# Response to Public Comments

## Re: Proposed Total Maximum Daily Load for Zinc in the Red Clay Creek, Delaware

### I. Introduction

The Delaware Department of Natural Resources and Environmental Control (DNREC) proposed to establish a Total Maximum Daily Load (TMDL) for zinc in the Red Clay Creek. The proposed TMDL was published in the Delaware Register of Regulations, Vol. 3, Issue 2, on Sunday, August 1, 1999. A Public Hearing was held on Tuesday, September 7, 1999 to gather formal public comment on the proposed TMDL. The hearing record was kept open for public comment until the close of business Tuesday, September 14, 1999.

### II. Commenters

The table below identifies the individuals who submitted comments prior to the deadline, the affiliation of the commenters, the date the comments were received by DNREC, and the DNREC-assigned comment numbers. Those numbers will be used in Section III of this document to organize DNREC's responses.

| Commenter | Affiliation | Date of Comment | Comment Number |
|---|---|---|---|
| Chris Brown | Delaware Nature Society | 9-7-99 | 1 |
| Herbert Allen | Representing the National Vulcanized Fibers Company | 9-7-99 | 2 - 8 |
| Herbert Allen | Representing the National Vulcanized Fibers Company | 9-14-99 | 9 - 11 |
| Robert Whetzel | Representing the National Vulcanized Fibers Company | 9-14-99 | 12 - 25 |
| James Stuhltrager | Widener University, Eastern Environmental Law Center | 9-14-99 | 26 - 29 |
| Robert Struble, Jr. | Red Clay Valley Association | 9-14-99 | 30 - 35 |
| Debbie Heaton | Delaware Chapter of the Sierra Club | 9-14-99 | 36 - 40 |

## III. Response to Comments

The specific comments received on the proposed TMDL and the DNREC's responses appear below.

**1.** The Delaware Nature Society (DNS) stated that they support the TMDL as proposed and believe the target for zinc loading is reasonable and necessary.

**Response:** DNREC appreciates the support expressed by the DNS. The proposed TMDL is designed to ensure compliance with the State of Delaware Surface Water Quality Standards and to meet the goals of the Clean Water Act.

**2.** The generic water quality standard used by the State of Delaware is not appropriate for this location. Species upon which the criterion is based are not resident in the Red Clay Creek (e.g., striped bass). If a species is known to be absent from the waterbody for reasons not associated with the concentration of zinc present, then the criteria should be recalculated to reflect a numerical value more applicable to the indigenous biological population. Also, it appears that the toxicity of Red Clay Creek water is less than what would be expected based on the water quality criteria. The Waters Effect Ratio procedure can be used to modify criteria to be reflective of the conditions present in the environment. For these reasons, an appropriate site specific modified standard should be applied.

**Response:** The DNREC used the duly adopted and applicable State of Delaware Surface Water Quality Standards as the basis of the zinc TMDL for the Red Clay Creek. The Standards used, and more correctly, the water quality criteria used, have been in place for nearly a decade. The commenter's use of the word "generic" appears to stem from the fact that the Delaware Standards are based upon national criteria developed by the U. S. Environmental Protection Agency (EPA) pursuant to Section 304(a)(1) of the federal Clean Water Act. The commenter suggests that a site-specific water quality criterion should be developed for the Red Clay Creek that accounts for the indigenous biological population as well as conditions present in the environment that tend to moderate toxicity.

Section 5.2 of the State of Delaware Surface Water Quality Standards allows the DNREC to consider modifications to water quality criteria in situations where substantial scientific evidence and analysis demonstrates the existence of site-specific differences in the chemical, physical, and biological characteristics of the surface water in comparison to the conditions under which the "generic" criteria were developed. The DNREC does not believe that substantial scientific evidence and analysis demonstrating site-specific differences was submitted during the comment period. For instance, the commenter makes the statement that striped bass, which are sensitive to zinc, and which were used in the derivation of the national criteria, are not present in the Red Clay Creek. The commenter provided no fisheries data to support the claim. Furthermore, the DNREC is not aware of any recent fish population studies showing the presence or absence of

striped bass in the Red Clay Creek to support the claim. If striped bass are indeed sensitive to zinc, it is quite possible that striped bass are not present in the Red Clay Creek due, at least in part, to elevated zinc concentrations. The fact that the DNREC's Division of Fish and Wildlife has observed striped bass in the tidal portion of the White Clay Creek, and further, that the White Clay Creek and the Red Clay Creek are hydraulically connected, offers some support for the hypothesis that zinc levels in the Red Clay may preclude striped bass. The point here is that the absence of a sensitive species from a waterbody is not sufficient basis, in and of itself, to eliminate that species during a site-specific criterion recalculation.

In a similar manner, the commenter states that it appears that the toxicity of Red Clay Creek water is less than what would be expected based on the water quality criteria. Again, no data to support this statement was provided during the comment period, nor is the DNREC aware of any data that supports this statement.

Finally, Section 5.2 of Delaware's Surface Water Quality Standards states that requests for modification of water quality criteria must actually propose alternate site-specific criteria. The comments submitted by Dr. Allen for the record on September 7, 1999 do not propose alternate site-specific criteria. As will be discussed later in this Response Document, Dr. Allen does, however, propose an alternate chronic aquatic life criterion in his comments dated September 14, 1999. The alternate criterion, which Dr. Allen characterized as preliminary, was 0.275 mg/L. This value was computed by eliminating striped bass from the dataset used to compute the national criterion, by assuming a Water Effects Ratio of 1.5, and by assuming a hardness value of 140 mg/L as measured by NVF at Wooddale. Again, no justification for eliminating striped bass from the dataset was provided. Further, the use of a Water Effects Ratio of 1.5 was not justified based on any site-specific study done on the Red Clay Creek that DNREC is aware of. Also, the use of a median hardness value from data collected at Wooddale is questionable. Doing so ignores any changes in hardness that may occur between the source of the zinc in Yorklyn and Wooddale, which is approximately 9 miles downstream from Yorklyn. Also, using a median hardness value for computation of the criterion ignores the seasonality of hardness levels in the Red Clay. Finally, and perhaps most significantly, Dr. Allen suggests an alternate *chronic* criterion for zinc, whereas the controlling criterion based on DNREC's TMDL calculations is the *acute* criterion.

In summary, the DNREC does not believe that substantial scientific evidence and analysis demonstrating site-specific differences was submitted during the comment period that would cause us to consider a modification to the zinc criteria at this time. When, as, and if a formal request to modify the existing zinc criteria for the Red Clay Creek is submitted pursuant to Section 5.2 of Delaware's Surface Water Quality Standards, the DNREC shall consider that request, provided that it is based on a sound rationale, and it is supported by substantial scientific evidence and analysis. As an aside, it is noted that the Standards used by DNREC as the basis of the zinc TMDL have been in place for nearly a decade. The DNREC believes that adequate time has transpired to allow the NVF Company the opportunity to perform a site-specific criteria modification, and that the performance of a site-specific criteria study at this point only serves to delay

the legally mandated requirement to establish a TMDL by December 15, 1999 that ensures compliance with applicable water quality standards. NVF, nevertheless, has the legal right to pursue the site-specific studies if they so choose. The DNREC, however, does not intend to defer adoption nor implementation of the current TMDL based upon future and speculative actions of the NVF Company.

**3.** The flow conditions used in the calculations are inappropriate for the computation of the TMDL. The zinc load in Red Clay Creek is neither constant nor random. Rather, it is seasonal and not in phase with the seasonal variation in stream flow. Maximum loads correspond with periods of high flow, mid-March through April. Loading is lower during low flow, mitigating the severity of concentration peaks.

**Response:** The flow conditions used in the calculations, namely the 1Q10 flow for acute aquatic life protection and the 7Q10 flow for chronic aquatic life protection, are based upon the flows listed in Section 8 ("Critical Flows") of the State of Delaware Surface Water Quality Standards. Consequently, the flow conditions that were used are based upon the duly adopted and applicable standards. Not only are the flows legally applicable, they are ideally suited for the case of zinc in the Red Clay Creek because the high concentrations that we wish to prevent are most frequent and severe during times when these flows are most likely to occur during the summer and fall.

DNREC has not claimed that the zinc mass loading in the Red Clay Creek is constant or random, nor has DNREC stated that the load is, or is not, in phase with the seasonal variation in stream flow. Rather, DNREC noted on pages 15 and 16 of the Technical Background and Basis Document (TBBD) for the TMDL that the mass loading of zinc at the Ashland sampling station, (which is approximately 1.7 miles below NVF Yorklyn), has remained *fairly steady* over the 5 year period from the fall of 1993 through the fall of 1998. DNREC acknowledged a nominal difference of 38.5 % between the highest annual median zinc mass loading and the lowest annual median zinc loading at the Ashland site for the period considered, but pointed out that year-to-year differences were not statistically significant.

