

Appendix F
Storm Water and Watershed Modeling Methodology

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Storm Water Runoff Modeling

To estimate baseline storm water runoff and peak flow volumes and the potential impacts of each of the proposed development scenarios on Fort Belvoir, affected streams were modeled using Technical Release 55 (TR-55), *Urban Hydrology for Small Watersheds* (NRCS, 1986). TR-55 includes simplified procedures for estimating storm-event runoff and peak discharges in small watersheds.

An assessment of land cover and hydrologic factors that characterize the current flow conditions of streams located within proposed development areas was made to determine the potential environmental consequences that would result from the adoption of each of the BRAC proposed alternatives. The assessment included analysis of the existing distribution of land uses and soil types, characterization of surface elevations, subwatersheds, and stream networks. TR-55 model input data were developed based on the proposed development footprint coverage for each of the alternatives and current GIS data layers for land cover, streams, soils, topography, and other watershed attributes.

Hydrologic conditions on Fort Belvoir are characterized based on storm water management units. The delineation of these subwatersheds was provided by the Fort Belvoir GIS Center (US Army Garrison Fort Belvoir DPW GIS Center, 2005). Hydrologic soil types and areas were characterized using the State Soil Geographic (STATSGO) coverage for Virginia, developed by the Natural Resources Conservation Service (NRCS). Land cover, surface elevations, and stream networks were derived from the 2001 National Land Cover Dataset (NLCD), 30-meter Digital Elevation Model (DEM), and National Hydrography Dataset (NHD), developed by the United States Geological Survey (USGS). The assessment of current conditions was used as a baseline from which potential impacts on storm water runoff volumes and stream flow velocity were estimated for each of the proposed alternatives. Note that BMPs required by state and federal regulations have various percent efficiencies depending on their design and site characteristics; therefore, BMP implementation was not considered in the storm water modeling scenarios.

Model Background

TR-55 model scenarios for each subwatershed were run using local precipitation data for the 1, 2, 5, 10, 25, 50, and 100-year design storm events over a 24-hour period. 24-hour rainfall distributions for the Washington, DC, metropolitan region were packaged with the TR-55 model and were used to simulate precipitation and runoff conditions for each of the subwatersheds modeled. These data were derived from NOAA isoline precipitation maps for the eastern United States. Precipitation data were used to estimate runoff volumes by assigning a weighted curve number to the land area of each modeled subwatershed based on the distribution of land cover and hydrologic soil types. Peak stream flow was then estimated based on flow routing procedures that calculate runoff travel time, also known as time of concentration, through the subwatershed. Runoff travel time between two locations was used as a measure of flow velocity. For each TR-55 model scenario, travel time was assumed to be implicitly dependent on stream flow length. Other important model parameters are discussed below.

The runoff curve number determines the fraction of total precipitation that either infiltrates into ground water storage or enters surface water as over-land runoff. Curve numbers are calculated based on the distribution of land use/cover and hydrologic soil types within each subwatershed. Area weighted curve numbers for Fort Belvoir subwatersheds were calculated using available land cover (2001 NLCD) and soils (STATSGO) GIS data layers.

To estimate stream flow velocity, TR-55 divides surface flow into three distinct types—sheet flow, shallow concentrated flow, and open channel flow—that together form a continuous flow route from the most hydrologically distant point to the farthest downstream point within a watershed. The algorithm to

calculate flow velocity varies for each type, but all consider slope and surface roughness. Calculated velocities for sheet flow and concentrated shallow flow are impacted primarily by land use and slope, while channel flow also considers channel geometry.

Sheet flow usually occurs at the headwaters of a stream and is characterized by the volume of water that flows over land surfaces. Sheet flow is restricted in the model to a maximum length of 300 feet. This maximum was assumed for all subwatersheds due to the lack of site-specific information. The flow velocity associated with sheet flow is a function of Manning's roughness coefficient for overland flow and slope of the hydrologic grade line. Manning's roughness coefficients were derived from land cover data (NLCD), and hydraulic grade lines (land slope) were calculated using 30-meter DEM data.

Sheet flow is usually conveyed into shallow concentrated flow once the maximum length of 300 feet is reached. The velocity of shallow concentrated flow is a function of slope and land cover. Land cover types were simplified and classified as either pervious or impervious surfaces. Shallow concentrated flow was assumed to occur at the end of sheet flow and beginning of stream channel flow, based on the location of streams depicted in the NHD streams coverage (USGS).

