UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
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Decision Rationale for the Total Maximum Daily Loads for the Recreation Use (Bacteriological) Impairments on the Banister River Watershed, Halifax and Pittsylvania Counties, Virginia

Signed

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Decision Rationale for the

Total Maximum Daily Loads for the
Recreation Use (Bacteriological) Impairments for Banister River, Bearskin Creek, Cherrystone Creek, Polecat Creek, Stinking River, Sandy Creek and Whitehorn Creek Watersheds, Halifax and Pittsylvania Counties, Virginia

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those waterbodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS) that may be discharged to a water quality-limited waterbody.

This document will set forth the U.S. Environmental Protection Agency's (EPA) rationale for approving the TMDLs for the primary contact use (bacteriological) impairments for Banister River, Bearskin Creek, Cherrystone Creek, Polecat Creek, Stinking River, Sandy Creek and Whitehorn Creek watersheds. EPA's rationale is based on the determination that the TMDLs meet the following seven regulatory conditions pursuant to 40 CFR §130.

1) The TMDL is designed to implement applicable water quality standards.
2) The TMDL includes a total allowable load as well as individual wasteload allocations (WLAs) and load allocations (LAs).
3) The TMDL considers the impacts of background pollutant contributions.
4) The TMDL considers critical environmental conditions.
5) The TMDL considers seasonal environmental variations.
6) The TMDL includes a MOS.
7) The TMDL has been subject to public participation.

In addition, these TMDLs considered reasonable assurance that the TMDL allocations assigned to nonpoint sources can be reasonably met.

II. Background

Segments of the Banister River, Bearskin Creek, Cherrystone Creek, Polecat Creek, Stinking River, Sandy Creek, and Whitehorn Creek watersheds were listed as impaired for bacteria on Virginia's 1996, 1998, 2002, 2004, and/or 2006 section 303(d) List of impaired waters, and Reports (DEQ, 1996) due to violations of the state's water quality standard for fecal coliform bacteria and/or *E. coli*. The impaired segments are located in the Banister River Basin in Virginia. The watershed is located in the hydrologic unit (HUC) 0301010. The impaired watersheds include portions of Pittsylvania and Halifax Counties.

Two segments of the Banister River were identified as impaired for bacteria on Virginia Department of Environmental Quality's (VADEQ) 2004 and 2006 Section 303(d) List of impaired waters. First listed as impaired in the 2004 Section 303(d) List of impaired waters, the

upstream impaired segment (VAC-L65R-01) of the Banister River is 11.67 miles long and includes the Banister River from Bearskin Creek to its headwaters. Between January 1, 2000, and December 31, 2004, two of 18 fecal coliform samples (11%) collected at listing station, 4ABAN070.20, exceeded the bacteria instantaneous criterion of 400 cfu/100 ml. The second segment for the Banister River (VAC-L67-01) is 13.18 miles and runs from Elkhorn Creek to Banister Lake. Between January 1, 2000, and December 31, 2004, four out of 16 *E. coli* (25%) samples collected at listing station, 4ABAN023.38, exceeded the *E. coli* standard of 235 cfu/100 ml.

The impaired segment of Bearskin Creek (VAC-L65R-02) which is 9.31 miles and includes the entire creek from its headwaters to the mouth of the Banister River was first listed on the 2006 Section 303(d) List for impaired waters for exceedences of the *E. coli* standard of 235 cfu/100 ml. Between January 1, 2000, and December 31, 2004, two out of seven samples (29%) collected at listing station, 4ABKN000.52, exceeded the *E. coli* criterion of 235 cfu/100 ml.

The impaired segment of Cherrystone Creek (VAC-L66R-01) which extends for 8.44 miles includes the Cherrystone Creek mainstem from the Cherrystone Creek dam to the Banister River confluence. This segment was first listed on the 1996 Section 303(d) List for impaired waters. Between January 1, 2000, and December 31, 2004, at listing station, 4ACRR003.56, one out of nine *E. coli* samples (13%) exceeded the *E. coli* standard instantaneous of 235 cfu/100 ml; and one out of eight samples (11%) exceeded the fecal coliform instantaneous standard of 400 cfu/ml.

