

**Proposed Amendments to Chapter 6 (Storm Drainage)  
of  
The Fairfax County Public Facilities Manual**

**Revisions to advertised amendments recommend by staff  
November 14, 2013**

*The following is not the full text of the advertised amendments to the Public Facilities Manual. Only those parts of the advertised amendments for which changes are proposed are set forth below. Advertised amendments (9/10/13) are indicated by single strikethroughs and single underlines. Revisions (11/14/13) to the advertised amendments recommended by staff are indicated by double strikethroughs and double underlines.*

1 **Amend §6-0200 (Policy and Requirements for Adequate Drainage), by revising 6-0203**  
2 **(Analysis of Downstream Drainage System) to read as follows:**

3  
4 **6-0203 Analysis of Downstream Drainage System (91-06-PFM)**

5  
6 6-0203.1 The downstream drainage system shall be analyzed to demonstrate the adequacy of the  
7 system (§ 6-0203.3), or it shall be shown that there is no adverse impact to the downstream system as  
8 well as a ~~proportional~~ an improvement of the pre-development conditions (§ 6-0203.4 and § 6-0203.5).

9  
10 6-0203.2 The extent of the review of the downstream drainage system shall be as required by  
11 Chapter 124 of the County Code. Note that the extent of review for channel protection and flood  
12 protection requirements are different.;

13  
14 ~~6-0203.2A To a point at which the that is at least 150 feet downstream of a point where the~~  
15 ~~receiving pipe or channel is joined by another that has a drainage area that is at least 90 percent~~  
16 ~~of the size of the first drainage area at the point of confluence; or~~

17  
18 ~~6-0203.2B To a point at which the total drainage area is at least 100 times greater than the~~  
19 ~~contributing drainage area of the development site; or~~

20  
21 ~~6-0203.2C To a point that is at least 150 feet downstream of a point where the drainage area is~~  
22 ~~360 acres or greater.~~

23  
24 6-0203.2A ~~6-0203.2D~~ When using §§ 6-0203.2A and 6-0203.2C for the extent of review, t  
25 he analysis must be to a point where all the cross-sections are adequate in the farthest downstream  
26 reach of 150 feet. A minimum of three cross-sections shall be provided in the 150-foot reach. If  
27 the detention method described in § 6-0203.4A ~~§ 6-0203.4C~~ is used, the three cross-sections in  
28 the farthest downstream reach of 150 feet shall be limited to showing a defined channel or a

1 man-made drainage facility and checking for flooding as described in § 6-0203.4A(3) ~~§ 6-~~  
2 ~~0203.4C(3)~~ and § 6-0203.5.

3  
4 ~~6-0203.2B~~ ~~6-0203.2E~~ The Director may require analysis farther downstream when the submitted  
5 narrative described in § 6-0204 and all related plats and plans are insufficient to show the true  
6 impact of the development on surrounding and other lower lying properties, or if there are known  
7 drainage problems downstream.<sup>1</sup>

8  
9 ~~6-0203.2C~~ ~~6-0203.2F~~ Cross-section selection and information shall be determined in accordance  
10 with Chapter 5 of the latest edition of the “Virginia Erosion and Sediment Control Handbook”  
11 (Virginia Department of Conservation and Recreation) under the section titled “Determination of  
12 Adequate Channel.” Cross-sections shall be shown on the plans with equal horizontal and vertical  
13 scales.

14  
15 ~~6-0203.2D~~ ~~6-0203.2G~~ If the downstream owner(s) refuse to give permission to access the  
16 property for the collection of data, the developer shall provide evidence of this refusal and make  
17 arrangements satisfactory to the Director to provide an alternative method for the collection of  
18 data to complete the outfall analysis (e.g., through the use of photos, aerial surveys, “as built”  
19 plans, County topographic maps, soils maps, and any other relevant information).

20  
21 6-0203.3 Adequacy of all natural watercourses, channels and pipes shall be verified in  
22 accordance with the channel protection and flood protection requirements of Chapter 124 of the  
23 County Code and the following as follows:

24  
25 ~~6-0203.3A~~ ~~The developer shall demonstrate that the total drainage area to the point of analysis within~~  
26 ~~the channel is 100 times greater than the contributing drainage area of the development site; or~~

27  
28 ~~6-0203.3B(1)~~ ~~Natural watercourses shall be analyzed by the use of a 2-year frequency storm to~~  
29 ~~verify that stormwater will not overtop channel banks nor cause erosion of channel bed or banks;~~

30  
31 ~~6-0203.3B(2)~~ ~~All previously constructed man-made channels shall be analyzed by the use of a 10-~~  
32 ~~year frequency storm to verify that stormwater will not overtop channel banks and by the use of a 2-~~  
33 ~~year frequency storm to demonstrate that stormwater will not cause erosion of channel bed or banks;~~

34  
35 ~~6-203.3A~~ ~~6-0203.3B(3)~~ Pipes, storm sewer systems and culverts, which are not maintained by  
36 VDOT, shall be analyzed by the use of a 10-year frequency storm to verify that stormwater will  
37 be contained within the pipe, system, or culvert; and

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38  
<sup>1</sup> These drainage problems may be documented as parts of County watershed or drainage studies, complaints on file with the County, or complaints on file at the offices of County Supervisors.

