Braehead Woods
Stormwater Plan Review, Watershed Landcover Evaluation, and Preliminary Drainage Improvement Recommendations

Prepared By:
Timmons Group
20110 Ashbrook Place, Suite 100
Ashburn, VA, 20147

February 6, 2020

TIMMONS GROUP

Project Purpose

This study was initiated to help the City of Fredericksburg preliminarily evaluate the existing drainage issues throughout the Braehead Woods Subdivision (Braehead Woods), evaluate the potential impact of development within the watershed, and provide preliminary recommendations on potential solutions that could help alleviate some of these drainage issues. This study and subsequently the proposed recommendations are intended as a planning resource and further engineering evaluation is recommended.

Scope of Services

As stated above, the purpose of Timmons Group (TG) involvement on this project was to assist with the evaluation of the potential cause of several existing drainage issues within the Braehead Woods community. In pursuit of this objective, TG performed the following scope of services:

- **Task 1:** Project Kickoff Meeting and Braehead Woods Neighborhood Walkthrough;
- **Task 2:** Stonewall Heights Residential Subdivision SWM Plan Review;
- **Task 3:** The Vintage Residential Subdivision SWM Plan Review;
- **Task 4:** Braehead Woods Watershed Pre-Development vs. Post-Development Land Cover Evaluation;
- **Task 5**: Memo Report and Recommendations of Potential Drainage Improvements
- **Task 6:** Braehead Woods Homeowners Association (HOA) Meetings
- **Task 7:** Project Meetings & Coordination

The full scope of services, along with a brief description of the intended goal of each task is included in **Appendix E** of this Report.

Introduction

Braehead Woods, located in the City of Fredericksburg, was developed in the late 1960's. Braehead Woods is bounded to the west by Lafayette Boulevard and to the east by Lee Drive and the Fredericksburg Battlefield (Fredericksburg and Spotsylvania National Military Park). Due to the community being developed in an era with limited stormwater regulations, there is little stormwater infrastructure such as curbs, gutters, engineered culvert systems, and stormwater management facilities in place. The subdivision has an active stream system that intertwines itself between multiple residences and ultimately discharges through an elliptical culvert under Braehead Drive. The subdivision also has several unique hydrologic characteristics related to the depth of the water table, active groundwater seeps, steep watershed slopes, and soils with high ability to transmit water (transmissivity). Because of the lack of stormwater infrastructure coupled with the unique neighborhood hydrologic characteristics, localized drainage issues have the potential to be frequent, especially when paired with a runoff producing rainfall event. For frame of reference throughout this study, it is important to note that in 2018 the City of

Fredericksburg saw a record rainfall total of approximately 69 inches according to the NOAA National Centers for Environmental Information Historical Data. The annual precipitation records dating back to 2008 for the City of Fredericksburg have been included in **Appendix F** (The historical data for the year 2015 was not available).

As part of this study, TG performed a site visit and met with local Braehead Woods property owners to discuss their historical observations of the drainage patterns and issues throughout the community. TG also performed a third-party plan review on two (2) residential development plan sets (Stonewall Heights, The Vintage). Both subdivisions are within the Braehead Woods watershed and are either finalizing construction activities or are in the process of full site build out. The purpose of TG's plan review was to evaluate the stormwater specific engineering practices used to assemble the plans and identify any potential non-code compliant water quantity design methodologies. TG's comments on the City approved Plans are provided in **Appendix A and B**, and the comment responses provided by the Engineering Firm responsible for the plan set development is provided in **Appendix G.** Furthermore, to assist with quantifying the potential effect of the residential developments on the Braehead watershed, TG conducted a pre-development vs. post-development land cover evaluation to determine the increase in drainage area imperviousness to analyze the potential impact the two subdivision projects may have had on the contributing watershed. This memo report and subsequent appendices summarize TG's due diligence, plan review findings, pre-development vs. post-development land cover analysis, and provides three (3) preliminary design recommendations that could assist in alleviating some localized drainage issues.

Project Due Diligence and Site Visit

As part of the initial task, TG and the City of Fredericksburg met with Braehead Woods property owners and conducted a site walkthrough on December 18th, 2019. The purpose of the site visit was to discuss the existing drainage issues with the property owners and help identify any pertinent site features that could potentially help evaluate the cause of the localized drainage problems. During the site walkthrough, long-term residents of the Braehead community informed TG that drainage problems have existed in the community for many decades. TG staff spoke with a property owner at the lower end of the watershed and she highlighted that she has experienced localized drainage issues since she moved into the Braehead community roughly 40 years ago. Further evidence of potential drainage issues were identified during the site walkthrough, such as differing culvert sizes at parallel driveways, steep watershed slopes, paved ditches transitioning to vegetated ditches, and areas of ponded water. TG staff also noticed limited stormwater infrastructure, and the infrastructure present was either deteriorating, malfunctioning, or inadequate to convey stormwater adequately throughout the watershed. This qualitative information was incorporated into the potential drainage recommendations provided later in this report.

Braehead Woods Watershed – Pre vs. Post-Development Land Cover Analysis

To help analyze the potential impact the Stonewall Heights and Vintage subdivisions are having on the overall Braehead Woods watershed, a pre vs. post development land cover analysis was performed. The predevelopment conditions analysis represented the drainage area land use composition to a point of interest (9,10 Lockhart Circle) without the two subdivisions (Stonewall Heights, The Vintage) present. The post development analysis accounted for the full build-out associated with the addition of all impervious surfaces from the two proposed subdivisions. The goal of this analysis was to quantify the percent change in overall drainage basin imperviousness caused by the developments. The analysis was conducted utilizing the best available City of Fredericksburg GIS shapefile information, best available aerial imagery, as well as the two subdivision plans to determine the percent imperviousness change. The pre vs. post landcover summary is shown in Table 1, and a map and drainage area soils report illustrating this analysis is provided in **Appendix C**.

Table 1: Land Cover Summary

Pre-development Analysis		
Name	**Area**	**Unit**
Total Drainage Area	113.32	ac
Impervious Area	27.78	ac
Impervious Percent	24.52%	-
Pervious Area	85.54	ac
Pervious Percent	75.48%	-
Post-development Analysis		
Name	**Area**	**Unit**
Total Drainage Area	113.32	ac
Impervious Area	29.26	ac
Impervious Percent	25.82%	-
Pervious Area	83.93	ac
Pervious Percent	74.06%	-
Impact of Development		
Impervious Area Increase	1.48	ac
Percent Difference	**1.30%**	-

As seen in the Table 1, the two developments increased the overall drainage basin imperviousness by 1.48 acres or 1.30%. The increase in drainage area imperviousness is minor, and when evaluated in terms of an overall drainage area of approximately 114 acres, should have a negligible contribution to localized flooding across the entire Braehead Community. If a quantification of the estimated differential in pre vs. post development stormwater runoff flow rates throughout the neighborhood stream system is desired to facilitate further analysis, TG recommends a full watershed study be performed at a drainage basin level.

Stormwater Management Plan Review Introduction

TG conducted a third-party plan review of the following residential site plans:

1.) The Stonewall Heights Residential Subdivision (Approved Mar. 11, 2015); and,
2.) The Vintage Residential Subdivision (Approved Mar. 24, 2015).

The plan review specifically focused on the stormwater management components of the plan assembly pertaining to water quantity. The Plan Reviews were subdivided into the following three (3) main categories: 1.) General Comments, 2.) Best Management Practice (BMP) Design Review, and 3.) Stormwater Quantity Review. The review was intended to identify the stormwater management and drainage components of the plan set, and evaluate them in accordance with approved engineering methodologies, practices, codes, and regulations. Both plan sets were reviewed against the Virginia Stormwater Management Program (VSMP) regulations and design codes that were in place at the time of approval. The following documents used to evaluate plan compliance were:

1.) The Virginia Stormwater BMP Clearinghouse 2011 Draft Design Specifications;
2.) The Virginia Runoff Reduction Method (VRRM) Worksheet June 2014;
3.) The Virginia Stormwater Code 9VAC25-870-66 (Stormwater Quantity);
4.) The Virginia Stormwater Code 9VAC25-870-69 (Stormwater Quality); and,
5.) 9VAC-25-840-40-19 (Minimum Standard 19)
6.) The 2013 Virginia Stormwater Management Handbook (Second Edition – Draft)

In performing the Plan Reviews, TG developed comments outlining potential deficiencies noted for each plan. The TG review comments, as well as each plan set is provided in **Appendix A and B**. The engineering design firm responsible for the development of the two above referenced plan sets comment responses (to TG's comments) are provided in **Appendix G.**

Stonewall Heights Residential Subdivision Plan Review

The TG review of the Stonewall Heights Residential Subdivision plans found potential non-compliance issues with stormwater management design standards. The plan set evaluation focused on a site-specific analysis related to site imperviousness, soils, slopes and grades, site size, and the methodologies utilized to implement and control the stormwater related to the site improvements. In evaluating this plan, TG found that the stormwater quantity analysis performed in these plans had discrepancies with several of the documents referenced earlier in the Stormwater Management Plan Review Introduction.

