M E M O R A N D U M

Commonwealth of Virginia
Department of Environmental Quality
Water Division

SUBJECT: Guidance Memo No. 03-2007
Implementation of Bacteria Standards in VPDES Permits

TO: Regional Directors

FROM: Larry G. Lawson, P.E., Director

DATE: March 27, 2003

COPIES: Regional Permit Managers, Regional Water Permit Managers, Regional Compliance and Enforcement Managers, Martin G. Ferguson, Alan Pollock, Kathleen O'Connell, OWPP staff

Summary:

On January 15, 2003, new bacteria standards in the Water Quality Standards Section 9 VAC 25-260-170.A became effective, as did the revised disinfection policy of 9 VAC 25-260-170.B. These standards replaced the existing fecal coliform standard and disinfection policy of 9 VAC 25-160-170. In short, E.coli and enterococci criteria replaced the existing fecal coliform criteria. The agency intends to allow the continued use of chlorine as a surrogate parameter for evaluation of compliance with the bacteria standards. However, case-by-case demonstration of the adequacy of chlorine as a surrogate should be made. This memorandum addresses how this adequacy can be demonstrated and how the new bacteria standards should be implemented in VPDES permits.

The results of all case-by-case demonstrations should be submitted by the regions to the contact person listed below to enable DEQ to review whether the need for case by case demonstration remains appropriate.

All references to the VPDES permit manual in this guidance is to Guidance Memo 01-2010, Amendment 1 – VPDES Permit Manual Revisions, December 5, 2001. If the permit manual is updated after the date of this guidance memo, the referenced permit manual requirements of this memo should be superceded.

Contact Information:

If you have any questions regarding this guidance, please contact Jon van Soestbergen at (804) 698-4117, email jvansoest@deq.state.va.us.

Disclaimer:

This document is provided as guidance and, as such, sets forth standard operating procedures for the agency. However, it does not mandate any particular method nor does it prohibit any particular method for the analysis of data, establishment of a wasteload allocation, or establishment of a permit limit. If alternative proposals are made, such proposals should be reviewed and accepted or denied based on their technical adequacy and compliance with appropriate laws and regulations.

Implementation of the Water Quality Standards' Bacteria Standards in VPDES Permits

A. Bacteria Standards and Disinfection Policy

The Water Quality Standards (WQS) which became effective on January 15, 2003 included the new bacteria standards in 9 VAC 25-260-170.A became effective, as well as the revised disinfection policy of 9 VAC 25-260-170.B. These standards replaced the existing fecal coliform standard and disinfection policy of 9 VAC 25-160-170. The current bacteria standards in 9 VAC 25-260-170.A.2 are as follows:

E.coli and enterococci bacteria per 100 ml of water shall not exceed the following:

	Geometric Mean	Single Sample Maximum
Fresh water		
E.coli (N/100 ml)	126	235
Saltwater and Transition Zone		
enterococci (N/100 ml)	35	104

The disinfection policy of 9 VAC 25-260-170.B requires that all effluents attain the applicable bacteria concentrations in 9 VAC 25-170.A.2 prior to discharge.

The geometric mean criteria in the water quality standards are footnoted as follows: "For two or more samples taken during any calendar month." Generally, when establishing VPDES permit limits based on applicable water quality criteria and evaluating compliance with those limits, 1/month sampling is equated to or compared with a monthly average concentration requirement in a VPDES permit. However, unlike most other water quality criteria, both a geometric mean and a single sample maximum are specified for bacteria in the water quality standards. Because the two criteria for bacteria are subject to this additional specificity, particularly in regard to the referenced footnote, in addition to the freshwater versus saltwater and transition zone differences set forth in the standards, DEQ will interpret the bacteria standards as follows:

- Where effluent sampling is performed more than once per month, the geometric mean applies.
- Where effluent sampling is performed once per month or less, the single sample maximum applies.

B. Evaluation of Chlorine as a Surrogate and Disinfection Study

For years, DEQ's implementation of the disinfection policy used a surrogate parameter for the majority of effluents. For those facilities that use chlorination as the disinfection technology, VPDES permits contain chlorine requirements as follows:

- 30-minute contact time (not specifically stated in permit)
- 1-2 mg/l target chlorine residual after contact
- 0.6 mg/l minimum residual after contact

The use of these requirements was demonstrated through the efforts of a disinfection task force to result in final effluent fecal coliform bacteria counts of at least an order of magnitude below the standard of 200 counts/100 ml as a geometric mean. As a result DEQ implemented these chlorination requirements in VPDES permits in lieu of a fecal coliform limitation.

