

EPA NEW ENGLAND'S TMDL REVIEW

TMDLs: Centennial, Bartlett, Englesby and Morehouse Brooks, Chittenden County, VT

STATUS: Final

DATE: September 28, 2007

IMPAIRMENT/POLLUTANT: Biological impairment (aquatic life support) caused by stormwater-related stressors: the TMDLs are proposed for stormwater runoff volume as a surrogate for the pollutant sediment and a variety of other stressors associated with stormwater.

BACKGROUND: The Vermont Department of Environmental Conservation (VTDEC) submitted drafts of the TMDLs on May 8, 2007. A public comment period was held from May 8, 2007 to June 14, 2007. The state submitted the final TMDLs with a letter dated August 10, 2007. In addition to the TMDLs themselves, the submittal included, either directly or by reference, the following additional documents:

- Expanded Technical Analysis: Utilizing Hydrologic Targets as Surrogates for TMDL Development in Vermont's Stormwater Impaired Streams, US EPA and VT DEC, September 2006.
- Stormwater Modeling for Flow Duration Curve Development in Vermont, TetraTech, 2005.
- Final Report – Investigation into Developing Cleanup Plans for Stormwater Impaired Waters, Vermont Water Resources Board, 2004.
- University of Vermont Stormwater Project – Statistical Analysis of Watershed Variables, prepared for VT ANR by the University of Vermont, October 2005
- Public Comments and Responses to Public Comments on the Draft Centennial, Bartlett, Englesby, and Morehouse Brook TMDLs, VT DEC, August 2007.

REVIEWER: Eric Perkins (617) 918-1602.

REVIEW ELEMENTS OF TMDLs

Section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations at 40 C.F.R. § 130 describe the statutory and regulatory requirements for approvable TMDLs. The following information is generally necessary for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations, and should be included in the submittal package. Use of the verb "must" below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation.

1. Description of Waterbody, Pollutant of Concern, Pollutant Sources and Priority Ranking

*The TMDL analytical document must identify the waterbody as it appears on the State/Tribe's 303(d) list, the pollutant of concern and the priority ranking of the waterbody. The TMDL submittal must include a description of the point and nonpoint sources of the pollutant of concern, including the magnitude and location of the sources. Where it is possible to separate natural background from nonpoint sources, a description of the natural background must be provided, including the magnitude and location of the source(s). Such information is necessary for EPA's review of the load and wasteload allocations which are required by regulation. The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as: (1) the assumed distribution of land use in the watershed; (2) population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources; (3) present and future growth trends, if taken into consideration in preparing the TMDL; and, (4) explanation and analytical basis for expressing the TMDL through surrogate measures, if applicable. Surrogate measures are parameters such as chlorophyll *a* and phosphorus loadings for excess algae and reduced clarity in the water column.*

A. Description of Waterbodies and Background Information

The TMDL documents provide a description of each brook (Centennial, Bartlett, Englesby, and Morehouse) including location, drainage area, and tributary information. They also provide background information on the development of the TMDLs, explaining that the roots of the TMDL approach go back to the Investigative Docket conducted by the Vermont Water Resources Board in 2004.

B. Pollutant of Concern

The primary pollutant of concern for these TMDLs is sediment. However, as the TMDL documents explain, the aquatic life impairments in these streams are believed to be caused by the mix of pollutants found in stormwater runoff. The TMDLs use the surrogate of stormwater runoff volume to address needed reductions in sediment and other pollutants. This surrogate is appropriate because the amount of pollutant load discharged from a watershed is a function of the amount of stormwater runoff generated from a watershed for a given set of conditions. This relationship is especially strong for sediment and sediment-associated pollutants, as described in the "Expanded Technical Analysis: Utilizing Hydrologic Targets as Surrogates for TMDL Development in Vermont's Stormwater Impaired Streams" (EPA and VT DEC, 2006). There are no known wastewater or non-stormwater related discharges contributing to the impairments, so the stormwater runoff surrogate effectively represents the pollutants of concern.

Use of this surrogate has the secondary benefit of addressing the physical impacts to the stream channels (such as scour and channel over-widening) caused by stormwater runoff. These physical alterations to the stream are additional contributors to the aquatic life impairment. Also, reductions in stormwater runoff volume will help restore diminished base flow (another aquatic life stressor) by increasing infiltration and groundwater recharge. Because of the difficulty of sorting out the impacts of all the different stressors, both hydrologic and pollutant-related, VT DEC listed these streams on the 2006 Vermont 303(d) list as impaired by “stormwater”.