The impaired segment of the Stinking River (VAC-L69R-01) was first listed on the 2004 Section 303(d) List for impaired waters. This segment of Stinking River is impaired for fecal coliform for 8.99 miles, from the mouth of the Stinking River to the mouth of the North Fork of the Stinking River. Between January 1, 2000, and December 31, 2004, three out of 20 samples (15%) collected exceeded the instantaneous fecal coliform bacteria standard of 400 (cfu/100ml).

The impaired segment of Sandy Creek (VAC-L70R-01) extends for 11.78 miles from the confluence of Johns Run to the mouth of Sandy Creek. This segment was first listed on the 2002 Section 303(d) List for impaired waters. Between January 1, 2000, and December 31, 2004, three out of 19 samples (16%) collected at listing station, 4ASNA000.20, were recorded as exceeding the instantaneous fecal coliform bacteria criterion of 400 (cfu/100ml).

The impaired segment of Whitehorn Creek (VAC-L68R-01) extends 24.73 miles and was first listed on the 2002 Section 303(d) List of impaired waters, and extends from the mouth to the headwaters of Whitehorn Creek. One out of eight samples (12.5%) collected at listing station, 4AWRN0005.50, between January 1, 2000, and December 31, 2004, exceeded the instantaneous fecal coliform bacteria standard of 400 (cfu/100ml). Also, at this station, two out of eight (25%) of the samples collected within this same timeframe exceeded the *E. coli* standard instantaneous of 235 cfu/100 ml.

The total length of these eight segments is approximately 110 miles.
Table 1 describes the stream segment, impairment and violation rate.

Table 1. 2006 303(d) Impaired Segments within the Banister River, Bearskin Creek, Cherrystone Creek, Polecat Creek, Stinking River, Sandy Creek and Whitehorn Creek Watersheds.						
TMDL ID	**Stream Name**	**Miles**	**Boundaries**	**Station ID:**	**Impairment for**	**Violation Rate**
VAC-L65R-01	Banister River	11.67	Banister River mainstem from the mouth of Bearskin Creek upstream to its headwaters.	4ABAN070.20	Total Fecal Coliform	2/18
VAC-L67R-01	Banister River	13.18	Elkhorn Creek to Banister Lake	4ABAN023.28	*E. Coli*	4/16
VAC-L65R-02	Bearskin Creek	9.31	Bearskin Creek and its tributaries from its mouth on the Banister River upstream.	4ABKN000.52	*E. coli*	2/7
VAC-L66R-01	Cherrystone Creek	8.44	Cherrystone Creek mainstem from its mouth on the Banister River upstream to the Cherrystone Creek Dam.	4ACRR003.56	Total Fecal Coliform	1/8
VAC-L71R-05	Polecat Creek	9.66	Polecat Creek from its headwaters to the mouth at the Banister River	4APEC006.49	Total Fecal Coliform	3/13
VAC-L70R-01	Sandy Creek	11.78	Johns Run to mouth on Banister River	4ASNA000.20	Total Fecal Coliform	3/19
VAC-L69R-01	Stinking River	8.99	Stinking River mainstem from its mouth on the Banister River upstream to the mouth of the North Fork of Stinking River.	4ASNE005.30	Total Fecal Coliform	3/20
VAC-L68R-01	Whitehorn Creek	24.73	Whitehorn Creek mainstem from its mouth upstream to its headwaters	AWRN000.43	*E. coli* (2006), Total Fecal Coliform (2002)	*E. coli* - 2/8 Fecal Coliform 1/8

Virginia designates all of its waters for primary contact; therefore, all waters are required to meet the bacteriological criteria for this use. The criterion applies to all flows. The *E. coli* criteria requires a geometric mean concentration of 126 cfu/100 ml of water with no sample exceeding 235 cfu/100 ml of water.

The United States Geological Survey (USGS) Hydrologic Simulation Program-Fortran

(HSPF) water quality model was selected as the modeling framework to simulate fecal coliform existing conditions and to perform fecal bacteria TMDL allocations. The HSPF model is a continuous simulation model that can account for nonpoint source (NPS) pollutants in runoff, as well as pollutants entering the flow channel from point sources. The TMDLs developed Banister River, Bearskin Creek, Cherrystone Creek, Polecat Creek, Stinking River, Sandy Creek and Whitehorn Creek watersheds were based on the Virginia State Standard for *E. coli*. The model was set up to estimate loads of fecal coliform, and then the model output was converted to concentrations of *E. coli.*

The TMDL allocations are summarized in allocation Tables 2 through 9, including the maximum daily loads for allocation.