In the summer of 2002, in recognition of the proposed WQS changes, a bacteria disinfection study was performed by DEQ to ascertain whether it remains appropriate to continue to use chlorine as a surrogate in implementation of the new bacteria standards in VPDES permits. The study focused on five facilities in the metropolitan Richmond area that utilize chlorination to disinfect the effluent. All samples were collected from effluents that were in compliance with their permitted chlorine requirements. The results of the study were documented in the August 28, 2002 memorandum "Special Study of the Effects of Chlorination on E.coli and Enterococci in Final Effluents". Subsequent evaluation of the results of the study determined that they were inconclusive relative to the use of chlorine as a surrogate to implement the bacteria standards in VPDES permits because the sample values too frequently exceeded the maximum reportable value of the dilution used in the test. As a result, the study was expanded in the fall of 2002 to include multiple dilutions. Data from this subsequent phase was compiled and documented in the spreadsheet, "Chlorine Disinfection Special Study 025179", compiled 01/21/02 (note that the compiled date is incorrect – it should be 01/21/03). These two documents are attached to this Guidance Memo.

Further analysis of the data resulted in two conclusions:

- The use of chlorine as a measure for meeting the enterococci criterion is questionable. However, the data may represent some sort of anomaly and there is insufficient data to make a determination one way or the other.

- The data set for E.coli, particularly for small facilities, is small relative to the decision that is to be made regarding the use of chlorine as a surrogate compliance measure for the bacteria criteria, which will affect hundreds of facilities for a long period of time. Therefore, additional data collection is warranted to determine whether it is an appropriate procedure to globally apply the use of chlorine as a surrogate for measuring compliance with the E.coli criterion in all VPDES permits where chlorine is used as the disinfection technology.

Based on the results and conclusions of the disinfection study, the following decision was made:

Chlorine may be an adequate surrogate for measuring compliance with the bacteria standards, but at this time this should be demonstrated on a case by case or permit by permit basis. The results of each case by case demonstration should be submitted to the Office of Water Permit Programs for future evaluation as to whether demonstration on a case by case basis remains necessary.

The following sections provide guidance on:

- Applicable criteria and requirements for demonstration of the adequacy of chlorine as a surrogate on a case by case or permit by permit basis, and

- Implementation of the demonstration requirements and bacteria standards into VPDES permits.

C. Demonstration

A demonstration that chlorine limits can be used as a surrogate for bacteria limits in a permit for an individual discharge can be made for discharges to waters where the use of chlorine limitations in lieu of fecal coliform limitations is allowable per existing guidance and the permit manual. The demonstration can be made either as part of the application process or during the permit term. Demonstration should be made by the applicant or permittee and will be based on an evaluation of bacteria data taken from an effluent. The plant flow and the chlorine residual concentration at the time the bacteria sample was taken should also be recorded.

1. Parameters

Samples to be analyzed for the following parameters should be taken within 15 minutes of each other:

- Applicable bacteria -E.coli or enterococci (N/100 ml)
- Chlorine residual after contact but before dechlorination (mg/l)
- Effluent flow (mgd)

2. Minimum Data Set and Monitoring Frequency

For demonstration purposes, 12 data points will be considered the minimum acceptable data set, to be collected at the frequency shown below. This frequency is consistent with the monitoring frequencies in the VPDES permit manual for discharges that use alternate disinfection, with the notable exception that discharges to public water supplies (PWS) and shellfish waters are subject to the same monitoring frequency requirements as discharges to waters other than PWS or shellfish waters. This is because the intent of the demonstration is unrelated to the type of waterbody the discharge is to. Rather, its intent is to demonstrate that the use of chlorine as a surrogate remains valid with regard to the new bacteria standards. Note that the monitoring requirements are minimums. Additional monitoring and larger data sets are acceptable.

- Minimum data set size 12 data points
- Monitoring Frequency

Design flow $\geq$ 1.0 MGD	3/Week by grab sample at 48 hour intervals between 10 a.m. and 4 p.m.
Design flow < 1.0 MGD	1/Week by grab sample between 10 a.m. and 4 p.m.

3. Demonstration Criteria

Demonstration that chlorine is an adequate surrogate is to be considered satisfied if there are no exceedences of the applicable criterion in the demonstration data set while the discharge is in compliance with the facility's permitted chlorine limitations. Specifically:

- If more than one sample is taken in a calendar month, the geometric mean of the data for that calendar month can not exceed the applicable geometric mean criterion.
- If only one sample is taken in a calendar month, the value of that data point can not exceed the applicable single sample maximum criterion.