C. Pollutant Sources

The documents explain that the source of the pollutant loads is stormwater runoff from the Centennial, Bartlett, Englesby, and Morehouse Brook watersheds. In addition to carrying pollutants from the watersheds, increased stormwater volume is destabilizing the stream channels, releasing sediment from the stream banks, degrading stream habitat and washing out biota, as discussed above.

D. Priority Ranking

The 2006 §303(d) list indicates that Centennial, Bartlett, Englesby and Morehouse Brooks are in the high priority category, meaning that they are scheduled for TMDL completion by 2008.

Assessment: EPA concludes that the TMDL documents meet the requirements for describing the waterbodies, pollutant of concern, pollutant sources, and priority ranking.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

The TMDL submittal must include a description of the applicable State/Tribe water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the antidegradation policy. Such information is necessary for EPA’s review of the load and wasteload allocations which are required by regulation. A numeric water quality target for the TMDL (a quantitative value used to measure whether or not the applicable water quality standard is attained) must be identified. If the TMDL is based on a target other than a numeric water quality criterion, then a numeric expression, usually site specific, must be developed from a narrative criterion and a description of the process used to derive the target must be included in the submittal.

The TMDL documents describe the applicable water quality standards beginning on page 8 of each document. The brooks are listed as impaired based on narrative criteria relating to aquatic biota. The impact of excessive stormwater runoff flows into the brooks has resulted in violation of the VTWQS §3-04(B)(4) which states that there shall be:

“No change from the reference condition that would prevent the full support of aquatic biota, wildlife, or aquatic habitat uses. Biological integrity is maintained and all

expected functional groups are present in a high quality habitat. All life-cycle functions, including overwintering and reproductive requirements are maintained and protected.”

In Vermont, numeric biological indices are used to determine the condition of fish and aquatic life uses. Vermont’s Water Quality Standards at 3-01(D)(1) and (2) provide the following regulatory basis for these numeric biological indices:

“(1) In addition to other applicable provisions of these rules and other appropriate methods of evaluation, the Secretary may establish and apply numeric biological indices to determine whether there is full support of aquatic biota and aquatic habitat uses. These numeric biological indices shall be derived from measures of the biological integrity of the reference condition for different water body types. In establishing numeric biological indices, the Secretary shall establish procedures that employ standard sampling and analytical methods to characterize the biological integrity of the appropriate reference condition. Characteristic measures of biological integrity include but are not limited to community level measurements such as: species richness, diversity, relative abundance of tolerant and intolerant species, density, and functional composition.

(2) In addition, the Secretary may determine whether there is full support of aquatic biota and aquatic habitat uses through other appropriate methods of evaluation, including habitat assessments.”

Pursuant to the above provisions in its water quality standards, VT DEC developed numeric biological indices to aid in the determination of whether aquatic biota and habitat uses are supported. These indices are described in the document: “Biocriteria for Fish and Macroinvertebrate Assemblages in Vermont Wadeable Streams and Rivers” published by VT DEC in February 2004. Biological data collected from Centennial, Bartlett, Englesby, and Morehouse Brooks were evaluated in accordance with the procedures laid out in this guidance document (or prior versions for data evaluated prior to 2004). Macroinvertebrates were assessed as in the poor range for a majority of the samples. The TMDL documents explain that in most cases, including these, biological condition ratings of fair or poor indicate impaired status for Class B waters.

Establishment of the water quality targets

Because the impairments are based on biological indices, there are no numeric pollutant criteria to use as TMDL targets. Instead, the instream targets are expressed as measures of the hydrologic conditions believed necessary to achieve the Vermont water quality criteria for aquatic life. As described in more detail below, a target expressed as a percent flow reduction in relation to the 0.3% flow (the flow that is equaled or exceeded 0.3% of the time) was established for each brook, based on the hydrologic conditions of reference (attainment) watersheds where the aquatic life criteria are met. The flow reduction targets are 25% for Englesby Brook, 54% for Morehouse Brook, 9% for Bartlett Brook, and 50% for Centennial Brook (see Table 3 of each TMDL document). These hydrologic targets serve as indicators for sediment and sediment-

associated pollutants, along with the other stressors to aquatic life such as channel scour and loss of pool/riffle habitat. Based on the comparison with the attainment watersheds, the target hydrologic conditions represent the conditions in which all these stressors are reduced to levels compatible with attainment of the aquatic life criteria. The TMDL documents explain which attainment watersheds were selected for each impaired stream, and the statistical and scientific basis for the selection.

