

**MEMO —** 3/27/23 **SUBJECT —** Wolf Farms Soccer Fields – Stormwater Management  
**FROM —** Justin Doty, P.E. – Frederick, Seibert and Associates

The purpose of this memo is to describe the preliminary analysis of stormwater management requirements and BMP design for Wolf Farms Soccer Fields in South Middleton Township, PA. The project is situated approximately 500 feet west of the intersection of South Middlesex Road and York Road (PA SR 74) in South Middleton Township in Cumberland County. After proposed subdivision, the site will consist of a 51.2 acre area (including access easement). For this analysis the limit of disturbance has been assumed to be the proposed property line (excluding ROW) as well as the access easement. This tentative LOD totals 49.33 acres. Soil research has been done on the site to determine the Hydrological soil groups, takeoffs have been performed in preconstruction conditions and proposed post construction conditions, and BMP's have been approximately sized.

**Soils:**

Soils on this site have been researched using Web Soil Survey. The site is primarily composed of Hagerstown and Huntington soils with small areas of Penlaw and Duffield soils on the south edge of the site. Hagerstown, Huntington, and Duffield soils on site are all Hydrologic Soil Group B soils. Penlaw is considered Hydrologic Soil Group C/D depending on the compaction and saturation of the particular soil. Since this site has historically been farmland, it has been properly tilled and no signs are present of overly saturated conditions. For this reason, the areas of Penlaw Soil were considered to be C soils in the volume analysis of this site.

**Karst Geology:**

The geology of the property in question, as well as much of the region, consists of carbonate rock and is susceptible to sinkhole formation. In order to minimize the risk of sinkhole formation for this project, several design principles will be implemented. Existing drainage patterns will be maintained as much as possible, stormwater management will be directed away from known sinkhole formations, volume runoff and velocity will be minimized by maximizing pervious surfaces, only broad, shallow basins will be considered for BMPs (ponding less than 2 ft.), and operation and maintenance notes will be added to future land development plans to provide the owner with instructions to maintain BMP's and repair them if needed. Employing these design principles will reduce the risk of sinkhole formation and thus reduce the risk of groundwater intrusion by untreated stormwater runoff. A complete geotechnical assessment will be performed at the time of land development plan preparation.

**Preconstruction:**

In preconstruction, the site is mainly farmland. Analysis was performed for this site as if it were meadow, and a second analysis was performed with it as contoured row crop farmland (more accurately reflecting site conditions). Farmland can have various CN values, but choosing contoured row crop farmland produces one of the lowest CN values in this series of cover conditions. This is the conservative option since lower preconstruction volumes result in a higher treatment burden when compared to the post construction volume. When a volume analysis was run using the takeoffs of this area in the 2-year/24-hour storm, a preconstruction runoff volume of 42,351 ft<sup>3</sup> was found to be generated by this site when it is considered meadow. If it is considered contoured farmland, the runoff volume is 157,810 ft<sup>3</sup>. A summary for each condition is shown below.

Cover Type/Condition	Soil Type	Area (sf)	Area (Ac)	CN	S	Ia (0.2*S)	Q Runoff (In)	Runoff Volume (ft3)
Meadow	B	2133608	48.98	58	7.24	1.45	0.23	41485
Meadow	C	15129	0.35	71	4.08	0.82	0.69	866
<b>Total</b>			<b>49.33</b>					<b>42351</b>

Weighted  
C.N. = 58.1

Table 1- Runoff volume assuming a pre-development condition of meadow

Cover Type/Condition	Soil Type	Area (sf)	Area (Ac)	CN	S	la (0.2*S)	Q Runoff (In)	Runoff Volume (ft3)
Contoured Farm Land	B	2133608	48.98	75	3.33	0.67	0.88	155900
Contoured Farm Land	C	15129	0.35	82	2.20	0.44	1.28	1611
Total			49.33					157510

Weighted  
C.N. = 75.0

Table 2- Runoff volume assuming a pre-development condition of contoured row crop farm land

**Post Construction:**

In the post construction condition, the same limit of disturbance was considered. Takeoffs were performed for all new parking asphalt, driveway, and buildings. Three of the soccer fields will be artificial turf, so these were also considered impervious for these takeoffs. In order to reduce impervious, the developer is considering using reinforced turf for large portions of parking which will not only reduce runoff, but will provide additional treatment volume. Runoff volumes were calculated for these areas being reinforced turf as well as if they were to be paved/gravel in the charts below.

Cover Type/Condition	Soil Type	Area (sf)	Area (Ac)	CN	S	la (0.2*S)	Q Runoff (In)	Runoff Volume (ft3)
Meadow	B	75857	1.74	58	7.24	1.45	0.23	1475
Open Space	B	1504227	34.53	61	6.39	1.28	0.32	39754
Open Space	C	9182	0.21	74	3.51	0.70	0.83	633
Impervious	B	367067	8.43	98	0.20	0.04	2.64	80719
Impervious	C	5587	0.13	98	0.20	0.04	2.64	1229
Reinforced Turf	B	186817	4.289	61	6.39	1.28	0.32	4937
Total			49.33					128746

