major river basins feed it

~2M acres

of open estuarine water

Why It's So Vulnerable

- Shielded from the Atlantic by the Outer Banks, with only a handful of inlets allowing any exchange with the ocean
- Shallow, with minimal tidal range, so it doesn't flush the way a more open coastal system would
- Albemarle Sound runs largely fresh to brackish; freshwater inflow from the Roanoke and Pasquotank rivers overwhelms any saltwater influence
- Nutrients that enter tend to accumulate rather than disperse, exactly the dynamic behind the Neuse and Tar-Pamlico rules
- In 1989 the Pamlico River was declared commercially dead, a real, visible consequence of this system's nutrient balance breaking down

The Bigger Picture

- Every region in this deck, mountains, Piedmont, Coastal Plain, ultimately drains toward this one shared receiving water
- Congress designated it an estuary of national significance in 1987, the same year it became one of the first National Estuary Programs
- Today it's run as the Albemarle-Pamlico National Estuary Program, still tracking water quality across the whole watershed
- It supports dozens of fish and shellfish species and underpins a real commercial and recreational fishing economy

The Fall Line

Where the Piedmont meets the Coastal Plain — and conditions change rapidly

What Is the Fall Line?

The Fall Line is the geologic boundary where the crystalline bedrock of the Piedmont meets the softer sedimentary formations of the Coastal Plain. Rivers crossing the Fall Line drop in elevation sharply, historically creating waterfalls and rapids. This is the reason so many early NC cities (Raleigh, Durham, Fayetteville) were founded along it, where waterpower was available.

For construction stormwater purposes, the Fall Line matters because soil type, stream gradient, and BMP performance can change dramatically over a distance of just a few miles. A project spanning the Fall Line may encounter completely different conditions on one end versus the other.

Soil Transition

Clay-dominant Piedmont soils give way to sandy Coastal Plain soils. Erosion mechanisms and sediment behavior shift completely.

Stream Gradient

High-energy Piedmont streams become low-gradient Coastal Plain rivers. Sediment deposited in the transition zone can be significant.

BMP Performance

Controls designed for one side of the line may underperform on the other. Site-specific assessment is essential for projects near or spanning the transition.

Project Planning

Soil borings and geologic review should inform E&SC plan design for any large project near the Fall Line.

Rainfall and Climate

Why stormwater controls here don't get an off-season

>40"

NC statewide avg. annual rainfall

6 mo.

Atlantic hurricane season (Jun-Nov)

12 mo.

NC effective rainy season

2"+/hr

Peak convective storm intensity

The Pattern

- Rainfall is distributed year-round. NC has no defined dry season that allows unprotected disturbance
- Convective summer thunderstorms: short duration, very high intensity, 2" or more per hour possible
- Hurricane season (June–November) brings episodic extreme events that can overwhelm controls
- Freeze-thaw cycles in the Piedmont and Mountains can weaken vegetation and destabilize disturbed soils
- Active E&SC controls are required year-round. There is no off-season

The Operational Reality

- Inspection and maintenance schedules can't assume a seasonal lull. Controls need year-round attention.
- Contractors used to seasonal markets might under-budget for winter and early-spring BMP maintenance.
- Hurricane season overlaps half the year, so storm recovery must be built into the schedule.
- Planning around a "dry season" is not a viable strategy anywhere in the state.

The Regulatory Landscape

Two programs, two agencies, one construction site

The Dual-Track System

Sedimentation Pollution Control Act (SPCA)

State E&SC program administered by NCDEQ's Land Quality Section. Requires an approved E&SC plan for disturbed areas exceeding one acre. Enforced by Land Quality inspectors.

NPDES Construction General Permit NCG010000

Federal Clean Water Act program, also administered by NCDEQ. Requires a SWPPP and compliance with permit conditions. Enforced by NPDES inspectors.

The Key Difference

Two separate inspectors from two separate program areas can visit the same site for different reasons. A finding under one program does not preclude action under the other.

Enforcement Today, and Where It's Heading

Enforcement in Practice

A stop-work order, a Notice of Violation, and civil penalties can all originate from either program independently. Paperwork that satisfies one program's recordkeeping doesn't automatically satisfy the other's.

NCG010000 Today

Relies primarily on narrative standards rather than numeric limits. Most sites are not required to conduct effluent sampling. E&SC plan compliance is the primary enforcement mechanism.

NC's Trajectory

NC's permit currently relies on narrative standards rather than numeric limits in most cases, and the most recent 2024 renewal kept that structure largely intact.

BMP Performance by Region

The same control does not perform the same way everywhere

BMP	Mountains	Piedmont	Coastal Plain
Silt Fence	Useful on gentler slopes; overwhelmed on steep grades	Poor for clay fines. Passes colloidal particles; better for coarser fraction	Coarser sand particles settle and are retained effectively
Sediment Basin	Difficult to site; limited flat area; may require engineered design	Captures settleable fraction; clay fines may require flocculant treatment	High water table complicates design; may need liner or elevated outlet
Seeding / Mulch	Slow establishment at elevation; cool temps; native species critical	Cereal rye and fescue viable; clay compaction limits germination without prep	Fast establishment; longer growing season; coastal natives highly effective
Check Dams	Essential in steep channels; rock or log construction standard	Useful in drainage channels; moderate gradient makes them effective	Less relevant on flat terrain; flow energy generally low

Native Vegetation by Region

Right plant, right place.

Establishment speed and effectiveness vary dramatically

Standard seed mixes from one region routinely fail in another. Native species establish faster, require less maintenance, and provide superior erosion protection once established.

Mountains	Piedmont	Coastal Plain
Grasses and Sedges • Virginia wildrye • Mountain oat grass • Canada wild rye	Grasses and Sedges • Broomsedge • Little bluestem • Switchgrass	Grasses and Sedges • Coastal panicgrass • Gulf muhly • Eastern gamagrass
Forbs and Wildflowers • Coneflower • Wild bergamot • Blue mistflower	Forbs and Wildflowers • Black-eyed Susan • Partridge pea • Wild senna	Forbs and Wildflowers • Narrowleaf sunflower • Swamp rose mallow • Buttonbush (wetland edges)
<i>Short growing windows at elevation. Cool-season species preferred. Avoid warm-season mixes that won't establish before winter.</i>	<i>Clay soils require seedbed preparation. Cereal rye is the standard winter annual cover. Native warm-season grasses establish slowly but provide long-term stability.</i>	<i>Longer growing season allows faster establishment. Sandy soils drain quickly, so drought-tolerant species important. Wetland transition species needed at seasonal wet edges.</i>

Think Geographically

North Carolina is the example. The principle is universal.

1

Know Your Soils

Texture, structure, erodibility, and infiltration capacity before the first blade of equipment touches the ground. A soil survey is the foundation of your E&SC plan.

2

Understand Your Topography

Slope length and gradient determine erosive energy. Drainage patterns determine where runoff goes. Flat terrain creates different problems than steep terrain.

3

Know Your Receiving Waters

What is downstream? Trout stream, nutrient-sensitive estuary, impaired waterbody, or public water supply? The sensitivity of the receiving water drives the standard of care required.

4

Match Controls to Conditions

A silt fence installed exactly by the book does not perform the same way in every soil type. Select BMPs based on actual site conditions, not habit or convenience.

This is as true wherever you work as it is in North Carolina. The soil, the slope, the rainfall, and the receiving water are always the starting point.

Questions?

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