The TMDL documents note that the VT Water Resources Board's 2004 report identifies flow duration curves (FDCs) as the best method for defining hydrologic targets. The following text from the TMDL documents (page 10 of each TMDL) summarizes the benefits of the FDC approach:

“FDCs are very useful for describing the hydrologic condition of a stream/watershed because the curves incorporate the full spectrum of flow conditions (very low to very high, including critical conditions) that occur in the stream system over a long period of time. The FDCs also incorporate any flow variability due to seasonal variations. A comparison of the FDCs for an impaired and appropriate attainment stream/watershed can reveal obvious patterns. For example, a FDC for a stormwater-impaired stream/watershed will typically show significantly higher flow rates per unit area for high flow events and significantly lower flow rates per unit area for low-base flow conditions than the FDC for the attainment watersheds. The increased predominance of high flow events in the impaired watershed creates the potential for increased watershed stormwater pollutant loadings, increased scouring and stream bank erosion events, and the possible displacement of biota from within the system. Also the reduction in stream base flow revealed by the FDC can create a potential loss of habitat for low flow conditions.”

For the above reasons, the TMDLs used FDCs to establish the hydrologic targets for each of the four brooks. For each brook, a high flow value (0.3%) and a low flow value (95%) were selected as points along the continuum of the FDCs useful for setting specific hydrologic targets. The 0.3% exceedance flow closely matches the one year return flow (the flow level that occurs on average once a year) and the 95% exceedance flow represents a low flow condition comparable to the 7Q10. The 0.3% flow was selected for the high flow targets because: 1) the one year flow level is generally considered the channel forming flow for small streams, and by targeting the channel forming flow one can directly reduce key channel altering events that damage biota and produce large amounts of sediment from within the stream system; 2) the 0.3% flow is close to the upper end of the high flow portion of the flow duration curve – selecting a target close to the upper end of the curve helps ensure that the implementation measures chosen to meet the target will also reduce the impact of the full range of storms that drive the shape of the rest of the flow duration curve; and 3) the design specifications for stormwater management measures in Vermont's stormwater manual are largely based on controlling the one year storm events -- the task of determining and implementing the mix of controls necessary to achieve the in-stream target can be accomplished most efficiently if reductions are measured with respect to one year flows.

Since there are limited hydrologic data for either impaired or attainment streams, the Water Resources Board's 2004 report recommended developing synthetic FDCs by employing a calibrated rainfall-runoff model based on land use and cover. Accordingly, FDCs were developed for both impaired and attainment streams and the relative difference between the two was used to establish the flows needed to restore a stream's hydrology. In the TMDLs, the hydrologic targets are expressed as percentage reductions or increases relative to the attainment watersheds' FDCs at the representative high and low flow values. Only the high flow targets are actually used for the load and wasteload allocations, but the low flow targets are included for informational purposes and to help communicate the overall aim and expected result of the TMDLs: to match all attainment stream FDC points (both on the high and low ends of the curve).

The TMDL documents explain that, based on available data and the model outputs necessary to develop the FDCs, the P8-Urban Catchment Model (P8-UCM) was selected to simulate the hydrology of impaired and attainment watersheds. Inputs to P8-UCM include climatological data, percent watershed imperviousness, pervious curve number, and times of concentration for ground water base flow and surface runoff. After initial calibration and review, additional changes were made to improve the low flow prediction capability of the model and refine the estimated surface runoff time of concentration. Upon final review and model verification, the calibrated model was used to develop FDCs for all impaired and attainment streams. A complete discussion of the model setup, calibration, adjustments and results can be found in the report entitled "Stormwater Modeling for Flow Duration Curve Development in Vermont" (Tetra Tech, 2005).

Assessment: EPA concludes that VTDEC has properly described its water quality standards, the relevant criteria and uses, and the water quality targets.

The use of surrogate hydrologic targets in place of numeric aquatic biota or pollutant targets is appropriate for these TMDLs because the hydrologic targets serve as indicators for conditions under which the water quality criteria for aquatic life can be attained. EPA's regulations state that TMDLs can be expressed in several ways, including in terms of toxicity, which is a characteristic of one or more pollutants, or by some "other appropriate measure." 40 C.F.R. § 130.2(i). They also state that TMDLs may be established using a biomonitoring approach as an alternative to the pollutant-by-pollutant approach. 40 C.F.R. § 130.7(c)(1). This flexibility in the expression of TMDLs supports reliance on a surrogate where, as in this case, there is a reasonable rationale and the TMDL is designed to ensure attainment with water quality standards.

