

Stormwater Management Report for:

Spotsylvania Solar Energy Center
Spotsylvania County, Virginia

Prepared for:
Swinerton Renewable Energy
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Introduction

The subject property is located in western Spotsylvania County, Virginia. A majority of the project (Site A) is located between West Catharpin Road and Orange Plank Road, with the smaller Sites B and C located just south of West Catharpin Road. The subject property is made up of 30 parcels consisting of approximately 6,258 acres. The parcels are identified as tax map no. 28-A-71, 29-A-2A, 29-A-2, 28-A-77, 16-A-1, 29-A-24, 29-A-25, 29-A-26, 29-A-27, 17-A-47, 29-A-28, 29-A-22, 18-A-15, 18-A-20, 29-A-7, 28-A-1, 28-A-78, 29-A-1, 28-A-79, 30-A-1, 18-A-16, 17-A-4, 17-A-3, 17-5-19, 17-A-3A, 17-A-48, 17-A-7, 28-A-58, 43-A-3, 29-A-7. The property is currently undeveloped and used for silviculture. The property is currently zoned A-3 (Agricultural) as defined by the Spotsylvania County zoning map. The development efforts will consist of grading, drainage, landscaping, and additional improvements necessary to support the proposed land use and allow adequate vehicular access. The total land disturbance proposed for the overall project is approximately 4,234 acres.

The overall project is proposed to install solar panels to produce 500MW_{AC} of power; however, a bulk of the details in this report will pertain to Phase 1 of the project, producing 75MW_{AC} of power. Phase 1 will disturb approximately 598 acres of land.

This report summarizes the design strategies implemented to meet the Stormwater Management requirements of Spotsylvania County and the Virginia Department of Environmental Quality. Full design of stormwater BMPs will be provided during the site plan process for each associated phase.

Site Description

The existing site consists of hydrologic soil group "B", "C", and "D" type soils. There are both culturally (cemeteries) and environmentally (wetlands) sensitive areas located on-site, as well as resource protection areas (RPA). The development is proposed to avoid these sensitive areas to the maximum extent practical. Any impacts proposed to the wetland areas and RPAs within the development will be offset with the purchase of wetland credits. The site contains significant slopes and generally drains from north to south and southeast towards the existing wetland areas. In existing conditions, there is no stormwater management infrastructure located on the site.

In proposed conditions, the overall drainage patterns will be maintained with the site generally grading towards the wetland areas in the south and southeast. Various approved stormwater management methods are proposed to meet quantity and quality requirements, as described below.

Stormwater Management

Criteria and Methodology

The following calculation methods were used for analysis on the project site:

- SCS Method (stormwater quantity compliance)

- Time of Concentration calculated per TR-55

The following software programs were used for the analysis on the project site:

- FlowMaster
- HEC - HMS

The following criteria were used in design and evaluation of the existing and proposed stormwater improvements:

- Sheet Flow Max. Length 100 ft
- Stormwater quantity compliance 9VAC25-870-66
- Stormwater quality compliance DEQ Virginia Runoff Reduction Method
New Development Compliance Spreadsheet
– Version 3.0

Water Quantity Control

Based on the existing topography of the project area, there are six watershed areas that will be impacted by the overall project. Phase 1 will impact two of the watersheds – Watersheds 3 and 4 (**Appendix A**).

The site was analyzed at two outfall locations through which the water from Phase 1 passes. Watersheds 3 and 4 drain through a network of existing wetlands before reaching the two points of analysis (POA), POA 3 and POA 4, respectively. For this analysis, each watershed was broken into two components – the area to be left mostly undisturbed (Offsite) and the area proposed for the solar panels (Onsite) within Phase 1. The flow rates and drainage have increased negligibly in the mostly undisturbed areas of the watersheds but have increased more significantly in the disturbed areas. Overall, at the POAs analyzed for this project, the flow rates and drainage have increased slightly. This is mainly due to the Phase 1 area being at the downstream portion of the watersheds and peaking prior to the entire watershed areas contributing to the peak.

The pre- and post-development comparisons are summarized below in Tables 1-4. The Overall Site, Grading and Drainage Plan, Pre- and Post-Development Drainage Area Maps, VDEQ Quality Maps, and Soil Quality Map can be found in **Appendix A**. The time of concentration calculations, FlowMaster Hydrology Report, and HEC-HMS Hydrology Report can be found in **Appendix B**.

Watershed 3, Q_{peak} (cfs)						
	Offsite		Onsite		Overall – POA 3	
Storm Frequency (Years)	Pre-development PRE-3.2 (cfs)	Post-development POST-3.2 (cfs)	Pre-development PRE-3.1 (cfs)	Post-development POST-3.1 (cfs)	Pre-development (cfs)	Post-development (cfs)
1	380.9	384.1	29.5	73.1	393.3	409.5
2	736.8	743.5	65.1	124.5	760.1	786.2
10	2,267.0	2,289.5	227.3	315.1	2,333.8	2,394.0
100	6,325.8	6,388.7	666.9	767.0	6,505.9	6,642.7