DNREC does not agree nor disagree that maximum zinc loads in the Red Clay Creek occur during high flows in mid-March through April. DNREC believes that this point is largely irrelevant to the zinc TMDL in the Red Clay Creek. What DNREC does feel is relevant, however, is the relationship between stream flow and zinc *concentration* in the Red Clay Creek. On this point, DNREC demonstrated (on pages 16 and 17 of the TBBD) that there is a strong, statistically significant, *inverse* relationship between stream flow and zinc *concentration* at the Ashland sampling site, (again, which is located 1.7 miles below the NVF Yorklyn facility). In other words, the *concentration* of zinc at the Ashland site tends to *increase* when stream flow *decreases*, and vice versa. That zinc mass loading may increase in the Red Clay Creek during high flows as stated by the commenter, is most likely only an artifact of a serial correlation between stream flow and computed mass loading. Since streamflows tend to be higher in the winter and spring, and because mass loading is the product of streamflow and concentration, one would

expect mass loading in the Creek to increase during periods of higher flow, especially in situations such as this when the mass loading from the zinc source appears to be far less variable than the variability in streamflow.

Similar to the response above concerning high flows, DNREC does not agree nor disagree that zinc mass loading is lower during lower flow. We strongly disagree with the commenter, however, that zinc concentration spikes in the Red Clay Creek are mitigated during low flows. We believe that the concentration versus flow data presented for the Ashland station clearly demonstrates that concentration peaks are more frequent and intensified during low flows. Again, even if there are lower zinc mass loadings during low flows, DNREC believes a likely explanation is a serial correlation between flow and loading.

In the final analysis, what really matters is that the *assimilation capacity* of the Red Clay Creek *decreases* during *low flows*. During higher flows, the Creek can accommodate more zinc without violating applicable criteria. The Red Clay Creek is not at its most vulnerable stage during high flows, even if higher mass loads of zinc occur during those higher flows. During low flows, there is a maximum amount of zinc that can be present in the creek without risk of violating the applicable criteria. This maximum load is the TMDL.

**4.** The [water quality] standard that has been applied is not valid.

**Response:** The water quality standard that has been applied is the legally applicable standard for the Red Clay Creek. See response to comment 2.

**5.** The most extensive monitoring of the concentration of zinc is that of NVF, conducted at Wooddale.

**Response:** DNREC agrees that valuable data have been collected by NVF at the Wooddale station. We do not agree, however, that this data is the most extensive monitoring of zinc in the Red Clay Creek. It is true that the weekly sampling performed by NVF makes this data the most *frequently* collected data. DNREC's sampling at this site, by contrast, is typically performed on a monthly basis, or at a minimum, on a quarterly basis. The other unique feature of the NVF sampling at Wooddale is that it is based on daily compositing, as opposed to grab sampling as performed by DNREC. As will be discussed in more detail below, frequency of monitoring and type of sampling (e.g., composite vs. grab), are only 2 aspects of monitoring that influence how "extensive" a monitoring program is. Other important factors include: the length of record; the spatial coverage of monitoring; the placement and proximity of sampling stations immediately above and below major pollution sources; testing of various environmental media (e.g., surface water, groundwater, sediment, and biota); and whether the data has been quality assured.

Before we discuss some of these other factors that influence a monitoring program, we will address the issue of grab sampling versus composite sampling since the commenter appears to implicitly prefer composite sampling. Ideally, the type of sampling performed has some relevance to the duration of the water quality criterion against which the results are to be compared. In the case of the Red Clay Creek, the controlling water quality criterion for the zinc TMDL is the acute aquatic life criterion. This criterion has a 1-hour averaging period. DNREC believes that grab sampling provides data which are well suited for comparison to the short duration of the acute criterion. In contrast, 24-hour composite sampling as performed by NVF may mask concentration peaks that may occur from hour-to-hour throughout the day. So, DNREC does not agree that composite sampling is necessarily better for purposes of determining compliance with an acute aquatic life criterion.

Another concern that DNREC has with the composite sampling performed by NVF at the Wooddale station is that no information was provided regarding how the composite samples were actually collected (e.g., time-paced or flow-paced); where in the stream cross-section these samples were taken (e.g., in the center of the channel or in a sheltered area directly adjacent to the bank that does not mix well with the main flow); how the samples were composited (e.g., manually from individual bottles or automatically into a single container); what type of equipment was used to collect the composites; what laboratory analyzed these samples; what lab methods were used; and what the results of field and lab quality assurance/quality control testing have been. The absence of such information in the commenter's report does not imply that the data are flawed, only that, at present, the data are of unknown quality to DNREC.

A related concern over the composite samples is how the commenter used that data to estimate mass loading of zinc at Wooddale. For instance, no justification is offered by the commenter as to why mass loading was computed by multiplying the zinc concentration (based on an unclear compositing scheme) by the arithmetic average of the "current" daily flow and the "previous" daily flow. Further, it is not clear whether the technique used by the commenter to compute zinc mass loading at Wooddale is the same as the technique used by NVF in computing annual zinc releases under the Toxics Release Inventory (TRI), the details of which have never been submitted in writing to DNREC.

As noted above, several other factors influence how "extensive" a monitoring program is. With regard to length of record, the DNREC has collected data on the concentration of zinc in the Red Clay Creek for approximately 25 years. We chose, for purposes of the zinc TMDL, to focus on the last 5 years of monitoring data since that data reflects more recent conditions. DNREC did note, however, that there has been a drop in the concentration of zinc in the Red Clay Creek when viewed over a quarter of a century (page 12, TBBD).

With regard to spatial coverage, DNREC's monitoring program covers essentially the entire Delaware mainstem of the Red Clay Creek, thereby allowing an assessment of the entire waterbody. Further, DNREC's monitoring program, run in cooperation with the

Commonwealth of Pennsylvania, effectively brackets water quality conditions immediately upstream and immediately downstream from the NVF Yorklyn facility. Zinc results from the upstream station (Marshall's Bridge Road) and the first downstream station (Ashland) can be compared to determine if changes occur between the stations, and through inference, to determine what influence the NVF Yorklyn facility is having on the concentration of zinc in the Red Clay Creek.

Like NVF, DNREC also samples at the Wooddale site. Although this station is important due to its proximity to a USGS gage, it is also important to recognize that this station is a full 9 miles downstream from the NVF facility, which is the primary source of zinc to the Red Clay Creek. Because of dilution, and to a lesser extent, settling of particulate zinc, the Wooddale station does not provide an accurate measure of peak zinc concentrations that occur in the Red Clay Creek adjacent to and immediately downstream from the NVF Yorklyn facility. Thus, the Wooddale site is less than ideal for evaluating compliance with water quality standards. The other important thing to realize regarding the Wooddale site is that zinc concentrations are likely to be further diluted by water releases from Hoopes reservoir during periods of extremely low flow in the watershed. Because the outlet of Hoopes reservoir enters the Red Clay Creek just above the Wooddale gage, and because the water released from Hoopes has far lower zinc concentrations than the Red Clay Creek, any release from Hoopes will tend to dilute the concentration of zinc measured at Wooddale. For this reason, both the DNREC data collected at Wooddale, as well as the NVF data collected at Wooddale, are likely to be biased low during extremely low flow conditions. DNREC recognized the dilution effect from Hoopes, as well as the general dilution that occurs between Yorklyn and Wooddale, and responded by placing a routine monitoring site at Ashland, which is a full 7.3 miles upstream from Wooddale and only 1.7 miles below the NVF Yorklyn facility.

In addition to the superior coverage of DNREC's routine water quality monitoring program in comparison to NVF's data collected at the single Wooddale station, DNREC also collected or otherwise availed itself of data on zinc levels in sediments, groundwater, and fish of the Red Clay Creek watershed. DNREC used its own data as well as corroborating data collected by other researchers and governmental agencies. That data, which was reported in the TBBD along with the monthly to quarterly water quality data from multiple stations over the entire length of the Creek, allowed DNREC to prepare a more comprehensive characterization of zinc contamination in the Red Clay than had we relied solely upon composite water samples taken once weekly at a single location 9 miles from the source of the contamination.

Regardless of whether you consider NVF's data from Wooddale or DNREC's data from multiple stations, both datasets clearly show that applicable water quality criteria for zinc in the Red Clay Creek below the NVF facility are violated a large percentage of the time. For instance, the weekly results for Wooddale, which are presented on pages 32 through 36 of the commenter's report, show that over 75 % of the results between 12/19/92 and 4/27/99 exceeded a zinc concentration of 173.3 ug/L, which is the acute aquatic life criterion computed by DNREC for purposes of the TMDL. Because the commenter did not present the hardness values along with the zinc results, the frequency at which the

Delaware acute and chronic criteria were actually exceeded, considering the hardness and zinc concentrations for the individual samples, could not be determined. This percentage, however, is likely to be higher than 75 % due to the influence of hardness on the computation of the criteria.

With regard to quality assurance/quality control, DNREC's routine ambient monitoring data for the Red Clay Creek is of known quality. Sampling procedures are well documented and consistent from one sampling event to the next. Further, laboratory performance, with very few exceptions, have met acceptance criteria. As noted previously, the NVF data collected at Wooddale and presented in the commenter's report, on the other hand, are largely of unknown quality.

