

Permitting and Implementation - Erosion & Sedimentation Control Plans for Solar Farms

Tamera Eplin, PE, CPESC

*NCDEQ/IECA Innovative Erosion and Sedimentation Control Design Workshop
December 4, 2018*

What is the difference between the average construction site



And a solar farm site?



Department of Environmental Quality



Regarding Erosion and Sediment Control? Nothing!





All construction has the potential to damage our natural resources



NC Sediment Regulations Have 6 Basic Control Objectives:

- Identify critical areas
- Limit exposed areas
- Limit time of exposure
- Control surface water
- Control sedimentation
- Manage stormwater runoff

Refer to 15A NCAC 04B .0106



Begin with post-construction & general construction stormwater requirements



E-6. Solar Farms



Image SAS, Cary, NC

Design Objective

Solar farms consisting of large arrays of ground-mounted photovoltaic systems are becoming increasingly common in North Carolina. Responsible development of solar farms must balance the growth of this valuable industry with the need to protect our natural resources, including addressing issues related to stormwater runoff. Solar farms that use traditional elevated solar panels are unique because they contain an impervious surface (elevated solar panel) that often have a pervious surface (vegetation) underneath the panel. Stormwater management may be achieved in a cost-effective manner by disconnecting rows of solar panels and directing runoff over the vegetated areas between the rows.

Regulatory Requirements

Currently, the State allows solar panels associated with ground-mounted solar farms to be considered pervious if configured such that they promote sheet flow of stormwater from the panels and natural infiltration of stormwater into the ground beneath the panels. Other structures associated with the solar farm such as buildings, entrance roads, transformers, and footings would still be considered impervious.

Important Links

N.C.G.S. 143-214.7(b2): "For purposes of implementing stormwater programs, 'built-upon area' means impervious surface and partially impervious surface to the extent that the partially impervious surface does not allow water to infiltrate through the surface and into the subsoil."

Post-Construction Stormwater Regulations affect your design, and therefore your ESC Plan

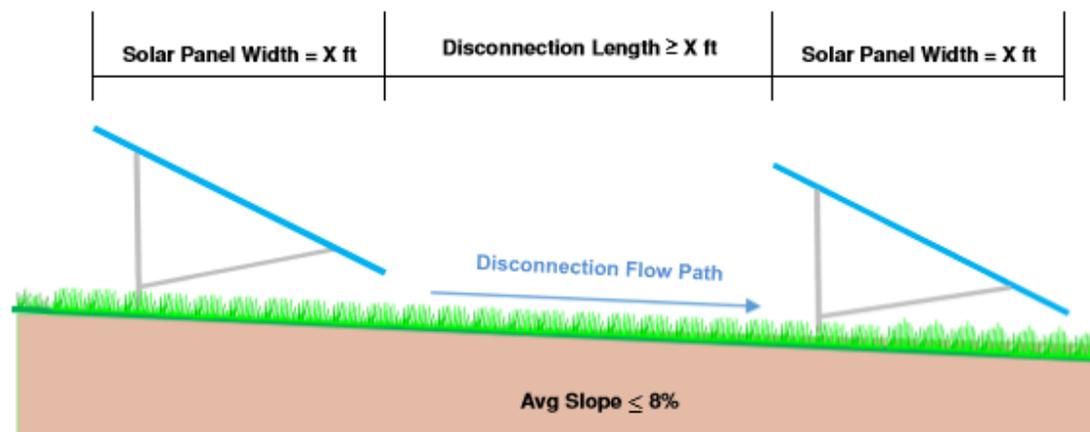
RECOMMENDATION 1: AVOID COMPACTION OF SUBSOIL

Subsoil compaction should be minimized during and after installation of solar arrays to allow the maximum amount of natural infiltration. If compaction occurs during construction, subsoil should be tilled and amended to return the soil to its pre-compaction condition.