Average channel flow velocity was calculated using Manning's roughness coefficient for open channel flow, channel slope, and channel geometry. It was assumed that no natural channels would be converted to artificial materials (concrete, metal, or polyethylene). Stream channel geometries were estimated using regional curves that depict the relationship between bankfull and drainage area for the Eastern United States hydro-physiographic province (Dunn and Leopold, 1978).

For each of the BRAC proposed alternatives (Preferred, Town Center, City Center, and Satellite Campuses), the current land use grid (2001 NLCD) was edited to reflect the locations of the proposed development projects. Estimated footprints for planned facilities and associated developed areas within each subwatershed were added to the land cover grid as either high or medium intensity development areas. These changes in land cover were used to update the weighted curve number and time of concentration values for each subwatershed and estimate potential changes in peak flow discharge that may result from each of the proposed alternatives.

Table F-1 presents the peak flow modeling results for all subwatersheds under each of the proposed alternatives. The percent change in peak flow discharge for the 1, 2, 5, 10, 25, 50, and 100-year storm event scenarios are shown in this table. The results for the 1-year and 10-year storm events are summarized in Section 4.7.

**Table F-1
TR-55 Runoff modeling results (percent change from baseline to future condition)**

Sub-watershed	Preferred Alternative							Town Center Alternative							City Center Alternative							Satellite Campuses Alternative						
	Peak discharge % change							Peak discharge % change							Peak discharge % change							Peak discharge % change						
	Storm Frequency (years)							Storm Frequency (years)							Storm Frequency (years)							Storm Frequency (years)						
	1	2	5	10	25	50	100	1	2	5	10	25	50	100	1	2	5	10	25	50	100	1	2	5	10	25	50	100
1	100	83	70	63	61	56	51	131	106	86	75	71	65	59	10	6	5	4	4	4	3	54	41	30	25	24	20	16
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	12	7	6	5	5	4	4	22	15	12	10	9	8	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	9	7	6	5	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	36	23	19	16	14	12	10	36	23	19	16	14	12	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	25	19	15	13	12	11	11	0	0	0	0	0	0	0	25	19	15	13	12	11	11
30	0	0	0	0	0	0	0	24	16	12	10	9	8	7	0	0	0	0	0	0	0	25	16	12	10	9	8	7
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table F-1
TR-55 Runoff modeling results (percent change from baseline to future condition) (continued)

Sub-watershed	Preferred Alternative								Town Center Alternative								City Center Alternative								Satellite Campuses Alternative							
	Peak discharge % change								Peak discharge % change								Peak discharge % change								Peak discharge % change							
	Storm Frequency (years)								Storm Frequency (years)								Storm Frequency (years)								Storm Frequency (years)							
	1	2	5	10	25	50	100	1	2	5	10	25	50	100	1	2	5	10	25	50	100	1	2	5	10	25	50	100				
32	0	0	0	0	0	0	0	15	11	7	6	5	5	4	0	0	0	0	0	0	0	15	11	7	5	5	4	4				
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44	29	20	16	14	13	11				
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	14	10	9	8	7	6				
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	91	72	53	42	38	33	28				
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
53	77	46	27	22	20	18	16	0	0	0	0	0	0	0	77	46	27	22	20	18	16	0	0	0	0	0	0	0				
54	29	20	13	10	10	9	8	0	0	0	0	0	0	0	14	13	6	4	5	4	4	0	0	0	0	0	0	0				
55	56	35	21	17	15	13	12	0	0	0	0	0	0	0	53	33	20	17	15	13	12	0	0	0	0	0	0	0				
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
57	93	58	40	33	29	26	23	0	0	0	0	0	0	0	93	58	40	32	29	25	22	0	0	0	0	0	0	0				
58	70	51	38	31	28	25	21	0	0	0	0	0	0	0	70	51	38	31	28	25	21	0	0	0	0	0	0	0				
59	82	59	42	34	31	27	22	0	0	0	0	0	0	0	82	60	42	34	31	27	22	0	0	0	0	0	0	0				
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				

Watershed Modeling (Nutrient Analysis and Cumulative Impacts Analysis)

The Generalized Watershed Loading Functions (GWLF) model was used to estimate current (baseline) conditions and potential changes in flow volume and pollutant loads. Separate watershed models were developed for Accotink Creek, Pohick Creek, and Dogue Creek. A fourth watershed model was developed to incorporate direct drainage areas (watershed areas that flow directly into Gunston Cove, Accotink Bay, Pohick Bay, and the Potomac River). Average annual flow volume and nutrient loads (total nitrogen (TN) and total phosphorus (TP)) were calculated in order to assess potential cumulative impacts on water quality that may result from the Preferred Alternative and anticipated future development within each watershed. In addition, loading coefficients were calculated for TN and TP based on the Accotink Creek watershed model results in order to estimate the percent change in nutrient loads for the modeled subwatersheds under each BRAC development alternative. Table F-2 presents the subwatershed nutrient loading results. Subwatersheds with greater than a ten percent change in nitrogen and phosphorus loads are summarized in Section 4.7. Watershed results for the cumulative impacts analysis are presented in Section 5.7.

