UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Decision Rationale

For the Shellfish Harvest Impairment TMDLs in the Gulf, Cherrystone Inlet, Nassawaddox Creek, Holly Grove Cove, Warehouse Creek, Church Creek and 2 segments of Westerhouse Creek located in the Chesapeake Bay Watershed, Northampton County, VA

Signed

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Total Maximum Daily Load for
Shellfish Impairments in the Gulf, Cherrystone Inlet, Kings Creek, Nassawaddox Creek, Holly Grove Cove, Warehouse Creek, Church Creek and 2 segments of Westerhouse Creek located in the Chesapeake Bay Watershed
Northampton, 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 shellfish harvesting (bacteriological) impairments in the Gulf, Cherrystone Inlet, Kings Creek, Nassawaddox Creek, Holly Grove Cove, Warehouse Creek, Church Creek and 2 segments of Westerhouse Creek located in the Chesapeake Bay Watershed. EPA's rationale is based on the determination that these TMDLs meet the following seven regulatory conditions pursuant to 40 CFR §130.

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

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

II. Background

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed the Gulf, Cherrystone Inlet, Kings Creek, Nassawaddox Creek, Holly Grove Cove, Warehouse Creek, Church Creek and 2 segments of Westerhouse Creek as impaired on Virginia's 1998 Section 303(d) list for being unable to attain the production of edible and marketable natural resources use due to elevated levels of fecal coliform bacteria. All of these watersheds discharge to the Chesapeake Bay. Table 1 documents the major land uses and total acreage for each of the watersheds.

Table 1. The Gulf, Cherrystone Inlet and Nassawaddox Watershed Land Uses

	Total Area (acres)	Forest (acres)	Agriculture (acres)	Grassland (acres)	Water/Wetland (acres)
The Gulf	2921	948	716	1018	161
Cherrystone Inlet, Kings Creek	2921	645	847	815	246
Nassawaddox Creek	4,067	2,045	1,585	922	106
Holly Grove Cove	3,085	1,504	991	995	62
Warehouse Creek	2,060	1,002	1,059	977	93
Church Creek	3,190	1,564	1,369	1,538	44
Westerhouse Creek	581 (each segment)	510	310	504	115

The impairment is based on restrictions placed upon the harvesting of shellfish from these waters to protect the public from health affects associated with the consumption of bacteriologically contaminated shellfish. The restrictions which are issued by the Virginia Department of Health's Division of Shellfish Sanitation (DSS) are based on monthly monitoring data. DSS collects monthly fecal coliform bacteria samples from each of its sampling stations in the watersheds. DSS calculates geometric mean and 90th percentile concentration values based on the most recent 30-months of sampling data. The criteria calls for a 30-month geometric mean concentration of less than 14 most probable number (mpn)/100 millimeters (ml) and a 90th percentile concentration, based on the same 30-months of data below 49 mpn/100 ml. The criterion is identical to criteria developed under the National Shellfish Sanitation Program which is regulated by the U.S. Food and Drug Administration. Table 2 identifies the TMDL loadings for the impaired waters.

Table 2. TMDL Loadings for the Gulf, Cherrystone Inlet and Nassawaddox Watershed

Water	Pollutant	TMDL (mpn/day)	Wasteload Allocation	LA (mpn/day)	MOS
Nassawaddox Cr. (VAT-C13E-14)	Fecal Coliform	1.61E+11	N/A	1.61E+11	Implicit
Holly Grove Cove (VAT-C13E-13)	Fecal Coliform	7.42E+10	N/A	7.42E+10	Implicit
Warehouse Cr. (VAT-C13E-10)	Fecal Coliform	6.84E+10	N/A	6.84E+10	Implicit
Church Cr. (VAT-C13E-11)	Fecal Coliform	1.61E+11	N/A	1.61E+11	Implicit
Westerhouse Cr. (VAT-C13E-15)	Fecal Coliform	1.78E+10	N/A	1.78E+10	Implicit
Westerhouse Cr. (VAT-C13E-16)	Fecal Coliform	7.54E+09	N/A	7.54E+09	Implicit
The Gulf (VAT-C14E-14)	Fecal Coliform	8.59E+10	N/A	8.59E+10	Implicit
Cherrystone Inlet, Kings Creek (VAT-C15E-10)	Fecal Coliform	2.86E+10	N/A	2.86E+10	Implicit

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the seven basic regulatory requirements for establishing shellfish harvesting use impairment TMDLs for the impaired waters. EPA is therefore approving these TMDLs. EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDLs are designed to meet the applicable water quality standards.

The waters were listed as impaired due to restrictions placed on the harvesting of shellfish as a result of excessive concentrations of fecal coliform bacteria in the water column. Virginia developed these TMDLs to insure that they would meet the applicable criteria of a 30-month geometric mean of 14 mpn/100ml and a 90^{th} percentile of 49 mpn/100 ml. Most of the DSS monitoring stations within the impaired waters were unable to attain the 90^{th} percentile criteria. The TMDLs were modeled by the Commonwealth using a volumetric load approach.