The final point to be made concerning the data collected by NVF at the Wooddale station is that DNREC did not require NVF to collect the data at the Wooddale station and so DNREC had no control over the methods used, nor did DNREC have any regulatory control over whether NVF had to provide the Wooddale data to DNREC. It is significant to note that DNREC did ask NVF, in a meeting with NVF and their legal counsel on 10 June, 1999, if NVF had any data or information they wished to share with DNREC to help in the development of the zinc TMDL. NVF declined that request. Consequently, the first time that DNREC became aware of the actual data collected by NVF at Wooddale was at the 7 September, 1999 public hearing when the commenter included that data in his comments. Again, however, no information was provided by the commenter or by NVF directly regarding exactly how this data was collected prior to the 14 September, 1999 comment deadline.

In summary, DNREC does not agree with the commenter that the sampling performed by the NVF Company at Wooddale is the most extensive monitoring of the concentration of zinc in the Red Clay Creek. Provided this data is ultimately shown to be valid and representative, DNREC believes that the NVF data merely supplements the primary data presented by DNREC in its TBBD. If anything, DNREC believes that the NVF data may help to further justify the need for a zinc TMDL in the Red Clay Creek.

**6.** The highest concentrations of zinc occur cyclically near the end of the late summer-autumn low-flow period. Flow is never at its lowest during high concentration episodes.

**Response:** DNREC agrees that the highest concentrations of zinc in the Red Clay Creek generally occur in the summer and fall. Consistent with this observation, DNREC noted in its TBBD that the peak concentration it observed at the Ashland station over the period July 1993 and September 1998, namely, 2010 ug/L, occurred on September 11, 1995, when flows throughout the watershed fell to very low levels and the flow at Marshall's Bridge Road broke an all-time low up to that point in time. Based on this observation, we disagree that flow is never at its lowest during high concentration episodes. DNREC demonstrated the relationship between flow and zinc at the Ashland station through formal regression analysis (pgs. 16 – 17 TBBD). That analysis revealed a

strong, statistically significant, inverse relationship between streamflow and zinc at the Ashland monitoring station, which, as noted earlier, is located less than 2 miles below the NVF Yorklyn facility. In other words, flow is often at its lowest at the Ashland station during high concentration episodes. It is important to recognize that the timing of low flow in the Red Clay Creek is not identical from year to year, and so zinc concentration peaks can occur sooner or later than what might be expected on average. Historically, however, critical low flows have occurred in this system any time from early June to late September, which corresponds well with observed peak zinc concentrations.

DNREC's conclusion regarding the relationship between stream flow and zinc concentration is consistent with that of other researchers cited in the TBBD. Dobroski and Soloman (1988) noted that higher concentrations of zinc occur during periods of lower flows [for stations below Yorklyn]. Further, they note that the highest zinc concentrations occur during the late summer and early fall, except for Ashland, which, based on the records available to them at the time, exhibited their highest zinc levels during the month of June.

The commenter's statement that flow is never at its lowest during high zinc concentration episodes is also suspect because the commenter bases his conclusion on data collected at Wooddale. As noted in our response to comment #5, the concentration of zinc at Wooddale during low flow periods is likely to be biased low due to water releases from Hoope's reservoir. Furthermore, Wooddale is a significant distance downstream from the source of the zinc in Yorklyn. Dilution and other mechanisms between Yorklyn and Wooddale act to attenuate zinc concentrations in the Red Clay Creek, bringing into question any major conclusion concerning the relationship between zinc and stream flow at the Wooddale site.

In summary, the conclusion that flows are never at their lowest during high zinc concentration episodes is not supported by the preponderance of the evidence, especially at the monitoring station closest to the NVF Yorklyn facility.

**7.** Because of the covariance of load and stream flow in the Red Clay Creek environment, the calculation of the TMDL is overly conservative due to the assumption of independence in load and flow.

**Response:** DNREC did not assume that mass loading and flow are independent variables. Rather, DNREC computed mass loading as the product of stream flow and zinc concentration, which implicitly means that DNREC assumed that mass loading and flow are dependent variables. DNREC does not believe that the TMDL is overly conservative nor overly permissive. Rather, the TMDL is designed to meet the applicable water quality criteria for zinc under critical design conditions.

**8.** Since the highest concentrations in the creek do not correspond with the lowest streamflows, it is inappropriate to calculate the TMDL based on a constant-load at lowest-flow basis.

**Response:** DNREC disagrees that the highest concentrations of zinc do not correspond with the lowest streamflows, especially at the monitoring station closest downstream from the NVF Yorklyn facility [see response to comment # 6]. Further, DNREC did not calculate the TMDL based on a constant load at lowest flow basis. DNREC calculated the maximum daily load, as required by section 303(d) of the Federal Clean Water Act, at the critical design flow of the stream, as specified in the State of Delaware Surface Water Quality Standards. Higher loads are acceptable in the stream at higher streamflows, without the applicable water quality criteria being violated. However, during critical design flow conditions, there is a maximum load that the stream can accommodate while still meeting applicable criteria. Mass loading less than the calculated maximum during critical low flow is desirable, but not necessary to ensure compliance with the applicable criteria and federal requirements.

**9.** In computing the TMDL, DNREC used the 7Q10 flow in its computation. The DNREC has also suggested that a large amount of the zinc comes from groundwater, not direct discharge to the creek. If this is true, then the use of 7Q10 is inappropriate. The commenter cites a 1991 U.S. EPA document that states that, "In situations where nonpoint source loading at wet weather flow conditions are more significant than the point source loadings, the use of low flow-related design conditions is inappropriate."

**Response:** The DNREC used the 1Q10 flow to compute the TMDL based on the acute aquatic life criterion and the 7Q10 flow to compute the TMDL based on the chronic aquatic life criterion. The TMDL based on the 1Q10 and the acute criterion proved to be the more stringent loading, and was therefore selected by DNREC as the basis for the proposed TMDL for zinc in the Red Clay Creek.

The DNREC disagrees with the commenter regarding the appropriateness of using the 7Q10, just because a large amount of zinc comes from groundwater as opposed to a discreet point source discharge. DNREC believes that the passage quoted from the U.S. EPA's Technical Support Document for Water Quality Based Toxics Control is referring to a very different loading scenario than the critical loading conditions for the Red Clay Creek. The quote provided refers to *nonpoint source loading* during *wet weather* flow conditions. First, the zinc TMDL for the Red Clay Creek is not based on wet weather flow conditions in the Creek. The critical condition for zinc concentration in the Red Clay Creek occurs during low flow, and hence the use of low flow-related design conditions is perfectly appropriate. Second, although groundwater discharge may in general be considered a nonpoint source, groundwater discharge from a specific site may, by certain legal definitions, be considered a point source, despite the fact that the discharge is not conveyed from a discreet pipe. Finally, the quote provided refers to a situation in which the nonpoint source loading is more significant than the point source

loading. Although the DNREC believes that the mass loading of zinc through the groundwater flow pathway is more significant than the mass loading through NVF's permitted discharge 002, it is unclear whether the commenter, in offering this quote is implicitly conceding that the groundwater loading is more significant than the permitted discharge from outfall 002.

**10.** The commenter presents preliminary calculations to support an alternative TMDL based on a log normal probabilistic approach. An allowable load of 29.5 pounds of zinc per day is offered as an alternative TMDL designed to meet a chronic aquatic life criterion of 0.141 mg/L, 99.908 % of the time at Ashland. At a recalculated chronic criterion of 0.275 mg/L, the commenter suggests that a mass loading as high as 59 pounds of zinc per day would ensure that aquatic life are protected 99.08 % of the time at Ashland.

**Response:** Section 8.3 of Delaware's Surface Water Quality Standards allows DNREC to consider scientifically reasonable requests for the use of dynamic modeling techniques for developing water quality-based discharge limitations on a case-by-case basis. The log normal probabilistic technique is one example of the dynamic modeling approach. Not only has this "request" come rather late in the TMDL development process, DNREC has identified several methodological problems with the commenter's analysis as presented. The methodological problems will be addressed first.

First, the log normal analysis is based on two alternative *chronic* aquatic life criteria of 0.141 mg/L and 0.275 mg/L, respectively. As noted in our response to comment #3, DNREC believes that neither of these criteria are based on substantial scientific data and analysis. Furthermore, the controlling criterion based on DNREC's calculations is the *acute* criterion, not the chronic criterion. It is unclear from the commenter's log normal analysis whether the commenter merely neglected to consider the acute criterion, or whether the commenter believes the acute criterion is unnecessary for some unspecified technical reason. In either event, DNREC believes that the commenter has failed to consider the applicable criterion in the log normal probability analysis.

The second major methodological flaw identified in the commenter's analysis is that zinc concentrations at Wooddale were used to project zinc concentrations upstream at Ashland through interpolation based on differences in drainage area between Wooddale and Ashland. This literally means that zinc concentrations at Ashland were calculated by multiplying the concentration of zinc at Wooddale by the drainage area above Ashland and then by dividing the resulting product by the drainage area above Wooddale. Because the drainage area above Ashland is less than the drainage area above Wooddale, the projected concentration of zinc at Ashland, using this technique, will always *be less than* the concentration of zinc at Wooddale. This method clearly does not provide a correct result, given that the concentration of zinc at Ashland is virtually always greater than the concentration of zinc at Wooddale. As discussed in the TBBD and in our response to comment #5, the concentration of zinc in the Red Clay Creek declines between Ashland and Wooddale due to dilution from noncontaminated baseflow and

tributary inflow, and, to a lesser degree, due to settling of particulate zinc between these two stations. Also as explained in our response to comment #5, the concentration of zinc measured at Wooddale during extreme low flow can be biased low due to water releases from Hoopes reservoir, thus making any extrapolation from Wooddale questionable. Finally, the log normal analysis offered by the commenter considered water quality criteria compliance at Ashland, as opposed to in the critical area directly adjacent to and just downstream from the NVF Yorklyn facility, where it should have.