The 2001 NLCD GIS coverage was modified to account for future development in each watershed as a result of the BRAC Preferred Alternative and planned development within these watersheds based on information provided by the Fairfax County Department of Planning and Zoning (2006). The NLCD grid was modified as discussed in the storm water modeling section above. Future development locations within the vicinity of Fort Belvoir were represented in a GIS point coverage provided by the Fairfax County Planning Department. The planned development area associated with each location was reclassified as high intensity development. BRAC and other future on- and off-post development projects located within each watershed that drains part of Fort Belvoir are shown in Table F-3. Fairfax County development projects located in other watersheds are shown in Table F-4. Note that BMPs required by state and federal regulations have various percent efficiencies depending on their design and site characteristics; therefore, BMP implementation was not considered in the watershed modeling scenarios.

Model Background

The watershed models for Accotink Creek, Pohick Creek, Dogue Creek, and Direct Drainage watersheds were developed using GWLF and the BasinSim 1.0 interface. The GWLF model, which was originally developed by Cornell University (Haith et al., 1992), provides the ability to simulate runoff and pollutant loadings from watersheds given variable-size source areas (e.g., agricultural, forested, and developed land). GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations. Monthly calculations are made for pollutant loads based on daily water balance totals that are summed to give monthly values. The BasinSim 1.0 watershed simulation program is a Windows based modeling system that facilitates the development of model input data and provides additional functionality for simulating daily flows and flow and pollutant routing (Dai et al., 2000)

GWLF is an aggregate distributed/lumped parameter watershed model. For surface loading, it is distributed in the sense that it allows multiple land use/cover scenarios. Each area is assumed to be homogeneous with respect to various attributes considered by the model. In addition, the model does not spatially distribute the source areas, but aggregates the loads from each area into a watershed total. In other words, there is no spatial routing. For subsurface loading, the model acts as a lumped parameter model using a water balance approach. No distinctly separate areas are considered for subsurface flow contributions. Daily water balances are computed for an unsaturated zone as well as for a saturated subsurface zone, where infiltration is computed as the difference between precipitation and snowmelt minus surface runoff plus evapotranspiration.

GWLF models surface runoff using the Natural Resources Conservation Service Curve Number (NRCS-CN) approach with daily weather inputs of temperature and precipitation. Erosion and sediment yield are estimated using monthly erosion calculations based on the Universal Soil Loss Equation (USLE) algorithm (with monthly rainfall-runoff coefficients) and a monthly composite of KLSCP values for each source area (e.g., land cover/soil type combination). The KLSCP factors are variables used in the calculations to depict changes in soil loss/erosion (K), the length/slope factor (LS), the vegetation cover factor (C), and the conservation practices factor (P). A sediment delivery ratio, based on watershed size, and a transport capacity, based on average daily runoff, are applied to the calculated erosion to determine pollutant yield for each source area.

Surface nutrient losses are determined by applying dissolved nitrogen and phosphorus coefficients to surface runoff and applying a sediment coefficient to the yield portion for each agricultural source area. Urban nutrient inputs are all assumed to be solid phase, and the model uses an exponential accumulation and washoff function for these loadings. Subsurface losses are calculated using dissolved nitrogen and phosphorus coefficients for shallow groundwater contributions to stream nutrient loads, and the subsurface submodel considers only a single, lumped-parameter contributing area. Evapotranspiration is determined using daily weather data and a cover factor dependent on land use/cover type. Finally, a water balance is performed daily using supplied or computed precipitation, snowmelt, initial unsaturated zone storage, maximum available zone storage, and evapotranspiration values. All the equations used by the model can be found in the original GWLF paper (Haith and Shoemaker, 1987) and GWLF User's Manual (Haith et al., 1992).

Nonpoint source pollution is driven by rainfall, and therefore precipitation data are necessary to drive the watershed model. Local rainfall and temperature data were used to simulate flow conditions in modeled watersheds. Daily precipitation and temperature data were obtained from local National Climatic Data Center (NCDC) weather stations. There was one station in close proximity to the modeled watersheds—Reagan National Airport. Temperature and precipitation data recorded at this station from April 1995 through December 2004 were used in the simulations.