The United States Fish and Wildlife Service has been provided with a copy of the TMDL.

Table 2. Banister River (Segment VAC-L65R-01) Distribution of *E. coli* Load under Existing Conditions and TMDL Allocation

Land Use/Source	Annual Average *E. coli* Loads (cfu/yr)		Reduction (%)	Maximum Daily Loads (MDL) for Allocation
	Existing	Modeled Loads for Allocation		(cfu/day)
Forest	3.14E+11	3.14E+11	0.0%	2.99E+09
Cropland	9.48E+11	1.80E+11	81.0%	1.72E+09
Pasture	1.47E+13	2.80E+12	81.0%	2.67E+10
Low Density Residential/Pets	1.71E+13	3.25E+12	81.0%	3.11E+10
Medium Density Residential/Pets	6.03E+11	1.15E+11	81.0%	1.09E+09
High Density Residential/Pets	4.60E+11	8.75E+10	81.0%	8.35E+08
Commercial/Industrial	3.93E+12	7.46E+11	81.0%	7.12E+09
Cattle - Direct Deposition	9.19E+12	0.00E+00	100.0%	0.00E+00
Wildlife-Direct Deposition	1.19E+13	7.71E+12	35.0%	7.36E+10
Failed Septics & Straight Pipes	3.14E+08	0.00E+00	100.0%	0.00E+00
Point Source*	8.86E+10	1.52E+11	0.0%	4.17E+08
Total Loads/Overall Reductions	**5.92E+13**	**1.54E+13**	**74.1%**	**1.46E+11**

(*) there are no individual NPDES municipal point source dischargers; the WLA includes 1 percent of the total NPS allocations to account for future growth as well as allocated bacteria loads from the domestic sewage discharges

Table 2.1. Banister River (Segment VAC-L65R-01) TMDL Allocation Plan Loads (cfu/day) for *E. coli*			
WLA (Point Sources)	**LA (Nonpoint sources)**	**MOS (Margin of safety)**	**TMDL**
4.17E+08	1.45E+11	IMPLICT	1.46E+11

Table 3. Banister River (Segment VAC-L67R-01) Distribution of *E. coli* Load under Existing Conditions and TMDL Allocation				
	Annual Average *E. coli* Loads (cfu/yr)			**Maximum Daily Loads (MDL) for Allocation**
Land Use/Source	**Existing**	**Modeled Loads for Allocation**	**Reduction (%)**	**(cfu/day)**
Forest	4.27E+12	4.27E+12	0.00%	3.87E+10
Cropland	2.31E+13	1.85E+12	92.00%	1.67E+10
Pasture	1.95E+14	1.56E+13	92.00%	1.42E+11
Low Density Residential/Pets	3.65E+14	2.92E+13	92.00%	2.64E+11
Medium Density Residential/Pets	8.48E+13	6.79E+12	92.00%	6.15E+10
High Density Residential/Pets	4.71E+13	3.77E+12	92.00%	3.42E+10
Commercial/Industrial	5.38E+13	4.30E+12	92.00%	3.90E+10
Cattle - Direct Deposition	3.51E+13	0.00E+00	100.00%	0.00E+00
Wildlife-Direct Deposition	6.21E+13	4.04E+13	35.00%	3.66E+11
Failed Septics & Straight Pipes	1.76E+10	0.00E+00	100.00%	0.00E+00
Point Source	5.56E+09	2.78E+10	0.00%	2.78E+10
Total Loads/Overall Reductions	**8.70E+14**	**1.06E+14**	**87.80%**	**9.89E+11**

Table 3.1. Banister River (Segment VAC-L67R-01) TMDL Allocation Plan Loads (cfu/day) for *E. coli*			
WLA (Point Sources)	**LA (Nonpoint sources)**	**MOS(Margin of safety)**	**TMDL**
7.62E+07	9.61E+11	IMPLICT	9.62E+11