With regard to the timing of the "request" for the use of a dynamic modeling approach, DNREC points out that Section 8.3 of Delaware's Surface Water Quality Standards has been available to NVF for nearly a decade. Not only has this "request" come rather late, there are serious technical flaws that force DNREC to reject it in its current form. When, as, and if a more defensible dynamic modeling analysis is submitted pursuant to Section 8.3 of Delaware's Surface Water Quality Standards, the DNREC shall consider it. The DNREC, however, does not intend to defer adoption nor implementation of the current TMDL based upon future and speculative actions of the NVF Company.

**11.** The commenter states that it is clear that the TMDL value initially proposed by DNREC, 1.81 lb/d, is far too conservative. Its low value is due to the use of inappropriate steady-state modeling.

**Response:** The TMDL proposed by DNREC was designed to ensure compliance with the State of Delaware Surface Water Quality Standards and to be consistent with the intent of the Federal Clean Water Act. The DNREC does not agree that the TMDL is far too conservative.

**12.** The process used in the development of the TMDL was rushed, with little or no opportunity for meaningful interaction among DNREC, the NVF Company, and the public. Although NVF supports the adoption of a TMDL for zinc in the Red Clay Creek, the TMDL should be based on the best available science, data, and technical understanding of the issues. Because of the lack of time, the TMDL is not based on the best available science related to the Red Clay Creek ecosystem.

**Response:** The DNREC agrees that the zinc TMDL for the Red Clay Creek was developed under an aggressive schedule. However, DNREC is faced with aggressive schedules for the development of all TMDLs in the State. These aggressive schedules are the result of a federal consent decree which mandates deadlines for all TMDLs required by Delaware's 1996 Section 303(d) List. We do not agree that the process lacked sufficient opportunity for meaningful interaction between DNREC, NVF, and the public. Below is a chronology of public meetings and announcements related to the Red Clay Creek zinc TMDL.

- March 5, 1999: DNREC Presentation to the Christina Basin Task Force, "Development of Zinc TMDLs for the Red Clay and White Clay Creeks." [Note: A representative of NVF Yorklyn attended this presentation.]

- June 17, 1999: DNREC Presentation at the Public Forum, "Interstate Initiatives for Clean Water in the Christina Basin," held at the Ashland Nature Center. Presentation entitled, "Development of Zinc TMDLs for the Red Clay and White Clay Creeks." [Note: A representative of NVF Yorklyn attended this presentation, as did the commenter.]

- August 1, 1999: DNREC proposed the zinc TMDL for the Red Clay Creek within the Delaware Register of Regulations. This notice also announced the availability of the supporting technical documentation for the proposed zinc TMDL. Further, the August Register also announced the September 7, 1999 public workshop and public hearing concerning the proposed zinc TMDL for the Red Clay Creek.

- August 26, 1999: The "DNREC News," Volume 25, announced that a public workshop and a public hearing would be held on September 7, 1999 concerning the proposed zinc TMDL for the Red Clay Creek.

- September 7, 1999: Public workshop and public hearing held concerning the zinc TMDL for the Red Clay Creek. [Note: A representative from NVF and the commenter attended both the workshop and the hearing.]

The announcements, public meetings, workshops, and hearing listed above far exceed the public participation requirements for the establishment of a TMDL. Nearly four full months transpired from the March 5, 1999 meeting to the time DNREC announced the proposed TMDL in the Delaware Register on August 1, 1999. An additional month after that transpired prior to the workshop and hearing on September 7, 1999.

In addition to the general public meetings listed above, DNREC and the NVF Company had at least two additional communications concerning the zinc TMDL for the Red Clay Creek prior to August 1, 1999 when DNREC published the proposed zinc TMDL. First, on May 24, 1999, DNREC responded to a Freedom of Information Act (FOIA) request submitted by the commenter on behalf of the NVF Company. To aid NVF's review of the DNREC's records, all of the readily available data were provided to the commenter in electronic format, thereby greatly reducing the amount of time that NVF might have had to spend re-entering that data into a spreadsheet for their analysis. Then, on June 10, 1999, representatives from DNREC's Division of Air and Waste Management and Division of Water Resources met with several representatives from the NVF Company and the commenter to discuss the zinc TMDL for the Red Clay Creek. As noted in our response to comment #5, DNREC asked NVF at that meeting if NVF had any data of information they wished to share with DNREC to help in the development of the zinc TMDL. Again, as noted previously, NVF declined that request.

In conclusion, we agree that the schedule has been aggressive. However, many opportunities have been provided for meaningful interaction between DNREC, NVF, and the public.

**13.** There is extensive work underway at the NVF Yorklyn facility as a part of an EPA removal action being conducted under the authority of the Comprehensive Environmental Response, Compensation and Liability Act. The data being developed in conjunction with the removal action will lead to a better and more comprehensive understanding of the zinc transport mechanisms at the site. The commenter suggests that the data developed and response actions taken during the removal action should be considered in the promulgation of the zinc TMDL for the Red Clay Creek.

**Response:** DNREC does not believe that the work underway at the NVF Yorklyn facility as a part of the referenced removal action alters the proposed TMDL in any way. We believe that the TMDL provides the target that the removal action should be shooting for, as opposed to the removal action determining what the TMDL should be. We are hopeful that the work underway as a part of the removal action will be of use in terms of implementing the TMDL.

**14.** The commenter questions the scheduling and prioritization of the Red Clay Creek TMDL for zinc and suggests that the timing should be re-evaluated.

**Response:** The State of Delaware's 1996 and 1998 draft Section 303(d) Lists were both made available for public comment prior to being finalized and approved by the U.S. EPA. The rationale that the DNREC used to list individual waterbodies, as well as the factors that DNREC considered in establishing the priority of each listed segment were integral parts of both the draft 1996 303(d) List and the draft 1998 303(d) List. The draft 1996 303(d) List identified the Red Clay Creek zinc TMDL as a medium priority rather than a high priority, primarily because other TMDLs were already underway that needed to be addressed first (Inland Bays and Nanticoke/Broad Creek). The draft 1998 303(d) List elevated the Red Clay Creek zinc TMDL to a high priority. Because no comments were submitted that opposed the listing of the Red Clay Creek for zinc, and no comments were submitted that questioned the priority designations, DNREC finalized the 1996 and 1998 Lists as they had been proposed. It is not DNREC's intent to revisit the scheduling and prioritization of the Red Clay Creek zinc TMDL.

**15.** The commenter states that the TMDL contains no consideration of the attainability of the proposed regulation, and no consideration of the potential economic costs of attainment. Further, there has been no analysis of the benefits that will result from the proposed TMDL, nor has there been a balancing of costs and benefits.

**Response:** Section 303(d) of the Federal Clean Water Act does not require consideration of attainability, costs, or benefits associated with TMDLs, nor does that Section require a balancing of costs and benefits in establishing TMDLs.

**16.** At page 1 of DNREC's TMDL Technical Background and Basis Document (TBBD) and elsewhere throughout the document, DNREC notes that contaminated groundwater is a source of zinc to the Red Clay Creek. There is little, if any, data on this issue, and extensive data is being developed on this issue in the course of the EPA removal action at this site. As such, DNREC's specific conclusions regarding the potential zinc contribution of contaminated groundwater at this site are premature.

**Response:** As stated on page 29 of DNREC's TBBD, DNREC believes that a number of factors *strongly point to* the discharge of contaminated groundwater under the site as the pathway through which the additional zinc (i.e., in addition to that discharged from outfall 002) is reaching the Red Clay Creek. Those factors are not repeated here, with the exception of one. Namely, perhaps the simplest of the factors is that there is no above-ground point source discharge that releases zinc from the site to the Red Clay Creek other than outfall 002. That being the case, and in consideration of the other corroborating factors listed in the TBBD, DNREC is confident in its conclusion that the "additional" zinc originates below ground level and is discharged to the Creek via a subsurface flow (groundwater) pathway. We believe this is the only possible conclusion that can be drawn.

**17.** At pages 1 and 2 of DNREC's TBBD, DNREC notes its obligation under Section 303(d) of the Clean Water Act to prepare a list of impaired water segments, and to establish a priority ranking for the identified segments, including an identification of waters targeted for action within the next two year reporting cycle. DNREC then notes that its schedule for development of the Red Clay Creek zinc TMDL was memorialized in a Memorandum of Understanding (MOU) between EPA and DNREC. The commenter states that the MOU was not submitted to NVF for review and comment and was not submitted for notice and comment to members of the public.