4. Reporting of Results

The demonstration submitted by the permit applicant should include the following:

a. The original data set including the following information and data:

- date and time sample collected
- bacteria (colonies/100 ml)
- chlorine residual after contact but before dechlorination (mg/l)
- chlorine contact time (minutes)
- flow (mgd)

b. The geometric mean calculations and results; and

c. A summary of results in tabular format and a statement of compliance or noncompliance with the demonstration requirements.

The results of all case-by-case demonstrations should be submitted by the regions to the contact person for this guidance memo to enable DEQ to review whether the need for case-by-case demonstration remains appropriate.

D. Implementation of the New Standards into VPDES Permits

The new bacteria standards should be implemented into all new VDPES permits and into existing VPDES permits upon reissuance using the same procedures and protocols as for fecal coliform per the permit manual and existing guidance, substituting the applicable new bacteria criterion for fecal coliform, except that where fecal coliform was previously used as a surrogate for fecal coliform limitations, this must be demonstrated on a case by case basis for the applicable bacteria standard. This section addresses implementation of this demonstration where chlorine is used as the disinfection technology. This section also provides guidance to implement the new bacteria standards where alternate disinfection is used such that demonstration of the facility's ability to meet the new criterion is demonstrated prior to the limit being effective.

For reissuances, the permit applicant has the option to satisfy the demonstration requirements in conjunction with the permit application or during the first year of the term of the reissued permit.

1. Chlorine as Disinfection Technology

If demonstration is satisfied that the bacteria standards are met while the discharge is in compliance with the facility's VPDES chlorine limitations, bacteria monitoring requirements in a VPDES permit can be waived or removed. If demonstration is not satisfied, the permit should contain applicable bacteria limitations.

a. Demonstration as Part of the Application Process

To qualify, the permit applicant should submit the demonstration data and its results and conclusions as part of the permit application. If the demonstration is satisfied, bacteria monitoring is not required. The permit should contain chlorine limitations per the permit manual.

If demonstration is not satisfied, the permit should contain, in addition to the chlorine limitations per the permit manual, geometric mean bacteria limitations and monitoring in accordance with the water quality standards and the permit manual, and a four-year schedule of compliance. The following exception to the monitoring frequency in Table MN-E.4 (Sampling Schedule Table) of the permit manual applies: For discharges greater than or equal to 0.0011 mgd and less than or equal to 0.04 mgd, the monitoring frequency shall be 2/Month (10 am-4 pm). The permit manual will be updated to reflect this change.

b. Demonstration During the Permit Term

If a demonstration data set is not included as part of the application, then the permit should contain chlorine limitations and require bacteria monitoring sufficient to generate a data set adequate to perform an evaluation as specified in Section B - Demonstration above. Upon collection of the data set, an evaluation is to be made and results are to be reported to DEQ.

The permit should contain the following special condition. Note that throughout, the applicable bacteria must be selected. Monitoring frequency should be in accordance with the permit manual and Section C.1.a above. In B.4, only the appropriate test method section should be included.

BEGIN SPECIAL CONDITION LANGUAGE

B. BACTERIAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS – ADDITIONAL INSTRUCTIONS

1. Beginning no later than [insert date no later than six months of the permit effective date], [select appropriate][E.coli or enterococci] monitoring shall be performed at a minimum as prescribed below:

   [select appropriate based on flow – Q≥1.0 MGD or Q<1.0 MGD, respectively]

   [3 per week by grab sample at 48 hour intervals between 10 a.m. and 4 p.m. until a minimum of 12 data points are collected.

   Once per week by grab sample between 10 a.m. and 4 p.m. until a minimum of 12 data points are collected.]

   Effluent flow shall be measured and chlorine residual (after contact but before dechlorination) shall be sampled within 15 minutes of the time each [select appropriate][E.coli or enterococci] sample is taken. The date and time the samples were collected shall also be recorded.

   If only one datum is collected in any given calendar month, it shall be compared to the single sample maximum of [select appropriate][235 colonies/100 ml or 104 colonies/100 ml] for compliance with the applicable water quality criterion. If more than one datum are collected in any given calendar month, the geometric mean for that month shall be compared to [select appropriate][126 colonies/100 ml or 35 colonies/100 ml] for compliance with the applicable water quality criterion.