As noted in the "Expanded Technical Analysis: Utilizing Hydrologic Targets as Surrogates for TMDL Development in Vermont's Stormwater Impaired Streams," (US EPA and VT DEC, 2006), this surrogate approach is consistent with the recommendations of the "Report of the Federal Advisory Committee on the Total Maximum Daily Load Program" (National Advisory Council for Environmental Policy and Technology, 1998). The report recommends that: "When the impairment is tied to a pollutant for which a numeric criterion is not possible, or where the impairment is identified but cannot be attributed to a single traditional 'pollutant', the state

should try to identify another (surrogate) environmental indicator that can be used to develop a quantified TMDL, using numeric analytical techniques where they are available, and best professional judgement where they are not....If they are used, surrogate environmental indicators should be clearly related to the water quality standard that the TMDL is designed to achieve.”

For these TMDLs, the relationship between the surrogate indicator and the water quality criteria is carefully laid out in the Expanded Technical Analysis report referenced above. This expanded analysis further describes the link between the aquatic biota impairment and sediment (the key pollutant), and then how watershed hydrology is driving sediment levels in these streams. Based on these clear linkages to Vermont’s water quality standards, EPA concludes that the surrogate approach has been used appropriately in these TMDLs, and that the surrogates for the water quality targets have been appropriately selected. EPA has also reviewed the supplemental report entitled “University of Vermont Stormwater Project: Statistical Analysis of Watershed Variables“ (2005), and concluded that the target setting process and the establishment of the surrogate water quality targets has been well documented and completed with admirable scientific rigor.

Some comments on the draft TMDLs (actually comments on the draft Potash Brook TMDL incorporated by reference into the comments on these four TMDLs) indicated a preference for the inclusion of wash-off sediment targets along with the hydrologic targets, as suggested in the Water Resources Board’s 2004 report. In its responses to public comments on the draft Potash Brook TMDL (incorporated by reference and attached to the responses to comments on the draft Centennial, Bartlett, Englesby and Morehouse Brook TMDLs) and in subsequent communications with EPA, VT DEC noted that one of the key reasons for not including such sediment targets is that new geomorphic data for all of these streams (Fitzgerald, 2006) combined with published analyses of sediment dynamics in streams with similar geomorphic characteristics (Simon and Rinaldi, 2006; Trimble, 1997) suggest that about three-quarters of the sediment in these streams is likely coming from within the channel system (e.g. bank erosion) and is mobilized by high flows resulting from stormwater runoff. This means that wash-off sediment targets would likely address only a quarter or less of the total sediment load (the portion entering through surface runoff). As documented in many studies (e.g., Zarriello and Barlow, 2002), there is a high correlation between stormwater runoff volume and wash-off sediment loads. And as explained in much more detail in the Expanded Technical Analysis report, there is also a high correlation between in-stream flows and in-stream sediment levels. Hydrologic targets are therefore a reasonable surrogate for both the wash-off sediment loads and the sediment loads generated from within the channel system. EPA believes that VT DEC’s decision to rely on hydrologic targets, which can serve as surrogates for total sediment load, is an appropriate and effective strategy in the case of these TMDLs.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

As described in EPA guidance, a TMDL identifies the loading capacity of a waterbody for a particular pollutant. EPA regulations define loading capacity as the greatest amount of loading that a water can receive without violating water quality standards (40 C.F.R. § 130.2(f)). The loadings are required to be expressed as either mass-

per-time, toxicity or other appropriate measure (40 C.F.R. § 130.2(i)). The TMDL submittal must identify the waterbody's loading capacity for the applicable pollutant and describe the rationale for the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In most instances, this method will be a water quality model. Supporting documentation for the TMDL analysis must also be contained in the submittal, including the basis for assumptions, strengths and weaknesses in the analytical process, results from water quality modeling, etc. Such information is necessary for EPA's review of the load and wasteload allocations which are required by regulation.

In many circumstances, a critical condition must be described and related to physical conditions in the waterbody as part of the analysis of loading capacity (40 C.F.R. § 130.7(c)(1)). The critical condition can be thought of as the "worst case" scenario of environmental conditions in the waterbody in which the loading expressed in the TMDL for the pollutant of concern will continue to meet water quality standards. Critical conditions are the combination of environmental factors (e.g., flow, temperature, etc.) that results in attaining and maintaining the water quality criterion and has an acceptably low frequency of occurrence. Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards.