Table 4. Bearskin Creek (Segment VAC-L65R-02) Distribution of *E. coli* Load under Existing Conditions and TMDL Allocation				
	Annual Average *E. coli* Loads (cfu/yr)		Reduction (%)	Maximum Daily Loads (MDL) for Allocation
Land Use/Source	Existing	Modeled Loads for Allocation		(cfu/day)
Forest	1.64E+11	1.64E+11	0.0%	1.67E+09
Cropland	5.88E+11	9.99E+10	83.0%	1.02E+09
Pasture	1.14E+13	1.94E+12	83.0%	1.98E+10
Low Density Residential/Pets	1.25E+13	2.13E+12	83.0%	2.17E+10
Medium Density Residential/Pets	2.37E+11	4.02E+10	83.0%	4.11E+08
High Density Residential/Pets	0.00E+00	0.00E+00	83.0%	0.00E+00
Commercial/Industrial	2.88E+12	4.90E+11	83.0%	5.00E+09
Cattle - Direct Deposition	7.72E+12	0.00E+00	100.0%	0.00E+00
Wildlife-Direct Deposition	7.20E+12	4.32E+12	40.0%	4.41E+10
Failed Septics & Straight Pipes	1.44E+08	0.00E+00	100.0%	0.00E+00
Point Source*	0.00E+00	9.18E+10	0.0%	2.52E+08
Total Loads/Overall Reductions	**4.27E+13**	**9.27E+12**	**78.3%**	**9.40E+10**

(*) there are no individual NPDES municipal point source dischargers; the WLA includes 1 percent of the total NPS allocations to account for future growth as well as allocated bacteria loads from the domestic sewage discharges

Table 4.1. Bearskin Creek (Segment VAC-L65R-02) TMDL Allocation Plan Loads (cfu/day) for *E. coli*			
WLA (Point Sources)	LA (Nonpoint Sources)	MOS (Margin of safety)	TMDL
2.52E+08	9.38E+10	IMPLICT	9.40E+10

Table 5. Cherrystone Creek (Segment VAC-L66R-01) Distribution of *E. coli* Load under Existing Conditions and TMDL Allocation				
	Annual Average *E. coli* Loads (cfu/yr)		Reduction (%)	Maximum Daily Loads (MDL) for Allocation
Land Use/Source	Existing	Modeled Loads for Allocation		(cfu/day)
Forest	3.32E+11	3.32E+11	0.0%	3.12E+09
Cropland	1.14E+12	6.85E+10	94.0%	6.45E+08
Pasture	2.07E+13	1.24E+12	94.0%	1.17E+10
Low Density Residential/Pets	6.44E+13	3.86E+12	94.0%	3.64E+10
Medium Density Residential/Pets	2.14E+13	1.28E+12	94.0%	1.21E+10
High Density Residential/Pets	1.32E+13	7.93E+11	94.0%	7.47E+09
Commercial/Industrial	6.40E+12	3.84E+11	94.0%	3.62E+09
Cattle - Direct Deposition	1.75E+13	0.00E+00	100.0%	0.00E+00
Wildlife-Direct Deposition	1.40E+13	1.05E+13	25.0%	9.88E+10
Failed Septics & Straight Pipes	3.15E+08	0.00E+00	100.0%	0.00E+00
Point Source	4.71E+10	5.86E+12	0.0%	1.60E+10
Total Loads/Overall Reductions	**1.59E+14**	**2.43E+13**	**84.7%**	**1.90E+11**

Table 5.1. Cherrystone Creek (Segment VAC-L66R-01) TMDL Allocation Plan Loads (cfu/day) for *E. coli*			
WLA (Point Sources)	LA (Nonpoint Sources)	MOS (Margin of safety)	TMDL
1.60E+10	1.74E+11	IMPLICT	1.90E+11

Table 6. Polecat Creek (Segment VAC-L71R-05) Distribution of *E. coli* Load under Existing Conditions and TMDL Allocation				
	Annual Average *E. coli* Loads (cfu/yr)		Reduction (%)	Maximum Daily Loads (MDL) for Allocation
Land Use/Source	Existing	Modeled Loads for Allocation		(cfu/day)
Forest	1.90E+11	1.90E+11	0.0%	1.87E+09
Cropland	6.18E+11	1.61E+11	74.0%	1.58E+09
Pasture	7.04E+12	1.83E+12	74.0%	1.80E+10
Low Density Residential/Pets	5.25E+12	1.36E+12	74.0%	1.34E+10
Medium Density Residential/Pets	1.88E+11	4.89E+10	74.0%	4.81E+08
High Density Residential/Pets	3.27E+11	8.50E+10	74.0%	8.37E+08
Commercial/Industrial	1.82E+12	4.72E+11	74.0%	4.65E+09
Cattle - Direct Deposition	3.47E+12	0.00E+00	100.0%	0.00E+00
Wildlife-Direct Deposition	7.08E+12	4.25E+12	40.0%	4.18E+10
Failed Septics & Straight Pipes	1.28E+08	0.00E+00	100.0%	0.00E+00
Point Source*	0.00E+00	8.40E+10	0.0%	2.30E+08
Total Loads/Overall Reductions	**2.60E+13**	**8.48E+12**	**67.3%**	**8.29E+10**