**Response:** This comment does not relate to any specific Article in the proposed zinc TMDL for the Red Clay Creek. Nevertheless, the commenter is correct in stating that the MOU was not submitted directly to NVF for review. However, the question of the MOU and the schedule is largely a moot point since DNREC followed all applicable public notice requirements for the proposed Red Clay Creek zinc TMDL. Furthermore, because NVF attended the March 5, 1999 Christina Basin Task Force meeting (see response to comment #12), NVF was aware of DNREC's schedule nearly 5 months prior to the August 1, 1999 announcement of the proposed zinc TMDL in the Delaware Register of Regulations.

**18.** At page 9 of DNREC's TBBD, DNREC notes that upstream zinc values are, more often than not, non-detect. DNREC's use of one-half of the detection limit for non-detected data points skews the calculations, suggesting the presence of more zinc upstream in the Red Clay Creek than may actually be present.

**Response:** There are 5 basic techniques of handling non-detected values in environmental data sets. They include the following:

- Censor the non-detected values (i.e., assume the samples were never taken);
- Set non-detected values equal to the detection limit, which is the largest concentration that could be present but not detected;
- Set non-detected values equal to zero;
- Set non-detected values equal to ½ of the detection limit; and
- Use statistical techniques (e.g., maximum likelihood estimators) to model the non-detected values.

The first 2 techniques will overstate the true, unknown concentration and mass loading. The third technique understates concentration and mass loading, especially for substances like zinc and other metals which occur naturally in the environment at low levels. The fifth technique is generally limited to situations in which the frequency of non-detection is less than 20 %, which was not the case for zinc in the Red Clay Creek at the Marshall's Bridge monitoring station. The fourth technique, which is the technique that DNREC used, does not purposely bias concentration and mass loading one way or the other. This technique is as likely to understate zinc concentration and mass loading as it is to overstate concentration and loading. As such, DNREC believes that the technique is reasonable and justified. Furthermore, DNREC used *medians* to characterize concentration and mass loading, as opposed to *means*. The median is a distribution-free measure of central tendency that is not sensitive to data skew, which is what the commenter appears to be concerned with.

**19.** At page 15 of DNREC's TBBD, DNREC makes a finding that mass loading of zinc in the Red Clay Creek did not decrease over the five-year period of evaluation. In making this finding, DNREC considers stream flow in the Red Clay Creek, but does not consider the changes in groundwater flow that typically occur on a seasonal or annual basis. As such, this finding may not be accurate.

**Response:** DNREC's finding that the mass loading of zinc at the Ashland monitoring station did not change over the 5-year period evaluated is technically sound, regardless of whether changes in groundwater flow were explicitly considered or not. Changes in groundwater flow were implicitly considered in the analysis because one component of streamflow is derived from groundwater flow (see also the response to comment #22).

**20.** At page 21 of the TBBD, DNREC notes that on May 12, 1999, EPA approved a response action plan for the NVF facility, thereby setting a removal action into motion. In fact, as noted above, the EPA removal action has been ongoing at the facility for several years.

**Response:** This comment does not relate to any specific Article in the proposed zinc TMDL for the Red Clay Creek. The comment, however, is duly noted.

**21.** At page 28 et seq. of DNREC's TBBD, DNREC addresses the Toxic Release Inventory (TRI) data submitted by NVF on an annual basis. DNREC attempts to use the TRI release data to "close" the mass balance for zinc in the Red Clay Creek, concluding that the amount of zinc released from the facility is equal to the amount of zinc found downstream. For purposes of calculating its TRI submission, NVF determines the amount of zinc in the Red Clay Creek downstream of NVF's facility, based on the flow and concentration measurement. NVF reports this amount (less any zinc found upstream of NVF) in its TRI report as the amount of zinc released from the facility. The TRI is not based on a direct measurement of process losses. Although this methodology may overstate the actual contribution from NVF's facility, it is NVF's objective to be conservative in its TRI calculations. Since the TRI calculation by NVF is substantially the same as the downstream "loading" calculations by DNREC, the results are, by necessity, quite similar. This equivalency stems only from the methodology underlying these calculations, and does not support the conclusions drawn by DNREC at pages 29-30 of the TBBD. DNREC's analysis is flawed, and stems from a misunderstanding of the methodology underlying the TRI submissions by NVF.

**Response:** DNREC disagrees with the commenter that the DNREC's analysis of the TRI data is flawed. To preface our response, we first offer a simple definition of "mass balance." A "mass balance" refers to the addition of 2 or more separate mass loads to produce an estimate of a single, combined mass load. A mass balance accounts for the inputs, outputs, and any changes resulting from chemical, physical, or biological processes which occur over the area under consideration. In the case of zinc in the Red Clay Creek, the masses being added are the upstream zinc load and the total zinc load released from the NVF Yorklyn facility. The single, combined mass load is the load downstream from the NVF Yorklyn facility. Because zinc is a conservative substance, changes in the mass loading of total zinc immediately below the NVF Yorklyn facility due to chemical, physical, and biological processes are relatively small.

Using the fundamental concepts of mass balance discussed above, DNREC concluded in the TBBD that the upstream load plus the annual release reported by NVF under the TRI, when averaged over the year, agrees closely with the zinc mass load in the Red Clay Creek below the NVF Yorklyn facility. The other main conclusion that DNREC provides in the TBBD on this topic is that NVF continues to have an on-going release of zinc to the Red Clay Creek, based on the simple fact that NVF continues to report the release of

zinc to the Red Clay Creek under TRI. DNREC stands behind these 2 main conclusions. Further, we believe that we have placed appropriate qualifiers on our conclusions.

It is unclear from the commenter's statements whether NVF disputes either of DNREC's main conclusions as articulated above, or if the disagreement relates more to NVF's belief that DNREC misunderstands the methodology underlying the TRI submissions. If the former, then there is serious dispute. If the latter, then DNREC believes this to be a far less serious issue and one which DNREC believes, in this case, to be largely irrelevant to the conclusions drawn in the TRI discussion. Specifically, at no place in the TBBD does DNREC state that NVF's release figures are based on a direct measure of process losses. Nor is it stated in the TBBD that NVF's release figures are based on flow and concentration measurements taken at Wooddale, (9 miles downstream from the NVF Yorklyn facility), less any zinc found upstream. The issue of *how* NVF arrived at their release estimates did not enter into DNREC's discussion of the TRI data, nor did it need to. We took those numbers only as NVF's own representation of the amount of zinc released from the Yorklyn facility to the Red Clay Creek. The fact that DNREC may not have known all the details of how NVF arrived at their TRI figures is due to the fact that NVF has never submitted a detailed written description of their methodology to DNREC. We still do not have that description, nor do we know whether the methodology used by Dr. Allen to compute zinc mass loading at Wooddale is the same methodology used by NVF in preparing their annual TRI submission (see response to comment #5).

Given what information DNREC does have concerning the methodology used by NVF to prepare their annual TRI submission, we doubt that NVF's release figures overstate the actual contribution of zinc to the Red Clay Creek from NVF's facility, as the commenter suggests they may. Our reason for doubting this suggestion is that DNREC has shown that there is a statistically significant drop in the mass loading of zinc between the Ashland monitoring station (1.7 miles below the NVF facility) and the Wooddale monitoring station (9 miles below NVF). DNREC concludes in the TBBD that this drop in mass loading between Ashland and Yorklyn is due to settling of particulate zinc between these 2 stations. In light of the elevated levels of zinc in the sediments below the NVF Yorklyn facility, including the area between Ashland and Wooddale, DNREC continues to believe the drop in zinc mass loading between Ashland and Wooddale is due to settling of particulate zinc to the creek bed. The point here is that the mass loading estimates derived by NVF for purposes of the TRI are not likely to overstate the actual release from the NVF facility, but rather underestimate it. DNREC acknowledges the difficulty in obtaining accurate estimates of off-site releases. However, we feel that we must take issue with the commenter's suggestion that the TRI data collected by NVF overstates the true release.

In summary to this comment, DNREC disagrees with the commenter that the DNREC's analysis of the TRI data is flawed. The analysis was based on basic principles of mass balance and was appropriately qualified in the TBBD. Finally, based on what DNREC now knows about how NVF derives their TRI figures, and in light of the decline in mass loading between Ashland and Wooddale, DNREC has reason to believe that the annual TRI release figures for zinc from the NVF facility understate true releases.

**22.** At page 30 of DNREC's TBBD, DNREC states that when streamflow is low, the percentage of flow in the Red Clay Creek derived from groundwater increases, thereby magnifying the influence of groundwater contaminants. In making this determination, DNREC does not present any analysis of groundwater flow or hydrology in the vicinity of the site. As such, DNREC's conclusion may be inaccurate. The EPA removal action will likely generate substantial data that could provide a basis for analysis of this issue.