Table F-2
GWLF nutrient loading results (percent change from baseline to future condition)

Sub-watershed	Preferred		Town Center		City Center		Satellite Campuses	
	TP	TN	TP	TN	TP	TN	TP	TN
1	-3	-4	9	15	4	6	-9	-10
2	0	0	0	0	0	0	0	0
3	-1	-4	-1	-4	2	3	0	-1
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	-1	-1	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0

Table F-2
GWLF nutrient loading results (percent change from
baseline to future condition) (continued)

Sub-watershed	Preferred		Town Center		City Center		Satellite Campuses	
	TP	TN	TP	TN	TP	TN	TP	TN
14	1	2	1	1	1	1	1	1
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0
25	-2	-6	5	3	0	0	0	0
26	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0
29	2	3	5	6	2	3	12	13
30	3	4	-3	-3	3	4	2	2
31	0	0	0	0	0	0	0	0
32	0	0	3	3	0	0	3	3
33	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	-2
39	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	2
43	0	0	0	0	0	0	-6	2
44	0	0	0	0	0	0	0	-1
45	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0
53	51	68	0	0	61	83	0	0

Table F-2
GWLF nutrient loading results (percent change from
baseline to future condition) (continued)

Sub-watershed	Preferred		Town Center		City Center		Satellite Campuses	
	TP	TN	TP	TN	TP	TN	TP	TN
54	8	17	0	0	7	14	0	0
55	26	39	0	0	26	39	0	0
56	0	0	0	0	0	0	0	0
57	19	31	1	1	11	19	1	1
58	22	33	0	0	13	19	0	0
59	2	-3	0	0	5	0	0	0
60	0	0	0	0	0	-1	0	0

Table F-3
Projects located in modeled watersheds (Fort Belvoir drainage area)

Watershed name	Map number	Project number	Project description
Accotink Creek			BRAC PROJECTS
	8	67959/ 67487/ 64097	INFRASTRUCTURE (INCLUDES GUNSTON ROAD IMPROVEMENTS)
	4	64238	HOSPITAL
	5	64241	DENTAL CLINIC
	16	66228	PURCHASE AMC RELOCATABLES
	15	63571	ACCESS ROAD/CONTROL POINT
	2	64234	WHS
	1	65416	NGA
	12	55661	CHILD DEV CENTER – 244 (NGA)
	13	55662	CHILD DEV CENTER – 303 (EPG)
	7	N/A	CORPS OF ENGINEERS INTERGRATION OFFICE
	6	65871	NARMC HEADQUARTERS BLDG
	19	62892	MODERNIZE BARRACKS
	9	64076	EMERGENCY SVCS CENTER (EPG)
			OTHER ON-POST PROJECTS
	26a	58466	MUSEUM OF THE US ARMY ALTERNATIVE LOCATION AT NORTH POST
	17	65317	GOLF CLUBHOUSE/CART STORAGE
	31	n/a	INFO DOMINANCE CENTER
	2	61458	RELIGIOUS EDUCATION CENTER
	20	57495	SOLDIER SUPPORT CENTER
	3	64231	PHYSICAL FITNESS CENTER (TROOP CANTONMENT AREA)
	18	63206	ADDITION TO MP STATION

Table F-3
Projects located in modeled watersheds (Fort Belvoir drainage area) (continued)