RECOMMENDATION 2: DISCONNECT RUNOFF FROM SOLAR PANEL ARRAYS

Solar arrays should be designed and installed to allow growth of vegetation under and between the solar arrays. Rows of panels should be installed with sufficient distance between rows to allow for capture of rainfall from at least 1.0 inch of rain (Figure 1). Where installed on slopes greater than 8%, consider options for maintaining sheet flow and dissipating energy at the drip edge of each row of panels.

Figure 1: Disconnection of flow path between solar panels when average slope is less than 8%.



Other Recommendations for Site Post-Construction Stormwater

- Avoid concentration of post-construction stormwater. Areas of steep slope may not be suitable or may require considerable grading
- Minimize use of herbicides and fertilizers.
- Plant mix of warm- and cool-season grasses.
- Limit vertical clearance to 10 feet or less to reduce scouring and erosion at the driplines.



NCG010000 Permit Conditions affecting your ESC Plan

- Onsite rain gauge
- **Self-monitoring/self-inspections**
- **Ground stabilization**
- **Surface withdrawal**
- Implementation of the E&SC Plan
- Maintenance of measures
- Proper equipment operation and maintenance
- Material handling (herbicides, pesticides, fertilizers)
- Building material waste handling
- Location of stockpiles at least 50 feet away from storm drain inlets and surface waters
- Proper handling of concrete
- Bypassing of stormwater control facilities



Wouldn't it be great if ESC design was always for solar sites like this?



ESC Design Considerations for Solar Farms

This guidance is not meant to be exhaustive. For further guidance, please refer to our North Carolina Erosion and Sediment Control Planning and Design Manual.



Include all potentially disturbed areas in LOD



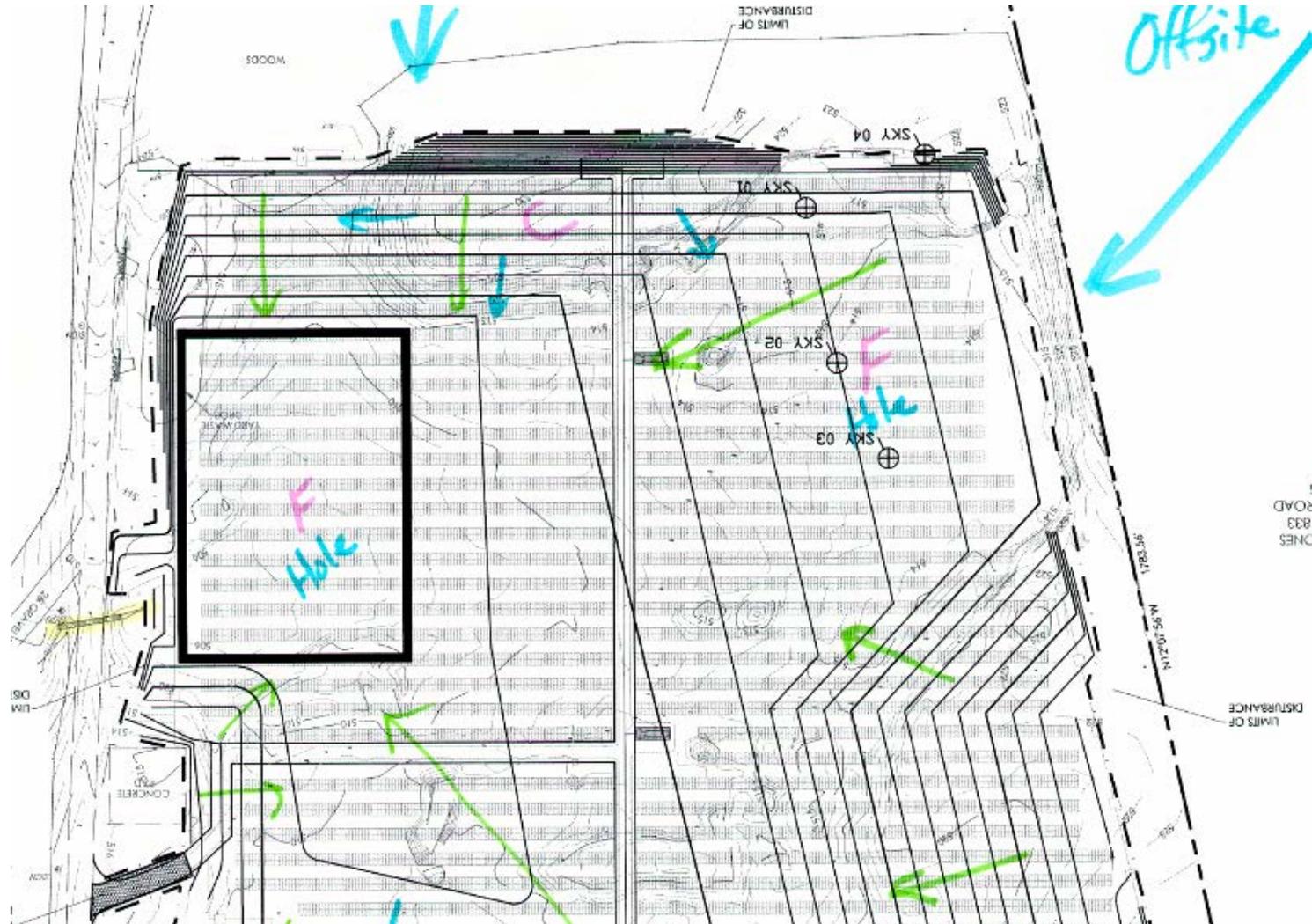
- All construction areas
- All area equipment may travel over
- Staging areas
- Haul roads
- Areas of access
- Areas of erosion control measures
- All tree clearing areas
- All landscaping areas
- Borrow and fill locations, if not already on an ESC plan