(*) there are no individual NPDES municipal point source dischargers; the WLA includes 1 percent of the total NPS allocations to account for future growth as well as allocated bacteria loads from the domestic sewage discharges

Table 6.1. Polecat Creek (Segment VAC-L71R-05) TMDL Allocation Plan Loads (cfu/day) for *E. coli*			
WLA (Point Sources)	LA (Nonpoint Sources)	MOS (Margin of safety)	TMDL
2.30E+08	8.27E+10	IMPLICT	8.29E+10

Table 7. Stinking River (Segment VAC-L69R-01) Distribution of *E. coli* Load under Existing Conditions and TMDL Allocation				
	Annual Average *E. coli* Loads (cfu/yr)		**Reduction (%)**	**Maximum Daily Loads (MDL) for Allocation**
Land Use/Source	**Existing**	**Modeled Loads for Allocation**		**(cfu/day)**
Forest	2.99E+11	2.99E+11	0.0%	2.97E+09
Cropland	2.49E+12	4.24E+11	83.0%	4.21E+09
Pasture	1.49E+13	2.53E+12	83.0%	2.51E+10
Low Density Residential/Pets	1.91E+13	3.24E+12	83.0%	3.22E+10
Medium Density Residential/Pets	8.18E+11	1.39E+11	83.0%	1.38E+09
High Density Residential/Pets	0.00E+00	0.00E+00	83.0%	0.00E+00
Commercial/Industrial	4.45E+12	7.57E+11	83.0%	7.52E+09
Cattle - Direct Deposition	9.17E+12	0.00E+00	100.0%	0.00E+00
Wildlife-Direct Deposition	1.17E+13	7.62E+12	35.0%	7.57E+10
Failed Septics & Straight Pipes	1.45E+08	0.00E+00	100.0%	0.00E+00
Point Source*	0.00E+00	1.50E+11	0.0%	4.11E+08
Total Loads/Overall Reductions	**6.29E+13**	**1.52E+13**	**75.9%**	**1.50E+11**

(*) there are no individual NPDES municipal point source dischargers; the WLA includes 1 percent of the total NPS allocations to account for future growth as well as allocated bacteria loads from the domestic sewage discharges.

Table 7.1. Stinking River (Segment VAC-L69R-01) TMDL Allocation Plan Loads (cfu/day) for *E. coli*			
WLA (Point Sources)	**LA (Nonpoint Sources)**	**MOS (Margin of safety)**	**TMDL**
4.11E+08	1.49E+11	IMPLICT	1.50E+11

Table 8. Sandy Creek (Segment VAC-L70R-01) Distribution of *E. coli* Load under Existing Conditions and TMDL Allocation				
	Annual Average *E. coli* Loads (cfu/yr)			**Maximum Daily Loads (MDL) for Allocation**
Land Use/Source	**Existing**	**Modeled Loads for Allocation**	**Reduction (%)**	**(cfu/day)**
Forest	9.42E+11	9.42E+11	0.0%	8.96E+09
Cropland	4.89E+12	7.34E+11	85.0%	6.98E+09
Pasture	3.64E+13	5.46E+12	85.0%	5.20E+10
Low Density Residential/Pets	5.60E+13	8.40E+12	85.0%	7.99E+10
Medium Density Residential/Pets	9.11E+12	1.37E+12	85.0%	1.30E+10
High Density Residential/Pets	6.11E+11	9.16E+10	85.0%	8.72E+08
Commercial/Industrial	8.92E+12	1.34E+12	85.0%	1.27E+10
Cattle - Direct Deposition	1.81E+13	0.00E+00	100.0%	0.00E+00
Wildlife-Direct Deposition	3.52E+13	2.11E+13	40.0%	2.01E+11
Failed Septics & Straight Pipes	2.52E+09	0.00E+00	100.0%	0.00E+00
Point Source*	0.00E+00	3.94E+11	0.0%	1.08E+09
Total Loads/Overall Reductions	**1.70E+14**	**3.98E+13**	**76.6%**	**3.76E+11**

(*) there are no individual NPDES municipal point source dischargers; the WLA includes 1 percent of the total NPS allocations to account for future growth as well as allocated bacteria loads from the domestic sewage discharges.