The plans are intended for a twelve-home subdivision and plan layout information regarding the grading related to residential properties was minimal. Furthermore, each parcel on the plan set depicted an estimated building footprint and driveway without the corresponding grading associated with those specific site improvements. The grading is crucial in relation to stormwater runoff as the homes,

driveways, lot grading, and lot layout could have an impact to the stormwater drainage. Also, the plan assembly, and subsequently the VRRM spreadsheet depicts areas with trees as forested while the predevelopment aerial imagery does not show any forest. For an area to be counted as forested it must meet the criteria set out in the VRRM Instructions and Documentation (Dated March 28, 2011) and be protected from future development through easements or similar practices. This essentially means that the forested lands classified on-site should potentially be classified as a different land cover, thus potentially changing the numerical outputs from the VRRM spreadsheet. This discrepancy could model a site as having a better existing hydrologic condition than the actual existing conditions.

In order to meet the increase in site imperviousness and volumetric runoff, two (2) bioretention facilities (BMP Clearinghouse Design Specification 9) were designed to be utilized to treat the runoff from the site. Both bioretention facilities had design elements that did not comply with certain design standards outlined in the BMP Clearinghouse Design Specification No. 9 (Bioretention). TG also noted that calculations and subsequent values for each bioretention's pertinent design features were not depicted on the plans which made it difficult to determine design compliance. Lastly, both bioretention facilities were designed to discharge onto adjacent properties that lacked the required stormwater conveyance channels required per 9VAC25-870-66 and 9VAC25-840-19.

While TG noted certain deficiencies associated with review, it was estimated that the deficiencies were not significant enough to influence or exacerbate the downstream drainage issues on a drainage basin level. TG's comment letter outlining the plan review, as well as the City approved plan set are provided in **Appendix A**.

The Vintage Residential Subdivision Plan Review

The Vintage Residential Subdivision plans contained many of the same compliance discrepancies as the Stonewall Heights plans. The VRRM spreadsheet contains the same forested area compliance error. The land use values shown on the plan's VRRM spreadsheet show the amount of impervious area being treated is higher than the total amount of impervious area present. TG cannot determine the cause of this, without obtaining the missing sheets from the VRRM spreadsheet which was not depicted on the plan set.

In relation to the stormwater quantity design and crediting, due to potentially insufficient plan information TG could not properly determine the designer's reasoning for certain design methodologies. Because of this, the majority of TG's analysis was based off of assumptions on designer intent. With relation to the on-site structural BMP utilized to meet stormwater quantity and quality goals, one filtering practice (BMP Clearinghouse Design Specification 12) with HDPE (high density polyethylene) storage pipes was utilized to treat and store the runoff from the site. In TG's opinion, a filtering practice should not have been used in this situation as the specification outlines that drainage areas going to a

filtering practice should be close to 100% impervious. The drainage area for this filtering practice at full site buildout is approximately 37% impervious.

Finally, the filtering practice discharges onto riprap and then flows directly on a neighboring property. Like Stonewall Estates, and per 9VAC25-870-66 and 9VAC-25-840-40-19 , an adequate receiving conveyance channel should have, at a minimum, been analyzed to ensure that the treated stormwater could adequately be conveyed to a downstream receiving channel without erosive velocities and encroachment on neighboring properties. It is currently unknown if this analysis was performed due to lack of information provided on the plan-set. Per state guidance, natural channels shall be analyzed by the use of a 2-yeer storm to verify that the channel banks will not overtop or erode, and all man-made channels shall be analyzed by the use of a 10-year storm to verify that stormwater will not overtop its banks. After evaluating the City's historical "The Vintage" stormwater plan review comment letters, the need for an adequate conveyance channel was discussed at a Technical Review Committee (TRC) meeting on September 25th, 2014 and was deemed not feasible. There is no documentation readily available on why providing an adequate downstream conveyance system was not feasible and thus it cannot be determined at this time why the TRC made that feasibility decision.

Like Stonewall Heights, while TG noted certain possible deficiencies associated with the design, it was estimated that any plan or design deficiencies noted were not significant enough to influence or exacerbate the downstream drainage issues on a drainage basin level. TG's comment letter outlining the plan review, as well as the City approved plan set are provided in **Appendix B**.

Recommendation of Potential Drainage Solutions

In order to assist with the mitigation of the known Braehead Woods drainage issues, TG has outlined three (3) general recommendations that could potentially help abate some of the known issues. Each of the potential recommendations has yet to be evaluated fully from an engineering feasibility and permitting perspective, and further analysis of all proposed solutions will be required. Furthermore, all potential solutions have significant project constraints that will have to be considered when evaluating the practicability of the solution. The following three potential solutions will focus on areas of known localized drainage issues within the subdivision. The three locations for the potential solutions are as follows:

- 9, 10 Lockhart Circle;
- Downstream from the culvert at Braehead Drive (Shown in Figure 2); and,
- 2, 3 Kinloch Circle.

Potential Drainage Solution #1 (9, 10 Lockhart Circle)

To assist with the localized flooding at 9,10 Lockhart Circle TG recommends the redesign and reconstruction of the culverts underneath the private road adjacent to 10 Lockhart Circle shown in Figure 1.

Figure 1: Three (3) 24" Culverts on private driveway adjacent to 10 Lockhart Circle

There are currently three (3) 24" corrugated HDPE (assumed) culverts that convey flow under a private driveway entrance. Replacement of these culverts was a subject of a study conducted by Welford Engineering (Welford) in September 2014 for the City. Welford analyzed solutions to mitigate the drainage issues occurring at location and recommended one of the following solutions:

- Implementation of three (3) 30" corrugated metal or reinforced concrete culverts;
- Implementation of a single corrugated metal arch with a 7-foot span and a 2.8 foot rise; or,
- Implementation of a Double 42" x 27" elliptical concrete culvert (long axis horizontal)

The one-page recommendation from Welford Engineering can be seen in **Appendix D**. The existing in-field noted conditions reflect that first option (3 – 30" culverts) was considered but the pipe size was changed from 30" to 24" during the construction process. Without knowing the history of that specific construction operation, TG can only speculate that the 30" pipes provided difficult to implement into the existing surrounding grade without significant stream channel and driveway alteration. TG recommends a solution that requires a more comprehensive approach. An updated hydraulic analysis of a proposed culvert or arch system is recommended. Furthermore, a grading plan and re-redesign of the driveway is also recommended in order to ensure the culvert or arch system is implemented at a correct skew in relation to the stream. It should be noted that the upgrade of this culvert system will have an effect on the downstream receiving stream channel as well as the downstream driveway ford. A comprehensive analysis of the channel hydraulics from the culverts at 10 Lockhart Circle to Lee Drive will have to be performed to evaluate the proposed culvert system's influence on the existing stream bed

and banks. TG recommends that these proposed improvements be addressed with the development of a Hydrologic and Hydraulic (H&H) Study as well as a set of construction plans to include survey services.

Potential Drainage Solution #2 (Downstream from Culvert at Braehead Drive)

Potential Drainage Solution #2 proposes the implementation of a step pool sequence downstream of the large culvert that coveys flow under Braehead Drive as shown in Figure 2.

Figure 2: Culvert under Braehead Drive.

A step pool sequence may allow for minor volumetric runoff detention from smaller storm events, as well as provide energy dissipation to ensure the downstream receiving channel does not degrade. This structural practice is typically utilized in outfall and stream restoration projects as a method for grade control and velocity reduction. Figure 3 is a typical design detail that illustrates a standard step pool sequence and Figure 4 shows an example of a step pool sequence post construction.