Watershed name	Map number	Project number	Project description
	15	n/a	DCNG RESOURCES TRAINING CENTER
	14	65139	EXPAND ARTS/CRAFT/AUTO
	19	55523/ 52694	POTOMAC HERITAGE NATIONAL SCENIC TRAIL
	29	n/a	OPERATIONS SECURITY EVALUATION GROUP TRAINING FACILITY
	16	62134	DLA RECEIVING AND SCREENING FACILITY
	30	n/a	FAIRFAX COUNTY PARKWAY EXTENSION
	28	n/a	FLIGHT CONTROL TOWER
	25	64230	PHYSICAL FITNESS CENTER (EPG)
	24	64742	CONSTRUCT SHOPPETTE
	30	64531	PX EXPANSION
			OFF-POST PROJECTS
	84	002463-Sp -002-2	OLD KEENE MILL PROFESSIONAL OFFICES
	1	002981-SP-004-2	WEST SPRINGFIELD BUSINESS CENTRE SITE 5 PARKING ADDN
	30	003330-SP -007-2	TELEGRAPH ROAD WAREHOUSE
	31	006839-SP-006-2	THE FAIRFAX BUILDING ADDITION
	25	006384-SD-001-3	MAZZELLO COVE
	55	000187-SP-002-1	UPS IN NEWINGTON
	128	000503-SP-001-3	U-HAUL RETAIL CENTER 8207 TERMINAL ROAD
	130	004198-SP-009-2	M AND S HOLDINGS LLC (FORM MILLERS OFFICE PRODUCTS)
	129	009730-SP-001-2	CROWN CENTER
	125	000497-SP-002-2	HUNTER PLAZA PHASE 2
	124	000497-SP-001-2	HUNTER PLAZA, PHASE ONE
	16	008082-SP-001-3	HOOES ROAD PARK
	106	005833-SP-002-2	ECHO INC
	3	005219-PI-001-2	ACCOTINK STREAM VALLEY TRAIL (REVIT AREA) (BR/SP)
	4	006945-SP-001-2	ACCOTINK PARK
	131	003189-SP -004-2	8501 BACKLICK ROAD (FORMERLY 8521)
	126	000230-SP-001-2	TAVARES/ALLEN PROPERTY
	127	001130-SP-001-2	ISLAND CREEK ELEMENTARY SCHOOL
	15	004998-PI-001-2	MOHTARAM MOZAFARI RESIDENCE
	107	007207-SP-002-2	VW SPRINGFIELD
	14	005694-SP-001-2	VA TIRE AND AUTO REPAIR
	87	006754-SD-005-3	TALBERT SUBDIVISION
	70	009990-SP -003-2	SPRINGFIELD METRO CENTER II ROAD IMPROVEMENTS

Table F-3
Projects located in modeled watersheds (Fort Belvoir drainage area) (continued)

Watershed name	Map number	Project number	Project description
	99	006561-SP-001-2	6715 COMMERCE STREET
	64	004072-SP-003-1	BOB EVANS RESTAURANT (SP) OLD KEENE MILL ROAD
	40	001988-SP-002-1	RESIDENCE INN SPRINGFIELD
	60	024588-SP-001-1	HOA NGHIEM PAGODA
	44	013408-SD-001-1	KENDRICK
	17	006836-SP-009-2	METRO PARK PHASE SEVEN
	112	009639-SP-008-2	SILVER LAKE IHOP RESTAURANT
	110	006836-SP-010-2	METRO PARK PHASE SIX
	108	001414-SP-001-2	2ND PARK STRUCTURE AT FRANC-SPRINGFIELD METRO STATION
	73	000438-SP-002-3	LOYAL ORDER OF THE MOOSE FRANCONIA LODGE 646 INC
	109	000677-SP-003-2	CALVARY ROAD BAPTIST CHURCH EXPANSION
	118	004099-SD-001-2	CHAPEL BRIDGE ESTATES
	2	002981-SP-005-2	WEST SPRINGFIELD BUSINESS CENTRE SITE 6
	178	009754-SP-005-2	GUNSTON COMMERCE CENTER LAND BAY B
	24	001343-SP-003-2	CIFUENTES PROPERTY PCLS 15 AND 15A
	181	RZ-2005-LE-025	Mid-Town Springfield Development (mixed use)
	182	PA-506-IV-SI	Springfield Mall Expansion
	183	05-IV-2MV	Mixed Use (Office, Hotel, Retail)
	184	05-IV-4MV	Mixed Use (Residential, Office, Retail, Hotel)
	185	05-IV-10S	Mixed Use (Residential, Office, Recreation/Open Space, Retail)
	186	05-IV-6S	Mixed Use (Office, Industrial)
	187	05-IV-1LP	Mixed Use (Office, Retail)
Direct Drainage			BRAC PROJECTS
	4	64238	HOSPITAL
	5	64241	DENTAL CLINIC
	16	66228	PURCHASE AMC RELOCATABLES
	17	65592/ 67321	PEO EIS ADMIN FACILITY
	8	64097/ 67487/ 67959	INFRASTRUCTURE (INCLUDES GUNSTON ROAD IMPROVEMENTS)
	6	66877	NARMC HQ BLDG
	15	63571	ACCESS ROAD/ CONTROL POINT
	18	54347	STRUCTURED PARKING FACILITY, 200 AREA
	14	65450	ADMINISTRATIVE BLDG (211, 214, 215, 220)
	3	MDA 580	MDA
	11	65447	USANCA REPLACEMENT
	10	65448	NETWORK OPS – PEO EIS

Table F-3
Projects located in modeled watersheds (Fort Belvoir drainage area) (continued)