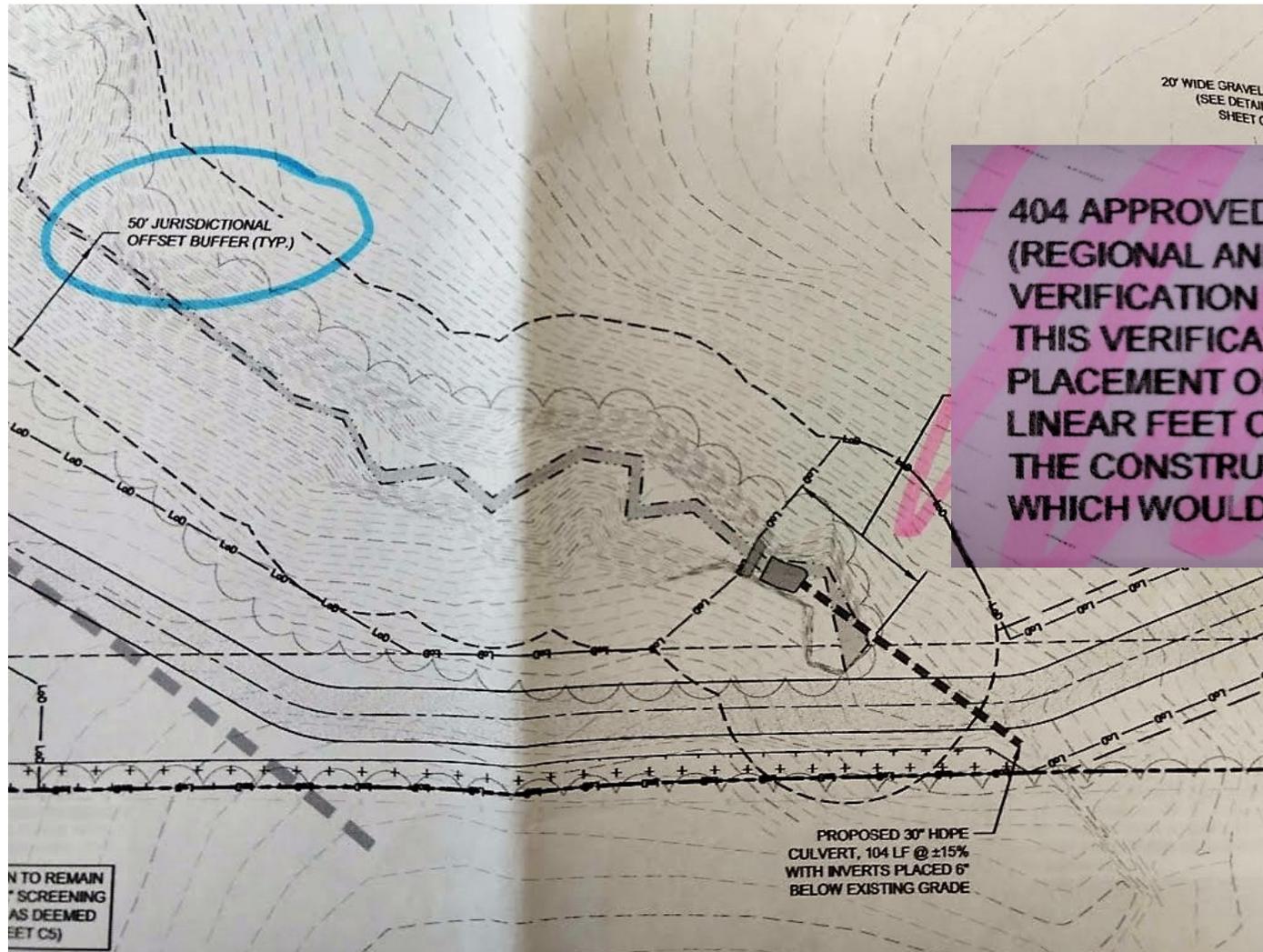
Include all 'tree cutting' areas



Don't plan solar panels in the area of sediment basins



Clearly show all riparian buffers, and areas of 401/404 temporary and/or permanent impact



404 APPROVED GENERAL PERMIT (REGIONAL AND NATIONWIDE) VERIFICATION SAW-2015-02491: THIS VERIFICATION AUTHORIZES THE PLACEMENT OF FILL MATERIAL IN 58 LINEAR FEET OF STREAM TO FACILITATE THE CONSTRUCTION OF A ROADWAY WHICH WOULD ACCESS A SOLAR FARM.



Piedmont Foothills Area Solar Farm ~400 acres



Solar arrays were built around creeks and wetland areas



NCG 01000 Ground Stabilization Requirements – Apply to any portion of the project for any period of inactivity

Ground Stabilization Requirements		
Site Area Description	Stabilization	Timeframe Exceptions
 Perimeter dikes, swales, ditches and slopes	7 days	None
 High Quality Water (HQW) Zones	7 days	None
 Slopes steeper than 3:1	7 days	If slopes are 10' or less in length and are not steeper than 2:1, 14 days are allowed.
 Slopes 3:1 or flatter	14 days	7 days for slopes greater than 50' in length.
 All other areas with slopes flatter than 4:1	14 days	None, except for perimeters and HQW Zones.

Refer to Section II.B. 2) of NCG 01000.



