UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029
7/15/2009

Ellen Gilinsky, Ph.D., Director
Division of Water Quality Programs
Virginia Department of Environmental Quality
629 E. Main Street
P.O. Box 1105
Richmond, Virginia 23218

Dear Dr. Gilinsky:

The U.S. Environmental Protection Agency (EPA), Region III, is pleased to approve the *Gardner, Jackson and Bonum Creeks Total Maximum Daily Load (TMDL) Report for Shellfish Condemnation Areas, Due to Bacteria Contamination, Westmoreland County, Virginia*. The TMDL Report was submitted to EPA for review on June 12, 2009. The TMDL was established and submitted in accordance with Sections 303(d)(1)(c) and (2) of the Clean Water Act to address impairments of water quality as identified in Virginia's Section 303(d) List.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) be designed to attain and maintain the applicable water quality standards; (2) include a total allowable loading and, as appropriate, wasteload allocations for point sources and load allocations for nonpoint sources; (3) consider the impacts of background pollutant contributions; (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated); (5) consider seasonal variations; (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality); and (7) be subject to public participation. The bacteria TMDLs for Gardner, Jackson and Bonum Creeks satisfy each of these requirements. In addition, the TMDLs considered reasonable assurance that the TMDL allocations assigned to nonpoint sources can be reasonably met. A copy of EPA's Rationale for approval of these TMDLs is included with this letter.

As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL wasteload allocations pursuant to 40 CFR §122.44 (d)(1)(vii)(B). Please submit all such permits to EPA for review as per EPA's letter dated September 29, 1998.

If you have any questions please call me, or have your staff contact Greg Voigt, at 215-814-5737.

Sincerely,

Larry Merrill for

Jon M. Capacasa, Director
Water Protection Division

Enclosure

cc: David Lazarus, VADEQ

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1650 Arch Street
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Decision Rationale
Total Maximum Daily Load
Shellfish Harvesting Use Impairments
Due to Bacteria Contamination
Gardner, Jackson, and Bonum Creeks
Westmoreland County, Virginia

Larry Merrill for

Jon M. Capacasa, Director
Water Protection Division

Date: 7/15/2009

TMDL Review Checklist

State: Virginia
Date of Submittal: June 12, 2009
Date of EPA Action:
EPA Reviewer: Gregory Voigt
State Document: Gardner, Jackson and Bonum Creeks Total Maximum Daily Load (TMDL) Report for Shellfish Condemnation Areas Listed Due to Bacteria Contamination: June 10, 2009

Review Element	Adequate?	Recommendations/Comments
Submittal Letter	Yes	Dated June 12, 2009
Identification of Waterbody	Yes	Gardner Creek: VAP-A33E-01-SF Jackson Creek: VAP-A33E-02-SF Bonum Creek: VAP-A33E-03-SF
Consent Decree Waters?	Yes	All three segments were originally listed on Virginia's 1998 Section 303(d) List.
Pollutant of Concern	Yes	Fecal Coliform
Impairment (as indicated on Section 303(d) List)	Yes	Shellfish Harvesting
Final TMDL	Yes	Table 5.4
Daily Loads	Yes	Table 5.4
Load Allocations	Yes	Table 5.2
Wasteload Allocations	Yes	Table 5.4
Margin of Safety	Yes	Implicit, Section 5.4
Seasonal Variations	Yes	Section 5.3
Critical Conditions	Yes	Section 5.3
Reasonable Assurance	Yes	Implementation plan provided in Section 6.0.
Public Participation	Yes	Section 7.0 and Appendix E
Technical Analysis/ Supporting Documentation	Yes	Appendix A, B, C, D and E
Other Comments	N/A	

Supporting Document for Approving Virginia's Bacteria TMDLs
Addressing Shellfish Harvesting Use Impairments
August 2008

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 (WQSs). 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 support the U.S. Environmental Protection Agency's (EPA) rationale for approving TMDLs for shellfish harvest use (bacteria) impairments in watersheds within the Commonwealth of Virginia. EPA's rationale is based on the determination that the TMDLs meet the following seven regulatory conditions pursuant to 40 CFR Part 130.

1. The TMDL is designed to implement applicable WQSs.
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, the TMDLs considered reasonable assurance that the TMDL allocations assigned to nonpoint sources (NPS) can be reasonably met.

II. Determination of Sources of Existing Loadings

A primary component of TMDL development for shellfish harvest use impairments is the evaluation of potential sources of fecal bacteria in the watershed. Sources of information that are used in evaluating potential pollutant sources include the Virginia Department of Environmental Quality (VADEQ), the Virginia Department of Conservation and Recreation (VADCR), the Virginia Department of Game and Inland Fisheries (VADGIF), Virginia Department of Health, public participation, watershed studies, stream monitoring, published information, previously approved fecal coliform TMDLs, and best professional judgment.