Use of stormwater runoff volume as a surrogate for sediment and other pollutants

Just as an instream flow target is used as the surrogate for the instream water quality target, stormwater runoff volume is used as the surrogate for the loading capacity (i.e. the maximum amount of pollutant inputs from the watershed that still allows attainment of Vermont's water quality standards).

As discussed in the TMDL reports, a combination of pollutants found in stormwater, including sediment (from wash-off and instream sources) and associated pollutants such as metals, is contributing to the aquatic life impairment in these brooks. However, there is no information that indicates that any pollutant is causing or contributing to an exceedence of any pollutant specific water quality criterion. Nor is there sufficient information available to identify specific pollutant loadings which, in combination, are contributing to the aquatic life impairment, particularly given the variability in types and amounts of pollutants depending on a range of storm events. On the other hand, there is a strong correlation between pollutant loads and stormwater flows, for the reasons explained in the TMDLs and supporting documentation. Therefore the TMDLs use the surrogate measure of stormwater runoff volume to represent the combination of pollutants that contribute to the impairment of these streams.

The supplemental document titled: "Expanded Technical Analysis: Utilizing Hydrologic Targets as Surrogates for TMDL Development in Vermont's Stormwater Impaired Streams" provides a detailed explanation of all stressors potentially contributing to the biological impairment in these streams (using the similar Potash Brook as an example), and how these stressors are linked to stormwater runoff. The relative importance of each stressor is also described in Table 3-1 of this document. Given that increased sedimentation is believed to be the most important pollutant stressor, the document includes, among other things, substantial detail on the relationship between sediment and streamflow. Figure 5-16 shows, for example, that based on sediment and flow data from similar streams, a 25% decrease in the 1-day flow can result in a 70% reduction in annual sediment load. This means that a relatively modest reduction in stormwater runoff volume can be expected to substantially reduce sedimentation. The document also lays out

similar stormwater runoff linkages to all other identified stressors. While the exact levels of sediment needed to be achieved in Centennial, Bartlett, Englesby and Morehouse brooks are not defined, the use of the reference watershed approach ensures that the necessary sediment levels will be achieved. This is because by achieving the reduced stormwater runoff volumes occurring in the attainment watersheds, the corresponding sediment reductions necessary to meet water quality standards are expected to be achieved as well.

The TMDL documents and the expanded technical analysis describe how each stressor contributing to the biological impairment is related either directly or indirectly to stormwater runoff volumes. The stressors include: increased watershed pollutant load (e.g. sediment), increased pollutant load from in-stream sources (e.g., bank erosion), habitat degradation (e.g. siltation, scour, over-widening of stream channel), washout of biota, and loss of habitat due to reductions in stream base flow. The stressors associated with stormwater runoff are acting individually or cumulatively to degrade the overall biological community to a point where aquatic life uses are not fully supported and the streams do not attain the VTWQS.

Establishment of stormwater runoff volume targets

In a pollutant-specific TMDL, a stream's loading capacity is the greatest amount of pollutant loading the water can receive without violating water quality standards. In these TMDLs, because the "pollutant of concern" is represented by the surrogate measure of stormwater runoff volume, the loading capacity is the greatest volume of stormwater runoff each stream can receive without violating the aquatic life criteria. The challenge is to determine what this maximum stormwater runoff volume is for each brook.

As explained above (in Section 2), the TMDLs use a reference watershed approach in which hydrologic targets are developed by using similar "attainment" watersheds as a guide. The streams within the attainment watersheds meet or exceed the Vermont water quality standards criteria for aquatic life. Based on the comparison of the 0.3% flow point (approximately the one-year flow event) on the flow duration curve (FDC) for each impaired stream with the mean value of the 0.3% points on the FDCs for the appropriate attainment streams, the TMDLs establish stream flow reduction targets of 50% for Centennial Brook, 9% for Bartlett Brook, 25% for Englesby Brook, and 54% for Morehouse Brook during these high flow events. Because stream flow during the high flow events in these small streams is nearly entirely a result of stormwater runoff, the percent reduction targets are used not only as the in-stream surrogate water quality targets, but also as the stormwater runoff volume reduction targets.