Watershed name	Map number	Project number	Project description
			OTHER ON-POST PROJECTS
	10	58697	MUSEUM SUPPORT CENTER
	26c	58466	MUSEUM OF THE US ARMY ALTERNATIVE LOCATIONS AT PENCE GATE
	4	54897	MARINA MODERNIZATION AND DOGUE CREEK DREDGING
	23	61453	REPLACE SOUTH POST FIRE STATION
	5	65218	EXPAND MAIN POST LIBRARY
	12	59554	BATTALION HEADQUARTERS FOR 249 ENGINEER BATTALION
	13	63035	SHOPETTE WITH GAS, BURGER KING, CAR WASH (SOUTH POST)
	21	65141	EXPAND BOWLING CENTER
	22	57837/ 51326	SOUTH POST FITNESS FACILITY & MULTIPURPOSE FIELDS
	6	65314	EXPAND RECREATION CENTER
	11	50356	INSTALLATION INDUSTRIAL SUPPORT CENTER
	9	62539	VET CLINIC ADDITION
	8	56184	JPRA RENOVATION/ADDITION (BLDG) 358
	7	63815	ADMINISTRATIVE BUILDING PEO SOLDIER
			OFF POST PROJECTS
	161	003642-SD-007-2	LORTON TOWN CENTER LANDBAY G
	34	008461-SP-001-2	ST JAMES EPISCOPAL CHURCH
Dogue Creek			OTHER ON-POST PROJECTS
	27	n/a	DCEETA Remote Delivery Facility
	29	n/a	Operations Security Evaluation Group Training Facility

Table F-3
Projects located in modeled watersheds (Fort Belvoir drainage area) (continued)

Watershed name	Map number	Project number	Project description
			OFF- POST PROJECTS
	133	001881-SD-001-2	ASHBY HEIGHTS
	132	001497-SD-001-2	PINEY GLEN
	74	003365-SP-006-1	HILLTOP RECLAMATION PROJECT (3365-LF-01, FOR BOND ONLY)
	111	007818-SD-002-2	GAYFIELDS ROAD
	90	006105-SP-002-1	FIRST BAPTIST CHURCH OF KINGSTOWNE
	19	004388-SD-001-2	WINDSOR KNOLL
	88	005318-SP-007-2	BB+T BANK DRIVE THRU ADDN- MANCHESTER LAKES SC
	6	006790-SP-001-2	SAINT JOHN'S LUTHERAN CHURCH
	8	000623-SP-002-4	NORTHAMPTON (FORMERLY OVERBROOK)
	43	006105-SP-023-1	APPLE FEDERAL CREDIT UNION
	89	009405-SP-001-2	WALMART STORE #2194 KINGSTOWNE CENTRE
	18	006105-SP-082-2	KINGSTOWNE SECTION 36A
	91	004838-SP-001-2	HAYFIELD ANIMAL HOSPITAL
	136	004124-SP-001-3	EVERGREEN FARM
	32	001938-SP-001-2	JETT MECHANICAL 8753 RICHMOND HIGHWAY
	161	003642-SD-007-2	LORTON TOWN CENTER LANDBAY G
	33	009465-SP-002-2	MOUNT VERNON COUNTRY CLUB GOLF COURSE IMPROVEMENTS
	34	008461-SP-001-2	ST JAMES EPISCOPAL CHURCH
	96	001900-SP-001-2	EPIPHANY LUTHERAN CHURCH
	81	024570-SD-001-2	HALLEY FARM SUBDIVISION
	27	006090-SP-001-2	HOPKINS HOUSE
	137	004989-SD-001-2	CECIL CASE ESTATES
	57	005223-SP-002-2	MASTER ROOFING AND SIDING INC (MV) 8463 RICHMOND HY
	67	008375-SD-001-2	ROSE HILL RESERVE
	10	000542-SP-001-2	COX COMMUNICATIONS SOUTHEAST HUB SITE
	76	002697-SD-001-2	LOFTY OAKS PLACE LOTS 41A 41B 41C
	45	022564-SP-001-1	GROVETON HEIGHTS
	134	005127-SP-003-2	FEDERAL REALTY INVESTMENT/SOUTH VALLEY SHOP CTR
	173	004687-SP-004-2	MT VERNON ORIENTATION CNTR EDUCATION CENTER AND MUSEUM
Pohick Creek			OFF-POST PROJECTS
	72	006454-SD-023-2	SILVERBROOK FARMS LOT 7
	12	005466-SD-002-2	LAKWOOD HILLS SECTION 10 PHASE 2

Table F-3
Projects located in modeled watersheds (Fort Belvoir drainage area) (continued)