The Virginia Department of Health Division of Shellfish Sanitation (VDHDSS) is responsible for classifying shellfish waters and protecting the health of bivalve shellfish consumers. The VDHDSS follows the requirements of the National Shellfish Sanitation Program (NSSP), which is regulated by the U.S. Food and Drug Administration. The NSSP specifies the use of a shoreline survey as its primary tool for classifying shellfish growing waters. Fecal coliform concentrations in water samples collected in the immediate vicinity of the shellfish beds function to verify the findings of the shoreline survey and to define the border between approved and condemned (unapproved) waters. DSS designs and operates the shoreline survey to locate sources of pollution within the watersheds of shellfish growing areas. This is accomplished through a property-by-property inspection of the onsite sanitary waste disposal facilities of most properties on un-sewered sections of watersheds, and investigations of other sources of pollution such as wastewater treatment plants (WWTPs), marinas, livestock operations, landfills, etc. The information is compiled into a written report with a map showing the location of the sources of real or potential pollution found, and is sent to the various agencies that are responsible for regulating these concerns in the city or County. Once an onsite problem is identified, local health departments (LHDs), and/or other State and local agencies may play a role in the process of correcting the deficiencies.

The VDHDSS collects monthly seawater samples at over 2,000 stations in the shellfish growing areas of Virginia. Though they continuously monitor sample data for unusual events, they formally evaluate shellfish growing areas on an annual basis. The annual review uses data from the most recent 30 samples (typically from the last 30 months), which are collected randomly with respect to weather. The data are assessed to determine whether the WQSs are met. If the WQSs are exceeded, the shellfish area is closed for the harvest of shellfish that go directly to market. Those areas that marginally exceed WQSs, and are closed for the direct marketing of shellfish, are eligible for shellfish harvesting under permit from the Virginia Marine Resources Commission and VDHDSS. The permit establishes controls that in part require shellfish to depurate for 15 days in clean growing areas or specially designed on shore facilities. Shellfish in growing areas that may be highly polluted, such as those in the immediate vicinity of a wastewater treatment facility (prohibited waters), are not allowed to be moved to clean waters for self-purification.

The potential fecal bacteria sources in the watershed can be broken down into point and nonpoint sources. Point sources are permitted pollutant loads derived from individual sources and discharged at specific locations. NPSs of fecal bacteria do not have one discharge point but may occur over the entire length of the receiving water. Fecal bacteria deposited on the land surface can build up over time. During rain events, surface runoff transports water and sediment to the waterway. Sources of fecal bacteria include grazing livestock, concentrated animal feeding operations, manure application, and wildlife and pet excretion. To assist in partitioning the loads from the diverse sources within the watershed, water quality samples of *E. coli* collected over long periods (one year or more) are evaluated using an antibiotic resistance analysis in a process called Bacterial Source Tracking (BST). The BST method used in Virginia is based on the premise that *E. coli* sources due to humans, domestic animals, 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 bacterial sources. These samples are compared to a reference library of fecal samples from known sources. The resulting data is used to assign portions of the load within the watershed to wildlife, humans, pets or livestock. The identification of a major source of bacteria loads helps to establish potential directions for remediation under a future implementation plan.

III. Discussion of Possible TMDL Models used to Address the impaired Shellfish Harvesting Waters

Numerical models have been widely used for TMDL development. It is a common practice to use a linked watershed model, such as the Hydrologic Simulation Program – Fortran (HSPF), and a receiving water model, to simulate bacteria concentration in the receiving water and develop the TMDL though long-term simulation. Once the relationship is developed, management options for reducing pollutant loadings to streams can be assessed. Besides using a complex numerical model, the Monte Carlo simulation, log-normal probability modeling, and the load duration curve (LDC) method can be used for TMDL development.

To estimate loading, a daily flow is required to estimate cross-section area and velocity. When possible, data from U.S. Geological Survey (USGS) gauge stations are used. If the water in question does not have a gauge station, watershed models such as the LSPC model can be used to simulate daily flow. The tidal range and tidal period of the water is estimated using data provided by the National Oceanic and Atmospheric Administration (NOAA).

A simple volumetric load approach can be applied to develop TMDLs in shellfish growing areas. To meet the water quality standards for both geometric mean and 90th percentile criteria, TMDLs for the impaired segments in the watershed are defined for the geometric mean load and the 90th percentile load. The allowable load for the geometric mean is calculated using the criteria value of 14 MPN/100 ml. The allowable load for 90th percentile is calculated based on the water quality standard of 49 MPN/100 ml. Virginia indicates that the total allowable loading is the loading derived by multiplying the more stringent criteria by the volume of water. A comparison of the reductions based on geometric mean load and on the 90th percentile load is performed to determine the critical condition for the waterbody. The criteria that requires the largest load reduction is then used to allocate source contributions and establish load reduction targets among the various contributing sources that will yield the necessary water quality improvements to attain the water quality standard in the waterbody.