2. No later than [insert date no later than one year after the permit effective date], a demonstration of adequate disinfection as described in Part I.B.3 shall be completed, or the limitations and monitoring requirements in Part I.B.4 shall become effective. No later than [insert date no later than 14 days prior to one year after the permit effective date] the permittee shall submit to the DEQ [insert region] regional office a written notice, including all data collected during the demonstration period. The written notice shall include the following:

   a. The original data set including the following information and data:

      - date and time sample collected
      - [select appropriate][E.coli or enterococci] (colonies/100 ml)
      - chlorine residual after contact but before dechlorination (mg/l)
      - chlorine contact time (minutes)
      - flow (mgd)

   b. The geometric mean calculations and results; and

c. A summary of results in tabular format and a statement of successful or unsuccessful demonstration of the requirements of Part I.B.3.

In the case of unsuccessful demonstration, the permittee shall comply with Part I.B.4.

3. If there are no exceedences of the applicable [select appropriate][E.coli or enterococci] criterion in a minimum of 12 consecutive samples collected under Part I.B.1 while chlorine limitations are being complied with, then upon written notification from DEQ, [select appropriate][E.coli or enterococci] monitoring shall no longer be required.

4. If there are any exceedences of the applicable [select appropriate][E.coli or enterococci] criterion in the data set collected under Part I.B.1 while chlorine limitations are being complied with, then:

a. The following limitations and monitoring requirements shall become effective for [select applicable][E.coli or enterococci] in accordance with the schedule of compliance in Part I.B.4.b below:

	Discharge Limit Monthly Average	Monitoring Requirements Frequency	Sample Type
[select appropriate]			
E.coli (N/100 ml)	126 (Geometric Mean)	2/Month Between 10 a.m. and 4 p.m. [revise frequency as appropriate]	Grab
	OR		
enterococci (N/100 ml)	35 (Geometric Mean)	2/Month Between 10 a.m. and 4 p.m. [revise frequency as appropriate]	Grab

b. The permittee shall achieve compliance with the final limits for [select appropriate][E.coli or enterococci] specified in Part I.B.4.a. above in accordance with the following schedule:

(1) Submit Progress Report	By [insert date no later than permit effective date + 12 months], and annually thereafter
(2) Achieve compliance with final limits	By [insert date no later than permit effective date + 4 years]

5. [select appropriate][E.coli or Enterococci] sampling and analysis shall be performed in accordance with the following: [retain the appropriate section– i.e. E.coli or enterococci]

Samples shall be analyzed for E.coli in accordance with 40 CFR 141.21, except that maximum holding times shall be limited in accordance with 40 CFR 136 to six hours.

Samples shall be analyzed for enterococci in accordance with one of the following methods:

a. EPA Method 1600: Membrane Filtration Method for Enterococci in Water
b. Standard Methods (18^{th}, 19^{th}, 20^{th} editions) Method 9230B: Multiple Tube Technique for Fecal Streptococcus and Enterococcus Groups
c. Standard Methods (18^{th}, 19^{th}, 20^{th} editions) Method 9230C: Membrane Filter Techniques for Fecal Streptococcus and Enterococcus Groups
d. ASTM Method D6503 (ASTM Volume 11.02): Standard Test Method of Enterococci in Water Using Enterolet(TM)

END SPECIAL CONDITION LANGUAGE

2. Alternate Disinfection

For VPDES permitted discharges where primary disinfection is by means other than chlorination, demonstration of compliance with the new bacteria criteria can be demonstrated in conjunction with the permit application or during the permit term.

a. Demonstration as Part of the Application Process

To demonstrate compliance with the new bacteria criteria in conjunction with a permit application, the information in Section B.4, Reporting of Results should be submitted, except that the original data set should include the following:

- date and time
- E.coli or enterococci (N/100 ml)
- Fecal coliform (N/100 ml)
- Flow (mgd)

Demonstration should be considered satisfied if there are no exceedences of the applicable new bacteria criterion when fecal coliform limitations are met.

If demonstration is satisfied, fecal coliform limitations and monitoring should not be required in the VPDES permit. The applicable freshwater or saltwater/transition zone geometric mean E.coli or enterococci limitations should be included in the VDPES permit on the Part 1.A. page. Monitoring frequency should be in accordance with the relevant Alternate Disinfection section of the Permit Manual.

If demonstration is not satisfied, the permit should contain fecal coliform monitoring per the permit manual, as well as the applicable freshwater or saltwater/transition zone geometric mean E.coli or enterococci limitations. Monitoring frequency should be in accordance with the relevant Alternate Disinfection section of the Permit Manual.

b. Demonstration During the Permit Term

If demonstration is to be made during the permit term, the VPDES permit should contain fecal coliform limitations per the permit manual. Monitoring frequency should be in accordance with the relevant Alternate Disinfection section of the Permit Manual. The permit should include the following special condition:

BEGIN SPECIAL CONDITION LANGUAGE

B. BACTERIAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS – ADDITIONAL INSTRUCTIONS

1. Beginning no later than [insert date no later than six months from the permit effective date], [select appropriate][E.coli or enterococci] monitoring shall be performed as prescribed below:

   [select appropriate based on flow – Q≥1.0 MGD or Q<1.0 MGD, respectively]

   [3 per week by grab sample at 48 hour intervals between 10 a.m. and 4 p.m. until a minimum of 12 data points are collected.