**Response:** It is true that DNREC did not present any specific analysis of groundwater flow or hydrology in the vicinity of the site. Rather, what DNREC did was to base its conclusion on basic principles of hydrology which tell us that streamflow is made up of three components: rain which falls directly on the stream (often referred to as direct wet deposition), surface runoff which reaches the stream by the process of overland flow, and flow from groundwater, (which is referred to as baseflow). During a rain event, flow in a stream typically increases in response to direct deposition and surface runoff, the latter occurring only if the intensity and duration of the rain event are sufficient to produce overland flow. In this case, the proportion of the total streamflow derived from direct deposition on the stream and from runoff typically increases during rain events and the proportion of the total streamflow attributable to groundwater decreases. During periods characterized by the lack of rain, the reverse is true. The proportion of the total streamflow associated with direct deposition and runoff decreases and the proportion of the total streamflow attributable to groundwater increases. Because there is a higher percentage of groundwater making up the total streamflow during dry weather periods, the concentration of contaminants in the stream will depend in part on and increase as a function of local contamination in the adjacent groundwater. This is especially true during periods of extended low flow, drought conditions.

DNREC felt and continues to feel confident in applying the general principles of hydrology and contaminant flux in this situation since it is well known among hydrology experts at the United States Geologic Survey (USGS), the Delaware Geological Service (DGS), and the DNREC that baseflow in the Piedmont portion of the Red Clay Creek is composed primarily of groundwater that has discharged into the Creek.

As a final note concerning this comment, it would appear, based on the commenter's own words, that it is likely, but not certain, that the EPA removal action will generate substantial data that could provide a basis for analysis of this issue.

**23.** At page 30 of DNREC's TBBD, DNREC suggests that subsurface piping or tankage failure is the likely source of zinc discharges from the facility. At this time, DNREC's conclusion regarding sources of zinc is largely speculative, not based on adequate data, and without sufficient basis.

**Response:** DNREC stated in the TBBD that, "It is likely, although not certain, that subsurface piping or tankage designed to carry or hold a zinc solution has failed." DNREC continues to believe that this is a plausible explanation. Further, we believe that we have properly qualified our view.

**24.** For the reasons set forth in this letter, as well as the reasons set forth in the technical comments of Dr. Allen dated September 6, 1999 and September 14, 1999, NVF respectfully submits that the proposed zinc TMDL for the Red Clay Creek is flawed.

**Response:** DNREC does not agree. The zinc TMDL is based upon sound scientific principles and the lawful application of applicable Federal and State statutory and regulatory requirements.

**25.** We (NVF) suggest that the promulgation of the zinc TMDL be deferred for a period of not less than one year, to allow all interested parties to engage in a meaningful evaluation and exchange of site-specific technical data relating to this matter.

**Response:** DNREC must establish the TMDL by December 31, 1999. If DNREC fails to do so, then EPA must establish the TMDL no later than December 15, 2000. DNREC does not intend to miss the December 31, 1999 deadline.

When, as, and if NVF collects site-specific technical data that might have some bearing on the TMDL, then DNREC will consider that information.

**26.** The Eastern Environmental Law Clinic (EELC) is concerned that NVF's permit allows it to discharge up to 1.98 pounds per day from outfall 002. This exceeds the proposed TMDL of 1.81 pounds per day. Although the EELC understands that NVF's permit is undergoing modification to reflect this discrepancy, the new permit limit must be consistent with the TMDL. Further, any resultant point source created as a result of EPA's removal action at the site should be incorporated into the final NPDES permit.

**Response:** The new permit will be consistent with all applicable requirements, including those related to the TMDL. DNREC will coordinate with the EPA to ensure that any point source created as a result of EPA's removal action at the site will meet applicable requirements. DNREC cannot guarantee that any point source created as a result of EPA's removal action will be incorporated into NVF's new state-issued NPDES permit because surface water discharges created in conjunction with the federal Superfund program do not require state NPDES permits. Any such discharge, however, does need to comply with "All Relevant and Applicable Regulations" (ARARs), which

would include Delaware Surface Water Quality Standards and any final zinc TMDL for the Red Clay Creek.

**27.** The EELC is concerned that the proposed 1 percent margin of safety is too low for actual conditions. We believe that such a low number is arbitrary and does not accomplish the intended purpose of the TMDL program. DNREC concedes that the majority of the zinc load in the Red Clay Creek is from an "unknown" source. With this in mind, EELC recommends that the margin of safety be modified to at least 10 percent of the anticipated zinc loads (WLA +LA).

**Response:** The DNREC does not agree that the 0.01 pounds of zinc per day Margin of Safety (MOS) is arbitrary, nor do we agree that the proposed MOS fails to accomplish the intended purpose of the TMDL program. With regard to the first issue, DNREC provided a quantitative basis for the 0.01 pounds per day Margin of Safety on pages 31 through 33, and Appendix C, of the TBBD. With respect to the second issue, the Margin of Safety is intended to account for uncertainties between mass loading and associated concentration response in the receiving water. DNREC has little to no uncertainty that the majority of zinc reaching the Red Clay Creek originates from the NVF Yorklyn property. Furthermore, DNREC has little uncertainty that the major pathway through which the zinc is released to the Red Clay Creek is through subsurface flow. What remains in question is not whether the NVF site is the source of the zinc but rather exactly where on the property that zinc is coming from. The fact that DNREC has yet to pinpoint the exact source of zinc is irrelevant to the determination of an acceptable maximum daily load or, in our view, to the determination of the Margin of Safety. We believe that the TMDL meets its intended purpose of defining the maximum mass loading that the Creek can accommodate under critical design conditions while still assuring compliance with applicable water quality criteria.

Finally, the commenter provides no specific justification for a modified Margin of Safety of at least 10 percent of the anticipated zinc loads. For DNREC to retract Article 4 of the proposed zinc TMDL (i.e., MOS = 0.01 pounds of zinc per day) and substitute a Margin of Safety of at least 10 % of the anticipated zinc loads *would* be arbitrary, given there appears to be no specific justification to do so.

**28.** The EELC is concerned that DNREC has proposed to combine the WLA discharge from outfall 002 with the LA discharge from groundwater for purposes of calculating the TMDL. For several reasons outlined in the commenter's letter, the EELC recommends that the individual known sources of zinc discharging into the Red Clay Creek be recognized and calculated independent of each other.

**Response:** We understand the commenter’s concern. However, for purposes of the TMDL, DNREC believes it makes perfect sense for the reasons outlined on page 34 of the TBBD, to combine the mass loading of zinc from NVF outfall 002 and the mass loading of zinc from the subsurface source into an overall site loading. DNREC acknowledges that the situation at the NVF Yorklyn site is unusual in that the permitted

source represents a small fraction of the total mass loading reaching the Creek from the site. We believe that we have developed a creative solution to a unique problem. Further, we believe that what we have proposed is not in conflict with existing laws and regulations. As noted in proposed Article 6 of the Red Clay Creek zinc TMDL, the manner in which the 1.2 pounds per day combined loading from NVF outfall 002 plus the mass loading from subsurface discharge is to be allocated between these 2 sources shall be addressed as a part of a Pollution Control Strategy to be developed by DNREC over the next year. This remains our intent.

**29.** The EELC states that since the major source of zinc is unknown, it is unclear what influence seasonality has on the unknown discharge. The EELC also points out that past data sets are indicators but are not an absolute measure of future weather patterns, flow rates, and zinc loadings. In this regard, the EELC recommends the calculations as presented in the DNREC proposal.

**Response:** As noted in our response to comment #27 above, DNREC does not believe that the major source of zinc to the Red Clay Creek is unknown. DNREC has considered seasonality in developing the TMDL through the use of critical low flow conditions in the Creek, which historically have occurred during summer to fall drought periods. We agree that past data sets are indicators and not absolute predictors of future weather patterns, flow rates, and pollutant loads. DNREC appreciates the EELC's implied support for the approach taken by DNREC in calculating the proposed zinc TMDL for the Red Clay Creek.

**30.** It would seem appropriate to develop TMDLs for a specific watershed in conjunction with each other. For example, it would be good to know what the non-point source TMDL for the Red Clay Creek will involve while developing the point source TMDLs. Since neither of these is yet complete and the non-point source TMDL is several years away, the zinc TMDL is being developed without the benefit of this information. For example, is there a relationship between runoff and zinc loading? Also, the Kennett Borough sewage treatment plant has a zinc limit and is about to construct a new plant. What would be the projected effect of the new facilities on zinc loading in the Red Clay Creek?

**Response:** The non-point source TMDL that is being developed for the Christina Basin, which includes the Red Clay Creek, involves nutrients delivered during high flow conditions. That TMDL has no bearing on the low flow TMDL for zinc in the Delaware portion of the Red Clay Creek.

With respect to the commenter's second point, DNREC demonstrated in its TBBD that the concentration of zinc in the Red Clay Creek below the NVF Yorklyn facility is inversely related to streamflow. This suggests not only that the concentration of zinc increases as streamflow decreases, but also the opposite, that the concentration of zinc decreases as streamflow increases, such as it does after runoff events.

Finally, DNREC believes that the effluent quality of the new Kennett Borough sewage treatment plant is likely to be better than the effluent quality of the old plant. Therefore, we do not believe that the mass loading of zinc from the Pennsylvania portion of the Red Clay Creek to the Delaware portion of the Red Clay Creek will increase when the new plant goes on line. However, DNREC will continue to monitor conditions in the Red Clay Creek in the future and will consider adjustments to the current TMDL as necessary to ensure compliance with applicable water quality criteria.