1 ~~6-203.3B~~ ~~6-0203.3B(4)~~ Pipes, storm sewer systems and culverts, which are maintained by VDOT,  
 2 shall be analyzed by the use of the 10-year or greater frequency storm in accordance with VDOT  
 3 requirements.

4  
 5 6-0203.3C Determinations of the adequacy of drainage systems shall be performed in  
 6 accordance with methods contained in Chapter 5 of the latest edition of the “Virginia Erosion  
 7 and Sediment Control Handbook” (Virginia Department of Conservation and Recreation) under  
 8 the section titled “Determination of Adequate Channel.”

9  
 10 6-0203.4 ~~A proportional~~ An improvement and no adverse impact to the downstream drainage  
 11 system shall be shown in accordance with the requirements of Chapter 124 of the County Code  
 12 and the following: ~~by one of the following methods:~~

13  
 14 ~~6-0203.4A~~ Critical Shear Stress Method

15  
 16 ~~6-0203.4A(1)~~ ~~If the outfall is inadequate due to erosive velocities along the extent of review,~~  
 17 ~~which is described in § 6-0203.2, the critical shear stress method may be used to show no~~  
 18 ~~adverse impact due to erosive velocities. The erosive work on the channel for the post-~~  
 19 ~~development conditions shall be reduced to a level below the erosive work on the channel under~~  
 20 ~~pre-development conditions by the required proportional improvement. The required~~  
 21 ~~proportional improvement of the downstream system at each inadequate cross section is the ratio~~  
 22 ~~of the post-development C times A (See § 6-0803 for a description of C times A) for the~~  
 23 ~~contributing drainage area of the site to the existing development C times A for the entire~~  
 24 ~~drainage area at that cross section. The required proportional improvement is computed as~~  
 25 ~~follows:~~

26  
 27 
$$P_i = [C_d A_d / C_{es} A_{es}] \times 100$$

28  
 29 Where,

30  $P_i$  = Required Proportional Improvement (%)

31  $C_d$  = Runoff Coefficient for the Contributing Drainage Area of the Site in a Post Development  
 32 Condition

33  $A_d$  = Contributing Drainage Area of the Site

34  $C_{es}$  = Runoff Coefficient for the Contributing Drainage Area to the Cross Section in an Existing  
 35 ——— Development Condition

36  $A_{es}$  = Contributing Drainage Area to the Cross Section

37  
 38 ~~Each inadequate cross section along the extent of review shall then be analyzed for the~~  
 39 ~~following:~~

40  
 41 ~~6-0203.4A(2) (107-11 PFM)~~ ~~The shear stress for both the pre-development condition and the~~  
 42 ~~post-development condition for the 2-year storm shall be plotted in relation to time at each cross-~~  
 43 ~~section. On each graph, the permissible shear stress also shall be plotted. The permissible shear~~

1 stress is based on the soil type, and may be determined for cohesive soils from Plate 76-6 and for  
 2 non-cohesive soils from Plate 77-6. The soil type may be determined by field test or the soil type  
 3 designated on the County soils maps may be used. If the soil type is designated using the County  
 4 soils maps, the most conservative permissible shear stress for the soil type shall be used. The  
 5 plans shall indicate how the soil type was determined. The County soil maps are available on the  
 6 County website and the soil properties are available from the USDA-NRCS website. The area  
 7 between the permissible shear stress and the actual shear stress on the graph is erosive work on  
 8 the channel. The erosive work for the post-development condition shall be less than the erosive  
 9 work for pre-development condition by a percentage equal to the required proportional  
 10 improvement.

11 The shear stress on the channel can be calculated using the following formula:

12 \_\_\_\_\_  
 13  
 14  $\tau = \gamma RS$

15 Where:

16  $\tau$  = shear stress (lb./sq.ft.)