The use of the FDC to establish reduction targets also ensures that critical conditions are accounted for in these TMDLs. The impacts to aquatic biota generally occur throughout the year on a cumulative basis – i.e., it is the cumulative effect of the stressors throughout the course of a year (or years) that ultimately degrade conditions and result in an aquatic life impairment. By targeting the conditions under which the key stressors are introduced (high flow conditions), the TMDLs address critical conditions and the cumulative effects caused by these conditions throughout the year. In addition, any one-time impacts (such as the washout of biota due to

channel scour) will also be addressed by these TMDLs through the reductions of the runoff volume from storm events that cause this damage.

Assessment:

EPA concludes that Vermont selected a reasonable surrogate for the loading capacity, adequately documented the assumptions and strengths and weaknesses in the modeling approach used to support the establishment of the loading capacity, and properly accounted for critical conditions. The basis for each of these conclusions is explained below.

Vermont's use of a surrogate is reasonable and appropriate

While TMDLs are intended to address impairments resulting from pollutants, there is nothing in EPA's regulations that forbids expression of a TMDL in terms of a surrogate for pollutant-related impairments. And as noted above (under Section 2) EPA's regulations state that TMDLs can be expressed in several ways, including in terms of toxicity, which is a characteristic of one or more pollutants, or by some "other appropriate measure." 40 C.F.R. § 130.2(i). They also state that TMDLs may be established using a biomonitoring approach as an alternative to the pollutant-by-pollutant approach. 40 C.F.R. § 130.7(c)(1). For the same reasons described above relating to the appropriateness of using stream hydrology as a surrogate water quality target, EPA concludes that the use of stormwater runoff volume as a surrogate for the loading capacity is also reasonable and appropriate. EPA believes this surrogate approach is suitable for small stream systems such as Centennial, Bartlett, Englesby and Morehouse brooks, where the impairment is for aquatic life, where stormwater is the cause of the impairment, and where no specific pollutant criterion is being violated.

The modeling assumptions and strengths and weaknesses are adequately documented

The assumptions and strengths and weaknesses of the modeling approach used to support the establishment of the loading capacity are discussed in the supplemental TMDL report entitled: "Stormwater Modeling for Flow Duration Curve Development in Vermont". Strengths and weaknesses associated with use of the P8 model are discussed on pages 14 and 17, and assumptions pertaining to each step in the modeling process are presented throughout the report. The results of the modeling work are thoroughly presented in this report. In addition, strengths and weaknesses and assumptions related to the use of statistical analyses of the modeling results to select appropriate attainment watersheds for Potash Brook are presented in a second supplemental report entitled: "University of Vermont Stormwater Project: Statistical Analysis of Watershed Variables" (2005). EPA concludes that the assumptions and results of both the modeling and statistical analysis steps are adequately documented in these reports.

Critical conditions have been accounted for

The critical conditions for the four brooks are associated with storm events which, in addition to potential immediate damage to aquatic biota, produce cumulative impacts to the biota over time. Because the TMDL reduction targets directly address these high flow conditions, EPA concludes that critical conditions are adequately accounted for.

Daily Loading

EPA's November 15, 2006 guidance entitled "Establishing TMDL 'Daily' Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in *Friends of the Earth, Inc. v. EPA, et al.*, No.05-5015, (April 25, 2006) and Implications for NPDES Permits," recommends that TMDL submittals express allocations in terms of daily time increments. This guidance also acknowledges that the decision of the U.S. Court of Appeals for the Second Circuit, *NRDC v. Muszynski*, 268 F.3d 91 (2nd Cir. 2001), established the controlling legal precedent for cases brought in the Second Circuit, which includes Vermont. In this decision, the Court required a reasoned explanation for the choice of any particular non-daily load. For the reasons discussed below, the Region believes that Vermont has provided a reasonable basis for not including daily loads in these four TMDLs.

Even though the TMDL targets are expected to achieve reductions during all storms large enough to generate runoff throughout the year, the TMDLs do not express the loading capacity in terms of specific loadings (or runoff volume amounts) for each day. The rationale for this decision is two-fold, as explained on page 2 of VTDEC's Responses to Public Comments:

1) The biological impairment in these brooks resulted from the cumulative effects of a range of stormwater runoff events throughout the year over a multiple year period. It is not the magnitude of loadings on any particular day that drives attainment of the biological criteria; instead, attainment will result from a long-term overall reduction in the amount of stormwater runoff. The flow duration curve approach provides for identification of this overall reduction target.