Table 8.1. Sandy Creek (Segment VAC-L70R-01) TMDL Allocation Plan Loads (cfu/day) for *E. coli*			
WLA (Point Sources)	**LA (Nonpoint Sources)**	**MOS (Margin of safety)**	**TMDL**
1.08E+09	3.75E+11	IMPLICT	3.76E+11

Table 9. Whitehorn Creek (Segment VAC-L68R-01) Distribution of *E. coli* Load under Existing Conditions and TMDL Allocation				
	Annual Average *E. coli* Loads (cfu/yr)			**Maximum Daily Loads (MDL) for Allocation**
Land Use/Source	**Existing**	**Modeled Loads for Allocation**	**Reduction (%)**	**(cfu/day)**
Forest	4.75E+11	4.75E+11	0.0%	4.45E+09
Cropland	3.60E+12	2.16E+11	94.0%	2.02E+09
Pasture	3.06E+13	1.84E+12	94.0%	1.72E+10
Low Density Residential/Pets	1.01E+14	6.04E+12	94.0%	5.66E+10
Medium Density Residential/Pets	1.75E+13	1.05E+12	94.0%	9.85E+09
High Density Residential/Pets	9.22E+12	5.53E+11	94.0%	5.18E+09
Commercial/Industrial	8.93E+12	5.36E+11	94.0%	5.02E+09
Cattle - Direct Deposition	1.87E+13	0.00E+00	100.0%	0.00E+00
Wildlife-Direct Deposition	2.07E+13	1.45E+13	30.0%	1.36E+11
Failed Septics & Straight Pipes	2.54E+09	0.00E+00	100.0%	0.00E+00
Point Source	6.11E+11	3.06E+12	0.0%	8.37E+09
Total Loads/Overall Reductions	**2.11E+14**	**2.82E+13**	**86.6%**	**2.44E+11**

Table 9.1. Whitehorn Creek (Segment VAC-L68R-01) TMDL Allocation Plan Loads (cfu/day) for *E. coli*			
WLA (Point Sources)	**LA (Nonpoint Sources)**	**MOS (Margin of safety)**	**TMDL**
8.37E+09	2.36E+11	IMPLICT	2.44E+11

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the seven basic requirements for establishing primary contact (bacteriological) impairment TMDLs for eight water segments leading to the Roanoke River. Additionally, Virginia provided reasonable assurance that the bacteria TMDLs can be met. EPA is therefore approving the TMDLs. EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to meet the applicable water quality standards.

Virginia has indicated that potential sources of fecal coliform include both point and nonpoint source contributions. The water quality criterion for fecal coliform was a geometric mean 200 cfu/100ml or an instantaneous standard of no more than 1,000 cfu/100ml. Two or more samples over a 30-day period are required for the geometric mean standard. Since the State rarely collects more than one sample over a 30-day period, most of the samples were measured against the instantaneous standard.

The Commonwealth has changed its bacteriological criteria to include *E. coli*. The new *E. coli* criterion requires a geometric mean of 126 cfu/100ml of water with no sample exceeding 235 cfu/100 ml. The new criterion is more stringent.

The HSPF water quality model was selected as the modeling framework to simulate fecal coliform existing conditions and to perform fecal coliform bacteria TMDL allocations. The HSPF model is a continuous simulation model that can account for NPS pollutants in runoff, as well as pollutants entering the flow channel from point sources. In establishing the existing and allocation conditions, seasonal variations in hydrology, climatic conditions, and watershed activities can be explicitly accounted for in the model. The use of HSPF allowed for consideration of seasonal aspects of precipitation patterns within the watershed. Existing conditions were adjusted until the water quality standards were attained. The model was set up to estimate loads of fecal coliform, and then the model output was converted to concentrations of *E. coli* through the use of the following equation (developed from a data set containing n-493 paired data points):

$$\log_2(C_{ec}) = -0.0172 + 0.91905 \cdot \log_2(C_{fc})$$

where C_{ec} is the concentration of *E. coli* in cfu/100 ml, and C_{fc} is the concentration of fecal coliform in cfu/100 ml.