Important Definitions within the NCG 01000 Permit

- **Ground cover** - Any vegetative growth or other material which, when applied to the soil surface, renders the soil surface stable against accelerated erosion.
- **Soil Stabilization** - The use of vegetative, physical or chemical coverage techniques that will restrain accelerated erosion on disturbed soils for temporary or permanent control needs.
- **Temporary Stabilization** - When the establishment of ground cover over all disturbed areas (such as mulching, RECP, vegetation, or other material) renders the surface stable against accelerated erosion. Stabilization shall be achieved with the establishment of a uniform and evenly-distributed (i.e., without large bare areas) ground cover with a cover density of at least 80%.
- **Permanent Stabilization** - When all soil disturbing activity is completed and exposed soils have been stabilized with a vegetative cover with a density of at least 80% or covered with a structural stabilization method. Permanent perennial vegetation may include sod, shrubs and ground cover plants mixed with mulching, aggregate or other landscaping techniques. Structural methods include concrete, asphalt, retaining wall or other stabilization techniques.



Your ESC design must consider

How much area can you manage and meet the 7/14 day stabilization requirements?

- Are you in a high quality water area?
- Trout waters!!
- Steep slopes?
- Threatened species?
- Subject to stricter local program requirements?

It is your responsibility to demonstrate through design, phasing, construction sequence, and implementation of your ESC plan that the open area can be effectively managed to meet the stabilization requirements.



Your ESC design must consider

How much area can you manage and meet the self-inspection requirements?

- How long does it take you to inspect your 1,000-acre site?
- How do you go about performing these self-inspections. Can you accomplish it within 24 hours of the 0.5 inch/24 hr rainfall?
- The reports require details including observations and actions taken in accordance with NCG 01000. If a large portion of the site is impacted, can the corrective actions take place by the next inspection, or ideally before the next inspection and next rainfall?
- Your self-inspection records are to available upon request. Are you willing to provide electronic copies for the duration of your project?

It is your responsibility to demonstrate through design, phasing, construction sequence, and implementation of your ESC plan that the open area can be effectively managed to meet the self-inspection requirements.



Have you herd? Cows don't like change. Or solar farms.



Keep cows out of your construction area



Cows developed a path across this sediment basin until it failed.



Keep cows out of your construction area



Silt fencing won't keep people out, let alone cows.