17  $\gamma$  = unit weight of water (62.4 lb./ft<sup>3</sup>)

18 R = hydraulic radius (ft.)

19 S = slope of the channel bed

20  
 21  
 22 ~~6-0203.4B Channel Capacity Method~~

23  
 24 ~~6-0203.4B(1) If the outfall is inadequate due to inadequate capacity along the extent of review,~~  
 25 ~~which is described in § 6-0203.2, the channel capacity method may be used to show no adverse~~  
 26 ~~impact due to overtopping. The largest storm that does not exceed the actual channel, pipe, or~~  
 27 ~~culvert capacity under pre-development conditions shall be determined for the cross-section that~~  
 28 ~~is most frequently over its capacity. The post-development peak flows for the above storm and~~  
 29 ~~the 2-year and 10-year storms shall be reduced to a level below the pre-development conditions~~  
 30 ~~by a percent equal to the required proportional improvement. See § 6-0203.4A(1) for a~~  
 31 ~~description of the required proportional improvement.~~

32  
 33 6-0203.4A ~~6-0203.4C~~ Detention Method <sup>2</sup>

34  
 35 6-0203.4A(1) ~~6-0203.4C(1)~~ It shall be presumed that no adverse impact and a proportional an  
 36 improvement will occur if on-site detention is provided as follows and the outfall is discharging  
 37 into a defined channel, which may include sections of natural streams with braided channels or  
 38 wetlands as determined by the Director, or manmade drainage facility:

39  
 \_\_\_\_\_  
<sup>2</sup> Because of the long detention times resulting from this method, consideration shall be given to hydrology, soils and extended detention when choosing the appropriate landscaping for the detention facility. ~~The detention method also is referred to as the energy balance method.~~

1 ~~6-0203.4C(1)(i) Extended detention of the 1-year storm volume for a minimum of 24 hours. If~~  
 2 ~~extended detention of the BMP volume (see § 6-0400 *et seq.*) also is provided, the 24 hours shall~~  
 3 ~~be applied to the difference between the 1-year storm volume and the BMP volume; and~~  
 4

5 ~~6-0203.4C(1)(ii) In order to compensate for the increase in runoff volume, the 1-year, 2-year~~  
 6 ~~and 10-year post-development peak rates of runoff from the development site shall be reduced~~  
 7 ~~below the respective peak rates of runoff for the site in good forested condition (e.g., for NRCS~~  
 8 ~~method, a cover type of “woods” and a hydrologic condition of “good”) in accordance with the~~  
 9 ~~requirements of Chapter 124 of the County Code. This reduction results in a proportional~~  
 10 ~~improvement and is computed as follows:~~

$$11 \quad R_i = [1 - (V_f / V_d)] \times 100$$

12 ~~Where:~~

13  ~~$R_i$  = Reduction of Peak Flow Below a Good Forested Condition (%)~~

14  ~~$V_f$  = Runoff Volume from the Site in a Good Forested Condition~~

15  ~~$V_d$  = Runoff Volume from the Site in a Post-Developed Condition~~

16 ~~The calculation of the peaks and cumulative volumes shall be based on the NRCS methodology~~  
 17 ~~described in § 6-0802 or other methods as approved by the Director.~~

18 ~~6-0203.4C(1)(iii) Computations demonstrating the 1½ year post-development peak rate of~~  
 19 ~~runoff from the development site does not exceed the 1½ year peak rate of runoff for the site in~~  
 20 ~~good forested condition are optional. The 1½ year storm is used to obtain Leadership in Energy~~  
 21 ~~and Environmental Design (LEED) certification.~~

22 ~~6-0203.4A(2) 6-0203.4C(2) If this method is used, each outfall from the site shall be analyzed~~  
 23 ~~independently and the allowable release rate shall be based on the area of the site that drains to~~  
 24 ~~the outfall under pre-development conditions.~~

25 ~~6-0203.4A(3) 6-0203.4C(3) If this method is used, the downstream review analysis shall be~~  
 26 ~~limited to providing cross-sections to show a defined channel, which may include sections of~~  
 27 ~~natural streams with braided channels or wetlands as determined by the Director, or man-made~~  
 28 ~~drainage facility, and checking for flooding of existing dwellings or buildings constructed under~~  
 29 ~~an approved building permit from the 100-year storm event for the extent of review described in~~  
 30 ~~§ 6-0203.2A, B, C and D.~~

31 ~~6-0203.4B 6-0203.4D Other scientifically valid methods, which show no adverse impact~~  
 32 ~~regarding erosion or capacity for an inadequate outfall and show proportional an improvement,~~  
 33 ~~may be approved by the Director in accordance with § 124-4-4 of the County Code.~~

34 ~~6-0203.5 In accordance with § 6-0202.4, if an existing dwelling or a building constructed under~~  
 35 ~~an approved building permit, which is located within the extent of review described in § 6-~~  
 36

1 0203.2, is flooded by the 100-year storm, the peak flow of the 100-year storm at the development  
2 site shall be reduced to a level below the pre-development condition in accordance with the  
3 requirements of Chapter 124 of the County Code ~~by a percent equal to the required proportional~~  
4 ~~improvement. See § 6-0203.4A(1) for a description of the required proportional improvement.~~