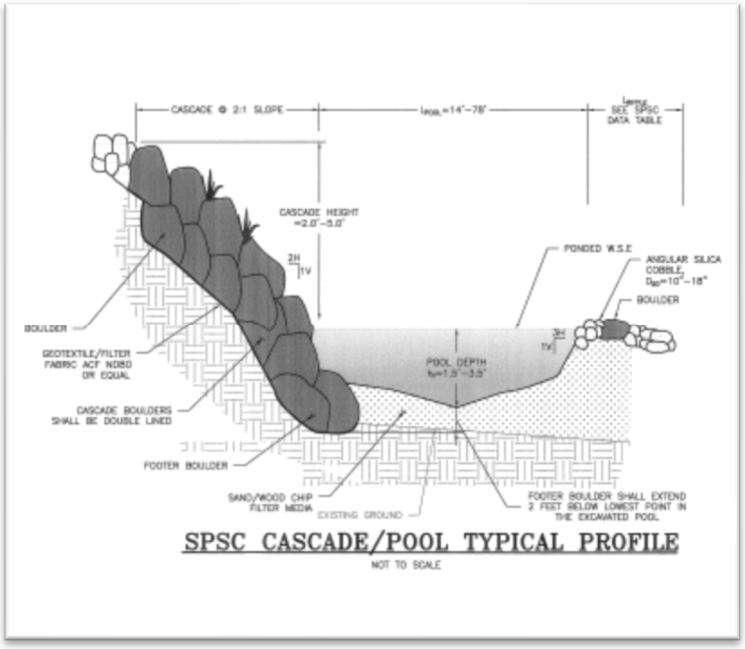


Figure 3. Step Pool Typical Detail.

Figure 4. Example of a Step Pool Sequence.

As stated above, implementation of a step pool sequence at the outfall of the culvert conveying flow under Braehead Drive could potentially help stabilize the downstream channel and provide minor volumetric runoff detention that could potentially give extra capacity to the 24” culverts at 10 Lockhart Circle. This practice would also add to the existing natural site features of the Braehead Community.

Potential constraints stemming from this practice are related to easement acquisition, construction disturbance, overall project design and construction costs, as well as environmental regulatory concerns. As with all of the proposed potential drainage solutions referenced in this memo, significant engineering analysis has to be performed in order to quantify if this solution is viable and addresses the overall arching neighborhood drainage issues.

Potential Drainage Solution #3 (2, 3 Kinloch Circle)

To assist with the localized drainage issue occurring at 2, 3 Kinloch Circle, TG recommends the installation of an adequate stormwater conveyance system. Because the outfall of one of the Stonewall Estates bioretention facilities discharges directly onto a neighboring adjacent parcel, TG believes that the most fail safe solution to potentially solving the drainage issue is the interception of the flow into a proposed piped storm sewer conveyance system. By installing a piped, underground conveyance system, the stormwater will leave the property in a controlled matter thus alleviating the adjacent property of the localized drainage issue. It is essential that the proposed stormwater conveyance system be analyzed to the overall downstream limits of discharge which could potentially be the receiving channel within the Dominion utility corridor. Because of the potential overall length of this proposed storm sewer system (estimated 1000 – 1500 linear feet), several constraints present themselves. Easement acquisition will have to occur from all property owners effected by the proposed storm sewer alignment. Furthermore, the cost and overall neighborhood disturbance of a project of this nature would be significant.

At the present time, TG recommends that the current homeowner at 3 Kinloch Circle remove all obstructions and modifications to the section of their yard that is receiving direct runoff from the bioretention outfall pipe. Allowing the discharging stormwater to naturally infiltrate into the ground could potentially provide minor volumetric runoff reduction until a engineered solution can be fully evaluated and implemented.

Potential Project Funding Mechanism

Potential drainage solutions each have their own opportunities and constraints based on specific project locations. The similarities that all have in common stem from significant project related costs due to further required environmental studies, engineering studies, site survey, and design and construction related costs. One potential funding mechanism to help address the potential project costs for each of the proposed solutions is the establishment of a Watershed Improvement District (WID). Per the Code of Virginia Article 3. Titled "Watershed Improvement Districts - Section 10.1-614. Establishment within soil and water conservation district authorized" states the following:

"Whenever it is found that soil and water conservation or water management within a soil and water conservation district or districts will be promoted by the construction of improvements to check erosion, provide drainage, collect sediment or stabilize the runoff of surface water, a small watershed improvement district may be established within such soil and water conservation district or districts in accordance with the provisions of this article."

The residents of the Braehead Woods subdivision as well as the City may want to consider establishment of a WID for their community. Creation of a WID would help with funding potential projects related to on-going neighborhood drainage issues and provide funding to help continue preservation of the environmental and watershed uniqueness of the overall community.

Conclusion

In conclusion, it is TG's opinion that based on the active stream system, presence of wetland areas, hydric and shrink swell soils, and unique environmental characteristics, modern development standards and regulations would not allow the Braehead Subdivision to be constructed today in its current configuration. As stated throughout this memo report, the Braehead Woods community has several unique hydrologic characteristics that make it more susceptible to drainage related issues. When those characteristics are paired with increasing higher intensity rainfall events that are becoming more commonplace, the perception of increased flooding can become reality. To upgrade the entire Braehead Community with modern day stormwater infrastructure would not only cost millions of dollars, but it would also take away from the natural landscape and uniqueness of the community. Furthermore, when taking a basin-wide evaluation of the drainage issues occurring, TG has to restate that any potential deficiencies with the stormwater management designs at The Vintage site and Stonewall Estates site have a negligible impact on the overall drainage issues occurring within the Braehead Woods Community. The recommendations outlined in this memo, if properly analyzed, engineered, implemented and constructed, could potentially help abate the major points of known localized flooding within the community, while limiting the overall impact for the vast majority of the residents.

APPENDIX A: STONEWALL HEIGHTS RESIDENTIAL SUBDIVISION SWM PLAN REVIEW

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

20110 Ashbrook Place
Suite 100
Ashburn, VA 20147

P 703.726.1342
F 703.726.1345
www.timmons.com

February 14, 2020

Charles Johnson
Director
Community Planning & Building Department
City of Fredericksburg
715 Princess Anne Street
Fredericksburg, VA 22401

RE: Stonewall Heights Residential Subdivision Review

Dear Mr. Johnson:

Below are the comments from the TG review of the Stonewall Heights Residential Subdivision Plan:

General Comments

1. Sheet 6 Grading Plan
    d. Need supplemental topography for the adjacent properties to determine overall offsite drainage divides *(9VAC25-870-55-B)*
2. Sheet 8 Drainage Area Plan
    a. Drainage divides have potential discrepancies.
        i. North area of DA 7 drains toward the north not toward the street/south
        ii. East part of DA 12A drains toward the east not toward the street/west
        iii. Area south of DA drains on to the site and should be accounted for
    b. Note claims that the design was based on worst case scenario. This assumption can't be made without knowing what each lot plans on developing *(9VAC25-870-55-A)*
    c. No information regarding houses/lot, but drainage divides are specific enough to split roof divide 2/3 different ways. *(9VAC25-870-55-B)*
    d. No topo information to support the SW limits of DA 13 and DA 12 *(9VAC25-870-55-B)*
3. Sheet 9 Drainage Profiles & Calculations & Road centerline Profile
    a. No information provided showing the breakdown of what was considered pervious/impervious within the drainage area *(9VAC25-870-55-B)*
    b. Rainfall intensity (10-yr storm) needs to be provided.

BMP Design Review

1. Sheet 7 Drainage Plan
    c. BMP 2 area (excluding pretreatment) has discrepancies with what is shown on the calculations
2. Sheet 16 Stormwater Management Calculations
    a. Provide void ratios for both BMPS *(9VAC25-870-55-B)*
    b. Void ratio for Bio #2 is not correct. *(BMP Clearinghouse Specification No. 9 – Section 6.1.1 Stormwater Quality)*
        1. Gravel is 56% (should be 40%)
        2. Media is 31% (should be 25%)
    c. No code reference to being allowed to use the cap with a 1" orifice.
    d. Provide detail on the control structure/top used for the riser. *(9VAC25-870-55-B)*
    e. Bio #1

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

20110 Ashbrook Place
Suite 100
Ashburn, VA 20147

P 703.726.1342
F 703.726.1345
www.timmons.com

i. Main outlet pipe is in the stone layer rather than underneath it like it is shown in the detail. Outgoing invert is 220.35'. Bottom of stone is 219.75'
ii. Underdrain (Culvert/Orifice Structure B) is not on. The "multi-stage" label is set to "No" while on Bio #2 it is set to "Yes"
iii. Weir Structure B seems to be turned on. "Multi-stage" label is to "yes"
iv. Underdrain is not set to the top of the stone as shown on the BMP clearinghouse detail. There is 0.83' of stone about the top of the underdrain. *(BMP Clearinghouse Specification No. 9 – Figure 9.5)*

f. Bio #2
   i. The underdrain (Culvert/Orifice Struct. B) is set to a length of 0 and slope of 0.
   ii. Weir Structure B seems to be turned on. "Multi-stage" label is to "yes"
   iii. There is only 0.67' of stone under the underdrain. A min. of 1' is required to qualify as a level 2 facility. *(BMP Clearinghouse Specification No. 9 – Section 6.7 Underdrain and Underground Storage Layer)*
   iv. No calculations provided showing the pretreatment area required and provided. *(BMP Clearinghouse Specification No. 9 – Section 6.4 Pretreatment)*
   v. Surface area size has discrepancies.