Weighted  
C.N. = 67.4

Table 3- Post development condition assuming parking is reinforced turf

Cover Type/Condition	Soil Type	Area (sf)	Area (Ac)	CN	S	la (0.2*S)	Q Runoff (In)	Runoff Volume (ft3)
Meadow	B	75857	1.74	58	7.24	1.45	0.23	1475
Open Space	B	1504227	34.53	61	6.39	1.28	0.32	39754
Open Space	C	9182	0.21	74	3.51	0.70	0.83	633
Impervious	B	367067	8.43	98	0.20	0.04	2.64	80719
Impervious	C	5587	0.13	98	0.20	0.04	2.64	1229
Reinforced Turf as Imp.	B	186817	4.289	98	0.20	0.04	2.64	41082
Total			49.33					164891

Weighted  
C.N. = 70.6

Table 4- Post development condition assuming turf fields and parking are impervious

**BMP (Best Management Practice) Sizing:**

An initial sizing has been performed for the BMPs on this site. The volume requirement is established by subtracting the preconstruction volume from the post construction volume. The requirements for the different combinations of preconstruction covers and post construction conditions are as follows:

Preconstruction as Meadow and Post Construction with Reinforced Turf- 86,395 ft<sup>3</sup>  
 Preconstruction as Meadow and Post Construction w/o Reinforced Turf - 122,540 ft<sup>3</sup>  
 Preconstruction as Contoured Farmland and Post Construction with Reinforced Turf - Net Volume Decrease  
 Preconstruction as Contoured Farmland and Post Construction w/o Reinforced Turf - 7,381 ft<sup>3</sup>

For this BMP sizing, three subsurface infiltration BMPs and 6 surface BMPs were taken account for. Each of the turf fields will have a subsurface infiltration bed. The chosen design criteria is shown below.

3 Subsurface Infiltration BMPs under turf fields:

Surface Area: 50,943.44 ft<sup>2</sup>  
 Assumed Media Depth: 1 ft  
 Porosity: 0.3  
 Storage per BMP: 15,283 ft<sup>3</sup>  
 Total Volume of 3: 45,849 ft<sup>3</sup>

Four surface infiltration BMPs are also proposed. The initial design criteria is shown below.

4 Surface BMPs

Total Surface Area: 75,857 ft<sup>2</sup>  
 Storage depth to first outlet stage: 0.75 ft  
 Assumed media depth: 1 ft  
 Porosity: 0.3  
 Total volume of surface BMPs: 79,650 ft<sup>3</sup>

When these provided volumes are added together, we are providing 125,499 ft<sup>3</sup> of volume which exceeds the highest possible requirement of 122,540 ft<sup>3</sup>.

If any other combination is to be considered the requirement, BMPs could be removed or made shallower to suit the requirements.

**Peak Rates:**

A rough peak rate analysis was done taking into account land cover changes and approximate slope changes. For this analysis, BMP routing was not performed. See peak rates in summary below.

Storm Event	Pre-Development Meadow Peak Flow (cfs)	Pre-Development Contoured Peak Flow (cfs)	Post-Development Reinforced Turf Peak Flow (cfs)	Post-Development Paved Parking Peak Flow (cfs)
2 Year	3.12	24.74	10.02	14.80
10 Year	17.45	55.42	29.68	37.52
50 Year	51.59	105.42	65.99	76.76
100 Year	74.73	135.08	88.64	100.57

Peak rate analysis shows that if pre-development conditions are considered to be meadow, some routing will have to take place in order to reduce peak flow. If pre-construction conditions are considered to be contoured farmland, the land cover and changes to time of concentration from flattening out the site in order to provide soccer fields will reduce peak flow without routing it into BMPs.

**Miscellaneous Items:**

In addition to the above items, additional volume credit is given by the DEP for trees added on a site. The DEP gives 10 ft<sup>3</sup> of credit for each evergreen tree planted and 6 ft<sup>3</sup> for each deciduous tree planted. The applicant tentatively plans to plant approximately 300 trees. Initial estimates show approximately half of the trees planted would be evergreen and half would be deciduous. This would result in an additional 2,400 ft<sup>3</sup> of volume credit unaccounted for in the above calculations. Woody vegetation increases evapotranspiration and decreases runoff, which would be an improvement over the existing condition.

**Conclusions:**

The proposed soccer complex will not increase the 2-year runoff volume or peak rates up to the 100-year storm. Most of the proposed condition is pervious cover, and in theory, is more pervious than the existing conditions. Runoff will not accumulate in great quantities and will infiltrate across the site as much as the native soils will allow. The conservative methods of pre to post development stormwater management calculations required by the PA DEP and the Township ordinance will require some forms of stormwater runoff treatment, over and above the infiltration on the turf fields and the reinforced turf parking areas. This calculated runoff will be managed in BMPs designed in accordance with the PA PCSM Manual. These BMPs will be designed with relatively low loading ratios (Impervious to BMP surface) because almost all of the surface runoff is generated by a small percentage of impervious cover. Much of the impervious cover being accounted for is turf fields, which have very high porosity and will generate relatively little runoff. Most of the parking lots will be installed with reinforced turf, reducing runoff and storing runoff volume. The small concentration of stormwater runoff across the property and implementation of the design principles discussed in the Karst section above will reduce the likelihood of sinkhole formation and impacts to the groundwater and will prevent surface runoff from impacting downstream properties.

If you have any questions or concerns, please feel free to call me at (717) 609-7513 or reach me by email at [jdoty@fsa-inc.com](mailto:jdoty@fsa-inc.com).



**Professional Certification**

I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Pennsylvania, License No. PE080613, Expiration Date: 09-30-2023