   Once per week by grab sample between 10 a.m. and 4 p.m. until a minimum of 12 data points are collected.]

   Effluent flow shall be measured with 15 minutes of the time each [select appropriate][E.coli or enterococci] sample is taken. The date and time the samples were collected shall also be recorded.

   If only one datum is collected in any given calendar month, it shall be compared to the single sample maximum of [select appropriate][235 colonies/100 ml or 104 colonies/100 ml] for compliance with the applicable water quality criterion. If more than one datum are collected in any given calendar month, the geometric mean for that month shall be compared to [select appropriate][126 colonies/100 ml or 35 colonies/100 ml] for compliance with the applicable water quality criterion.

2. No later than [insert date no later than one year after the permit effective date], a demonstration of adequate disinfection as described in Part I.B.3 shall be completed, or the limitations and monitoring requirements of Part I.B.4 shall become effective. No later than [insert date no later than 14 days prior to one year after the permit effective date] the permittee shall submit to the DEQ [insert region] regional office a written notice, including all data collected during the demonstration period. The written notice shall include the following:

   a. The original data set including the following information and data:

      - date and time sample collected
      - [insert appropriate][E.coli or enterococci] bacteria (colonies/100 ml)
      - fecal coliform (colonies/100 ml)
      - flow (mgd)

   b. The geometric mean calculations and results; and

   c. A summary of results in tabular format and a statement of successful or unsuccessful demonstration of the requirement of Part I.B.3.

   In the case of unsuccessful demonstration, the permittee shall comply with Part I.B.4.

3. If there are no exceedences of the applicable [select appropriate][E.coli or enterococci] criterion in a minimum of 12 consecutive samples collected under Part I.B.1 while fecal coliform limitations are being complied with, then upon written notice from the DEQ, beginning with the month following receipt of the written notice and continuing until the permit expiration date:

   a. the fecal coliform limitations and monitoring required in Part 1.A shall no longer be required, and
   b. the following limitations and monitoring shall become effective:

	Discharge Limit Monthly Average	Monitoring Requirements Frequency	Sample Type
E.coli (N/100 ml)	126 (Geometric Mean)	1/Week Between 10 a.m. and 4 p.m. [revise if Q≥1.0 MGD]	Grab
	OR		
enterococci (N/100 ml)	35 (Geometric Mean)	1/Week Between 10 a.m. and 4 p.m. [revise if Q≥1.0 MGD]	Grab

4. If there are any exceedences of the applicable [select appropriate][E.coli or enterococci] criterion in the data set collected under Part I.B.1 while the fecal coliform limitations are being complied with, then the permittee shall achieve compliance with the final limits for [select appropriate][E.coli or enterococci] specified in Part I.B.3.b above in accordance with the following schedule:

a. Submit Progress Report	By [insert date no later than permit effective date + 12 months], and annually thereafter
b. Achieve compliance with final limits	By [insert date no later than permit effective date + 4 years]

   Upon compliance with the final limits for [select appropriate][E.coli or enterococci], the fecal coliform limitations and monitoring required in Part 1.A. shall no longer be required.

5. [insert appropriate][E.coli or Enterococci] sampling and analysis shall be performed in accordance with the following: [retain the appropriate section – i.e. E.coli or enterococci]

   Samples shall be analyzed for E.coli in accordance with 40 CFR 141.21, except that maximum holding times shall be limited in accordance with 40 CFR 136 to six hours.

   Samples shall be analyzed for enterococci in accordance with one of the following methods:

   a. EPA Method 1600: Membrane Filtration Method for Enterococci in Water
   b. Standard Methods (18^{th}, 19^{th}, 20^{th} editions) Method 9230B: Multiple Tube Technique for Fecal Streptococcus and Enterococcus Groups
   c. Standard Methods (18^{th}, 19^{th}, 20^{th} editions) Method 9230C: Membrane Filter

Techniques for Fecal Streptococcus and Enterococcus Groups

d. ASTM Method D6503 (ASTM Volume 11.02): Standard Test Method of Enterococci in Water Using Enterolet(TM)

END SPECIAL CONDITION LANGUAGE