g. Provide all numerical inputs that went into the sizing of the Bios. Calculations seem to show discrepancies. *(9VAC25-870-55-B)*
   vi. Need information for Tv, RV, SA

<u>Stormwater Quantity Review</u>

1. Sheet 16 Stormwater Management Calculations & Details
   a. Channel protection was done under the energy balance equation
      i. None of the outfall points are stormwater conveyance systems. Per 9VAC25-870-66 "Concentrated stormwater flow shall be released into a stormwater conveyance system…"
      ii. Outfall B channel protection does not meet the required energy balance equation. Q allowa is 0.01 cfs and Q post is 0.09 cfs. *(9VAC25-870-66)*
      iii. Bypass channel protection was calculated incorrectly. They must be looked at independently of each other.
   c. Hydrograph Return Period Recap
      i. Need to show a node chart to be able to follow
      ii. Routings show discrepancies.
         1. In Bypass Area #2 and 3 the post development discharge is higher than the pre in the 1 year storm but becomes less in the 10 year storm. This is not possible unless there is a control structure
2. Sheet 17 Stormwater Management Drainage Plan and Calculations
   a. Need hatching showing what is considered impervious, pervious, forest *(9VAC25-870-55-B)*
   b. Need soil lines to show what is considered A & B soils *(9VAC25-870-55-B)*
   c. Drainage divide in the post development conditions does not match drainage divide shown on Sheet 8
   d. Predevelopment areas add up to 4.37 acres, which is higher than the site area. It seems offsite area was accounted for. Need to break up "Pre-development Outfall B" on to onsite and off site to accurately be able to follow quantity and quality calculations.

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

20110 Ashbrook Place
Suite 100
Ashburn, VA 20147

P 703.726.1342
F 703.726.1345
www.timmons.com

e. Time of concentration calculations are not correct
    i. Flow lengths, slope, and land cover conditions do not seem to match up with the rest of the plan (i.e predev bypass #3 = 14.16 vs postdev bypass #3 = 13.17)
    ii. Biofilter #2 flow path is through a house and is almost guaranteed to change once the homes on the property are built.

3. Sheet 18 Stormwater Management Calculations
    a. Hydrographs show deficiencies
        ii. Check Outfall A Post and Outfall B Post Hyd. *(9VAC25-870-55-B)*

Should you have any questions regarding the above responses, please feel free to contact me (703) 554-6713.

Thank you,

Jon D'Alessandro, P.E.

APPENDIX B: THE VINTAGE SUBDIVISION SWM PLAN REVIEW

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

20110 Ashbrook Place
Suite 100
Ashburn, VA 20147

P 703.726.1342
F 703.726.1345
www.timmons.com

February 14, 2020

Charles Johnson
Director
Community Planning & Building Department
City of Fredericksburg
715 Princess Anne Street
Fredericksburg, VA 22401

RE: The Vintage Residential Subdivision Review

Dear Mr. Johnson:
Below are the comments from the Timmons Group review of The Vintage Residential Subdivision Plan:

General Comments

2. Sheet 8 Drainage Area Plan
    a. No contour labels provided. Difficult to review correctness of drainage divides *(9VAC25-870-55-B).*
    b. Provide info to the west of the proj. area to validate drainage divides *(9VAC25-870-55-B)*
    c. DA 11 should be 4.85 instead of 4.19 ac
    d. DA 5 should be 0.93 instead of 1.61
    e. DA 2 seems to be the total area going to the sand filter but there is no label for the area that is sheet flowing to the sand filter. Should be 0.74 acres.
3. Sheet 9A Profiles & Calculations
    a. HGL is missing from the first profile. *(9VAC25-870-55-B)*
    b. No data to support the runoff coefficients being used. *(9VAC25-870-55-B)*
    c. No data to support the time of concentration being used. *(9VAC25-870-55-B)*
    d. HGL for both structures outfalling into sand filter is above the 100-year WSE calculated.

BMP Design Review

1. Per VA DEQ Spec. 12 "sand filters are best applied on small sites where the contributing drainage (CDA) area is as close to 100% impervious as possible." "The contributing drainage area should be as close to 100% impervious as possible in order to reduce the risk that eroded sediments will clog the filter". The drainage area is only 37% impervious. *(BMP Clearinghouse Specification No. 12 – Section 5 Contributing Drainage Area)*
2. It seems it is a "Non-Structural Sand Filter" being used but that is limited to sites less than 2 acres. Nowhere is the type of sand filter specifically called out so cannot confirm. *(BMP Clearinghouse Specification No. 12 – Section 5 Non-Structural Sand Filter)*
3. Detail provided does not match specification requirements
    a. Per Non-structural sand filter "The bottom is lined with an impermeable filter fabric and always has an underdrain"
        i. Filter fabric shown on the detail is not impermeable. Only one filter fabric is noted when there should be an impermeable one and a permeable one. *(BMP Clearinghouse Specification No. 12 – Section 5 Non-Structural Sand Filter)*
    b. Per Non-structural sand filter "The filter has two cells, with a dry or wet sedimentation chamber preceding the sand filter bed"

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

20110 Ashbrook Place
Suite 100
Ashburn, VA 20147

P 703.726.1342
F 703.726.1345
www.timmons.com

        i. A gravel diaphragm was used instead of pretreatment cells. This is acceptable for other sand filter but not the type being used. *(BMP Clearinghouse Specification No. 12 – Section 5 Non-Structural Sand Filter)*
    c. Per Surface Cover "the surface cover for struct. and non-struct. surface sand filters should consist of a 3-inch layer of topspoil on top of a non-woven filter fabric laid above the sand layer"
        i. Filter fabric only shown for pretreatment area and wraps around the perimeter and bottom of facility. *(BMP Clearinghouse Specification No. 12 – Section 5 Non-Structural Sand Filter)*
4. Sand Filter Sizing Calculations
    a. No information or calcs related to the Treatment Volume - TV (4123) *(BMP Clearinghouse Specification No. 12 – Section 6.1 Overall Sizing)*
    b. No information shown regarding the average height of water above filter bed - hf (0.50)
        i. The 10-yr storm is only 0.83' above filter bed and 1-yr storm is 4' below filter bed
    c. Required Treatment Volume equation is not shown.
5. Per Section 6.4 Conveyance and Overflow "Some underground filters will be designed and constructed as on-line BMPs. Designers must indicate how the device will safely pass the local design storm (e.g 10 yr. event) without re-suspending or flushing previously trapped material"
    a. Was this requirement met?
6. Per Depth of Media "Recent design guidance recommends a minimum filter bed depth ranging from 12 to 18". Greater depths can be used in order to facilitate the removal of 1 to 3 inches of sand during maintenance without having to necessarily replace it."
    a. 3' of sand was used in the design. *(BMP Clearinghouse Specification No. 12 – Section 6.5 Filter Media and Surface Cover)*

<u>Stormwater Quantity Review</u>

1. Missing information required to accurately review/confirm calculations *(9VAC25-870-55-B)*
    a. Hydrograph node map.
    b. Stage/storage voids that were used.
    c. Rainfall data that was used.
    d. Map showing was is considered impervious, forested, and managed turf.
    e. All hydrographs for drainage areas.
    f. Breakdown of each area in the routing (I.e area, cn, % impervious, % wooded, % turf)
2. Sheet 15 Stormwater Management Calculations & Details
    a. Channel protection - Used energy balance
        i. Calculations for energy balance are inconsistent. Predev. runoff volumes seem to include offsite area but the offsite area was excluded from the post dev. volumes.
        ii. The outfall point is not a stormwater conveyance system Per 9VAC25-870-66.
    b. Flood protection - Lowered the post below the pre for flood protection
        i. Can only be used in situation where localized flooding occurs downstream. No information about downstream conditions. *(9VAC25-870-66)*
        ii. Calculations seem to include offsite area only in the predevelopment conditions and exclude it from the post development conditions.
    c. Underdrain is not routed through the control struct. And bypasses and outfall independently
    d. No information showing what Node 7 is. It seems to include the offsite area (DA 11) draining to the sand filter. However, this area is not accounted for in the post development nodes.
    e. Summary report does not match what is shown on the plans.