Use conservative sediment basin design



Aesthetic Buffers



Matting may be necessary for stabilizing dripline areas



Department of Environmental Quality



Diversion Berms

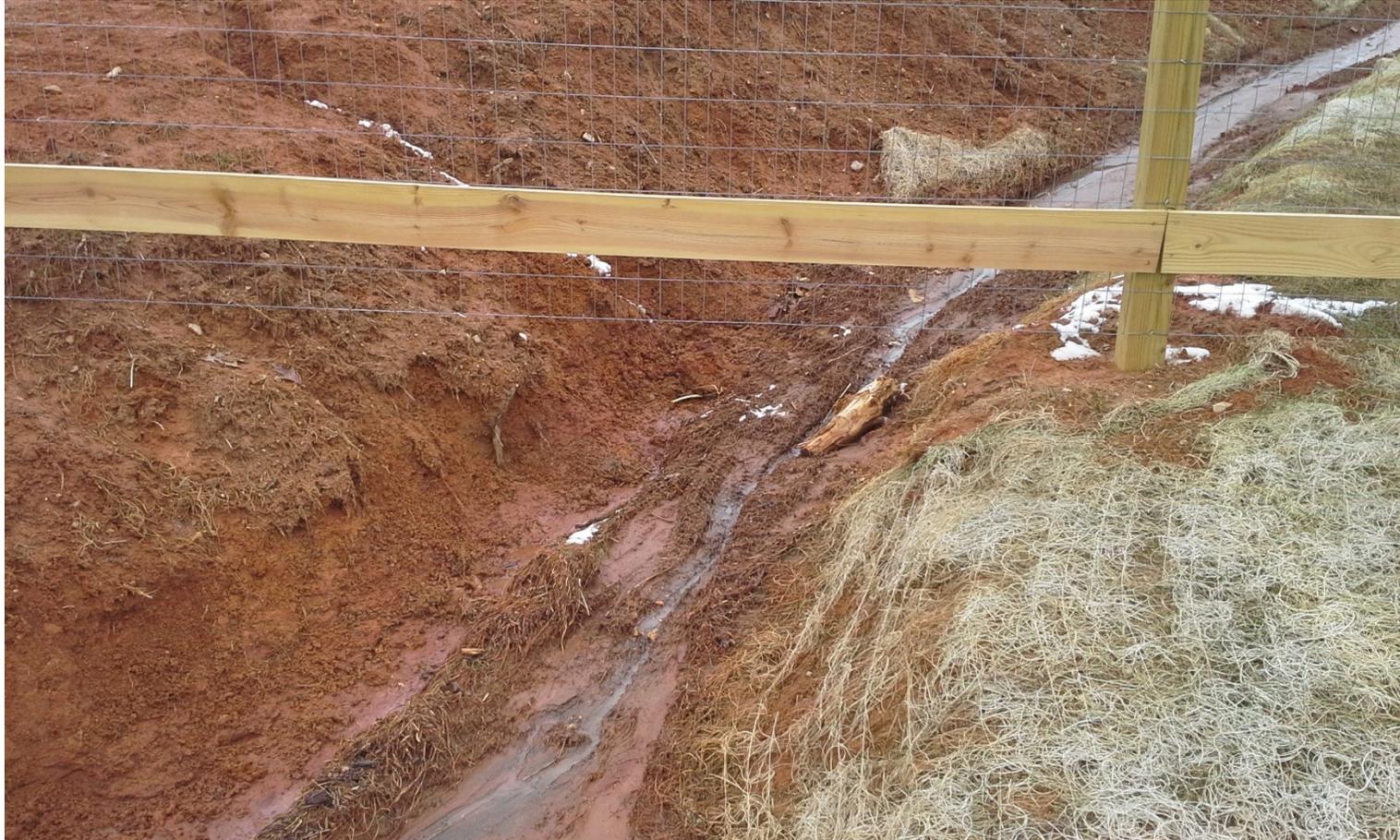
- Avoid long diversion berms. Multiple basins are preferable to one large basin.
- Per our design manual, and temporary diversion berm that will remain in place longer than 30 days should have matting and vegetative stabilization.
- Clean water diversion berms used to direct water around the site must be installed with immediate matting and vegetative stabilization. Their installation should be specified in the construction sequence.
- Diversions with sharp turns will be blown out.