The Commonwealth maintains a shellfish water quality monitoring network that consists of eight monitoring stations for the Gulf, five for Kings Creek, and Cherrystone Inlet, three for Nassawaddox, two for Holly Grove Cove, one for Church Creek, three for Westerhouse Creek and six for Warehouse Creek. This TMDL study examined bacterial monitoring data at these stations for a period of time from May of 2003 through December 2005. At least one station in each of these watersheds was sampled using the bacteria source tracking (BST) method. The fecal coliform concentration in an embayment varies due to the changes in biological, hydrological and meteorological conditions. The current condition was determined based on the 30-sample geometric mean and 90^{th} percentile of fecal coliform values of each condemned area. The maximum values for geometric mean and 90^{th} percentile were used to represent the current loads. Therefore, the current loads represent the worst case scenario.

The sources were broken down into four categories; human, pets, livestock and wildlife. An average percent loading per source category was obtained by summing the monthly percent concentrations and dividing that summation by 12. The Commonwealth then determined the current 30-month geometric mean and 90^{th} percentile concentrations for each condemned area. This data corresponded with previously described BST data. Waters in which data was collected from multiple stations within a condemned area had the data volume weighted. The existing load was determined for each criterion by multiplying the existing 90^{th} percentile and geometric mean concentrations by the impaired water volume. The allowable load was determined by multiplying the criterion by the volume of the impaired water. The required reductions were determined by subtracting the allowable load from the existing load. The 90^{th} percentile concentration was the more stringent criteria for the impaired waters and was used for all the TMDLs.

2) The TMDLs include 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 loading derived by multiplying the more stringent criteria by the volume of water. The total allowable loading contains the sum of the loads allocated to land based precipitation driven nonpoint source areas (developed and agricultural land segments) and point sources. Activities that increase the levels of fecal coliform to the land surface or their availability to runoff are considered flux sources. The actual value for total loading can be found in Table 2 of this document. The total allowable load is calculated on a daily basis.

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 no permitted point source discharges that affect the harvestable shellfish waters in the watershed. No wasteload is considered in this TMDL.

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 loads. Wherever possible, natural and nonpoint source loads should be distinguished.

BST was used to identify sources of fecal contamination from human as well as domestic and wild animals. The BST method used in Virginia is based on the premise that *Escherichia coli (E. coli)* found in human, domestic animal, and wild animals will have significantly different patterns of resistance to a variety of antibiotics. The Antibiotic Resistance Approach (ARA) uses fecal streptococcus or *E. coli* and patterns of antibiotic resistance for separation of sources of the bacterial contribution. The BST analysis used for this TMDL classified the bacteria into one of four source categories: human, pets, livestock, and wildlife. However, the BST analysis is an experimental, not approved, technique that is under evaluation and the error involved in correctly assigning *E. coli* isolates to the appropriate fecal sources is unknown.

LAs were developed for each of the four fecal coliform source categories (human, pets, livestock and wildlife). Table 3 documents the LAs for each source category of fecal coliform bacteria.

Table 3. Load Allocations by Source Based Upon 90th Percentile Standard Criterion

Water	Source	BST Allocation % of Total Load	Current Load MPN/ day	Load Allocation MPN/day	Reduction Needed
Nassawaddox Cr. (VAT-C13E-14)	Wildlife	43.6%	3.54E+11	1.61E+11	54%
	Human	18.1%	1.47E+11	0.00E+00	100%
	Livestock	32.5%	2.64E+11	0.00E+00	100%
	Pets	5.8%	4.71E+10	0.00E+00	100%
	Total	**100.0%**	**8.13E+11**	**1.61E+11**	**80%**
Holly Grove Cove (VAT-C13E-13)	Wildlife	44.8%	1.12E+11	7.42E+10	34%
	Human	16.9%	4.22E+10	0.00E+00	100%
	Livestock	31.2%	7.80E+10	0.00E+00	100%
	Pets	7.1%	1.77E+10	0.00E+00	100%
	Total	**100.0%**	**2.50E+11**	**7.42E+10**	**70%**
Warehouse Cr. (VAT-C13E-10)	Wildlife	50.2%	6.50E+11	2.65E+11	59%
	Human	15.8%	2.05E+11	0.00E+00	100%
	Livestock	25.5%	3.30E+11	0.00E+00	100%
	Pets	8.5%	1.10E+11	0.00E+00	100%
	Total	**100.0%**	**1.30E+12**	**2.65E+11**	**80%**
Church Cr. (VAT-C13E-11)	Wildlife	27.5%	6.87E+10	6.84E+10	0%
	Human	41.6%	1.04E+11	0.00E+00	100%
	Livestock	19.2%	4.79E+10	0.00E+00	100%
	Pets	11.6%	2.90E+10	0.00E+00	100%
	Total	**100.0%**	**2.50E+11**	**6.84E+10**	**73%**
Westerhouse Cr. Condemnation 85-199A (VAT-C13E-15)	Wildlife	37.5%	1.62E+10	1.62E+10	0%
	Human	25.0%	1.08E+10	0.00E+00	100%
	Livestock	21.4%	9.22E+09	0.00E+00	100%
	Pets	16.2%	6.98E+09	1.63E+09	77%
	Total	**100.1%**	**4.31E+10**	**1.78E+10**	**59%**
Westerhouse Cr. Condemnation 85-199B (VAT-C13E-16)	Wildlife	29.1%	1.32E+10	7.54E+09	43%
	Human	27.9%	1.27E+10	0.00E+00	100%
	Livestock	21.1%	9.60E+09	0.00E+00	100%
	Pets	21.9%	9.96E+09	0.00E+00	100%
	Total	**100.0%**	**4.55E+10**	**7.54E+09**	**83%**
The Gulf (VAT-C14E-14)	Wildlife	22%	1.56E+11	8.59E+10	45%
	Human	34%	2.42E+11	0.00E+00	100%
	Livestock	14%	9.95E+10	0.00E+00	100%
	Pets	30%	2.13E+11	0.00E+00	100%
	Total	**100.0%**	**7.11E+11**	**8.59E+10**	**88%**