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

20110 Ashbrook Place
Suite 100
Ashburn, VA 20147

P 703.726.1342
F 703.726.1345
www.timmons.com

3. Pond Report
    a. Stage/Storage does not match the detail
        i. Start of stage storage is at 212.92 when it should start at 211.92
        ii. Need void ratios
        iii. Stage from 0-3' has 100+% void ratio
            1. Assuming this is the perforated HDPE pipe
            2. Detail calls for pipes to be 24" not 36"
            3. Void ratio still can't be 100% due to stone around pipe and excess areas
    b. Culvert/Orifice A – 24" RCP
        i. Invert out in routing is 215 which is 2 feet above the invert out for the underdrain
    c. Culvert/Orifice B – Underdrain pipe
        i. This is supposed to be 8" below the HDPE pipe per the detail
        ii. HDPE pipe seems to be at 212.92 and underdrain is at 212.92
        iii. Length and slope are input as 0.01
        iv. Multistage is set to "No".
    d. Stage/Discharge table goes to 300 cfs but 100-year storm discharges 32.85 cfs.
4. Stormwater Management Summary
    a. Bottom elevation listed does not match the routing but matches detail
    b. 10 and 100 year elevation do not match the routings
    c. Volume Control Calculations
        i. Impervious area listed does not match the rest of the plans
        ii. Where does the total volume provided come from?
5. From site visits is seems that the 18" riser attached to DI-7 was never constructed or was removed.

Should you have any questions regarding the above responses, please feel free to contact me (703) 554-6713.

Thank you,

Jon D'Alessandro, P.E.

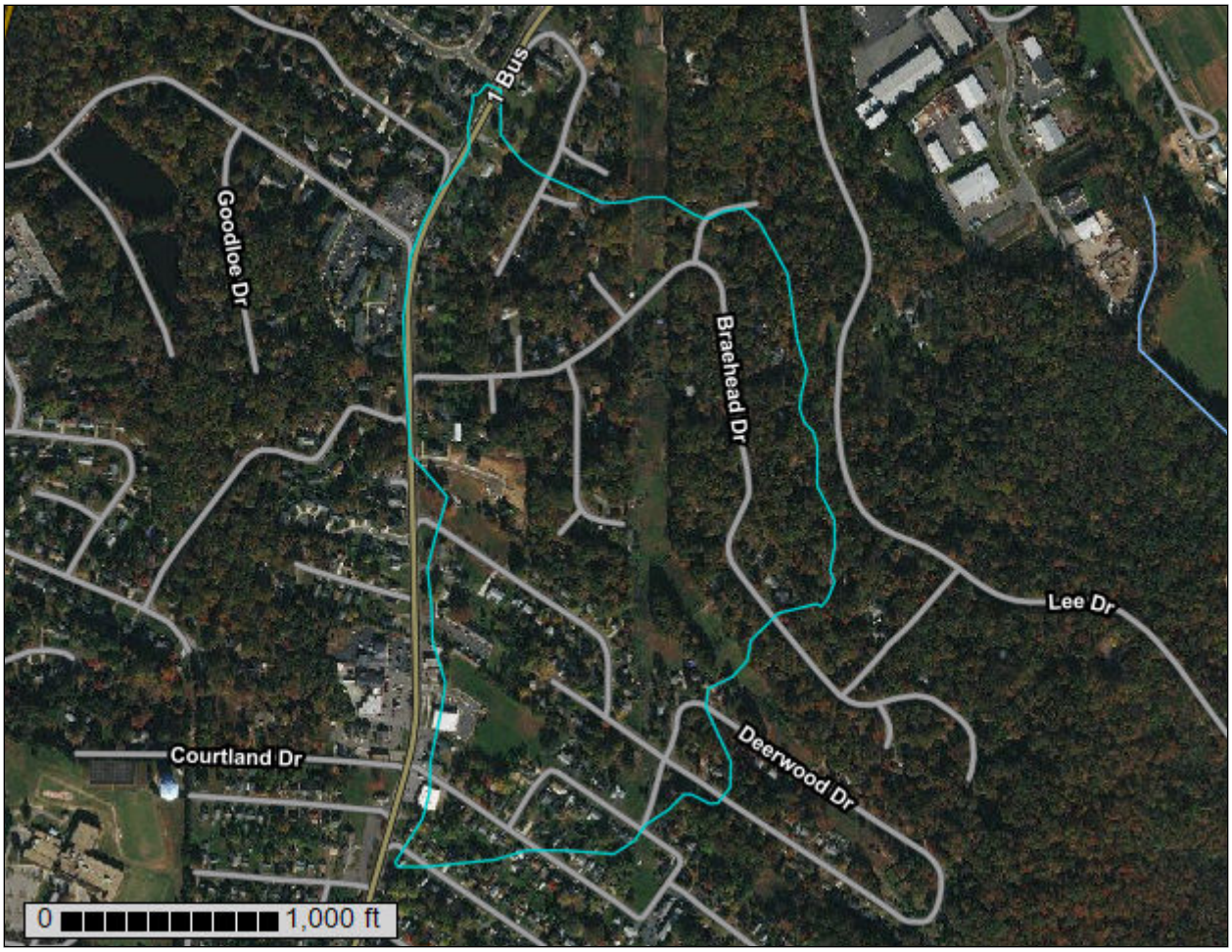
APPENDIX C: PRE VS. POST-DEVELOPMENT LAND COVER ANALYSIS

United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Fredericksburg City, Virginia



October 30, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Preface.....2
How Soil Surveys Are Made.....5
Soil Map.....8
Soil Map.....9
Legend.....10
Map Unit Legend.....11
Map Unit Descriptions.....11
Fredericksburg City, Virginia.....13
17C—Dystrudepts-Udults complex, sloping.....13
17D—Dystrudepts-Udults complex, moderately steep.....14
25B—Kempsville gravelly sandy loam, 2 to 7 percent slopes.....16
25C—Kempsville gravelly sandy loam, 7 to 15 percent slopes.....17
References.....19

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:6,400 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 300 600 1200 1800

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Fredericksburg City, Virginia
Survey Area Data: Version 6, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 25, 2014—Mar 10, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
17C	Dystrudepts-Udults complex, sloping	53.0	46.8%
17D	Dystrudepts-Udults complex, moderately steep	11.1	9.8%
25B	Kempsville gravelly sandy loam, 2 to 7 percent slopes	49.2	43.4%
25C	Kempsville gravelly sandy loam, 7 to 15 percent slopes	0.0	0.0%
Totals for Area of Interest		**113.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Fredericksburg City, Virginia

17C—Dystrudepts-Udults complex, sloping

Map Unit Setting

National map unit symbol: 2krv1
Mean annual precipitation: 36 to 55 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 129 to 156 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Dystrudepts and similar soils: 50 percent
Udults and similar soils: 40 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dystrudepts

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite and gneiss

Typical profile

H1 - 0 to 9 inches: loamy sand
H2 - 9 to 20 inches: sandy loam
H3 - 20 to 62 inches: sandy loam

Properties and qualities

Slope: 7 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.43 to 12.75 in/hr)
Depth to water table: About 18 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Udults

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve

Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite and gneiss

Typical profile

H1 - 0 to 11 inches: sandy loam
H2 - 11 to 57 inches: sandy clay loam
H3 - 57 to 62 inches: sandy loam

Properties and qualities

Slope: 7 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 5.95 in/hr)
Depth to water table: About 18 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Fluvaquents

Percent of map unit: 5 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

17D—Dystrudepts-Udults complex, moderately steep

Map Unit Setting

National map unit symbol: 2krv2
Mean annual precipitation: 36 to 55 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 129 to 156 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Dystrudepts and similar soils: 50 percent
Udults and similar soils: 40 percent
Minor components: 5 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dystrudepts

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Residuum weathered from granite and gneiss

Typical profile

H1 - 0 to 9 inches: loamy sand
H2 - 9 to 20 inches: sandy loam
H3 - 20 to 62 inches: sandy loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.43 to 12.75 in/hr)
Depth to water table: About 18 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Udults

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite and gneiss

Typical profile

H1 - 0 to 11 inches: sandy loam
H2 - 11 to 57 inches: sandy clay loam
H3 - 57 to 62 inches: sandy loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 5.95 in/hr)
Depth to water table: About 18 to 60 inches

Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.2 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Fluvaquents
Percent of map unit: 5 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

25B—Kempsville gravelly sandy loam, 2 to 7 percent slopes

Map Unit Setting
National map unit symbol: 2krvb
Mean annual precipitation: 36 to 55 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 129 to 156 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Kempsville and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kempsville

Setting
Landform: Marine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy marine deposits

Typical profile
H1 - 0 to 13 inches: gravelly sandy loam
H2 - 13 to 44 inches: gravelly sandy clay loam
H3 - 44 to 63 inches: gravelly sandy clay loam

Properties and qualities
Slope: 2 to 7 percent
Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.4 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

25C—Kempsville gravelly sandy loam, 7 to 15 percent slopes

Map Unit Setting
National map unit symbol: 2krvc
Mean annual precipitation: 36 to 55 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 129 to 156 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Kempsville and similar soils: 85 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kempsville

Setting
Landform: Marine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy marine deposits

Typical profile
H1 - 0 to 13 inches: gravelly sandy loam
H2 - 13 to 44 inches: gravelly sandy clay loam
H3 - 44 to 63 inches: gravelly sandy clay loam

Properties and qualities
Slope: 7 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Available water storage in profile: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Fluvaquents

Percent of map unit: 4 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

APPENDIX D: WELFORD ENGINEERING DESIGN RECOMMENDATIONS

(SEPTEMBER 2014)

4545 Empire Court
Fredericksburg, VA 22408
Phone (540) 898-9330
Fax (540) 898-9324
www.welford.com

Transmittal

To: Doug Fawcett
715 Princess Anne Street
P O Box 7447
Fredericksburg, Virginia 22404

Date: September 3, 2014

Project No.: 1101-170

From: Chris Kowalski

Re: 9 Lockhart Circle Drainage

Welford Engineering was asked by the City of Fredericksburg to analyze the drainage shed to a driveway crossing at 9 Lockhart Circle and provide recommendations for alternate solutions to the existing driveway crossing. Welford Engineering was also asked to help provide recommendations to help prevent further deterioration of a landscape wall located near the outlet of an existing drainage pipe.

The driveway crossing located at 9 Lockhart Circle was recently modified from a concrete ford style crossing to a dual 15″ corrugated metal culverts. The 15″ culverts were inadequate to convey large storm events. Welford Engineering calculated the 1 year, 2 year and 10 year storm events based on the United States Department of Agriculture's (USDA) Urban Hydrology for Small Watersheds Technical Release 55 (TR-55) methodology in conjunction with City of Fredericksburg Topographic Maps, and the USDA's Web Soil Survey. Based on these sources the drainage area to the driveway crossing in question was found to be 110 Acres with a Curve Number (CN) of 58. The time of concentration (Tc) from the most hydrologically distant point was found to be 33 minutes. This resulted in a one year flow of 7.3 cubic feet per second (cfs), a two year flow of 19.3 cfs, and a ten year flow of 87.1 cfs. No reservoir storage was taken into account for upstream culvert crossings.

Welford Engineering looked at a variety of solutions to improve the crossing. Below is a summary of solutions designed to avoid overtopping based on the ten year storm event. All crossings assume the driveway to be one foot above the top of the structure. The following drainage solutions will safely accommodate a ten year flow if one foot of cover is provided for the driveway.

- Three (3) 30″ corrugated metal or reinforced concrete culverts
- A single corrugated metal arch with a 7 foot span and a 2.8 foot rise
- Double 42″ x 27″ elliptical concrete culverts (long axis horizontal)

Additionally we recommend concrete be used on the sidewalls and surface to prevent any undermining of the driving surface.

If these options are not acceptable a concrete ford twelve feet in width (perpendicular to the stream) with six percent slopes or less leading to and away from the ford will provide a flow depth of six inches in a ten year peak storm event.

The landscape wall which is eroding should be rebuilt in conformance with VDOT Road and Bridge Standard 414.03 (d) "grouted rip rap for slopes". The stone should extend a minimum of five (5) feet beyond the end of the outlet pipe to avoid future failures.

APPENDIX E: TIMMONS GROUP SCOPE OF WORK

Task Order Proposal
City of Fredericksburg
Stormwater Plan Review and Braehead Woods Watershed Landcover Evaluation
Timmons Group Point of Contact – Jon D'Alessandro P.E.

Submitted to:
The City of Fredericksburg, Virginia
September 16, 2019

At the City of Fredericksburg's (City) request, Timmons Group (TG) is providing this task order proposal for two (2) site plan reviews, specifically focusing on the stormwater management components of the plan assembly. The two plan sets to be reviewed are as follows:

- *Stonewall Heights Residential Subdivision* (Fairbanks and Franklin – Approved March 11, 2015)
- *The Vintage Residential Subdivision* (Fairbanks and Franklin – Approved March 24, 2015)
    - The Vintage Residential Subdivision – Stormwater Management Calculations & Details – Sheet 15 Redline – Approved March 15, 2017)

Also, as part of this proposal, TG will perform a watershed land cover evaluation to a location of known localized flooding within the Braehead Woods Subdivision. A brief memo report outlining the findings of the watershed landcover evaluation, as well as recommendations of potential drainage improvements, will be included with this scope of services. A lump sum cost to perform this work is provided below and includes TG project management and coordination time. The seven (7) tasks that have been identified for the City of Fredericksburg Stormwater Plan Review and Braehead Woods watershed land cover evaluation are:

Task 1. Project Kickoff Meeting and Braehead Woods Neighborhood Walkthrough
Task 2. Stonewall Heights Residential Subdivision SWM Plan Review
Task 3. The Vintage Residential Subdivision SWM Plan Review
Task 4. Braehead Woods Watershed Pre-Development vs. Post-Development Land Cover Evaluation
Task 5. Memo Report and Recommendation(s) of Potential Drainage Improvements
Task 6. Braehead Woods Homeowners Association (HOA) Meeting
Task 7. Meetings & Coordination

Tasks one (1) through seven (7) are briefly discussed below:

This proposal, in its entirety, shall be considered proprietary and confidential and shall not be shared with any individual or entity outside of the City of Fredericksburg.

Task 1. Project Kickoff Meeting and Braehead Woods Neighborhood Walkthrough

Under this task, TG staff will be available for (1) project kickoff meeting with City Staff and Braehead Woods HOA Representation. The meeting will take place on September 25, 2019 at 8:30 a.m. TG anticipates discussing the neighborhood drainage issues and observations with the HOA representatives. As part of this task, TG staff will walk the existing neighborhood and photo-document areas of homeowner concern. If additional site visits, coordination activities, or neighborhood walkthroughs are requested, TG will prepare a separate scope of work and cost estimate for client approval prior to proceeding with the additional work.

Task 2. Stonewall Heights Residential Subdivision SWM Plan Review

Under this task, TG will review the following sheets from the "Stonewall Heights Residential Subdivision" Plan Set Approved on March 11, 2015:

- Sheet 1 – Cover Sheet
- Sheet 2 – General Notes
- Sheet 3 – Existing Conditions and Demolition Plan
- Sheet 6 – Grading Plan
- Sheet 7 – Drainage and Utility Plan
- Sheet 8 – Drainage Area Plan
- Sheet 9 – Drainage Profiles and Calculations and Road Centerline Profile
- Sheet 16 – Stormwater Management Calculations and Details
- Sheet 16A – Stormwater Management Calculations and Standards
- Sheet 17 – Stormwater Management Drainage Area Plan and Calculations
- Sheet 18 – Stormwater Management Calculations

The review will focus on the Stormwater Management Components of the Plan Assembly, specifically related to Water Quantity Control. TG will compare the Site BMP's to their corresponding VA BMP Clearinghouse Specifications to ensure design features and principles were adhered to. From this, TG will determine if the BMPs are providing the requisite runoff reduction/volumetric reduction required of the site. TG will provide comments on the Plan Assembly in the Memo Report (Task 5).

Task 3. The Vintage Residential Subdivision SWM Plan Review

Under this task, TG will review the following sheets from "The Vintage Residential Subdivision" Plan Set Approved on March 5, 2015:

- Sheet 1 – Cover Sheet
- Sheet 2 – General Notes
- Sheet 3 – Existing Conditions and Demolition Plan
- Sheet 6 – Grading Plan
- Sheet 7 – Drainage and Utility Plan
- Sheet 8 – Drainage Area Plan
- Sheet 9 – Profiles and Calculations
- Sheet 9A – Profiles and Calculations
- Sheet 15 – Stormwater Management Calculations and Details
- TG will also review the Stormwater As-Built Plan from "The Vintage Residential Subdivision" Plan Set (Sheet 15) approved on March 15, 2017.