2) Stormwater runoff will vary dramatically from one day to the next depending on rainfall amounts. There will be no runoff on some days, while storms may generate large runoff events on others. Because of this variability, it is neither feasible nor logical to establish specific daily loads linked to attainment of the biological criteria. In the face of such variability, the approach taken in these TMDLs, based on percent reductions tied to the flow duration curves, is both a practical and effective way to establish reduction targets. Rather than imposing particular daily limits, this approach establishes percent reduction targets for stormwater runoff volume that effectively apply to all storm events whenever they occur (i.e., on any given day) throughout the year.

4. Load Allocations (LAs)

EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity allocated to existing and future nonpoint sources and to natural background (40 C.F.R. § 130.2(g)). Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. § 130.2(g)). Where it is possible to separate natural background from nonpoint sources, load allocations should be described separately for background and for nonpoint sources.

If the TMDL concludes that there are no nonpoint sources and/or natural background, or the TMDL recommends a zero load allocation, the LA must be expressed as zero. If the TMDL recommends a zero LA after considering all pollutant sources, there must be a discussion of the reasoning behind this decision, since a zero LA implies an allocation only to point sources will result in attainment of the applicable water quality standard, and all nonpoint and background sources will be removed.

The load allocations for each brook are presented in Table 7 of each TMDL document. The stormwater runoff volume reductions for each stream were divided into WLA and LA portions, based on major land use categories in the watershed. The three major land use categories in these watersheds are urban/developed, agriculture/open, and forest/wetland. For all four of the TMDLs, the forest/wetland category received a load allocation of zero percent reduction, or no expected change in stormwater runoff, since the runoff characteristics from these areas are considered near optimal with regard to overall watershed hydrology. To assign allocations to the remaining two land use categories, a runoff coefficient was used to determine the relative influence of each land use category on runoff characteristics, and thus the FDC. The following paragraphs from the Centennial Brook TMDL document (page 17) explain how this was done for all four of the TMDLs:

“A runoff coefficient (R_v) is an expression of the percentage of precipitation that appears as runoff. The value of the coefficient is determined on the basis of climatic conditions and physiographic characteristics of the drainage area and is expressed as a constant between zero and one. By determining the relative contribution to stormwater runoff from each land use category using the R_v , the allocation between WLA and LA can be made accordingly.

The primary influence on R_v is the degree of watershed imperviousness. This is shown through data collected from numerous watersheds during the National Urban Runoff Program Study from which an equation was developed to define the R_v , as shown below (Schueler 1987):

$$R_v = 0.05 + 0.9(I_a)$$

Where: I_a = Impervious fraction

Percent imperviousness was estimated using a previously developed relationship...for the Vermont Center for Geographic Information land use data layer.”

Using the runoff coefficients and the area of each land use category, VT DEC determined the weighted influence on runoff in the Bartlett Brook watershed to be 93% for urban/developed land and 7% for the agriculture/open category. For the Centennial Brook watershed, which contains very little land in the agriculture/open category, the weighted influence on runoff was found to be 99% for urban/developed land and only 1% for agriculture/open land. For Englesby and Morehouse brooks, which have virtually no land in the agriculture/open category, the relative influence on runoff was found to be 100% for the urban/developed land.

Given that all stormwater discharges from the urban/developed land category are included in the wasteload allocation portions of the TMDLs (for reasons explained below in the WLA section), the load allocations include only discharges from the agriculture/open land category. There are no CAFOs in these watersheds, and the agricultural/open land is outside of the MS4 portions of the watersheds, so the TMDLs assign all runoff from the agricultural/open category into the load allocation portion. Based on the weighting factors, the load allocations work out to a 0.7%

reduction in stormwater runoff for Bartlett Brook, a 0.4% reduction for Centennial Brook, and then 0% for Englesby and Morehouse brooks, as indicated in Table 7 of each TMDL document.

Assessment: The State's approach to breaking out the load and wasteload allocations is reasonable because the forest/wetlands land use category corresponds to "natural background" conditions, and the urban/developed and agricultural/open space categories are reasonable surrogates for the relative contribution of point and nonpoint source runoff, respectively. The agriculture/open land category is a reasonable reflection of nonpoint source stormwater runoff because there are no regulated point source discharges within these portions of the watersheds. The State's use of a runoff coefficient to estimate the amount of runoff from the various land use categories (and to subsequently establish the load and wasteload allocations), is a logical approach to this task given the influence of watershed imperviousness on runoff volumes. EPA concludes that the load allocations are adequately specified in the TMDLs at a level sufficient (when combined with the wasteload allocations) to attain and maintain water quality standards.