The pollutant concentrations were simulated over the entire duration of a representative modeling period, and pollutant loads were adjusted until the standard was met. The pollutant loads were calculated at the outlet of each impaired segment and include the loads from all upstream reaches and WLAs. The development of the allocation scenarios was an iterative process requiring numerous runs where each run was followed by an assessment of source reduction against the water quality target. The long-term average *E. coli* loads and coefficient of variations were determined to implement the final allocation scenarios and to express the TMDL on a daily basis. Assuming a log-normal distribution of data and a probability of occurrence of

95%, the maximum daily loads were determined using the following equation (USEPA OWOW 2007 Options for Expressing Daily Loads in TMDLs):

$$MDL=LTA\times Exp[z\sigma-0.5\sigma2]$$

Where;
MDL = maximum daily limit (cfu/day)
LTA = long-term average (cfu/day)
z = z statistic of the probability of occurrence
$\sigma2 = \ln(CV2+1)$
CV = coefficient of variation

2) The TMDL includes a total allowable load as well as individual wasteload allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest and agricultural land segments) and point sources. Activities that increase the levels of bacteria to the land surface or their availability to runoff are considered flux sources. The actual values for total loadings can be found in Tables
2 through 9 of this document.

Wasteload Allocations

EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR §122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR §130.7." Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

There are eight individually permitted facilities and 18 general permits located in the Banister River watershed. Specifically, there are five general domestic sewage permits but no NPDES permitted facilities to discharge bacteria in the Banister River (VAC-L67R-01). Cherrystone Creek (VAC-L66R-01) has two permitted facilities discharging bacteria. Whitehorn Creek (VAC-L68R-01) has one municipal permitted facility discharging bacteria. All other impaired segments do not have any permitted facilities discharging into the waters. The allocation for the sources permitted for *E. coli* control is equivalent to their current permit levels (design discharge and 126 cfu/100 ml). The existing load for general domestic permits is based on the allowable flow rate of 1,000 gal/day and a maximum *E. coli* concentration of 126 cfu/100 ml. The allocated load for domestic sewage facilities is based on the actual design flow of the system and is computed by applying a factor of five to the actual design flow of the system to account for future growth. While the growth-expanded WLA is presented individually for each facility, it will be allocated to both new and existing facilities at the discretion of the permitting agency staff through permit issuances.

Load Allocations

According to Federal regulations at 40 CFR §130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In these TMDLs, LAs to nonpoint sources are divided into land-based loadings from land uses and directly applied loads in the stream (*e.g.,* livestock and wildlife). Source reductions include those that are affected by both high and low flow conditions. Land-based NPS loads have their most significant impact during high flow conditions, while direct deposition NPS loads have their most significant impact on low flow concentrations. The Bacteria Source Tracking (BST) results for 2005-2006 confirmed the presence of human, livestock, pet, and wildlife contamination.

Allocation scenarios were run sequentially, beginning with headwater impairments, and then continuing with downstream impairments until all impairments were allocated to 0% exceedences of both standards.

The TMDL documents provided the existing and allocated loads for each impaired segment of Bannister River, Bearskin Creek, Cherrystone Creek, Polecat Creek, Stinking River, Sandy Creek, and Whitehorn Creek Watersheds. The documents reported the total annual cfu's per year from both direct and land-based sources, the maximum daily loads and provided the percent reduction needed to meet zero percent violations of water quality standards from each source.

3) The TMDL considers the impacts of background pollution.

The TMDL considers the impact of background pollutants by considering the bacterial load from natural sources such as wildlife.

4) The TMDL considers critical environmental conditions.

According to EPA's regulations at 40 CFR §130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the impaired creek is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[1]. Critical conditions for waters impacted by land-based nonpoint sources generally occur during periods of wet weather and high surface runoff. In contrast, critical conditions for point source-dominated systems generally occur during low flow and low dilution conditions. Point sources, in this context also include nonpoint sources that are not precipitation driven (e.g., fecal deposition to stream).

Virginia provided an analysis from available in-stream water quality data and flow data from the nearest USGS flow monitoring stations. Graphical representations charting fecal coliform concentrations and available corresponding stream flow distribution showed that the majority of exceedences tended to occur predominantly during high to moderate flow conditions. This observation applies to data recorded on the Banister River. Several samples collected at the other stations did show exceedences of the water quality standards during dry to low flow conditions.