Water	Source	BST Allocation % of Total Load	Current Load MPN/ day	Load Allocation MPN/day	Reduction Needed
Cherrystone Inlet, Kings Creek (VAT-C15E-10)	Wildlife	32%	6.07E+10	2.86E+10	53%
	Human	14%	2.66E+10	0.00E+00	100%
	Livestock	27%	5.13E+10	0.00E+00	100%
	Pets	27%	5.13E+10	0.00E+00	100%
	Total	**100.0%**	**1.90E+11**	**2.86E+09**	**85%**

3) The TMDLs consider the impacts of background pollution.

Background pollutant contributions were considered in the TMDL development process by quantifying the fecal coliform loads from wildlife sources through the use of BST data.

4) The TMDLs consider critical environmental conditions.

According to the EPA regulation 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 impaired waters 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 are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum. These critical conditions ensure that water quality standards will be met for other than worst case scenarios. By quantifying the TMDL load reductions to the more stringent criteria and evaluating a 30-month data period, the TMDLs are ensuring that the standards are maintained during critical conditions. This TMDL was determined using a long-term record of water quality monitoring (observation) data.

A comparison of the geometric mean values and the 90th percentile values against the water quality criteria will determine which represents the more critical condition or higher percent reduction. If the geometric mean values dictate the higher reduction, this suggests that, on average, water sample counts are consistently high with limited variation around the mean. If the 90th percentile criterion requires a higher reduction, this suggests an occurrence of the high fecal coliform due to the variation of hydrological conditions. For this study, the 90th percentile criterion is the most critical condition. Thus, the final load reductions determined using the 90th

[1]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

percentile represents the most stringent conditions and it is the reductions based on these bacterial loadings that will yield attainment of the water quality standard.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in surface runoff, stream flow, and water quality as a result of hydrologic and climatologic patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Variations due to changes in the hydrologic cycle as well as temporal variability in fecal coliform sources, such as migrating duck and goose populations are accounted for by the use of the long-term data record to estimate the current load.

6) The TMDLs include 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 by making very conservative assumptions in the modeling effort.

7) The TMDLs have been subject to public participation.

During development of the TMDL for the Gulf, Cherrystone Inlet, Kings Creek, Nassawaddox Creek, Holly Grove Cove, Warehouse Creek, Church Creek and 2 segments of Westerhouse Creek, public involvement was encouraged through a public participation process that included public meetings and stakeholder meetings.

Table 4. Public Participation

Water	First Public Meeting	Second Public Meeting
The Gulf	2/6/ 2007	4/24/2007
Cherrystone Inlet, Kings Creek	2/6/ 2007	4/24/2007
Nassawaddox Creek	2/6/ 2007	4/24/2007
Holly Grove Cove	2/6/ 2007	4/24/2007
Warehouse Creek	2/6/ 2007	4/24/2007
Church Creek	2/6/ 2007	4/24/2007
Westerhouse Creek – 2 segments	2/6/ 2007	4/24/2007

The meetings were noticed in the Virginia Register and the TMDLs were subjected to a 30-day comment period. DEQ responded to any comments submitted by the public.

IV. Discussion of Reasonable Assurance

While section 303(d) of the CWA and current EPA regulations do not require the development of TMDL implementation plans as part of the TMDL process, they do require reasonable assurance that the load and wasteload allocations can and will be implemented. Additionally, Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (the

"Act") directs the State Water Control Board to "develop and implement a plan to achieve fully supporting status for impaired waters" (Section 62.1-44.19.7).

Since there are no point sources in the watershed contributing to shellfish contamination, the TMDLs will be met by reducing the nonpoint sources. In general, Virginia intends for the required 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 waterbodies. This has been shown to be very effective in lowering fecal coliform concentrations in waterbodies, both by reducing the cattle deposits themselves and by providing additional riparian buffers.

Additionally, reducing the human fecal 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.

VDH-DSS will continue sampling at the established bacteriological monitoring stations in accordance with its shellfish monitoring program. VADEQ will continue to use data from these monitoring stations and related ambient monitoring stations to evaluate improvements in the bacterial community and the effectiveness of TMDL implementation in attainment of the general water quality standard.