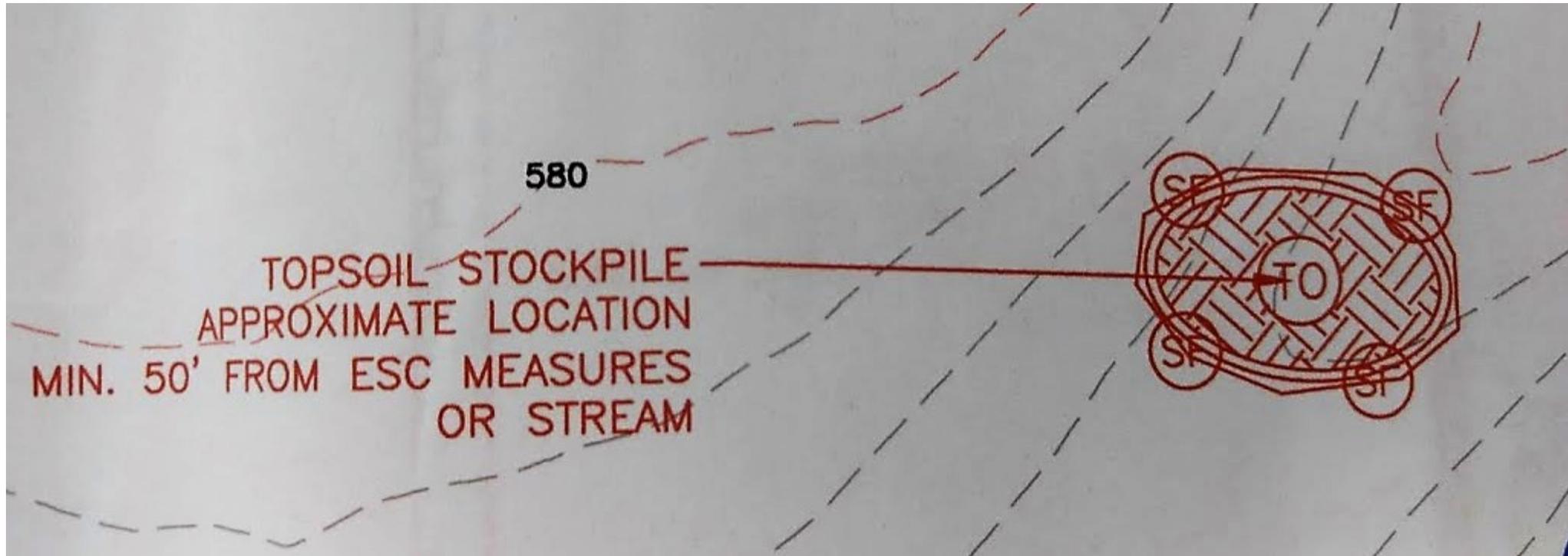
Improper use of a stone outlet



Poorly installed & non-maintained diversion through a fence



Plan to decommission sediment basins after all contributing areas are permanently stabilized



Access roads need to be stabilized/maintained



Case Study – ESC Design of a Solar Farm on Top of a Closed Landfill



“Impossible” Site Conditions

- **Site on top of a closed landfill with 18 to 24 inches cover.**
- **NO excavation allowed per landfill regulations. This meant no silt fencing, no basins within the landfill area, no digging for posts, security fence, etc.**
- **Site surrounded on 3 sides by creeks and a sewer line.**
- **Roughly one-third of the area had established trees and the rest was grassed.**
- **Two former sediment basins from the original landfill were downgradient from the site, but flow had to be diverted.**



Flow was diverted with 24-inch compost wattles



Security fence was built above existing ground



“Concrete canoes” anchored the arrays



*To avoid grading, uneven ground was built up “to grade”
using gravel*



Maintenance Challenge: erosion of the gravel areas built up, periodic replacement will be necessary



Excavation avoided by using overland lines



Excavation avoided by using overland lines





Diligent preventative maintenance of surface erosion will be crucial to maintain integrity of the landfill cap



The control station area was built up with gravel



Panels generally followed existing land contours



Summing up,

Good ESC plans have a construction path related to erosion and sediment control that is apparent by the use of **detailed construction sequences, phased plans** that take into account changes in drainage patterns, and **problem areas identified and protected.**



Credits

Michael Lawyer, CPSWQ, NCDEMLR, Fayetteville Regional Office
Keith Billy, Cypress Renewables
Matthew Gantt, PE, NCDEMLR, Winston-Salem Regional Office
Holliday Keen, NCDEMLR, Mooresville Regional Office
Kenny Llywelyn, NCDEMLR, Mooresville Regional Office
Karyn Pageau, EIT, CPESC, Wake County
Michael Peveler, NCDEMLR, Mooresville Regional Office
Isaiah Reed, NCDEMLR, Asheville Regional Office
Ashley Rodgers, PE, City of Raleigh
Danielle Rudisill, Lincoln County Local Erosion Control Program
Ashton Smith, PE, Ballentine Associates, PA
Mike Smith, NCDEMLR, Asheville Regional Office

Questions? Comments? We value your feedback!

Tamera Eplin, PE, CPESC
Assistant Regional Engineer

Land Quality Section, Mooresville Regional Office
Division of Energy, Mineral and Land Resources
North Carolina Department of Environmental Quality

704 663 1699 office
tamera.eplin@ncdenr.gov

610 East Center Avenue, Suite 301
Mooresville, North Carolina 28115

Department of Environmental Quality