Consequently, Virginia considered both high and low flow periods as the critical conditions because many of the observed exceedences occurred under these flow regimes. Exceedences under high flow conditions would occur from indirect sources of bacteria, and would most likely exceed the instantaneous standard. Bacteria loads under low flow conditions would likely occur from direct sources of bacteria, and would most likely violate the instantaneous and geometric mean standards.

These TMDLs are required to meet both the geometric mean and instantaneous bacteria standards. Therefore, it is necessary for the critical condition to consider both wet weather, high flow conditions and dry weather, low flow conditions.

5) The TMDL considers seasonal environmental variations.

Seasonal variations involve changes in stream flow and water quality because of hydrologic and climatological patterns. Seasonal variations were explicitly included in the modeling approach for this TMDL. The continuous simulation model developed for this TMDL explicitly incorporates the seasonal variations of rainfall, runoff and fecal coliform wash-off by using an hourly time-step. In addition, fecal coliform accumulation rates for each land use were developed on a monthly basis. This allowed the consideration of temporal variability in fecal coliform loading within the watershed.

6) The TMDL includes a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL. Virginia included an implicit MOS in the TMDLs through the use of conservative modeling assumptions. By adopting an implicit MOS in estimating the loads in the watershed, it is ensured that the recommended reductions will in fact succeed in meeting the water quality standard.

7) The TMDL has been subject to public participation.

VADEQ held two technical advisory committee (TAC) meetings and two public meetings within the watershed. The following is a summary of the meetings.

TAC Meeting No. 1: The first TAC meeting was held on January 27, 2007, at the Mary Bethune Office Complex in Halifax, Virginia, to present and review the steps and the data used in the development of the bacteria TMDLs for the Banister River, Bearskin Creek, Cherrystone

Creek, Polecat Creek, Stinking River, Sandy Creek, and Whitehorn Creek listed segments.

TAC Meeting No. 2: The second TAC meeting was held on March 12, 2007, at the USDA Center in Chatham, Virginia, to discuss the preliminary source assessment for the Banister River, Bearskin Creek, Cherrystone Creek, Polecat Creek, Stinking River, Sandy Creek, and Whitehorn Creek watersheds.

Public Meeting No. 1: The first public meeting was held on March 20, 2007, at the USDA Center in Chatham, Virginia, to present the process for TMDL development, for the Banister River, Bearskin Creek, Cherrystone Creek, Polecat Creek, Stinking River, Sandy Creek, and Whitehorn Creek bacteria impaired segments, and the data that caused the segments to be on the Section 303(d) list for impaired waters and identify data and information needed for TMDL development. Nineteen people attended the meeting. Copies of the presentation were available for public distribution. This meeting was publicly noticed in the Virginia Register. No written comments were received during the 30-day comment period.

Public Meeting No. 2: The second public meeting was held on May 8, 1007, in Halifax, Virginia. The meeting was public noticed in The Virginia Register of Regulations.

IV. Discussion of Reasonable Assurance

EPA requires that there be a reasonable assurance that the TMDL can be implemented. As discussed earlier, Virginia intends to develop a phased TMDL implementation plan to address the primary contact use impairments.

In general, Virginia intends for the required bacteria reductions to be implemented in an iterative process that first addresses those sources with the largest impact on water quality. For example, in agricultural areas of the watershed, the most promising management practice is livestock exclusion from streams. This has been shown to be very effective in lowering bacteria concentrations in streams, both by reducing the cattle deposits themselves and by providing additional riparian buffers.

Additionally, in both urban and rural areas, reducing the human bacteria loading from failing septic systems should be a primary implementation focus because of its health implications. This component could be implemented through education on septic tank pump-outs as well as a septic system repair/replacement program and the use of alternative waste treatment systems.

WLAs will be implemented through the NPDES permit process. According to 40 CFR §122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program. Additional funding sources for implementation include the U.S. Department of

Agriculture's Conservation Reserve Enhancement and Environmental Quality Incentive Programs, the Virginia State Revolving Loan Program, and the Virginia Water Quality Improvement Fund.

VADEQ will work closely with the public during the implementation plan development process and will include the formation of a stakeholders' committee as well as open public meetings. Stakeholders will assist in formulating the TMDL Implementation Plan. This committee will have the responsibility for identifying corrective actions that are founded in practicality, establishing a timeline to ensure expeditious implementation, and setting measurable goals and milestones for attaining water quality standards.