Table 1: Watershed 3 Peak Flow Comparison

Watershed 3, V (ac-ft)						
	Offsite		Onsite		Overall – POA 3	
Storm Frequency (Years)	Pre-development PRE-3.2 (ac-ft)	Post-development POST-3.2 (ac-ft)	Pre-development PRE-3.1 (ac-ft)	Post-development POST-3.1 (ac-ft)	Pre-development (ac-ft)	Post-development (ac-ft)
1	138.5	138.7	6.6	12.6	145.2	151.2
2	236.5	236.6	11.7	19.6	248.1	256.2
10	622.5	622.8	32.1	45.1	654.6	667.9
100	1,623.0	1,623.7	86.3	106.6	1,709.3	1,730.3

Table 2: Watershed 3 Volume Comparison

Watershed 4, Q_{peak} (cfs)						
	Offsite		Onsite		Overall – POA 4	
Storm Frequency (Years)	Pre-development PRE-4.2 (cfs)	Post-development POST-4.2 (cfs)	Pre-development PRE-4.1 (cfs)	Post-development POST-4.1 (cfs)	Pre-development (cfs)	Post-development (cfs)
1	508.3	508.3	35.2	70.8	524.2	532.5
2	973.6	937.6	70.5	120.4	1,003.1	1,014.9
10	2,973.0	2,973.0	222.2	305.1	3,054.9	3,072.7
100	8,290.7	8,290.7	619.2	743.9	8,508.9	8,530.5

Table 3: Watershed 4 Peak Flow Comparison

Watershed 4, V (ac-ft)						
	Offsite		Onsite		Overall – POA 4	
Storm Frequency (Years)	Pre-development PRE-4.2 (ac-ft)	Post-development POST-4.2 (ac-ft)	Pre-development PRE-4.1 (ac-ft)	Post-development POST-4.1 (ac-ft)	Pre-development (ac-ft)	Post-development (ac-ft)
1	201.8	201.8	8.6	13.6	201.4	215.5
2	345.0	345.0	14.6	21.2	359.5	366.2
10	909.8	909.8	38.1	49.0	947.9	958.7
100	2,375.4	2,375.4	99.0	115.8	2,474.4	2,491.2

Table 4: Watershed 4 Volume Comparison

Channel Protection

The 1-year storm was analyzed using the Virginia Energy Balance Equation. The onsite allowable discharge based on the following equation was calculated for each of the analysis points and is shown in Table 5. An improvement factor of 0.8 was used for all calculations since the project exceeds 1.0 acre.

$$Q_{post-actual} \leq Q_{pre} \left(\frac{V_{pre}}{V_{post}} \right) (IF)$$

Phase 1 (75MW), 1-Year Storm Results					
	Pre		Post		
Analysis Point	V ₁ (ac-ft)	Q ₁ (cfs)	V ₁ (ac-ft)	Q _{1 act} (cfs)	Q _{1 allow} (cfs)
POA 3	6.6	29.5	12.6	73.1	12.4
POA 4	8.6	35.2	13.6	70.8	17.8

Table 5: Energy Balance Equation Summary

Grass channels, bioretention, dry swales, infiltration, soil amendments, sheet flow to open space techniques, and other approved methods will be implemented to meet Channel Protection requirements.

Flood Protection

Per Part IIB of the stormwater management regulations on water quantity, when an outfall is experiencing flooding "confine the post-development peak flow rate from the 10-year 24-hour storm event within the stormwater conveyance system..." Tables 6 and 7 include the 10-year pre- and post-development peak flow comparisons.

Watershed 3, Q_{peak} (cfs)				
	Onsite		Overall – POA 3	
Storm Frequency (Years)	Pre-development PRE-3.1 (cfs)	Post-development POST-3.1 (cfs)	Pre-development (cfs)	Post-development (cfs)
10	227.3	315.1	2,333.8	2,394.0

Table 6: Watershed 3 Peak Flow Comparison

Watershed 4, Q_{peak} (cfs)				
	Onsite		Overall – POA 4	
Storm Frequency (Years)	Pre-development PRE-4.1 (cfs)	Post-development POST-4.1 (cfs)	Pre-development (cfs)	Post-development (cfs)
10	222.2	305.1	3,054.9	3,072.7

Table 7: Watershed 4 Peak Flow Comparison

Utilizing the techniques used to meet the required Channel Protection criteria, the 10-year peak flow rate will be decreased. If the post-development flow rate is still above pre-development, an analysis of the downstream conveyance system will be completed to illustrate that the storm event is adequately contained. The analysis will stop at the mapped floodplain.

Water Quality Control

Water quality requirements are proposed to be met by the preservation of forest/open space. Due to the presence of wetlands and associated buffers on the overall site, water quality requirements are met for both Phase I and the overall project by the preservation of these environmental lands. As the project moves into the site plan process, more detailed design will be done to verify the quality requirements. If additional quality measures are required, the following BMPs might be used to meet the VRRM requirements: grass channels, bioretention, dry swales, wet swales, infiltration wet ponds, and other approved methods. The VRRM spreadsheet calculations have been provided in **Appendix C**.

Wetlands/Streams

There are known wetlands, resource protection areas, and environmentally sensitive areas located on the subject site. The development is proposed to supply adequate buffering and avoid sensitive areas to the maximum extent practical. The applicant is in the process

of obtaining a NWP 51 for any proposed impacts on the wetlands. Additionally, wetland credits will be purchased to offset proposed impacts.

Overall Project, 500MW Stormwater Management Summary

Stormwater Management for the remainder of the overall project will be handled in a similar manner to Phase 1 (75MW_{AC}). If necessary, various approved methods as mentioned in this report will be utilized to meet Channel Protection, Flood Protection, and Water Quality requirements.