Watershed name	Map number	Project number	Project description
	104	005466-SD-001-2	LAKWOOD HILLS SECT 10 PHASE I
	97	001687-SP-001-2	THEMEADOWBROOK DRIVE PROPERTY
	122	001697-SD-001-2	MONACAN ESTATES
	54	004698-PI-003-1	8404 HELLER ROAD SANITARY SEWER SERVICE
	51	008043-SD-003-2	COVINGTON WOODS ADDITION
	50	000258-SD-002-1	7706 GAMBRILL ROAD (MV)
	119	001225-SP-001-2	ST RAYMOND PENAFORT CHURCH
	105	003303-SP-002-2	FAIRFAX PARK
	175	002144-SD-001-2	EVANS PROPERTY
	61	005787-SD-001-1	FERRY LANDING PRESERVE
	169	003642-SP-008-2	LORTON STATION SCHOOL
	79	006441-SP-006-1	AAA VEHICLE MAINTENANCE FACILITY
	176	005395-SP-007-3	GUNSTON SQUARE SECTION 2 PARCEL D
	167	004865-SP-010-2	LORTON STATION SOUTH SECTION 6
	168	006909-SD-001-2	BARNES PROPERTY
	80	005430-SP-003-2	COMMONWEALTH CONSTRUCTION MANAGEMENT INC
	158	003642-SP-010-2	LORTON TOWN CENTER LANDBAY D/F
	159	003864-SD-002-2	MEEKER PROPERTY
	160	001276-SP-001-2	LAUREL RIDGE CROSSING (FORMERLY PULTE PLASKETT LANE)
	162	003642-SD-008-2	GRACE BIBLE CHURCH
	157	001565-SP-001-2	POHICK ROAD SELF STORAGE FACILITY
	123	001859-SD-001-2	ROLLING OAKS
	52	000122-SP-006-2	GIANT #149 SARATOGA SHOPPING CENTER
	121	008043-SD-002-2	COVINGTON WOODS
	53	005638-SD-001-1	SABINA ESTATES
	120	005638-SP-002-2	HARVESTER PRESBYTERIAN CHURCH
	172	006839-SP-004-2	COOK INLET RESIDENTIAL SECTION THREE
	13	007732-SD-001-2	STREAM VALLEY ESTATES
	83	015444-SD-001-2	CARDINAL ESTATES
	94	006441-SP-005-2	BEST FOODS INC 9525 GUNSTON COVE ROAD
	95	004478-SD-001-2	ADKINS PROPERTY
	154	001183-SP-009-2	LAUREL HILL ELEMENTARY SCHOOL
	164	003642-SP-009-2	LORTON TOWN CENTER LANDBAY "B-2"
	163	003642-SP-011-2	LORTON TOWN CENTER LANDBAY C