5. Wasteload Allocations (WLAs)

EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to existing and future point sources (40 C.F.R. § 130.2(h)). If no point sources are present or if the TMDL recommends a zero WLA for point sources, the WLA must be expressed as zero. If the TMDL recommends a zero WLA after considering all pollutant sources, there must be a discussion of the reasoning behind this decision, since a zero WLA implies an allocation only to nonpoint sources and background will result in attainment of the applicable water quality standard, and all point sources will be removed.

In preparing the wasteload allocations, it is not necessary that each individual point source be assigned a portion of the allocation of pollutant loading capacity. When the source is a minor discharger of the pollutant of concern or if the source is contained within an aggregated general permit, an aggregated WLA can be assigned to the group of facilities. But it is necessary to allocate the loading capacity among individual point sources as necessary to meet the water quality standard.

The TMDL submittal should also discuss whether a point source is given a less stringent wasteload allocation based on an assumption that nonpoint source load reductions will occur. In such cases, the State/Tribe will need to demonstrate reasonable assurance that the nonpoint source reductions will occur within a reasonable time.

The wasteload allocations are presented in Table 7 of each TMDL and are expressed as percent reductions in stormwater runoff volume at Q0.3%. The reductions are 65.3% for Morehouse Brook, 34.4% for Englesby Brook, 63.0% for Centennial Brook, and 33.2% for Bartlett Brook. Sections 3 and 4, above, explain how overall allocations were established based on the flow duration curve targets, and how these overall allocations were then divided into load and wasteload components based on land use categories and the amount of runoff generated from each category.

All stormwater discharges from the urban/developed land category were included in the wasteload allocation portions of the TMDLs. This was done because EPA interprets 40 C.F.R. §130.2(h) to require that allocations for point source discharges subject to the requirement for an NPDES permit must be included in the wasteload allocation portion of the TMDL. The

urban/developed portions of these watersheds include the following types of NPDES permitted stormwater discharges:

- Discharges subject to Phase 2 municipal separate storm sewer system (MS4) permits
- Discharges subject to Phase 1 and 2 construction site stormwater permits
- Discharges subject to permits for stormwater associated with industrial activities

There are also some areas within the urban/developed portions of these watersheds that generate nonpoint source runoff and point source runoff not subject to NPDES permits. Discharges from nonpoint sources and point sources not regulated by the NPDES program normally receive load allocations rather than wasteload allocations. In the case of stormwater, however, where it is often difficult to identify and distinguish between discharges subject to NPDES and those that are not, EPA has stated that it is permissible to include all stormwater discharges from a particular land use category in the wasteload allocation portion of the TMDL. For these watersheds, insufficient data are currently available to separate out the parcels that generate stormwater that is not subject to NPDES permits and calculate the runoff volumes from these parcels. Therefore, the wasteload allocations include runoff from the NPDES regulated stormwater point sources listed above, runoff from nonpoint sources, and runoff from non-NPDES regulated point sources such as commercial areas and small construction sites (under an acre).

The runoff from sources within the urban/developed land category were then lumped into an aggregate wasteload allocation for each TMDL. The rationale for this aggregate allocation is described below. As indicated above, 40 C.F.R. § 130.2(h) provides that point source discharges must be addressed by the wasteload allocation component of a TMDL. Discharges involving process wastewater, non-contact cooling water, and other non-stormwater discharges are assigned individual waste load allocations pursuant to this regulation. Stormwater discharges, however, are less amenable to individual wasteload allocations. In recognition of this fact, EPA's November 22, 2002 guidance entitled "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Stormwater Sources and NPDES Permit Requirements Based on Those WLAs," provides that it is reasonable to express allocations for NPDES-regulated storm water discharges from multiple point sources as a single categorical or aggregate wasteload allocation when data and information are insufficient to assign each source or outfall individual WLAs. EPA's guidance recognizes that the available data and information usually are not detailed enough to determine waste load allocations for NPDES-regulated storm water discharges on an outfall-specific basis.

In the case of these four watersheds, VTDEC has determined that because the stormwater discharges are highly variable in frequency and duration, and because insufficient data is available on each parcel (e.g. detailed soils information) it is not feasible to establish specific wasteload allocations for each stormwater outfall. Although the State is developing this capability (to support implementation of the TMDLs), it is currently impossible to determine with any precision or certainty runoff amounts for individual discharges or groups of discharges. Therefore, all the stormwater runoff from the urban/developed land use category is combined