**31.** We (RCVA) understand that there are a large number of TMDLs to be developed and [these TMDLs] can't all be done at once. Perhaps a question to be raised and to be discussed in a public forum would be which TMDLs have the highest priority and with what criteria is the priority developed? Since it seems almost assured that TMDLs will be developed sequentially, a priority order based on public input might yield a better and more acceptable product.

**Response:** This comment does not apply to any specific article or articles of the proposed TMDL. However, we point out that the State of Delaware's 1996 and 1998 draft Section 303(d) Lists were both made available for public comment prior to being finalized and approved by the U.S. EPA. The rationale that the DNREC used to list individual waterbodies, as well as the factors DNREC considered in establishing the priority of each listed segment were integral parts of both the draft 1996 303(d) List and the draft 1998 303(d) List. The draft 1996 303(d) List identified the Red Clay Creek zinc TMDL as a medium priority, primarily because other TMDLs were scheduled to be developed first. The draft 1998 303(d) List elevated the Red Clay Creek zinc TMDL to a high priority. Because no comments were submitted that opposed the listing of the Red Clay Creek for zinc, and no comments were submitted that questioned the priority designation, DNREC finalized the 1996 and 1998 Lists as they had been proposed.

**32.** In developing the zinc TMDL certain streamflow data was used to determine low flow on which the limits would be based. The stream gauge readings at Marshall's Bridge were used for calculating these flows. One of the measurements involved was the seven day, ten year low flow. The commenter suggests that the flows at the Marshall's Bridge gage during the period September 2 through 8, 1995 could not have been accurate because withdrawal volume exceeded point source discharge volume, while at the same time the stream apparently did not go dry. For this reason, the commenter suggests that the flow at Marshall's Bridge during September 2 through 8, 1995 should not be used as the basis for calculation. The commenter suggests that this information be rechecked.

**Response:** DNREC did not use the flows at Marshall's Bridge between September 2 through 8, 1995 as the basis of the zinc TMDL for the Red Clay Creek. The USGS, however, did consider those flows in computing 1Q10 and 7Q10 flow statistics for the

Marshall's Bridge gage. DNREC, in turn, extrapolated the 1Q10 and 7Q10 flows at Marshall's Bridge downstream to NVF Yorklyn based on the ratio of drainage areas, and subtracting out the 0.5 MGD of water that NVF permanently withdrawals from the Red Clay Creek. This procedure was discussed on page 30 of DNREC's TBBD.

DNREC has confirmed with the United States Geological Survey (USGS) office in Lemoine, Pennsylvania that the flows recorded at the Marshall's Bridge gage, (formally known as the Red Clay Creek Near Kennett Square, PA gage, 01479820), were accurate as reported between September 2 and 8, 1995. DNREC has also confirmed the 1Q10 and 7Q10 flows at Marshall's Bridge with the USGS office in Lemoine.

DNREC believes that the commenter has confused the individual daily flow values during the period September 2 through 8, 1995 with the 1Q10 and 7Q10 flow statistics for the Marshall's Bridge gage. The daily average flow values at the Marshall's Bridge gage during the period in question ranged from a low of 0.86 cfs on September 4$^{th}$ to a high of 1.3 cfs on both September 5$^{th}$ and 8$^{th}$. In contrast, the USGS published values for the 1Q10 flow and 7Q10 flow at Marshall's Bridge are 1.94 cfs and 2.48 cfs, respectively.

The point that the stream did not apparently go dry during the September 2 through 8, 1995 period, despite the fact that withdrawal volume exceeded point source discharge volume is explainable from several angles. Withdrawal volumes and point source discharge volumes are typically reported on a monthly average and monthly maximum basis. Flows at the USGS gage, on the other hand, are reported for each day. The actual withdrawal volumes and point source discharge volumes during September 2 through 8, 1995, were, no doubt, different than the monthly average and maximum values. Further, there are other components of the water balance in addition to withdrawals and point source discharges that determine the flow in the stream at any particular time and place. A simple example is baseflow input. Finally, the possibility exists that the withdrawal volumes and/or the point source discharge volumes, as opposed to the USGS flows at Marshall's Bridge, were in error. For whatever reason or combination of reasons, the stream did not apparently go dry during the period in question. However, based upon the verified USGS flow records for Marshall's Bridge during this period, the stream came very close to being fully depleted.

In summary, DNREC has verified that the flows in question are correct. In addition, DNREC has verified the 1Q10 and 7Q10 flow statistics for the Marshall's Bridge gage. Finally, flows in the Red Clay Creek were not necessarily depleted between September 2 and 8, 1995 simply because longer-term withdrawal volumes exceeded longer-term point source discharge volumes.

**33.** One of the questions we (RCVA) would raise is the quantitative, measurable change in stream health that is expected to result by implementing the proposed limits. It is our understanding that bio-assays have been conducted for some time in the Red Clay Creek to measure the effect of zinc from the NVF discharge. Our

understanding is that these bio-assays do not show acute or chronic toxicity which raises the question what would be achieved by reducing the zinc limits? This is not to say that the zinc limits should not be reduced, it simply asks the question what would the reduction achieve, how can this be measured, and what is the value from that achievement? In a time of limited resources, including financial resources, we would suggest that money spent most effectively would be money spent on achieving the largest measurable improvement to the stream. Does the proposed zinc TMDL do that?

**Response:** The first major, quantitative, measurable change that DNREC would expect to see as a result of implementing the proposed TMDL is that the concentration of zinc in the water column of the Red Clay Creek below the NVF Yorklyn facility, which currently far exceeds applicable criteria designed to protect aquatic life, will decline to lower levels. Along with this decline in water column zinc concentration, we would expect to see slow but steady recovery of the macroinvertebrate and fish populations below the facility, provided zinc in the Creek sediments below the facility does not preclude recovery. Further, recovery below the facility will also depend in part on continued improvements in water quality conditions above the facility, since upstream conditions can and do have an influence on downstream conditions.

Concerning the results of bioassay testing, the commenter provides no specific data or analysis that the DNREC can respond to. We suspect that the commenter is referring to bioassay testing performed on NVF Yorklyn NPDES outfall 002. Assuming this to be the case, we point out, as we did in the TBBD, that the amount of zinc released through discharge 002 represents a relatively small fraction of the total zinc released from the facility. Consequently, bioassay results for discharge 002 are not expected to provide a good measure of the full impact of the total zinc released from the facility to the Red Clay. Based upon the information that DNREC is aware of, there appears to be limited bioassay data for Red Clay Creek water samples taken above and below the NVF facility.

Bioassays were performed by the U.S. EPA in 1985 and 1986 on samples taken above and below the NVF Yorklyn facility. The results of that work are presented in a report by Dobroski and Salamon (1988) as cited in DNREC's TBBD for the zinc TMDL. The results indicated significant toxicity both above and below the NVF Yorklyn facility. For this reason, it was not possible to ascertain the relative impact of the NVF facility on the Creek. Furthermore, the testing was done before NVF removed discharge 001 from the Creek, further confounding interpretation. The important thing to bear in mind concerning bioassay results is that the toxicity of NVF outfall 002 is not likely to provide a full indication of the toxicity in the Red Clay Creek below NVF Yorklyn.

With respect to the commenter's question concerning whether money spent on the proposed zinc TMDL will achieve the largest measurable improvement to the stream, we respond first by stating that such a cost benefit analysis is not required by Section 303(d) of the Federal Clean Water Act or by the implementing regulations. Further, this is a hypothetical question that presumes that DNREC has complete knowledge of all impacts in the Red Clay Creek and associated cost estimates for remediating those impacts.

Although DNREC has gathered a great deal of information concerning sources of contamination in the Red Clay Creek watershed over the years, our knowledge will always be less than complete, if for no other reason than the Red Clay Creek is an interstate waterbody that likely has some impacts in Pennsylvania that we are unaware of and which are out of our direct jurisdiction.

In summary to this comment, DNREC expects the concentration of zinc in the Red Clay Creek to decline and the biological condition in the Creek to improve following the implementation of the proposed zinc TMDL. DNREC cannot say, and is not required to say, whether implementing the proposed zinc TMDL will provide the largest benefit of all conceivable water quality projects in the Red Clay Creek. We can say, however, that implementing the proposed zinc TMDL is expected to address the zinc contamination problem in the water column during critical low flow conditions.

**34.** The TMDL process involves the public ultimately and our comment on this aspect is simply that the public involvement came rather late in the process. The zinc TMDL was frankly a surprise since it had been pretty much completed by the time DNREC made a presentation on the topic to the Christina Basin Task Force on March 5, 1999. To achieve public participation in the most satisfactory way we would suggest that this process begin as the TMDL development begins. There is a significant amount of information that RCVA and NVF could have provided in this process. We would offer that as the TMDL process continues that the affected parties be involved from the very beginning. The Christina Basin Task Force is a good forum to present information since it meets quarterly and has representation throughout the affected watersheds.