A one-dimensional tidally averaged transport model can be applied to compute the TMDL for shellfish areas that are located in a long and narrow tidally influenced stream. Stream depths are obtained from a NOAA bathymetric chart. The width of each segment is estimated based on data from the USGS stream Geographic Information System (GIS) layer. The mass balance for fecal coliform at segment *i* can be written as:

$$V_i \frac{dC_i}{dt} = Q_{i-1}C_{i-1} - Q_i C_i + E'_{i-1}(C_{i-1} - C_i) + E'_{i+1}(C_{i+1} - C_i) - kV_i C_i + L_i$$

where V_i is the volume of the ith segment, Q_{i-1} and Q_i are the flow enters and leaves the segment (m^3/s), C_i is the bacteria (or salinity) concentration, k is the decay coefficient, L_i is the loading ($mass/m^3/s$), and E' is the buck dispersion coefficient across the segment boundary, which is related to the dispersion coefficient E as follows:

$$E_i^{'} = \frac{E_i A_i}{\Delta x_i}$$

where A_i is the cross-section area and Δx_i is the distance between the center of segment $i\text{-}1$ and i. The magnitude of the dispersion coefficient depends on the tide, geometry, and hydrodynamic conditions. It can be estimated using salinity data, or through model calibration using salinity. The flow can be estimated based on the freshwater discharge from the sub-watershed with correction of tidal flow. A long-term mean salinity distribution can be simulated using a steady state approach (i.e., $dC/dt = 0$). The dispersion coefficients are calibrated until the simulated salinity values match the observations. Both geometric mean loads and 90^{th} percentile loads are estimated based on VADEQ's most recent data. To compute TMDLs, the water quality criteria for shellfish harvesting is applied.

IV. Discussion of Regulatory Conditions

EPA reviews each TMDL to determine if Virginia provided sufficient information to meet all of the seven basic requirements for establishing TMDLs for waterbodies that are not meeting their shellfish harvesting use due to bacteria. Additionally, EPA determines if Virginia provided reasonable assurance that the TMDLs can be met. Below are basic conditions in each of Virginia's TMDLs meant to restore a waterbody's shellfish harvesting use.

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

For a shellfish supporting waterbody to be in compliance with Virginia bacterial standards, VADEQ specifies the following criteria (9 VAC 25-260-160):

> *"In all open ocean or estuarine waters capable of propagating shellfish or in specific areas where public or leased private shellfish beds are present, and including those waters on which condemnation or restriction classifications are established by the State Department of Health the following criteria for fecal coliform bacteria shall apply; The geometric mean fecal coliform value for a sampling station shall not exceed an MPN (most probable number) of 14 per 100 milliliters. The 90_{th} percentile shall not exceed an MPN of 43 for a 5 tube, 3 dilution test or 49 for a 3 tube, 3 dilution test."*

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

<u>Total Allowable Loads</u>

The objective of the bacteria TMDL is to determine what reductions in bacteria loadings from point and nonpoint sources are required to meet State water quality standards. The TMDL considers all significant sources contributing bacteria to the impaired streams. The sources can be separated into nonpoint and point sources. The different sources in the TMDL are defined in the following equation:

	TMDL	=	WLAs + LAs + MOS
Where:			
	WLA	=	wasteload allocation
	LA	=	load allocation
	MOS	=	margin of safety

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.

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 NPS loads should be distinguished.

3) The TMDLs consider the impacts of background pollution.

Virginia considers background pollutant contributions in the TMDL development process by quantifying the fecal coliform loads from wildlife sources.

4) The TMDLs consider critical environmental conditions.

According to 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. 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.

Critical conditions for shellfish harvesting impaired waters are considered by quantifying the TMDL using a long-term record of water quality monitoring (observation) data, which spans different flow regimes and temperatures.

In addition, 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 90^{th} percentile criterion requires a higher reduction, this suggests an occurrence of high fecal coliform levels that is due to the variation of hydrological conditions. The final load reductions will be based on 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 climatic 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 long-term data records 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.

7) The TMDL has been subject to public participation.

Virginia generally seeks public participation at every stage of TMDL development in order to receive input from stakeholders and to apprise the stakeholders of the progress made. Virginia frequently conducts technical advisory committee (TAC) meetings and always conducts two public meetings within the watershed for which a TMDL is being developed.

V. Discussion of Reasonable Assurance

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 the issuance of an NPDES permit that is inconsistent with WLAs established for that point source. When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on the assumption that nonpoint source load reductions will occur, EPA's guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures will achieve load reductions in order for the TMDL to be approvable.

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 LAs and WLAs can and will be implemented. Additionally, Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (the "Act"), Section 62.1-44.19.7, directs the State Water Control Board to "develop and implement a plan to achieve fully supporting status for impaired waters."

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. In general, Virginia intends for the required nonpoint source 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 human fecal loading from failing septic systems will 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.

VDHDSS 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.

In urban areas, reducing human bacteria loading from leaking sewer lines could be accomplished through a sanitary sewer inspection and management program. Other BMPs that might be appropriate for controlling urban wash-off from parking lots and roads, and that could be readily implemented, may include more restrictive ordinances to reduce fecal loads from pets, improved garbage collection and control, and improved street cleaning.

Watershed stakeholders will have the opportunity to participate in the development of the TMDL implementation plan. Specific goals for BMP implementation will be established as the implementation plan is developed.