This proposal, in its entirety, shall be considered proprietary and confidential and shall not be shared with any individual or entity outside of the City of Fredericksburg.

The review will focus on the Stormwater Management Components of the Plan Assembly, specifically related to Water Quantity Control. TG will compare the Site BMP's to their corresponding VA BMP Clearinghouse Specifications to ensure design features and principles were adhered to. From this, TG will determine if the BMPs are providing the requisite runoff reduction/volumetric reduction required of the site. TG will provide comments on the Plan Assembly in the Memo Report (Task 5).

Task 4. Braehead Woods Watershed Pre-Development vs. Post-Development Land Cover Evaluation

TG will perform a Pre-Development vs. Post Development watershed land cover analysis for one (1) Point of Interest (POI) located in the Braehead Woods Subdivision. A drainage area will be delineated to the POI (10 Lockhart Circle) to determine the overall acreage and major conveyances of the drainage area. TG will also utilize best available GIS and Aerial Imagery to determine the land cover within the drainage area prior to the development of the Stonewall Heights and Vintage Subdivision (Pre-Developed Conditions). TG will then utilize the plan data in Tasks 2 and 3 to develop the Post-Developed Conditions landcover analysis. The purpose of this is to quantify the drainage area to the point of known flooding, and then determine the percent increase in overall imperviousness after the Stonewall Heights and Vintage communities were constructed. This analysis will allow for an engineering judgement decision on if the two residential developments could potentially be contributing to the existing flooding conditions in the Braehead Woods Subdivision.

Task 5. Memo Report and Recommendation(s) of Potential Drainage Improvements

TG will write a brief memo report outlining the findings of the SWM Plan Reviews (Task 2 and 3), as well as outline the findings from the land cover evaluation. TG will also include a brief write-up on two (2) potential drainage improvements. One write-up will focus on a potential neighborhood overall drainage improvement, and the other write up will focus on a localized drainage improvement for 10 Lockhart Circle, at the most downstream portion of the Braehead Subdivision.

Task 6. Braehead Woods Homeowners Association (HOA) Meeting

Under this task, TG staff will be available for (1) neighborhood HOA meeting to discuss the findings of the Plan Review(s) and the Land Cover evaluation. If additional meetings and coordination activities are requested, TG will prepare a separate scope of work and cost estimate for client approval prior to proceeding with the additional work.

Task 7. Meetings & Coordination

Under this task, TG staff will be available for (1) project coordination meeting, in person, to discuss the project. In addition, TG will participate in calls to discuss the project with the City staff. If additional meetings and coordination activities are requested, TG will prepare a separate scope of work and cost estimate for client approval prior to proceeding with the additional work.

Estimated Time for Completion

Upon receipt of a notice-to-proceed TG anticipates completing this scope of work within 10 weeks.

Project Deliverables

- A comment letter outlining the findings of each SWM plan review. These will be incorporated as an appendix in the Memo Report.
- An 11x17 GIS derived Pre-Development vs. Post-Development Watershed Land-Cover evaluation graphic.

This proposal, in its entirety, shall be considered proprietary and confidential and shall not be shared with any individual or entity outside of the City of Fredericksburg.

- A brief Memo Report and Drainage Improvements Recommendation write up summarizing the work outlined in this Scope of Services.
- An HOA Meeting with the Braehead Woods Community.

Overall Project Assumptions

For the purposes of developing this proposed scope of work and the accompanying cost estimate, TG has made the following assumptions:

- The City will provide the most recent and best available GIS shapefile/database information and aerial imagery.
- The scope of work described in this proposal does not constitute the preparation of construction documents. Drainage improvement design recommendations will only be based on the limited analysis performed within this Scope of Services.
- If stormwater design services or H&H modeling services is deemed to be required, those services can be provided as a separate Scope of Services.
- Limited presentation materials will be created for the HOA meeting. If renderings, posters, binders, etc. are required, those materials can be provided as a separate Scope of Services.
- The City will provide all available approved site plans/as-built plans for the project site.
- This proposal and the accompanying cost estimate are valid for a period of 30 days and will expire if not accepted within that timeframe.

This proposal, in its entirety, shall be considered proprietary and confidential and shall not be shared with any individual or entity outside of the City of Fredericksburg.

APPENDIX F: NOAA RAINFALL HISTORICAL DATA

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Global Summary of the Year
2000 - 2019

Generated on 01/21/2020

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Current Location: Elev: 216 ft. Lat: 38.2270° N Lon: -77.5120° W
Station: **FREDERICKSBURG 5.2 SSW, VA US US1VASP0002**

Date	**Liquid Precipitation (Inches)**			**Frozen Precipitation (Inches)**					**Number of Days**		
Elem->	PRCP	EMXP		SNOW	EMSN		EMSD		DP01	DP10	DP1X
Year	Total Liquid Content	Extreme Max Precip	Date of Occurrence	Snowfall	Extreme Max Snowfall	Date of Occurrence	Extreme Max Snow Depth	Date of Occurrence	Precip >= 0.01"	Precip >= 0.10"	Precip >= 1.00"
2008	47.50	3.17	Sep-07						121	79	12
2009	50.04	2.85	Jun-03						129	85	17
2010	40.90	3.68	Feb-06						98	71	10
2011	56.74	3.56	Sep-09						115	78	15
2012	33.35	4.10	Oct-30						124	70	7
2013	44.48	4.65	May-08						123	80	9
2014	43.76	3.11	Jul-16						120	77	10
2016	44.46	2.96	Sep-29						118	78	13
2017	39.82	1.82	Jul-07						119	66	13
2018	69.24	3.85	Oct-12						140	91	25
2019	40.03	2.00	Mar-22						118	87	5

(blank) Data element not reported or missing.

+ Occurred on one or more previous dates during the month. The date in the Date field is the last day of occurrence.

A Accumulated amount.

T Trace amount

APPENDIX G: FAIRBANKS AND FRANKLIN COMMENT RESPONSE LETTERS

Fairbanks & Franklin

Civil Engineering • Land Planning • Surveying

February 07, 2020

Charles Johnston
Director, Community Planning & Building Department
City of Fredericksburg
715 Princess Anne Street
Fredericksburg, VA 22401

Re: Stonewall Heights
Subdivision
Project #270-1000
City #CONST 2014-02

Mr. Johnston:

The purpose of this letter is to provide a response to the site plan comments included in the report prepared by Timmons Group titled Braehead Woods Stormwater Plan Review, Watershed Landcover Evaluation, and Preliminary Drainage Improvement Recommendations, dated 02/06/2020. As discussed on 02/06/2020, the comments not associated with stormwater management quantity control are not relevant. Therefore, we have limited our responses to comments associated with quantity control.

General Comments

Comment 1d: Offsite topography is provided on Sheet 18.
Comment 2a-d: The drainage areas are a conservative estimate of areas that could drain to the drainage inlets and are based on engineering judgement. The drainage area boundaries shown on Sheet 8 are solely for sizing inlets and pipes.
Comment 3a-b: The runoff coefficient and rainfall intensity are included in the Storm Sewer Calculations.

BMP Design Review

Comment 1c: The area is correct.
Comment 2a-b: The void ratios used are 40% for gravel and 25% for soil.
Comment 2c: The 1" orifice is a drilled orifice in a cap. This cap is on the 6" underdrain that lays in stone. Dirt should not get into the underdrain; however, the cap can be removed for cleaning purposes if necessary.
Comment 2d: The riser is a VDOT Std. DI-1 as labeled in the profiles.
Comment 2e i: The detail is a general detail for both facilities. Bioretention facility specific outfall pipe profiles are provided on Sheet 9.
Comment 2e ii: The orifice is on; however, the multi-stage was set to no. This has been checked and does not change the flow from the bioretention facility.
Comment 2e iii: There is no length or elevation information in Weir B. It is irrelevant if it is set to multi-stage or not.
Comment 2e iv: The underdrain is sloped per the specifications. It is impossible for the entire underdrain to be at the top of the stone.
Comment 2f i: The underdrain is modeled as an orifice.
Comment 2f ii: There is no length or elevation information in Weir B. It is irrelevant if it is set to multi-stage or not.
Comment 2f iii: This is a recommendation in the standards and not a requirement.
Comment 2f v: The surface area is correct.

1005 Mahone Street • Fredericksburg, VA 22401
Office: (540) 899-3700 • Fax: (540) 899-0030

Comment 2g: These numbers are provided in the Bioretention Surface Area Calculations.