**Response:** See response to comment #12. The commenter states that the zinc TMDL was pretty much completed by the time DNREC had made a presentation on the topic to the Christina Basin Task Force on March 5, 1999. In fact, DNREC had not begun working in earnest on the zinc TMDL until just prior to the March 5, 1999 presentation. In this regard, we believe that we initiated public participation at the earliest possible point in the TMDL development process. In addition, as noted in our response to comment #31, DNREC had also public participated its 1996 and 1998 Section 303(d) List of waters still needing TMDLs, its rationale for those listings, and the priorities assigned to each waterbody segment. Therefore, the commenter should have been aware of the Red Clay Creek zinc TMDL development schedule.

The commenter states that there is a significant amount of information that the RCVA and NVF could have provided as part of the process. It is unclear what information the commenter is referring to since the commenter (and NVF) attended some, if not all, of the public meetings previously identified in this Response Document (e.g., see response to comment #12), yet the commenter provided no information to DNREC at or subsequent to those meetings. DNREC believes there has been ample opportunity for the RCVA and NVF to provide information to DNREC to help in the TMDL development process. For reasons unknown to DNREC, this information was not provided.

We agree that the Christina Basin Task Force is a good forum to present information concerning water quality initiatives, including TMDLs, since it meets quarterly and has representation throughout the affected watersheds. This is why DNREC chose not to convene a separate TMDL Advisory Committee as it has done for the Indian River, Indian River Bay, Rehoboth Bay, Nanticoke River, and Broad Creek watersheds.

**35.** We (RCVA) suggest that the TMDL process has merit and is worthy of continuation.

**Response:** We agree that the TMDL process has merit. DNREC intends to continue its efforts.

**36.** While the Sierra Cub generally agrees with the TMDL set for zinc for the Red Clay Creek, we (Sierra Club) feel that the Margin of Safety does not completely take into consideration the future cumulative impacts that increased development and more prevalent seasonal low stream flow, due to drought, will inflict on the Creek.

**Response:** The DNREC acknowledges the Sierra Club's general concurrence with the TMDL. The Margin of Safety (MOS) proposed by the DNREC accounts for uncertainties related to the flux of dissolved zinc from the creek sediments to the water column under design conditions as well as uncertainties related to variations in hardness, which in turn influence the computation of water quality criteria. The MOS does not take into consideration future cumulative impacts that may occur in response to increased development, including the possibility of more prevalent low stream flow. At present, there is no scientifically objective way to accurately predict future cumulative impacts and whether those hypothetical impacts will have any influence on stream flows. However, DNREC will continue to monitor conditions in the Red Clay Creek in the future and will consider adjustments to the current TMDL as necessary to ensure compliance with applicable water quality criteria.

**37.** Sierra Club is concerned about the level of zinc in the water of this area and its increased movement from the stream level down to the local aquifers that are used for drinking water supplies in this developing section of the state.

**Response:** DNREC is unaware of any significant human health threat associated with the movement of zinc from the water column of the Red Clay Creek to local aquifers used for public drinking water supply, including the Cockeysville Formation. DNREC believes that the primary threat of zinc in the Red Clay Creek is to aquatic life. This is why the TMDL is designed to ensure compliance with the applicable zinc criteria for the protection of aquatic life during critical conditions.

**38.** Sierra Club understands that the industrial history of the stream led to the complete decimation of fish populations in the Red Clay Creek during the 1950s and 60s. The 1980s saw a comeback of some fish populations. The industrial history of the Red Clay Creek precludes allowing scientists a definitive understanding of what load this creek can bear, but the DNREC should be able to understand and gauge what loading this Creek should be, given that there are local creeks and rivers with similar geology, hydrology and climate.

**Response:** In DNREC's TBBD, a report by Dobroski and Salamon (1988) is referenced which documents, among other things, the results of various fisheries surveys performed in the Red Clay Creek over several decades dating back to the 1950s. Based on information presented in that report, it is true that the fish population in the Red Clay Creek below Yorklyn was indeed sparse to non-existent at one point but that the fisheries population appears to have recovered somewhat. Despite these improvements, there is still ample opportunity for further improvements based on the fact that applicable water quality criteria are not met in the Red Clay. Implementation of the zinc TMDL is expected to result in a measurable improvement in the concentration of zinc in the water, sediment, and fish of the Red Clay Creek, as well as measurable improvements in the biological community below the NVF Yorklyn facility. The fact that the Red Clay Creek has had a checkered history has not prevented DNREC from developing a TMDL designed to meet applicable water quality criteria at critical low flow conditions. There was no need for DNREC to determine an allowable loading for the Red Clay Creek based on other local creeks and rivers with similar geology, hydrology and climate.

**39.** The current fish consumption advisory is based on elevated levels of PCBs, dioxin and chlorinated pesticides in fish tissue. Are there any studies that indicate the combined influence of the chemical factors of zinc with these pollutants?

**Response:** DNREC has evaluated the cumulative human health risk associated with the combined presence of all contaminants detected in the fish from the Red Clay Creek, including zinc and the other pollutants mentioned by the commenter. Zinc represents an extremely small fraction of the cumulative human health risk, despite the fact that the concentration of zinc in fish from the Red Clay Creek is elevated relative to the concentration in fish elsewhere in the state.

**40.** A presentation by DNREC staff earlier this year at the Delaware Nature Society indicated that zinc harms macroinvertebrates. If fish populations are to recover in this area the quality of the water should be fully supportive of their habitat needs.

**Response:** DNREC stated that zinc can harm macroinvertebrates if the concentration of zinc in the pore water of the sediment is high enough to cause toxicity and the exposure occurs over a long enough time. As noted on pages 32 and 33 of the TBBD: "…the possibility exists that the concentration of zinc in the sediment pore water is toxic

to benthic organisms. This TMDL does not address that possibility because no relevant and applicable data are available to make such a determination. As a separate, but certainly related effort, a detailed assessment of sediment toxicity below NVF could be performed in the future. To provide the greatest level of confidence, any such assessment should take the so-called "triad" approach, where solid phase toxicity testing, macroinvertebrate assessment, and chemical testing are all performed on the samples." Because of complexity and cost, DNREC has not performed this type of assessment.

Although DNREC has not performed a sediment triad study in the vicinity of the NVF Yorklyn facility, DNREC has collected some information on the health of the benthic community above and below the facility. In addition to the macroinvertebrate data presented in the Dobroski and Salamon (1988) report referenced in DNREC's TBBD, DNREC has also collected macroinvertebrate data at one station above the NVF Yorklyn facility (near the Road 253 bridge) and one station below the NVF Yorklyn facility (near the Ashland covered bridge). That biological assessment work was performed in both the spring and fall of 1993, 1994, 1995, and 1996. DNREC did not introduce that information as a part of the official record for the zinc TMDL because doing so was not necessary to justify the TMDL. However, since the commenter has raised the issue of the health of the benthic community in the Red Clay Creek, DNREC has decided to briefly discuss that information as a part of this response.

The macroinvertebrate data collected by DNREC above and below the NVF Yorklyn facility in the spring and fall between 1993 and 1996 show impacts both above and below the facility, with a greater impact indicated, on average, below the facility. In comparison to the benthic community above the NVF facility, the benthic community below the facility typically exhibits fewer number of organisms per area, fewer number of taxa, fewer number of sensitive taxa, and a fewer percentage of sensitive taxa. Further, the condition of the benthic community below the NVF facility during the fall of 1995 (during drought conditions) was especially depressed in comparison to the station above the NVF Yorklyn facility. The lower overall number of organisms per area below the facility, and the fact that few sensitive species are typically found there, is suggestive of toxicity. However, based on this data alone, it cannot be stated unequivocally that zinc is the major cause. Again, a sediment triad study, including a toxicity identification evaluation (TIE), could provide a more definitive answer concerning the role of zinc in causing impacts to the benthic community of the Red Clay Creek. At the present time, however, such information is not available as noted above. Depending on the outcome of the adoption of this TMDL and as a part of the subsequent development of a Pollution Control Strategy, NVF may be asked or directed to conduct a sediment triad/sediment TIE, in addition to any other study they may choose to initiate of their own accord, (e.g., site-specific criteria study, Water Effect Ratio study, mixing zone study, and dynamic modeling study).

In summary, we agree with the commenter that for a fish population to fully recover, the quality of the water [and sediment] should be fully support of the fish's habitat needs. If it is determined that zinc in the sediments below the NVF Yorklyn facility is adversely impacting the benthic community, and as a result, is preventing a full recover of the fish

population in the Red Clay Creek, then additional actions may be necessary, including remediation of creek sediments. The need for and feasibility of such remediation would be the subject of a separate action and would likely be directed by the State or federal Superfund program.

## IV. Other Comments Received After the Comment Deadline

In addition to the comments that were discussed above and which were received prior to the September 14, 1999 deadline, DNREC also received comments regarding the proposed TMDL from the U.S. Environmental Protection Agency (EPA). Those comments were received by DNREC on 28 October, 1999. Because those comments were submitted after the official comment deadline, no response from DNREC is necessary as a part of this Response Document. Further, no consideration can be given to those comments with regard to a final action on the zinc TMDL. As an aside, however, it is noted that the EPA concludes in their comments that it appears that the draft TMDL developed by the DNREC for zinc in the Red Clay Creek meets the eight Federal regulatory requirements of an approvable TMDL. EPA further noted that they will reserve final judgement on approving the TMDL until which time DNREC submits a final version to EPA for their official approval action.