Table F-4
Off-post projects located outside modeled watersheds

Watershed name	Map number	Project number	Project description
Occoquan			
	78	001183-SP-014-1	LORTON WORK HOUSE
	145	001657-SD-001-2	OCCOQUAN PARK
	153	001183-SP-006-2	SOUTH COUNTY HIGH SCHOOL
	144	001811-SD-001-2	OCCOQUAN OVERLOOK
	142	001222-SD-001-2	DAVISON WOODS
	46	001653-SP-002-1	GROVETON PHASE II
	156	001183-SP-010-2	LAUREL HILL RECREATION CENTER
	147	001183-SD-002-2	LAUREL HILL SOUTH SEC 1 LANDBAY C
	148	001183-SD-003-2	LAUREL HILL NORTH
	149	001183-SD-005-2	LAUREL HILL SOUTH LANDBAY D SECTION 1
	151	001183-SP-004-2	LAUREL HILL SOUTH LANDBAYS E AND F, SECTION 1
	152	001183-SP-005-2	LAUREL HILL SOUTH LANDBAY E AND F SECTION 2
Mill Branch			
	143	001100-SD-001-2	NIRVANA PALACE
	29	001183-SP-011-2	LAUREL HILL GOLF COURSE MAINTENANCE FACILITY
	28	001733-SD-001-2	MALCOLM AT OX ROAD
	93	008036-SP-002-2	NEW HOPE CHURCH
	150	001183-SD-007-2	LAUREL HILL SOUTH LANDBAY D SECTION 2
	58	004204-SD-001-1	LAUREL OVERLOOK (FORMERLY HOOES ROAD-BLACKSTONE)
	141	000848-SD-001-2	COOKE PROPERTY
	140	008733-SD-001-2	REMINGTON PLACE FORMERLY COOKE PROPERTY
	69	006510-SP-002-1	SOUTH RUN RECREATIONAL CENTER FITNESS CENTER ADDN
	37	009754-SP-004-2	GUNSTON COMMERCE CENTER BUILDING 1
	180	001001-SP-001-2	GUNSTON CENTER
	35	003800-SP-001-3	FURNACE ROAD RECYCLING FACILITY
	82	001883-SP-001-1	LORTON DEBRIS LAND FILL
	166	009101-SP-002-2	GUNSTON COMMONS TOWNHOUSES
	165	001126-SP-004-2	LORTON VALLEY RECREATION CENTER
	155	001183-SP-009-2	SPRING HILL SENIOR CAMPUS SENIOR HOUSING BUILDING
	170	007713-SP-015-1	GUNSTON CORNER RESTAURANT
	174	007334-SP-002-4	GUNSTON COVE BUSINESS CENTER
	62	001664-SD-001-1	CRANFORD AT GUNSTON COVE
	36	006103-SP-003-5	ROCK STONE AND SAND YARD INC
	171	004865-SP-011-2	LORTON STATION SOUTH SECTION 7
	63	009754-SP-009-2	GUNSTON COMMERCE CENTER LAND BAY D
	155	001183-SP-012-2	SPRING HILL SENIOR CAMPUS
	177	009754-SP-006-2	GUNSTON COMMERCE CENTER LAND BAY C
Little Hunting Creek			
	113	001653-SP-001-2	GROVETON WOODS
	114	002174-SP-001-2	HOLLY ACRES
	146	001183-SD-001-2	LAUREL HILL LAND BAY A SECTION 1
	20	000871-SP-002-2	PROVIDENT BANK
	47	001860-SP-001-2	K AND M SHOPPING CENTER
	116	000871-SP-001-2	MOUNT VERNON SQUARE SHOPPING CENTER

Table F-4
Off-post projects located outside modeled watersheds (continued)

Watershed name	Map number	Project number	Project description
	115	009644-SP-002-2	SHURGARD MOUNT VERNON
	135	000106-SD-001-2	THE WOODLANDS
	138	015459-SD-001-2	GALLAHAN PROPERTY
	56	008972-SP-002-1	MOUNT VERNON GATEWAY
	139	004097-SP-001-2	VERNON HEIGHTS
	75	001850-SP-001-3	8214 AND 8218 RICHMOND HIGHWAY
	179	009754-SP-002-2	GUNSTON COMMERCE CENTER BUILDING 2 LB A
	92	007175-PI -001-1	SHERWOOD HALL LIBRARY
	77	009083-SP-004-1	INOVA MOUNT VERNON
	71	007473-SP-011-1	BEACON MALL FAMOUS DAVES
	48	007473-SP-010-1	BEACON MALL SILVER DINNER
	23	003484-SP-002-2	COMMERCE BANK BEACON HILL GROVETON
	21	007473-SP-008-2	BEACON MALL PROP DRIVE-THRU BANK AND FAST FOOD
	26	006468-SP-005-2	ROXBURY MEWS
Cameron Run			
	38	001381-SP-023-1	LOT 16 SHELL OIL PARK
	39	006367-SP-005-3	BREN MAR IV
	98	003195-SP-002-2	BACKLICK PLAZA
	42	006989-SP-002-2	VERIZON ADDITION TO FRANCONIA CENTRAL OFFICE
	102	009163-SD-009-2	DEVERS PROPERTY
	41	005307-SD-001-1	WOODLAND CREST
	86	002725-SP-002-3	RICKS CARPET AND FLOORS
	100	009163-SD-006-2	HIGHGROVE ESTATES SECTION 5
	101	004178-SP-001-2	JEFFERSON AT SULLIVAN PLACE
	5	017901-SP-001-2	PBS
	103	000623-SP-001-2	LDS CHURCH FRANCONIA WARD
	7	000220-SD-002-2	ANNE LY ESTATE 2
	9	001656-SD-001-2	CROWN ROYAL GATE
	65	000220-SD-003-1	WHEELER PROPERTY
	67	008375-SD-001-2	ROSE HILL RESERVE
	11	001260-SD-001-3	HIGHLANDS ESTATES
	66	000542-SP-002-1	SPICER CENTER
	85	007364-SP-004-1	PARCEL 8A SHELL OIL PARK
Belle Haven			
	49	016842-SP-001-1	MOUNT CALVARY BAPTIST CHURCH
	22	000180-SP-003-2	DEL RAY GLASS
	117	007950-SP-001-2	CHILIS BEACON HILL, 6601 RICHMOND HIGHWAY

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