Stormwater Quantity Review

Comment 1a i: The discharge point is correct because this is the runoff path in the predevelopment condition.
Comment 1a ii: The calculated allowable peak flow in the 1-year storm is 0.01 cfs. It is not practical to limit the outflow to this. The post development peak 1-year flow is 0.09 cfs using a 1" orifice.
Comment 1a iii: The Hydrograph Return Period Recap shows the post development 1-year peak flows in the individual bypass areas are less than the predevelopment or have a negligible increase.
Comment 1c i: The Hydrograph Return Period Recap can be followed without a node chart.
Comment 1c ii: The routings are correct. The bypass areas are small. The increase in the 1-year peak flow in bypass area #2 is 0.014 cfs and in bypass area #3 it is 0.002 cfs. This is negligible.
Comment 2a: The CN calculations provide a breakdown of land use.
Comment 2b: Soils data is provided in the Soils Map on Sheet 14.
Comment 2c: The drainage divides match.
Comment 2d: This is not necessary. The calculations match the drainage areas.
Comment 2e: Time of concentration calculations are correct. Bypass #3 area changes significantly in the post development conditions. This changes the location of the longest flow path in the drainage area. The flow path for Biofilter #2 is shown through an offsite shed; however, routing the path around the shed would not have any impact on the time of concentration. The flow path through the project lots may change once houses are built, but the change should be negligible.
Comment 3: The hydrographs are correct. The summary hydrographs are provided.

In addition to the above comments, I take exception to language on Pages 5 and 6 of the report in the Stonewall Heights Residential Subdivision Plan Review Section. The site plans were first reviewed and approved by the City. A second review of the plans was performed by another City employee about a year after approval which, to my knowledge, did not note any deficiencies. To state that the "plans would likely be found to be non-compliant with several of the documents referenced earlier in the Stormwater Management Plan Review Introduction" is not founded based on their comments and the responses provided in this letter. Timmons references that the site plans do meet criteria set out in VRRM Guidance Memo No. 16-2001 and states that the site plan is "illustrating a site with substantially better hydrologic conditions than the actual existing conditions". The memo referenced is dated May 2, 2016, over a year after the site plan was approved, and has no bearing on this site plan. The existing conditions plan shows the limits of wooded areas in the predevelopment conditions. Including wooded areas in the predevelopment analysis reduces the curve number of the drainage area and, therefore, reduces the predevelopment peak flow rates. This is a conservative estimate of the predevelopment conditions and only further reduces the allowed peak outflows from the site in the post development conditions.

The summary goes on to state that "calculations and subsequent values for each bioretention's pertinent components either were not consistent throughout the plans or were not provided. Lastly, both bioretention facilities were designed to discharge onto

adjacent properties that lacked the required stormwater conveyance channels required per 9VAC25-870-66." The bioretention facilities were not inconsistent throughout the plan. The facilities were designed to discharge onto adjacent properties because that is where the water discharged in the predevelopment conditions. By meeting channel protection and flood protection criteria, the plan meets the requirements of 9VAC25-870-66.

If there are any further comments or questions, please do not hesitate to contact me at (540) 899-3700.

Sincerely,

Fairbanks & Franklin

Jennifer Shea, PE
Project Manager

Fairbanks & Franklin

Civil Engineering • Land Planning • Surveying

February 07, 2020

Charles Johnston
Director, Community Planning & Building Department
City of Fredericksburg
715 Princess Anne Street
Fredericksburg, VA 22401

Re: Vintage Subdivision
Project #286-1000
City #CONST 2014-01

Mr. Johnston:

The purpose of this letter is to provide a response to the site plan comments included in the report prepared by Timmons Group titled Braehead Woods Stormwater Plan Review, Watershed Landcover Evaluation, and Preliminary Drainage Improvement Recommendations, dated 02/06/2020. As discussed on 02/06/2020, the comments not associated with stormwater management quantity control are not relevant. Therefore, we have limited our responses to comments associated with quantity control.

General Comments

Comment 2a, 2b: The drainage divides are correct.
Comment 2c, 2d: The drainage areas are correct.
Comment 2e: The sheet flow drainage area is irrelevant. The stormwater management facility does not rely on sheet flow.
Comment 3a: The HGL data is included in the table of calculations on the same sheet. The data shows the HGL is not an issue.
Comment 3b, 3c: The runoff coefficients and Tc calculated are correct.
Comment 3d: The starting HGL assumes a higher point than the 100 yr. WSEL in accordance with the standard practice of using 0.8 times the pipe diameter. This is a conservative calculation.

BMP Design Review

Comment 1: A sand filter is an appropriate measure for the site and associated constraints. The sand filter surface area is over 6 times larger than required.
Comment 2, 3: The comment is inaccurate. The plans do not specify differing types of sand filters. Pea gravel was utilized between the sand and aggregate as requested by the VSMP authority (City of Fredericksburg).
Comment 4: The treatment volume is correct and is from the VRRM spreadsheet. The average head is an assumed value because the surface area is over 6 times larger than required.
Comment 5: Re-suspended solids will not occur because the WSEL for the 1 yr. is below the top of the sand. Solids will not float up from within the sand (Stokes' law and Darcy's law) during the dewatering in any storm event.
Comment 6: The comment is irrelevant.

1005 Mahone Street • Fredericksburg, VA 22401
Office: (540) 899-3700 • Fax: (540) 899-0030

Stormwater Quantity Review

Comment 1: The data utilized for the design is accurate.
Comment 2a, 2b: The channel protection and flood protection calculations are correct. The discharge point is correct because this is the runoff path in the predevelopment condition.
Comment 2c: The underdrain is correct and specifically not intended to flow into the control structure. The control structure would not regulate the flow from the underdrain because the underdrain outlet is 4" and the outlet from the control structure is 24".
Comment 2d, 2e: The comments are inaccurate.
Comment 3a: The comment is inaccurate. The stage storage starts at the lowest point where runoff discharges from the facility.
Comment 3b: The comment is inaccurate. The invert out of the 24" culvert and underdrain is not 215. It is 212.5 as shown on the profile and grading.
Comment 3c: The comment is inaccurate.
Comment 3d: Stage discharge output graph simply depicts an extrapolated value. The 100 yr. peak discharge is correct.
Comment 4a: The bottom elevations are correct for the facility. The stage storage is correct because is starts at the lowest discharge point. As shown on the detail there is 1' of aggregate below the underdrain.
Comment 4b: The WSEL shown on the routing results vs. the summary table for the 10 and 100 differ by 0.02' and 0.04', respectively. These values are insignificant and do not change the fact that the project complies with state and local stormwater management requirements.
Comment 5: The comment is inaccurate. The 18" riser was installed with the control structure and was witnessed as being in place on multiple occasions including the date of this response letter, 02/03/2020, 03/07/2018 (at the time an as-built survey was completed), and 02/15/2018. There is no evidence that this structure was ever omitted or recently installed.

In addition to the responses above, we take exception to language on page 6 and 7 of the report in the Vintage Residential Subdivision Plan Review Section. The first paragraph incorrectly asserts that the VRRM spreadsheet is in error and that there is a forested area compliance error. There is a statement that the values must have been overwritten. No values were overwritten because all cells, other than input cells within the spreadsheet, are write protected. The impervious area includes upstream offsite areas that are treated by the facility. There is no forested area compliance error. The VRRM Guidance Memo No. 16-2001 referenced is dated May 2, 2016, over a year after the site plan was approved, and has no bearing on this site plan. The second paragraph incorrectly asserts that differing filtering practice specifications were shown throughout the plans. All notations, details, and specifications are explicitly clear that the facility is a sand filter with extended detention. The statement that this filtering practice should not have been used is not accurate. This facility meets the storage and treatment requirements and provides a surface area over 6 times larger than required. The statement that the 8" riser was never installed is not accurate. As noted in the response above, the 18" riser was installed with the control structure and was witnessed as being in place on multiple occasions including the date of this response letter, 02/03/2020, 03/07/2018 (at the time an as-built survey was completed), and 02/15/2018. There is no evidence that this structure was ever omitted or recently installed. The third paragraph

incorrectly asserts that the downstream channel should have been analyzed. By providing upstream stormwater management that meets channel protection and flood protection criteria, the plan meets the requirements of 9VAC25-870-66.

If there are any further comments or questions, please do not hesitate to contact me at (540) 899-3700.

Sincerely,

Fairbanks & Franklin

Justin R. Franklin, PE
Vice President